Towards Free Trade in Agriculture

K.S. PARIKH
G. FISCHER
K. FROHBERG
O. GULBRANDSEN

International Institute for
Applied Systems Analysis

MARTINUS NIJHOFF PUBLISHERS

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by

KIRIT S. PARIKH, GÜNTHER FISCHER,
KLAUS FROHBERG, ODD GULBRANDSEN

Food and Agriculture Program (FAP)
International Institute for Applied Systems Analysis (IIASA)
Laxenburg, Austria

1988 **MARTINUS NIJHOFF PUBLISHERS**
a member of the KLUWER ACADEMIC PUBLISHERS GROUP
DORDRECHT / BOSTON / LANCASTER

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

Distributors

for the United States and Canada: Kluwer Academic Publishers, 101 Philip Drive, Norwell, MA 02061, USA
for the UK and Ireland: Kluwer Academic Publishers, MTP Press Limited, Falcon House, Queen Square, Lancaster LA1 1RN, UK
for all other countries: Kluwer Academic Publishers Group, Distribution Center, P.O. Box 322, 3300 AH Dordrecht, The Netherlands

Library of Congress Cataloging in Publication Data

Towards free trade in agriculture.

Bibliography: p.
1. Produce trade--Government policy. 2. Agriculture and state. 3. International economic relations. 4. Free trade and protection--Free trade. I. Parikh, Kirit S. II. Food and Agriculture Program.
HD9000.6.T68 1988 382'.41 87-28162

ISBN 90-247-3632-3

PRINTED IN THE NETHERLANDS

Preface

Agriculture seems to be a difficult sector to manage for most governments. Developing countries face tough dilemmas in deciding on appropriate price policies to stimulate food production and maintain stable, preferably low, prices for poor consumers. Governments in developed countries face similar difficult decisions. They are called upon to give income guarantees to farmers whose incomes are unstable and relatively low when compared to those in the nonagricultural sector. These guarantees often lead to ever-increasing budgetary outlays and unwanted agricultural surpluses.

High prices make new investments and the application of new technologies more attractive than world prices warrant, and a process is set in motion where technological innovation attains a momentum of its own, in turn requiring price policies that maintain their rates of return.

Surpluses are disposed of with subsidies in domestic markets or in the international market. Price competition reduces the market share of other exporters, who may be efficient producers, unless they are willing to engage in subsidy competition. This lowers export earnings and farm incomes or depletes the public resources of developing countries that export competing products. Retaliatory measures have led to frictions and further distortions of world prices.

Every so often the major agricultural exporters – the USA, the EC, Australia, or Canada – accuse one another of unfair intervention. Though they have agreed to discuss agricultural trade liberalization under GATT negotiations, if anything, the expenditure on farm support has continued to increase in both the EC and the USA.

Some developing countries do benefit from the subsidized disposal of surplus cereals on the world market. This, however, might be only a short-term gain. Low prices are a disincentive to their own producers and lead, in the long run, to an unsustainable dependence on imports, as appears to be the case in many parts of Africa. Also, these benefits of cheap cereals may not offset the loss of markets, such as the sugar market, which is important to a large number of developing countries.

Against that background and in the light of the fact that many countries have agreed to discuss agricultural trade liberalization under GATT, it is important to assess the consequences of agricultural trade liberalization. It should increase efficiency at the global level as countries adjust their production more in line with their comparative advantages. However, in the absence of compensating transfers, some countries may lose under liberalization. An assessment of efficiency gains at the global level and gains and losses of countries can provide some insight into the degree to which their own production and trade have become distorted and how large the adjustment costs may be. Several questions are relevant here: what if the developed market economies remove border protection? But also: what consequences can be expected from the removal of border protection by developing countries only? (This is an issue that can be usefully analyzed as it belongs to the regular package of adjustment policies recommended by the World Bank and the IMF.) What would be the impact of simultaneous liberalization by all market economies? Who would gain and who would lose?

This book reports on a study that explored these questions using a system of empirically estimated national agricultural policy models linked together through trade and capital transfers. A general equilibrium approach is followed for both the national models and the international linkage. Thus, behavioral responses of consumers and producers, as well as the responses of government policies to changes in world market conditions, are accounted for.

We call this system of models the Basic Linked System (BLS). It consists of 18 national models, two models of regions – namely, the EC and the Council for Mutual Economic Assistance (CMEA) – and 14 somewhat simpler models of groups of countries. Together these cover all the nations of the world. We believe that the BLS is particularly suited – at least, better than any other existing analytic tool – for the analysis of issues related to agricultural trade liberalization and self-sufficiency.

The present study differs from other available studies on trade liberalization in combining all the following features: a general equilibrium approach is applied to both the national and international levels; most of the parameters are empirically estimated; a number of agricultural commodities are distinguished; nations are distinguished; and a rich variety of policy instruments for national governments is permitted, including tariffs, trade, quotas, taxes, transfers, and stock operations. The existence of these features can significantly alter policy conclusions derived from the analysis.

The development of BLS, without the use of which this study could not have been made, has involved many people in the Food and Agriculture Program (FAP) at the International Institute for Applied Systems Analysis (IIASA) and its network of collaborating institutions. As with any large project that takes many years, it is virtually impossible to give individual credit to all those who have contributed; yet one must try. The program core of FAP consisted of the following:

Kirit Parikh (Program Leader 1980–1986)
Ferenc Rabar (Program Leader 1976–1980)
Günther Fischer
Klaus Frohberg
Michiel Keyzer

The members of the program core have been responsible for all aspects of model development and analysis. Conception of the system and development of the algorithms was done mainly by Michiel Keyzer.

Other program participants who have contributed to development of various aspects of the BLS are: Michael Abkin, Csaba Csaki, Tom Christensen, Odd Gulbrandsen*, Janos Hrabovszky, Gerhard Krömer, Bozena Lopuch, Douglas Maxwell, Donald Mitchell, Jan Morovic, Nanduri Narayana, Martha Neunteufel, Karl Ortner, Gerald Robertson, Mahendra Shah, Ulrike Sichra, Ralph Seeley, T.N. Srinivasan, Eric Wailes, David Watt, Chris Wolf, and Laszlo Zeold.

A large number of others were involved in the program, particularly for the development of detailed national policy analysis models for specific countries. Though several of these models have been used in a number of countries, not all of them are currently available as a part of the BLS. Naturally the study has benefited from the country-specific knowledge and evaluations made by many of these researchers.

Other researchers have also commented constructively on various aspects of the system methodology and behavior. Among them are, in alphabetical order, the following: Reinaldo Adams, Harold Carter, Hartwig de Haen, U. Färber, Bruce Gardner, Erik Geyskens, John Graham, John Guise†, Werner Güth, Bruce Huff, Vladimir Iakimets, Raul Jorge, Werner Kiene, F. Desmond McCarthy, Constantine Meghir, Haruo Onishi, Brian Parmenter, Pierpaolo Pierani, Leon Podkaminer, Todor Popov, Alberto Portugal, Allan N. Rae, Bruno Raguet, Sudhaker Rao, E. George Rossmiller, Kozo Sasaki, Stephen Schmidt, Peter Michael Schmitz, Jörg-Volker Schrader, Taisto Sonnenson, Valter Jose Stülp, Stefan Tangermann, Robert Thompson, Anton Timman, Wouter Tims, Paul J.J. Veenendaal, Anton Visser, Matthias von Oppen, Jean Waelbroeck, Anton Wagemeyer, and Cheryl Williamson.

In designing our approach to the study of trade liberalization we have benefited from the suggestions and comments of Bruce Gardner, Bruce Huff, Michiel Keyzer, T.N. Srinivasan, and Robert Thompson.

We have also benefited from the constructive comments of T. N. Srinivasan and Wouter Tims, who read the various drafts of this report.

It is my privilege to gratefully acknowledge the many contributions of all my colleagues at IIASA and the various program participants in the many collaborating institutions. A great deal of credit goes to them; but the authors of this report bear all the responsibility.

Finally, the authors want to acknowledge with thanks Lilo Roggenland for typing and correcting numerous drafts of this report.

* in Geneva.

Kirit Parikh
Program Leader, FAP
International Institute for
Applied Systems Analysis

Contents

CHAPTER 1

Issues in Trade Liberalization

1.1. The Setting

1.1.1. Interventions are common in agriculture

Almost all governments in the world intervene in the determination of agricultural production and prices. As a consequence, international trade in agricultural products is affected. This is not a new phenomenon, as governments have done so from very early times for various reasons, such as to safeguard adequate food supplies, to extract resources from farm populations, or to exchange agricultural products for other desired commodities and services. These objectives still characterize agricultural policies in many developing countries today and, to some extent, also in the developed industrial countries. While in developing countries, because of the dominance of agriculture in employment and production, the major objective is often extraction of resources from the agricultural sector for the development of the entire economy, in developed countries relatively few people are still engaged in agricultural production, so supporting the incomes of these few at levels comparable to the rest of the population is the major objective of intervention. A multitude of interventions that influence domestic agriculture in virtually all countries has led to considerable distortions in international trade in the contemporary world.

Indeed, the patterns of interventions and distortions have become so complex that any attempt to disentangle them faces major problems. Even the terms to be used in describing the present situation are not unambiguous and therefore need to be defined with considerable care. A basic characteristic of world agriculture is the starting point of the analysis: policies affecting agriculture are nationally (and sometimes regionally) made, to serve overwhelmingly *domestic* objectives. However, these interventions in the national markets do have an impact on each country's external balance and can and do lead to distortions in international trade. There is no special agency that is charged with responsibility for international markets, let alone any explicit international objectives that such an agency would serve were it to exist. International negotiations concerning agricultural trade usually focus on price instability and distortions in these markets but, ironically, domestic policies, which cause the distortions, are outside the scope of these negotiations.

A first impression of the magnitude and spread of interventions can be gleaned from *Figure 1.1*, which shows the extent to which domestic prices of agricultural products differ from world market prices. These differences, when plotted against per capita gross domestic product (GDP) for the major agricultural producing countries of the world, demonstrate that richer countries tend to protect their agricultural markets more against foreign competition than do poorer countries. This confirms, to some extent, the differences in national objectives between developed and developing countries described earlier. It also suggests that richer countries have greater resources to finance their interventions.

The interventions are not without cost; some can, indeed, be quite expensive. The distribution of the costs and benefits depends on the nature of the intervention, both between the various affected economic groups and over time. Experience in many countries demonstrates that interventions that started as a transfer – in either direction – between producers and consumers become a major burden on the government budget. If policies are not flexible and timely adjustments are not made as the underlying situation changes, the adjustments are postponed until they become unavoidable. At that stage the needed adjustment is drastic and may involve politically difficult, if not impossible, redistribution of costs. The rigidity of interventions – the lack of flexibility in adjusting these over time – is a characteristic of almost all interventions in agriculture in virtually all countries.

1.1.2. A multiplicity of objectives behind interventions

Government interventions in agriculture are usually meant to achieve one or more of the following objectives:

(1) Food self-sufficiency and the expansion of domestic production of major agricultural inputs.
(2) Food security for all people in all regions within the country.
(3) Mobilization of resources for development.
(4) Maintenance of agricultural incomes compared to other sectors.
(5) Sustaining environmental balance.
(6) Exploitation of any real or perceived market power.

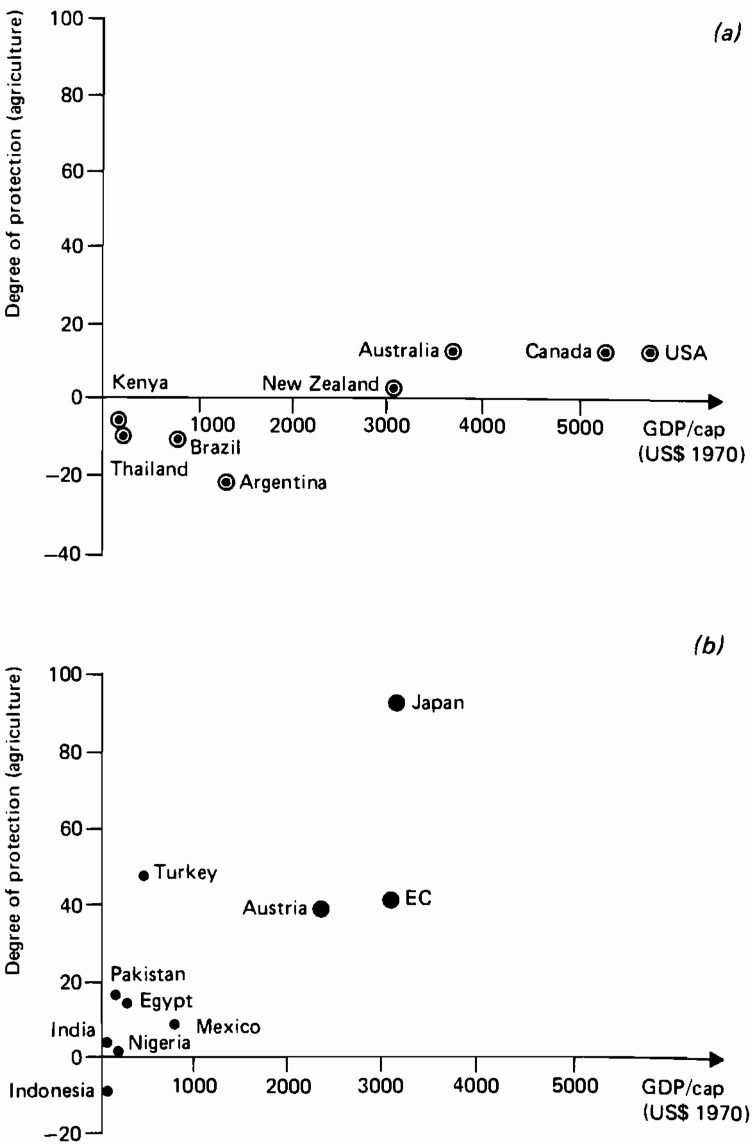


Figure 1.1. Degree of nominal protection in agriculture (1978–1980) for (*a*) net agricultural exporters and (*b*) net agricultural importers, given by:

$$\frac{(\text{Value of output at domestic prices} - \text{Value of output at world prices})}{(\text{Value of output at world prices})} \times 100$$

Food self-sufficiency, defined as the capability of a country to meet domestic food demand largely from domestic production, is an almost universal objective. It is based on the perception that dependence on food imports means exposure to sharply fluctuating world prices and physical availabilities; in cases of dependence on food aid, there is a further risk of potential external political pressure. Similar considerations may also apply in the case of imported inputs, such as fertilizers.

Fluctuations in world market prices can cause fluctuations in domestic prices and/or government budgets unless the country is insulated from world markets or holds sufficiently large stocks. If variability in the domestic production of a country is smaller than the variability in the world market prices, greater self-sufficiency may lead to greater stability in its domestic prices for a given allocation of resources through buffer stock operations or trade. Fluctuations in food prices can have undesirable consequences. Not only the poorest suffer more when food prices rise, but, to the extent that wages are influenced by food prices, a cost-push inflation may be triggered by food price increases, if prices and wages are so rigid that they do not fall when food availability increases later. It is thus conceivable that the social benefits of stabilizing food prices through food self-sufficiency, where feasible, exceed the costs of forgoing the benefits of dependence on imports that are cheaper on the average.

The objective of food security pursued by many governments includes, in addition to food price stabilization, income supplements for the poor in a way that assures minimum supplies to all people at all times. Achieving food security involves the use of government revenues to subsidize food distribution. Governments in rich countries may easily raise the revenues, as the poor are relatively few and the costs of subsidizing them small in comparison to other public expenditures. Poor countries are obviously not in such a comfortable position. Some poor countries have used subsidy schemes that do not involve *explicit taxation.* Food for distribution to the poor is procured through a compulsory levy on producers at below-market prices, which taxes the producers only implicitly.

The desire for food security may lead to interventions to promote food production at the expense of exportable cash crops, even in countries that are agriculturally self-sufficient in the sense that they could finance the foreign exchange costs of food imports through earnings from the export of cash crop.

The objective of food security can be at odds with the need to mobilize resources for development. The scope for levying taxes in developing countries is limited both because incomes are low and for reasons of limited administrative capacity. In a direct sense, this puts limits on the extent to which food security can be achieved. A second, more indirect, conflict arises as taxes on external trade – on imports as well as exports – are the easily levied taxes, if not the only feasible ones. Taxes on imported food can provide protection to domestic producers and at the same time raise revenues, but they also increase consumer prices and reduce food intake of the poorer classes unless the government can provide them with relief through subsidies. The cost of subsidies will exceed the tariff revenues generated if the poor consume more than imports or if the subsidy rate exceeds the tariff rate. Taxing agricultural exports will reduce domestic producer prices if the country cannot significantly influence world market prices.

In practice, many developing countries are concerned only with the food security of their urban populations, both for political reasons and because the costs and administrative requirements of extending it to the entire population are prohibitive. In order to assure adequate supplies, governments often monopolize the trade in major food items and export commodities. Even if the entire trade is not monopolized, the prices paid by government for its purchases for distribution to urban consumers or for exports are usually kept below the comparable world market price. There is thus an implicit transfer of resources from agriculture to the government, which may actually add to public revenues in the case of export crops or be passed on by way of lower food prices to consumers.

As countries become more developed, the sources of government revenues become more diverse. Besides, the private sector may increasingly generate the resources for economic development. As food becomes a less important part of most consumer budgets and the agricultural labor force declines, governments become less concerned with food security or with the extraction of resources from agriculture. Even though labor productivity in agriculture increases with development, productivity in nonagricultural occupations rises even faster. If the rate of migration out of agriculture required to equalize income under such differential productivity gains is too "high" from some social point of view, disparity between agricultural and nonagricultural incomes arises. Interventions gradually turn toward reducing this gap through measures that improve agricultural incomes and living standards. Thus, in a number of rich countries agricultural policies become the opposite of those in the developing countries, aiming at the maintenance or improvement of agricultural incomes as compared to other sectors of the economy. Objectives of social and political stability play a role in the formulation and implementation of these interventions, stemming the tide of urbanization, and allowing time for older farmers to retire and for the younger to be trained for other types of employment.

Interventions into agricultural production and trade can also be in response to environmental concerns and to public health considerations. Sometimes, such arguments are used to disguise protection in the form of essentially nontariff barriers rather than explicit tariff. Restrictions on alcoholic beverages and tobacco belong to this category, as do a number of border interventions addressed to quality controls on imported food items. Environmental considerations give rise to taxes aimed at avoiding overgrazing in vulnerable areas, to incentive or disincentive measures for particular crops, and to associated border measures that have an impact on international trade. To the extent that such interventions merely serve to prevent a market failure that would otherwise occur, they may not be distortions.

Finally, one should also recognize that in some situations intervention may be the optimal national policy, even from an economic point of view. Exporting countries with some power in the world market for certain commodities may raise their export earnings by suitably restricting exports. Similarly, importers with market power may improve their terms of trade by restricting imports. Here, as in many other policies, one should recognize that the short-term gains from intervention may be lost in the long run. For example, when a monopolistic exporter restricts exports and keeps the world price at a higher level, potential competitors may expand their production and substitute products may emerge. Moreover, even in the short run, these are *national* gains secured at the expense of the rest of the world.

1.1.3. The questions interventions raise

All of these interventions may be rational, given the social objectives of a national government; they may even be necessary for economic optimality. Yet a number of questions must be raised in analyzing their effects. What are the (net) economic costs or benefits of these interventions? How are the costs and benefits distributed among the various participants in the economy? Are some parts of these costs, or benefits, passed on to other countries? Are there differences in those distributions when comparing the short-term and the long-term effects of those interventions? From an international point of view, there is the further question: Are these the best policy instruments to attain the stated objectives?

The effects of one country's policies on other countries' development are of considerable concern and interest. While world agriculture and international food markets are strongly influenced by the behavior of a few major producing and trading countries, all the remaining countries have no such influence and must passively accept the consequences of the policies of major actors. Even though some poor countries have market power in some commodities, by and large the market power of countries in which hunger and malnutrition are endemic appears to be limited. This puts before the student of international food relations, as before the policy-maker, the question whether large countries or groups of countries acting together exploit their influence on the world market or not, and to what extent the policies pursued by the strong can hinder or help in reducing hunger.

In the present study this question, as well as the others referred to earlier, will be analyzed particularly from the angle of trade liberalization. However, before addressing these issues concretely, in the next section we discuss the policy relevance of the study. Then, in Section 1.3, the specific issues addressed, a broad outline of the approach taken, and the way in which this study differs from other studies on trade liberalization are indicated. Finally, we present a brief outline of the organization of this volume.

1.2. Why Study Agricultural Trade Liberalization?

Understanding the impact of trade liberalization on a country's own economy as well as on the economies of other countries is of considerable policy relevance. To what extent the protection that countries provide to domestic producers or consumers deprives other countries of their legitimate market share is often the bone of contention in trade policy negotiations among countries. For example, the USA repeatedly claims that the subsidies provided to European farmers exemples under the Common Agricultural Policy (CAP) of the European Community (EC) lead to much subsidized export of grains by the EC, resulting in a loss of market to US farmers. Similarly, developing countries often complain that the subsidized sugar production in the EC not only deprives them of potential exports to the EC but also depresses world prices. On the other hand, the import quotas on dairy products and beef imposed by the USA are objected to by countries exporting those products.

1.2.1. History of trade negotiations

A brief review of the history of negotiations in agricultural trade liberalization indicates the importance of studying its consequences. Negotiations geared at dismantling tariff and nontariff barriers impeding free trade have been conducted under the umbrella of the General Agreement on Tariffs and Trade (GATT) since its creation in 1947. Though much progress has been made in lowering trade barriers among developed market economies for trade of nonagricultural products, such has not been the case for agricultural commodities. As summarized by the GATT Secretariat itself (1979):

> When GATT rules were originally drafted in the 1940s, they were intended to apply to trade in agricultural and industrial products alike. Things have worked out differently however. Agriculture has been virtually excluded from the broad sweep of trade liberalization and insulated from the normal disciplines of market forces and international competition. . . .
>
> The variety and complexity of the protective measures used in agriculture made the negotiations of balanced reductions particularly difficult. If the underlying problems were essentially technical, ways could be found of overcoming them by the adoption of appropriate negotiating techniques. It is, however, the fundamental political and social factors governing the protection of farmers, and the link between production policies and measures at the frontier, that give rise to the basic problems.

During the 1950s and 1960s, nations conducted their agricultural policy in a basically self-serving way, either by simply bypassing GATT's rules or through obtaining exceptions and waivers.

By the end of the 1960s, there was, however, a general concern with the need to discuss agricultural matters under the GATT umbrella. Very minimal results had been reached during the Kennedy Round (1963–1967). The debate went on – and is still alive today – as to whether a distinction should be made in the upcoming negotiations between agricultural and industrial products or whether they should be considered as one undertaking. This reflected two fundamentally different approaches between, among others, the USA and the EC. In the words of the GATT Secretariat (GATT, 1979):

> The US wanted the negotiations to lead to the liberalization of agricultural trade and increased access to foreign markets for products of which they were efficient producers. The EC, on the other hand, sought the stabilization of agricultural trade through commodity arrangements, a sufficiently high income level for its farmers, and the preservation of an effective CAP.

Hence, the USA defended the same treatment for agricultural and industrial products alike, although with added exceptions. The EC emphasized the unique characteristics that sharply distinguish agriculture from the industrial sector. Stressing that it had largely eliminated quantitative restrictions, the EC pointed out that tariffs cannot be considered in isolation from minimum prices, maximum prices, stockpiling, subsidies, international supply commitments, etc. As far as developing countries were concerned, commodity agreements were seen as a good method to ensure their goal – namely, to secure improved and liberal access to markets and stabilization of agricultural trade at fair and remunerative prices.

During the Tokyo Round (1973–1979), which was the last round of negotiations held within GATT, agriculture was discussed in the context of nontariff barriers in general, and more particularly in the context of the codes on subsidies. A few main agricultural products were discussed in specific subgroups – namely, grain, dairy products and bovine meat. In addition to reaching arrangements on the latter two products, progress was made with regard to liberalization of a number of products through the traditional process of a number of bilateral concessions. A compromise was reached over the issue of subsidies, but its application to agriculture was left very general. Parties discussed the need to create a "multilateral agricultural framework" in order to organize in a more systematic manner future consultations and exchange of information under the aegis of GATT.

Owing to growing tensions since the end of the 1970s, the need to draw a new set of international rules to govern agricultural trade seems almost inescapable. Given the structural issues at stake, conflicts cannot continue to be solved on a case-by-case basis. Furthermore, advocates of trade liberalization argue that agricultural trade, if it is to become more responsive to world market forces, must be treated as a whole in a consistent manner. Hence, since 1982, there has been considerable talk within GATT regarding the most efficient way to integrate agriculture in the upcoming round of multilateral negotiations scheduled for 1986–1987, when preparatory discussions will have reached consensus over the general agenda. The prominence given to agricultural trade issues by the governments of many developed countries promises to bring these issues to the forefront of GATT negotiations.

These negotiations have often involved discussions on questions of the degree of distortion introduced by a variety of tariffs and nontariff measures, and the securing of "just market shares". The safeguard clauses of GATT rules permit the imposition of import restrictions when they are necessary to enforce government measures that operate to restrict domestic production. However, import restrictions in this case should be such that the ratio of imports to domestic production is maintained at a level that would have prevailed in the absence of restrictions. Similarly, export subsidy is permitted if it does not secure more than an equitable share of the market or does not cause a serious prejudice to the interests of other contracting parties.

1.2.2. Importance of quantitative analysis

Notionally, "just" or "equitable" market shares are conceived of as those shares that would have prevailed in a situation of free trade. However, to determine these shares in practice is not easy for a number of reasons. When agricultural protection of a commodity is removed by a country, the relative prices change and not only the production, consumption, and trade of the commodity itself, but those of others as well, may change. If the country is also a major trader, this will result in changes in world market prices; and as a reaction to these changes other countries may alter their policies, production, and trade patterns. As a result of the interplay of all these changes, the world moves to a new pattern of trade and world prices. To determine this new pattern, one needs to look not only at all the major commodities, but also at all the countries simultaneously.

The importance of the adjustments and reactions of other countries in determining the impact of free trade can be seen in an example of the impact on farmers' income in the EC. For farmers in the EC, as we have noted, the protection provided by the CAP is of great importance. However, this does not mean that, were the EC to dismantle the CAP and eliminate all protection, the farmers' income would fall by 40%, which is the nominal rate of protection. This is because a number of adjustments would take place in the EC and in the world market, were the EC to liberalize. The changes in domestic EC prices would change demand by consumers in the EC as well as change the levels and composition of production by farmers in the EC. As a consequence, the EC's trade on the world market would change, leading to changes in world prices since the EC is a major trader on the world market. The final impact on the incomes of agricultural producers in the EC cannot be easily predicted without accounting for all these adjustments. For the producers and consumers of other countries with a relatively large degree of distortion, the impact of agricultural trade liberalization would be similarly unpredictable. Also, the impact on EC farm income would be quite different, were the EC to liberalize alone or were other countries also to liberalize.

The EC import levies on cereals provide another example of interdependence of policies. The levies aim at improving the income of the farmers in the EC. Because of the large size of the EC the levies depress the world market prices. This lowering of world market prices and, through them, of the domestic prices in developing countries makes consumers better off and producers worse off. Whether it hurts the poor in a country depends on whether by and large the poor are purchasers or producers of cereals. Similarly, owing to EC levies, agricultural employment may decline everywhere. Again, its incidence on poverty depends on whether the poor depend on agricultural employment to a greater extent.

Also, the income distributive effects in the EC of the levies are not unequivocally socially beneficial for the various groups, even within the EC. With inelastic land supply, the levies are capitalized in the land value, providing a fortune to those who have a lot of land, which means making the rich even richer. The small farmers, however, gain little; and the poor consumers, spending a large proportion of their income on food, suffer real income losses owing to the high food prices.

Although it is a complex task requiring an elaborate analytical apparatus, determining the characteristics of a free trade situation is important for bilateral and multilateral trade negotiations between countries, for monitoring the agreements reached, and for adjudication of some of the disputes that may arise.

For developing countries, understanding the impacts of agricultural trade liberalization may be particularly important. In most developing countries, agriculture constitutes a significant part of the economy and employs much of the population. Thus, changes in prices of agricultural goods, consequent to trade liberalization, can significantly affect income distribution and thereby the incidence of hunger in these countries. Moreover, the macroeconomic effects on changes in savings, investments, and allocative efficiency can be relatively larger in developing countries than in developed countries. This is reflected in the advice often given to developing countries by international lending agencies, such as the World Bank and the International Monetary Fund (IMF), to pursue a more liberalized policy toward agriculture. Many economists as well have argued that more outward-oriented policies would be beneficial to developing countries (Balassa, 1981a, b, c; Bhagwati, 1978; Krueger, 1978, 1982, 1983; Krueger *et al.*, 1981; and Srinivasan, 1986). To what extent should such advice be followed? A quantitative evaluation of the impact of agricultural trade liberalization is important for answering this question and for determining strategies for development.

In the absence of nondistortionary compensatory transfers, economic theory of trade liberalization does not provide, from qualitative reasoning alone, any general guidance regarding the distribution of gains and losses between countries and within countries (shown in Appendix A1). These have to be evaluated and assessed before one can reach a conclusion on the desirability of free trade.

1.3. Issues Addressed, Outline of the Approach, and Distinguishing Features of the Study

1.3.1. Issues addressed

From the discussion in the preceding sections, one can see the importance of exploring the impacts of agricultural trade liberalization. In assessing these impacts, consequences for income parity in developed countries and for growth and hunger in the developing countries should be specially emphasized as important policy objectives that lead governments to intervene. In particular, in this study we address the following issues:

(1) How would world market prices, trade patterns, and market shares of different countries for agricultural commodities develop over a 15-year period if countries were to continue to pursue their present policies?
(2) How would world market prices and market shares change if all countries, or a subset of them, were to liberalize agricultural trade?
(3) Is a move to free trade in agriculture desirable globally? For all countries? For some countries? What would happen to production, consumption, trade, prices, farm incomes, and government incomes in different countries in the event of elimination of trade and production restrictions? In the near future and after some years?
(4) Should a country move to free trade even when others do not? What would be the impact on a country if it were the only one to liberalize? If only the developed countries were to liberalize? If only the less developed countries (LDCs) were to liberalize? Should major actors, such as the USA or the EC, liberalize unilaterally?
(5) Which groups and countries lose in a shift to free trade, and by how much? Can they be compensated for their losses? What would be the impact on LDCs, and particularly the poor in them? Does one need to design special protection measures for them even when the developed world moves toward free trade?
(6) What domestic policy changes could help the poor countries to better adjust to agricultural trade liberalization?

1.3.2. Outline of the approach

To answer these questions, as pointed out earlier, one needs sophisticated analytical methods that can account for the various adjustments and interdependencies when protection levels change. The behavioral responses of producers and consumers, and the responses of government policies to changes in world market conditions, which themselves may result from changes in the policies of other governments, have to be accounted for. Unfortunately, as shown in Appendix A1, economic theory does not give unambiguous answers to these questions from purely qualitative reasoning. One needs a quantitative approach that describes the world food system in a reasonable way.

We have explored these questions using a system of empirically estimated national agricultural policy analysis models, which have these features and which are linked together through trade and capital transfers. We call this system the Basic Linked System (BLS). The system consists of 18 national models, two models of regions – namely, the EC and the Council for Mutual Economic Aid (CMEA) – and 15 somewhat simpler models of groups of countries. Together these cover all the nations of the world. We believe that the BLS is particularly suited, and, at least, better than any other existing analytic tool, for the analysis of issues related to agricultural trade liberalization and self-sufficiency.

The present study differs from other available studies on trade liberalization in having all the following features together: it has a general equilibrium approach at the national and international level; most of the parameters are empirically estimated; a number of agricultural commodities are distinguished; it distinguishes nations and permits a rich variety of policy instruments to national governments, including tariffs, trade quotas, taxes, transfers and stock operations. The existence of these features can significantly alter policy conclusions from analysis.

The BLS differs from many past global models (FAO, 1971; Japanese Ministry of Agriculture and Forestry, 1974; Takayama and Hashimoto, 1976; Rojko and Schwartz, 1976; and Lundborg, 1981) in that it distinguishes nations. The Model of International Relations in Agriculture (MOIRA) (Linnemann *et al.*, 1979) distinguishes nations, but has only one aggregate agricultural commodity and a restricted set of government policies. Other multicountry general equilibrium models include those by Gunning *et al.* (1982), Manne and Preckel (1983), Miller and Spencer (1977), Whalley (1982), and Whalley (1985). The model of Deardorff and Stern (1981) is not a fully general equilibrium one.

These models – except for MOIRA, which uses empirically estimated parameters – use elasticities obtained from literature search, best-guess or alternative specifications, and benchmarking procedures from one year data for describing production and consumption behavior. Moreover, the models by Gunning *et al.* and Manne and Preckel have only regions and do not distinguish nations. Whalley in his two four-"region" and seven-"region" models does distinguish the EC, the USA, and Japan, but other countries are grouped by region. Only Deardorff and Stern distinguish 34 different nations, but they treat only two highly aggregated agricultural goods out of 22 tradable goods.

In the tradition of agricultural economists and commodity modelers, studies of trade liberalization are usually for a single commodity, and are most often assessed by relying on partial equilibrium models. The reason for such a partial equilibrium approach is to be found in the costs and time needed to build these models. General equilibrium models are costly to build and quite time-consuming. The partial equilibrium approach itself varies quite often in terms of spatial and commodity coverage. In terms of spatial extension, the simplest model is the one that covers only the country under investigation and neglects the impact on, and feedbacks from, the international market completely. The so-called "small country" assumption implied in such an approach is violated in many cases. To overcome this deficiency a net trade response of the outside world is added to the country model. While this approach is theoretically sound, its problem lies in the fact that it is very difficult to obtain reliable empirical information. Therefore, partial equilibrium models are built to include explicitly the most important countries from the point of view of trade in the product(s) under study.

A few studies of the latter kind are mentioned here. Anderson and Tyers (1984) and Tyers (1985) analyze the the EC grain and meat policies including uncertainties in supply. Meyers *et al.* (1985) study the impact of trade liberalization for wheat, feed grains, and soybeans; and Tangermann and Krostitz (1982), liberalization for beef. World trade in vegetable and fruit products is investigated by Sarris (1981). The GOL model covers grain, oilseeds, and livestock (Liu and Roningen, 1985). The impact of the the EC sugar policies on the world market and on developing countries is investigated in a study by Koester and Schmitz (1982). Buckwell *et al.* (1982) assess the costs of the CAP of the EC by using a free trade policy as reference scenario. A similar study restricted to 11 commodities is published by Matthews (1985). Valdés and Zietz (1980) analyze the impact of a 50% reduction in agricultural protection by countries of the Organization for Economic Cooperation and Development (OECD), covering 99 raw and processed agricultural products.

The Food and Agriculture Organization (FAO) study *Agriculture: Toward 2000* (FAO, 1981a) is in a certain way the most comprehensive analysis to date. Though not a trade policy study, it does bring out some implications for future trade patterns. It covers 90 developing countries and 98% of the developing countries' population excluding China. Twenty-six agricultural commodities are analyzed in this study. The results of various scenarios for the developing countries are linked with projections for 34 developed countries.

The number of studies following a general equilibrium approach is much smaller. The MOIRA study deals with two aggregates, one for agriculture and one for nonagriculture, but includes 104 countries. Harrison (1984) uses a model for 11 countries and seven commodities, of which one is an aggregate of agriculture, forestry, and fishing, to analyze welfare effects of unilateral and multilateral trade liberalizations. Lundborg (1981) employs a general equilibrium approach to assess the impact of agricultural policy in the USA and the EC on income distribution in developing countries. Trade liberalization in European agriculture is analyzed by Burniaux and Waelbroeck (1985) with the RUNS agricultural model described by Burniaux (1984).

1.4. Plan of the Book

The study is organized as follows:

In Chapter 2 we explore in some detail the magnitude of, and driving forces behind, agricultural distortions. Estimates of distortions are also summarized.

In Chapter 3 the analytical framework needed for assessing the impacts of agricultural trade liberalization is discussed; this is followed by a brief description of the BLS. Alternative scenarios are defined, and a framework for analyzing the scenarios is set up.

In Chapter 4 a perspective on agricultural development until 2000 as it emerges from the reference scenario of our modeling system is described.

Chapters 5–8 deal with various trade liberalization scenarios in which different groups of countries liberalize their agricultural trade.

Chapter 5 deals with the impact of agricultural trade liberalization by the OECD countries.

Chapter 6 gives results of two scenarios of unilateral trade liberalization by the EC and the USA. The gains from such trade liberalization are compared with the gains from trade liberalization by all OECD countries.

Chapter 7 analyzes the impact of agricultural trade liberalization by only the developing countries (excluding China).

Chapter 8 presents the results of agricultural trade liberalization by all market economies, both developed and developing.

Finally, in Chapter 9 we discuss and summarize our results.

In Appendix A1 we give some selected results from economic theory of trade liberalization, while in Appendix A2 the problems of definition, measurement, and estimation are discussed. Appendix A3 looks at individual countries in all the various relevant trade liberalization scenarios and highlights their behavior and policy implications for them. Appendix A4 is a list of countries and groupings.

1.5. A Guide for the Reader

We provide below some guidance for the reader, as one cannot expect everyone to have the same level of interest in all issues addressed in this book.

A reader who is primarily interested in the main findings of the study regarding trade liberalization may follow Chapter 1 by reading parts of Chapter 3 (namely, Sections 3.1, 3.3.1, 3.3.2, 3.3.3, and 3.3.5), parts of Chapter 4 (namely, Sections 4.1, 4.2, 4.8, and 4.9), any or all of the chapters on trade liberalization (namely, Chapters 5, 6, and 7), and Chapter 8.

A reader who is interested in the empirical aspects of agricultural protection and trade liberalization may want to read, in addition to the above parts, Chapter 2 as well as Appendix A2.

Professional economists who want to read not only the main findings, but also to evaluate them, need to read Chapters 1 to 8. Note that Chapters 6 and 7 may be read in any order after the first five chapters have been read.

Those interested in the behavior of specific countries may want to read the relevant portions of Appendix A3.

Finally, readers not too familiar with international trade theory may want to read Appendix A1, which summarizes some of the relevant results.

CHAPTER 2

Agricultural Distortions: Magnitudes and Driving Forces

What constitutes an agricultural intervention? What constitutes a "distorting" intervention in some well-defined sense, and how does one determine whether a particular intervention is "distorting" in this sense or not? Formally, one could define intervention as any government policy that has an effect on the equilibrium levels of prices, outputs, inputs, domestic absorption in various forms, and foreign trade.

Even when government intervention in foreign trade may be appropriate from a country's viewpoint – for instance, in the unilateral exercise of market power by those countries that have such power – even then such exercise of market power by some reduces global welfare from what could be realized under free trade with nondistorting transfers. When such transfers are not available, free trade may not lead to a Pareto-superior global outcome. Thus, such protectionist interventions, which may be appropriate from one country's viewpoint, are viewed as *distortions* of the system. Similarly, other taxes, subsidies, quantitative restrictions, etc. that are not imposed to correct some failure of the market system are also viewed as distortions. Needless to say, there is analytical interest in an intervention (or the absence of it) if it is distorting (or if there is a market failure).

There are alternative ways in which an intervention – for instance, in foreign trade in agriculture – could be measured. In Appendix A2 we describe forms of intervention, alternative quantitative measures thereof, and how we estimated the extent of agricultural protection in different countries. Here we summarize only the estimates of agricultural protection.

2.1. The General Pattern of Distortion

It is a "tariff equivalent" that is reported in most studies, and which is also referred to herein. As already mentioned, this reflects quite well the overall protection level in agriculture in developed countries. [According to the FAO (1975) study, only two out of 13 developed countries had input subsidies for a few products (mainly for fertilizer) that amounted to a few percent of the output price.] For developing countries, input and factor subsidies often have a relatively larger share in the protection, but they might work to offset the negative effect of a domestic producer price below the world market level (owing to export taxes or excessive margins between purchase and selling price administered by a state export monopoly) rather than increase border protection.

For developing countries, there is an additional problem in measuring the protection level. This stems from a lack of convertibility of the currencies of many of them. Owing to frequent overvaluation of the official exchange rate and irregular large devaluations to offset a sometimes galloping domestic inflation, conversions of world market prices to domestic currency equivalents are difficult to obtain. Figures on tariff equivalents are therefore particularly error-prone as regards these countries.

It is with these limitations in mind that one has to examine the protection levels shown in *Table 2.1*. These protection levels are estimated by the authors, and the details are given in Appendix A2. The figures reveal the general pattern referred to in the preceding chapter – namely, that the highest agricultural protection is found in Japan and Western Europe, with levels of 50–175% of the world market price, whereas developed countries in North America and Oceania, as well as developing countries in general, show lower protection levels or even negative ones.

The somewhat lower protection rate for the USA should be interpreted with care. The USA follows a number of protective policies whose effects are not captured in the estimates of tariff equivalence. The US policies on land set-asides, payment-in-kind (PIK) type programs, loan rate subsidies, etc. provide protection to US producers without adding to the difference between domestic price and world market price. Though some of these policies increase farm incomes, they do not increase output. Nonetheless, they do affect the world market.

When we consider the development of protection over the period 1961–1980, the individual countries show very different patterns. Japan, topping the list, shows a steady increase from 150% to 175% protection over the period. According to a more recent source, this development has continued, but with a tendency to stabilize in the early 1980s. [Tyers and Anderson (1984) used a somewhat different set of commodities and weighting pattern to show that the protection level for Japan increased from 147% in 1975–1979 to 151% in 1980–1982.]

Table 2.1. Average agricultural protection (at nominal prices) and exchange rate changes in various countries, 1961–1980.

	Agricultural protection averages (%)			*Exchange rate yearly change (%)*
	1961–1963	*1969–1971*	*1975–1976*	*1970–1980*
Japan	152	161	175	–4.5
EC	76	65	55	–
Italy	86	68	85	–
UK	77	56	69	0.3
Belgium	82	69	56	–5.2
France	60	64	54	–2.7
West Germany	109	86	53	–6.8
Denmark	55	38	37	–2.8
Ireland	28	30	–	1.5
Netherlands	79	56	23	–5.8
Portugal	61	77	78	5.7
Egypt	9	13	58	4.9
Turkey	43	38	57	20.9
Sweden	84	84	55	–2.0
USA	45	31	48	0
Canada	32	8	33	–1.1
Kenya	11	14	31	0.4
India	–	30	–	0.5
Mexico	42	16	26	6.3
Austria	47	49	16	–6.8
Nigeria	35	74	10	–2.6
Brazil	–5	–26	6	27.6
Thailand	–25	–3	–1	–0.2
Australia	33	18	–13	–0.3
New Zealand	–11	1	–14	1.4
Argentina	–11	–16	–	85.7
Indonesia	–	15	–19	5.6
Pakistan	–26	–29	–	7.6

Source: FAP estimates based on FAO data, using production valued at world market prices as weights. Exchange rate changes from IMF *Yearbook of International Finance Statistics* (various years). They are expressed in relation to the US dollar. Increase means devaluation and decrease revaluation.

Some other countries show a pattern similar to that of Japan: for example, Portugal, with protection increasing from 60% to 80%; Egypt, from 10% to 60%; and Kenya, from 10% to 30%. Most other countries show an irregular pattern.

Since the EC is a major trader in agricultural commodities and since the CAP is widely regarded as a strongly protectionist policy, we look in some detail at the protection levels in the EC and its member countries.

Table 2.2 shows the development of EC protection levels for the period 1968–1981 according to three different measures. One is based on FAO data on domestic producer prices and world market prices at the raw material level; a second refers to a comparison between EC intervention prices and the corresponding import prices; and a third, to a similar comparison for EC threshold prices. As intervention takes place only when domestic prices fall below the threshold prices by a certain percentage, the latter prices will give a higher figure for the protection level than the intervention prices. The realized tariff equivalent would be expected to lie between the second and the third measure and, in principle, be most correctly estimated by the first measure. In practice, however, differences in product coverage and data information might give other results.

Table 2.2. Average agricultural protection levels[a] (%) in the EC, 1968–1969 to 1979–1980.

Price level	*Raw material*[b]	*Intervention*	*Threshold*
1968–1969	76	113	
1969–1970	64	128	
1970–1971	65	92	
1971–1972	46	43	54
1972–1973	40	47	52
1973–1974	42	31	39
1974–1975	51	37	43
1975–1976	58	59	68
1976–1977		108	125
1977–1978		116	134
1978–1979			140
1979–1980			114
1980–1981			67

[a]Protection levels for the FAP are averages of eight of the standard FAP commodity groups (excluding protein feed). The other protection levels are averages of soft wheat, barley, sugar, beef, pork, butter and skim milk powder, using 1977–1978 production valued at world market prices as weights and assuming that 1 kg of milk gives 0.044 kg of butter and 0.09 kg of skim milk powder.
[b]Raw material price refers to the price of the unprocessed product, i.e., it is the retail price less value of trade, transport, and processing.
Source: Raw material: FAP estimates based on FAO data. Commodity protection levels at intervention price: P.M. Schmitz (1980), Wohlfahrtsökonomische Beurteilung preis- und währungspolitischer Interventionen auf EG-Agrarmärkten, *Europäische Hochschulschriften*, **272**, 39 (Frankfurt). Commodity protection levels at threshold price: Eurostat; *Yearbook of Agricultural Statistics*, various issues, Table F4.

The figures lend themselves to three comments. First, the protection gradually fell from a high level at the end of the 1960s of 70% (raw material prices) or 110% (intervention prices) to about 40% in the middle of the 1970s; then, in the latter half of the 1970s, it increased to levels even higher than the 1960 ones, and reverted to the levels of the 1960s at the beginning of the 1980s.

The main reason for this movement is that cereals and sugar prices in the world market increased strongly during the food crisis of the early 1970s and, at times, were higher than the EC prices. These latter are mainly based on cost and income considerations within the Community and, therefore, are primarily dependent on the development of the general domestic price and salary levels. Thus, the EC relative producer prices have remained more or less constant, and the fluctuations in protection levels more or less reflect the changes in the world market prices. It is likely that similar changes in the movements of protection level occurred in most other developed countries with high protection as the protection-determining factors are in general the same in these countries.

Second, the protection level based on intervention prices is about 15–20% lower than the level based on threshold prices. This is consistent with the fact mentioned above that the intervention prices are those calling for intervention when the domestic prices fall below them.

Third, protection levels based on raw material prices (i.e., retail prices less value of trade, transport, and processing), which are used for the free trade analysis in this book, most closely follow those based on intervention prices. That they are on the low side for the late 1960s may be due to a broader coverage of products for raw material prices, which include products with more stable protection (e.g., tropical and nonfood products).

Returning for a moment to *Table 2.1*, one notes that protection levels for countries that are members of the EC deviate considerably from both the EC average and each other. In addition, these deviations are not symmetric over time. For example, West Germany shows the highest protection to begin with, whereas later Italy shows the highest protection. The protection levels in the Netherlands fall drastically over the period, from about the EC average level to less than half of this.

That the protection levels for new members of the EC – the UK, Ireland, and Denmark – may show deviations from the EC average in the period 1961–1980 is not surprising, as these countries became members only in 1973, and there was a phasing-in period of several years. But how can the differences between the others be explained, with a variation in 1976 from 85% for Italy to 23% for the Netherlands?

There are two main explanations. One is the difference in production mix: for example, the Netherlands produces large amounts of pork, which has low nominal protection. The other reason is the arrangement that dampens the influence of exchange rate fluctuations on national prices – the so-called Monetary Compensatory Amounts – which has effectively split price harmony in the EC (although it is not clear, without detailed analysis, in what direction these amounts affect the protection levels).

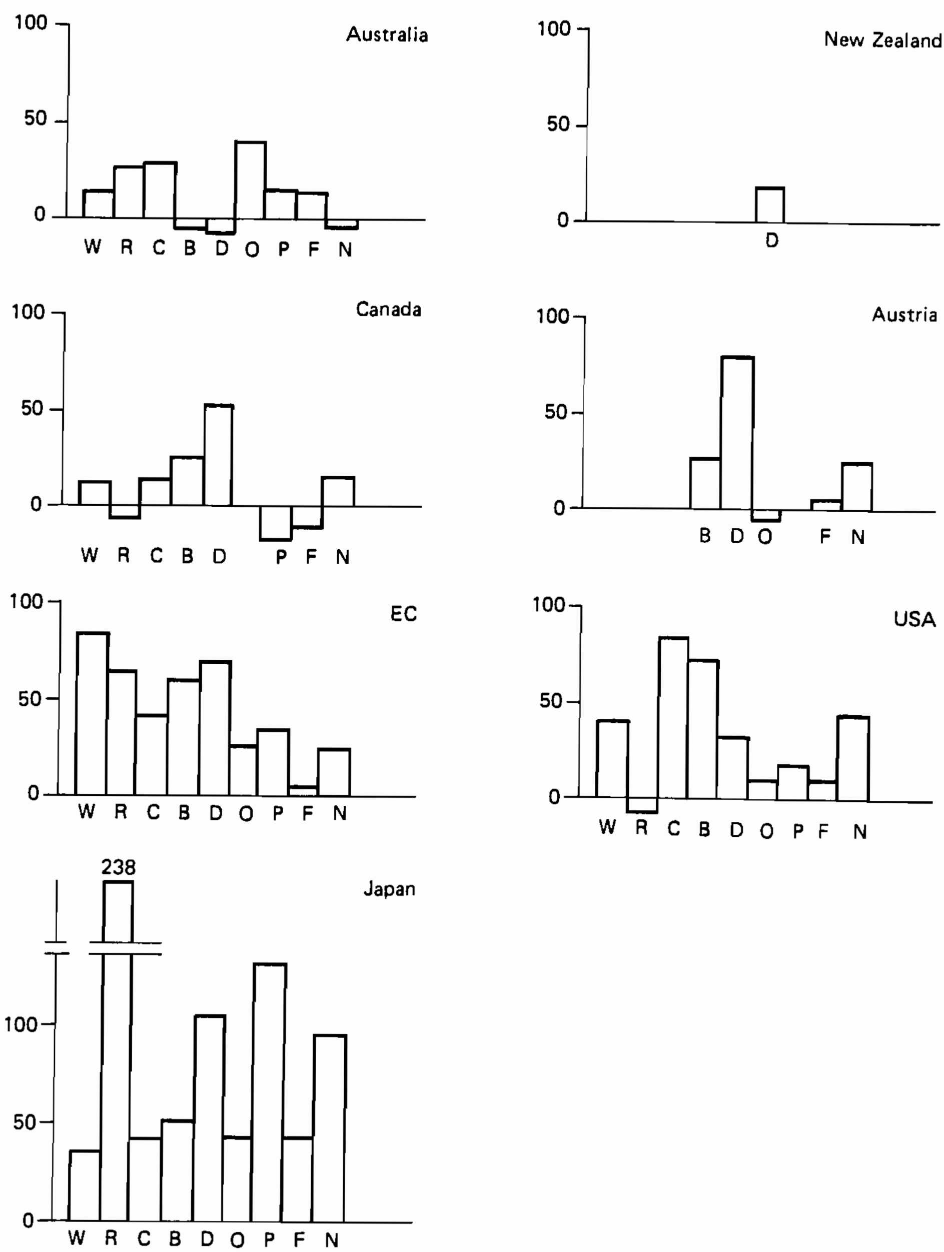


Figure 2.1. Nominal tariff rates (%) on agricultural commodities (1978–1980): selected *developed* countries. W, wheat; R, rice; C, coarse grain; B, bovine and ovine meat; D, dairy; O, other animals; P, protein food; F, other food; N, nonfood agriculture.

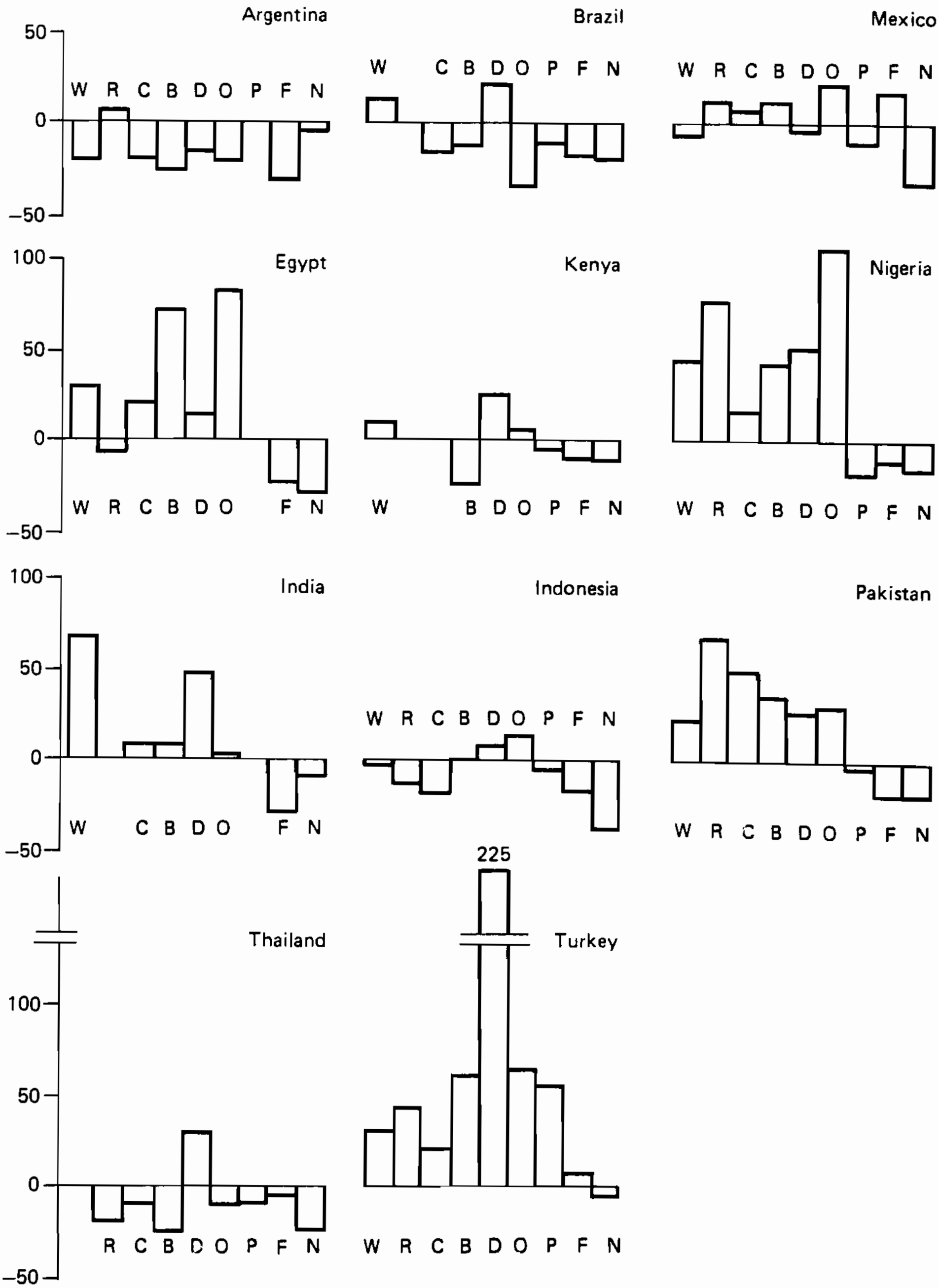


Figure 2.2. Nominal tariff rates (%) on agricultural commodities (1978–1980): selected *developing* countries. W, wheat; R, rice; C, coarse grain; B, bovine and ovine meat; D, dairy; O, other animals; P, protein food; F, other food; N, nonfood agriculture.

Owing to price variations on the world market and the way these are transferred to the domestic markets, protection rates vary from year to year. Commodity-wise estimates of protection rates for different countries for 1978–1980 are given in *Tables A2.11* and *A2.13* of Appendix A2, which also provides the details of our estimations of protection rates. These protection rates are obtained from simulation runs of the national models, in which world market prices were taken at their observed prices and domestic prices were obtained from the simulation runs. These are the protection rates that are eliminated in any free trade scenario. These are plotted in *Figures 2.1* and *2.2*.

The pattern of protection levels depicted in *Figures 2.1* and *2.2* shows large differences in protection rates across commodities within a country. For example, in Japan the protection rates vary from 35% for wheat to 238% for rice. Similarly in the EC, the protection rates range from a low value of 5% on "other food" to high values of 70% for dairy products and 84% for wheat. The protection rates for a commodity differ significantly across countries. Thus, wheat has a negative protection of 21% in Argentina and a positive protection of 84% in the EC, even though both of them export wheat. Similar differences are observable for protection levels in all commodities.

2.2. Driving Forces behind Agricultural Distortions

When distortion, despite its negative effects on the functioning of the economy in many situations, is so widespread, there must be strong forces behind its persistence. An appreciation of these forces is useful in determining which particular impacts of agricultural trade liberalization are especially important. The alternative theories advanced for explaining distortions have been broadly classified by Magee (1984) as policy theories, terms-of-trade theories, and political theories. According to policy theories, governments, in pursuit of the various objectives of economic policies, may distort agriculture, as was indicated in Chapter 1. However, here the question remains whether tariffs and other distortions are the best way of achieving these objectives or not (see Bhagwati, 1971, 1982b). If other, less expensive, ways of achieving the same objectives can be found, removing distortions introduced to realize these objectives should be comparatively easy. Yet distortions persist.

The terms-of-trade theories explain tariffs and taxes as devices to increase the welfare of the country at the cost of other countries. Thus, a country can introduce a scientific or optimal tariff (see Johnson, 1960) to increase its welfare. If this is the only objective behind tariffs, countries should be willing to dispense with their optimal tariffs if appropriate international compensations are given. Though, for a large country, optimal levels of tariffs may be nonzero, for small countries free trade is the optimum policy. And yet distortions persist also in small countries.

The political theories explain tariffs as an outcome of successful lobbying by some groups in the economy who try to increase their wealth at the cost of others in the economy. Here, tariffs (distortions of various kinds) "are an equilibrating variable in political markets, which balance opposing forces in redistributional battles (Magee, 1984)". These theories are reviewed by Magee (1984) and the results summarized by Magee *et al.* (1983). The theories thus try to explain why societies pursue particular policy or redistributional objectives. In that sense the political theories are extensions of the policy theories of tariffs. It would seem that, in the political marketplace (implicit behind many political theories of endogenous tariff is an elective form of government), the more numerous group should have more power and should be able to get more protection. Yet agriculture, the most numerous and largest sector in most developing countries, is penalized rather than protected. (Within the context of political theories, this cannot be explained away by the costs of lobbying and the inability of poor agriculturists to bear them, for why do not political entrepreneurs finance such lobbying?) Olson (1965, 1982) has argued that small homogeneous interest groups can more effectively organize themselves as pressure groups. Thus, the numerically small groups of agriculturists in developed countries are able to press successfully for protection. Yet Olson's arguments about the difficulties of organizing large but homogeneous interest groups are not persuasive enough to explain why political entrepreneurs are unable to organize a large number of fairly homogeneous farmers in developing countries into successful pressure groups to secure more protective government action.

This very brief review of theories explaining tariffs shows that none of them can fully or exclusively explain the driving forces behind agricultural distortions. One can, however, look at the pattern of protection and the main beneficiaries within a country of such distortions to see what may be the more important objectives.

2.2.1. Income parity – a major objective of protectionism in developed countries

Among agricultural economists, it is widely held that the income objective is one of the main reasons for agricultural protectionism in developed countries. Other objectives, such as food security, particularly in view of cut-off risks in war situations, price stabilization, employment safeguard, and environmental considerations, will be of secondary importance. This is not to say that these other objectives could not, in certain situations, be of overriding significance.

The introduction of agricultural protection in Europe during the Great Depression was certainly strongly motivated by price stabilization and employment objectives. The experience of World War II solidified the food security argument, particularly in neutral states. The latter argument has, by now, lost a lot of its strength as a result of the greater economic integration and prosperity in Western Europe.

If one accepts (a) that the income objective is the primary goal of protectionism in developed countries at present, and (b) that it is caused by problems of agriculture's adjustment in a rapidly developing society, then insight as to the economic consequences for income parity, suitable nondistorting compensating mechanisms to protect income parity, and a wide acceptance of the benefits to the economy as a whole are required before agricultural trade liberalization becomes acceptable in such countries.

The low-cost producers among developed countries demonstrate that it is possible for agriculture to be competitive. Despite facing prices lower than the equivalent free trade world market prices, agriculture manages to provide an income that is the same as or larger than that from nonagriculture in, for example, New Zealand and Australia (see *Table 4.13*). This might partly be due to favorable climatic and soil conditions, low density of population, and the fact that they have been only recently settled by the present dominant groups so that problems of adjustments have not yet become important. For countries of the Old World, increasing farm sizes cannot be accomplished without out-migration from agriculture. It is often argued that, even when out-migration is possible, an obstacle to reducing protectionism stems from the capitalization of high prices in the values of fixed resources, particularly land. If protection were removed, farmers with no or little debt would suffer a fortune loss and those with high debt would face bankruptcy. They would certainly oppose liberalization. Once the losses had been absorbed, however, the new set of lower output and land prices would allow profitability for efficiently run farms. Moreover, since free trade is an optimal policy for a small economy, the gains would be enough to compensate the farmers who lost.

As for a number of studies of various countries, a recently published analysis indicates that Swedish agriculture has reached a stage where such a strategy for liberalization may be followed (Bolin *et al.*, 1984). In this country, agriculture has demonstrated a higher productivity growth than other sectors, which has brought it to a stage of international competitiveness when the inputs are assessed at opportunity cost. (A contributory factor to making the Swedish agriculture competitive might be the series of devaluations the country has undertaken in recent years.) By compensating farmers for the fortune loss and overburden of debt, protection could be removed without negative effects on the production capacity. The gains in terms of consumer welfare, current fiscal expenditures, and increased efficiency of agriculture would, over some years, cover the compensation cost.

2.2.2. Policy objectives for taxing agriculture in LDCs

Most LDCs penalize agriculture rather than protect it. The reasons and compulsions for doing so may be many.

At the early stage of development, agriculture accounts for a large share of the employment and income in the economy. For the low-income economies in 1980, agriculture provided 70% of total employment and generated 37% of the gross domestic product (GDP) in the economy. For individual countries, the share of GDP varied from 21% to 75% (World Bank, 1983a). If surpluses have to be generated for investment, they have to come mainly from agriculture.

Taxing agricultural income directly in developing countries with generally many small farmers is administratively very difficult. Thus, governments tend to tax agriculture through indirect taxes, which can be collected with greater ease at either at large-scale processing facilities or at the border.

The comparative ease of collection of trade taxes and tariffs is important for developing economies with poor administrative infrastructure. This is reflected in the proportion of government revenues obtained from trade taxes. For low-income countries, taxes on international trade and transactions provided 30–50% of government revenue in 1981 (World Bank, 1983b). The reliance on these taxes decreases with increasing per capita income [1]. When the impact of a move toward free trade is examined, the importance of tariffs and taxes on international trade and transactions for the central government budget should be kept in mind.

Other policy objectives for taxing agriculture include some degree of monopoly enjoyed by some developing countries in specific export commodities (tea, coffee, cocoa, jute, etc.). The removal of an optimal tariff under trade liberalization would be reflected in loss of external terms of trade.

Protection of poor, and many times not-so-poor but well-organized, urban consumers also motivates governments to keep food prices lower than the world market prices. This indirectly punishes (taxes) agricultural producers. Thus, the impact on the consumption level of the poor and urban consumers should also be looked at in evaluating the desirability of trade liberalization or the need for other compensating policies.

2.2.3. Assessing the impact of agricultural trade liberalization: Some indicators of interest

The discussion above indicates that, for assessing the desirability of agricultural trade liberalization, the impacts on income parity in developed countries and on government budget and consumption levels of the poor and urban consumers in developing countries may be of particular importance.

Indicators that reflect other policy concerns include the conventional indicators of economic well-being – namely, GDP per capita, indicators of consumer welfare such as equivalent income or cost of consumption comparison, and self-sufficiency ratios. Finally, indicators that reflect social well-being – but which sadly are not always reflected in the policies of countries – are the impact on the poor, their calorie intake, the number of persons who suffer from hunger, and life expectancy at birth.

Note

[1] This is seen in a regression fitted to cross-country data for 1981 given below, where figures in parentheses are t-statistics:

$$T_{\mathrm{itt}} = \underset{(12.5)}{85.9} - \underset{(-9.2)}{8.682} \ln (\mathrm{GNP/capita})$$

$$\bar{R}^2 = 0.47 \qquad \text{degrees of freedom} = 93$$

where T_{itt} is taxes on international trade and transaction as a percentage of central government revenue in 1981, and GNP/capita is the gross national product (GNP) per capita in US dollars for 1981.

CHAPTER 3

The Analytical Approach

It is useful to describe at the outset the analytical tool or model and the scheme of analysis used to obtain the economic and social consequences of removing protection. We begin by examining the essential as well as desirable properties of any tool for analyzing the issues addressed. Then, in Section 3.2, we justify our approach and briefly describe our analytical tool, the Basic Linked System (BLS), in a nontechnical fashion. The scheme of analysis followed (including a description of the notion of trade liberalization in this study, the alternative scenarios, the approach used to explain the results of scenarios, and the welfare indicators used to evaluate the results) is described in Section 3.3.

The reader who is primarily interested in the results can, without loss, skip Section 3.2.

3.1. The Analytical Framework Needed for Assessing Impacts of Trade Liberalization – and Our Approach

For a satisfactory analysis of the impacts of agricultural trade liberalization, one needs a framework that accounts for a number of important interrelationships and feedbacks. There are three groups of actors within each country: namely, *producers* who *supply* commodities and *demand* inputs including primary factors; *consumers* who *demand* commodities and *supply* primary factors; and *government*, which sets taxes, subsidies, and quotas, and otherwise intervenes in the market. Each group is constrained – producers by technology, consumers and government by their budgets – and economists usually assume that the agents are rational and that each maximizes its objective. It is also customary in microeconomics to assume that profits are maximized by producers, utility by consumers, and social welfare by governments. Alternatively, governments can be described by behavior rules that may or may not correspond to any explicit maximization of an objective function. When agricultural trade is liberalized, relative prices and the relative scarcity of resources such as land, labor, and capital change. One should model:

(1) The response of:
   (a) Producers to the prices of inputs and outputs they face.
   (b) Consumers to the prices of factors and consumer goods that they face.
(2) The determination of consumer income as a function of factor prices and factor supplies.
(3) Finally, the market clearance condition.

These responses of producers, consumers, and government interact in the determination of the new equilibrium.

The need to account for the effects of price changes on farmers' incomes, and consequently on their consumption as well, is particularly important for countries where agricultural incomes form a large part of national incomes, as is the case for most developing countries.

Since the difference between domestic supply and demand is, by definition, the volume of international trade, it is usually, though not always, much smaller than domestic supply or demand. Changes in demand due to changes in income, assuming domestic supply is fixed, get fully reflected in trade volume. Thus, even small income effects can lead to large changes in traded quantities.

It is well known that the impact of changes in domestic prices on net exports can be of either sign. The analytical implication of this is that the equilibrium interactions between prices, supply, income, demand, and trade all have to be considered. And these interactions cannot be correctly assessed if there are unaccounted supply sources or demand sinks that mask some feedbacks. In other words, a closed general equilibrium framework incorporating *all* supply sources and demand sinks is needed.

Trade policies are but a part of a government's economic policies. For analyzing the consequences of substantial shifts in trade policies, such as those implied by trade liberalization in most countries, one needs to account for the changes in the government's other policies. The macroeconomic effects of policy changes can have a significant impact on trade patterns as well as on income distributions.

For example, if tariffs are a major source of government revenues, trade liberalization not compensated by external aid or transfers will lead to higher taxes or lower government revenues, public consumption, and/or public investment. Even when the lost tariff revenue is regained through changes in other taxes, the incidence of these taxes may fall on groups other than those that bore the burden of the tariff.

Even small changes in policy, such as changing over from tariff to an equivalent quota, may affect income distributions. Unless the government auctions the quota, which governments seldom do, the tariff revenue, which accrued to the government earlier, now accrues as a rent to the party to whom the quota is allotted.

An analysis of trade liberalization based on consideration of nominal rates of protection, or even effective rates of protection, can be misleading if it is a partial one. Thus, a general equilibrium framework is needed that incorporates the relevant government policy instruments and the behavioral responses of various economic agents, producers, and consumers to changes in such policies.

But it is not enough just to account for the behavioral responses of economic agents within the country to changes in government policies: consideration of the trade responses of other countries is also necessary. Particularly for major traders, the reactions of other nations to changes in the country's own policies can be very significant for analysis of trade policies. Even countries that at present follow policies of self-sufficiency, and hence are not active in world trade, may become so once the trade environment changes.

One could argue that, if the net export functions from the rest of the world are known for a country, one can do policy analysis using only the national model inclusive of these net export functions. For a number of policies, such stand-alone analysis based on a national model may be adequate. However, net export functions are not easily available. Moreover, shifts in such functions consequent on the responses of other governments to major policy changes by one government would be difficult to account for in an analysis with a single-country model. Thus, what we need is a system of general-equilibrium-type national policy models linked together through trade and transfers.

The interactions of the policies of different countries are such that a simultaneous abolition of tariffs by two trading partners can raise, lower, or leave unchanged the world market prices. This possibility is illustrated using the traditional geometric tool of international trade theory in Appendix A1. What this shows is that the outcome of trade liberalization on terms of trade cannot be predicted independently of the description of the behavior of all groups of economic agents and, thus, of the system as a whole.

The BLS national agricultural policy analysis models of the International Institute for Applied Systems Analysis (IIASA), Food and Agriculture Program (FAP), is such a descriptive system. We believe that it is particularly suited to analyze issues related to agricultural trade liberalization and self-sufficiency.

3.2. The BLS for National Models

3.2.1. The general approach

The system of linked national models is called the Basic Linked System (the BLS). The national models in the system cover more than 80% of the world's food attributes, such as land, population, demand, production, trade, and so on. The remaining countries of the world are covered by 14 simplified models comprising groups of countries. Countries that are likely to have similar relations with the world market are grouped together, such as poor calorie importers of Africa, poor calorie self-sufficient African countries, Middle Eastern oil exporters, etc. Currently, in the basic linked system there are three types of models, as shown in *Table 3.1*.

Table 3.1. Models in the BLS.

Models with common structure	*Models with country-specific structure*	*Regional group models*
Argentina	CMEA	African oil exporters
Australia	China	African medium-income calorie exporters
Austria	India	African medium-income calorie importers
Brazil	USA	African low-income calorie exporters
Canada		African low-income calorie importers
Egypt		Latin American high-income calorie exporters
Indonesia		Latin American high-income calorie importers
Japan		Latin American medium–low income
Kenya		Southeast Asia high–medium calorie exporters
Mexico		Southeast Asia high–medium calorie importers
Nigeria		Asia low income
New Zealand		Southwest Asia oil exporters/high income
Pakistan		Southwest Asia medium–low income
Thailand		Rest of the world
Turkey		
EC		

The first set contains the common structure models, developed at IIASA. Though they have a common structure they are individually estimated, with the parameters separately estimated for each country from country-specific data. The second set contains some detailed models that were built outside FAP at IIASA and have not necessarily followed the common structure. These models also relied on country-specific data and embody much more country-specific policy structures. The third set of models consists of the country groups.

Though the national models may have greater commodity detail, the international exchange among the national models occurs at the level of the 10 commodities shown in *Table 3.2.* Each of the national models, as well as the international system linking them, has a general equilibrium framework. The major features of the approach are that it is quantitative, the parameters are empirically estimated, it includes behavior responses, and it is a comprehensive general equilibrium framework in the sense that it includes the whole economy and the whole world without any unaccounted supply sources or demand sinks. Moreover, it distinguishes nations and various economic agents within nations.

In the system national governments are important actors with a wide range of permitted policies. Taxes and transfers, tariffs, quotas, and rationing, partial or total, are all permitted. Though one talks about the determination of

Table 3.2. Commodities and units used in international trade.

Commodity aggregate	*Main components*	*Type of measurement*
Wheat		Total weight
Rice, milled		Total weight
Coarse grains		Total weight
Bovine and ovine meat		Carcass weight
Dairy products		Milk equivalent
Other animal products	Pork, poultry, eggs, fish	Protein equivalent
Protein feed	Oilcakes, fish/meat meal	Protein equivalent
Other food	Oils, fats, sugar, vegetables, fruits, coffee, cocoa, tea	Unit values of exports (expressed in US$), averaged over the period 1969–1970
Nonfood agriculture	Clothing fiber, industrial crops	Averaged over the period 1969–1970
Nonagriculture	All nonagricultural outputs	1970 domestic prices (expressed in US$)

equilibrium prices, it is not necessary in this system or in the approach followed that governments select only price as their equilibrating instrument. Governments may decide to fix prices and let other things adjust; the models determine relative prices. Also, there is no demand for money or foreign exchange and the models are independent of exchange rates. The solution of the system gives not only a global agricultural balance sheet of commodity flows, but also traces how these come about under the influence of which policies. Not only does the system provide international trade flows, but also it identifies the domestic supply and demand forces that determine exports and imports. Thus, the system constitutes a tool to assess the impact on each country's domestic food situation due to a country's own government policies, as well as to policies of other governments.

The internal consistency of a solution of the system is ensured in a number of ways, which is important but not normally realized in other analytical approaches. Not only is there consistency among physical flows of commodities, but also that of the financial accounts of economic agents is ensured:

(1) Quantities produced, demanded, and traded balance at national and global levels.
(2) For consumers and nations, expenditures and incomes balance.
(3) Income earned is consistent with income generated by production and trade.
(4) Prices for producers, consumers, and government taxes are consistent.
(5) Government expenditures balance inflows.
(6) Balance of trade is realized at national and global levels.

These consistencies and the global coverage ensure that secondary effects and adjustments, which may be quite important, are accounted for.

Again, we emphasize what the BLS is and what it is not. It is a powerful analytical engine to explore and to understand the impact of alternative policies. It is not, and one cannot emphasize this enough, a forecasting tool. If forecasting had been the main objective, a different model would have been built with more emphasis on statistical fits and less on economic structure.

3.2.2. A typical national policy model of the FAP

The building blocks of the FAP model system are the national policy models. Each national model has to reflect the specific problems and characteristics of that particular nation. Although the national models do not differ in their structure, they are country-specific in their contents, particularly in their descriptions of government policies. The model system of the FAP enables such diverse models to be linked, but requires that all the national models meet a few conditions. They have to have a common sector-classification at the international trade level (nine agricultural and one nonagricultural) and some fairly reasonable additional technical requirements. For example, net exports have to be continuous functions of relative world prices and independent of their absolute level. Even though the national models differ from each other, the broad structure is common to most models. In some, food supply and demand are distinguished by various income groups. The information flow in a typical model is shown in *Figure 3.1*.

Past prices and government policies affect production decisions. The domestic production in each of the sectors of the economy accrues to each of the sectoral groups. The income this amounts to is determined by the price that these products command. For example, if farmers have grown two million tons of wheat and one million tons of rice, they would have an income of twice the price of a million tons of wheat plus the price of a million tons of rice, minus the cost of producing wheat and rice. These initial entitlements of the different products for the various groups may be redistributed by government policies.

Given these entitlements and world prices, groups trade among themselves under the influence of government policies, which include national market policies (price, buffer stock, trade), public finance policies (balance of payments, public demand, direct tax), and international market and finance policies (agreements on price, buffer stock, trade, financing). The resulting exchange equilibrium determines the domestic prices, net exports, tax rates, and consumption patterns of different income groups whose demand behavior is characterized by a linear expenditure system. In the process of exchange all the markets are cleared within the (national) balance of trade constraint and the income and resource constraints faced by the various actors. Each model distinguishes three types of economic agents: producers, consumers, and governments. Though all the

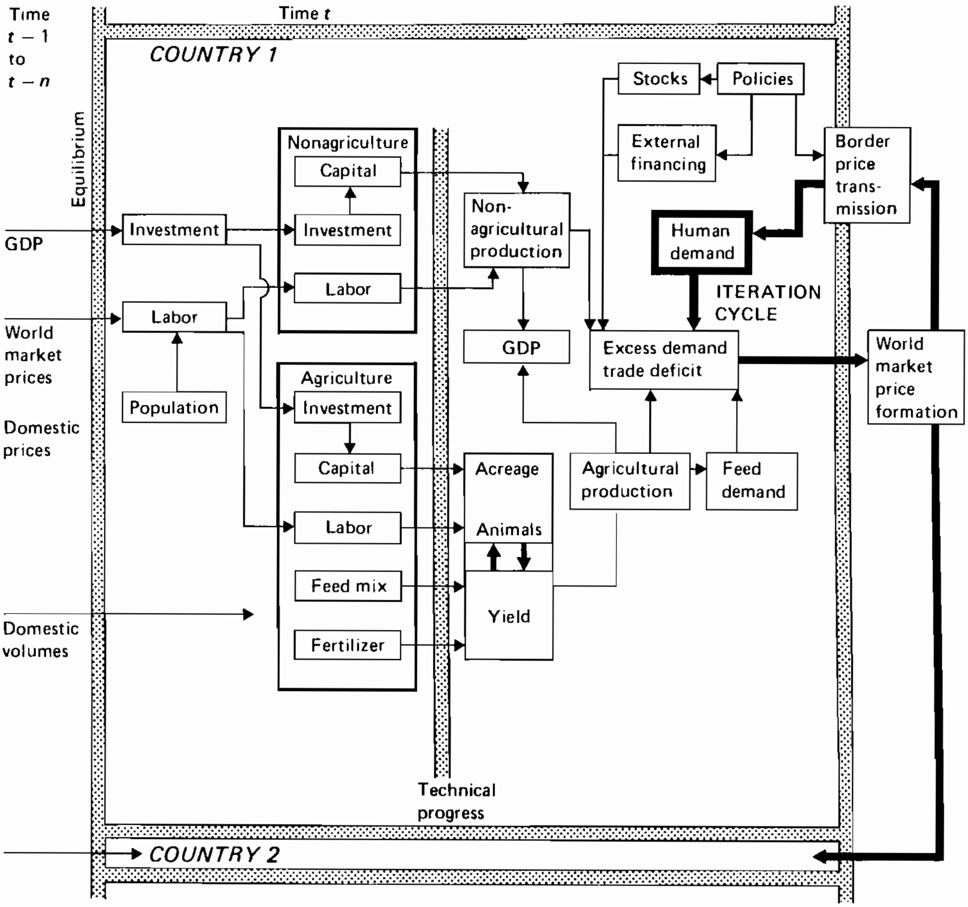


Figure 3.1. Information flow in a typical national model.

national models follow the broad schematic outline described above, the methodological approaches in modeling behavior of these agents do differ from model to model.

Some of the methods most commonly used are:

(1) *Producer behavior.* Four alternative approaches are used in various models for modeling the supply response of agricultural products:

(a) Econometric estimation of acreage response and yield functions. These include relative profitabilities, critical inputs, and factors such as explanatory variables. This is the approach followed in the models of India, the USA, and one version of the Canadian model.

(b) A nonlinear programming model to allocate land, factors, and inputs for different crops based on estimated production functions is used in the models constructed by FAP at IIASA.
(c) A linear programming approach, which integrates economic and institutional aspects with agronomic potentialities and constraints, is used in models of Thailand and in one earlier version of the model for Bangladesh.
(d) A hierarchy of linear programs is used in models of the centrally planned economies (Hungary and Poland) to describe and coordinate the behavior of planned sectors and various agricultural subsectors.

Nonagricultural production in most models is determined by a Cobb–Douglas production function.

(2) *Income generation.* In some models of the developing countries different classes are identified based on the distribution of assets, such as land, draught animals, equipment, etc., and the product is distributed across these classes as income entitlements accruing to labor, land, capital, etc. The common structure models do not distinguish different classes of consumers.
(3) *Consumer behavior.* The demand behavior in the BLS is described using estimated equations, one for each commodity, which express human consumption as a function of income and price. Each year, the expected consumption levels are approximated by a linear expenditure system. For those developing countries for which different expenditure classes are distinguished (notably India), a separate demand system is estimated for each class from time series of household expenditures.
(4) *Government policy behavior.* Government policy in each national model can be described by a hierarchical set of adjustment rules for policy targets, such as domestic price targets, trade quotas, stock targets and bounds, tax rate bounds, etc. However, to minimize the problem of exploding numbers of variants in the BLS, price transmission functions are used to characterize government policy. These functions relate current to past world market relative prices and self-sufficiency to the domestic relative target price.

3.2.3. Capital accumulation, labor movement, and trade deficit

Savings are a function of GDP and trade deficit. They are equated to investment, which is allocated between agriculture and nonagriculture, depending on the relative marginal value product of the capital in, and the size of, the two sectors. Similarly, labor is also allocated between the two sectors based on its relative marginal value product and income parity.

In allocating labor and capital to the two sectors, some friction and rigidities are assumed so that marginal value products are not equalized in the two sectors. The factor allocations are, however, such that the marginal value products in the two sectors tend to come nearer to each other over time.

Targets for net trade deficit (including grants and concessional and market borrowings, and the net of all service and repayment obligations) are set for each national or country group model. These net trade deficits or net capital flows each year must add up to zero at the global level.

In modeling net trade deficit targets, emphasis has been placed on the development aspect. A country with higher growth rate, larger exports as a percentage of GDP, and a smaller debt service burden can commercially borrow more in a sustainable way. Thus, low-income countries are assumed to enhance their ability to invest by obtaining aid and borrowing as much as is commercially sustainable in terms of their openness and growth performance. With growing income, their propensity to seek foreign savings would decrease to zero upon entering a developed stage. This behavior has been formalized in a net trade deficit target, based on past performance and a cross-country analysis of trade balances. As debt has become a serious issue for many developing countries, the debt service burden has been taken into account in setting trade deficit targets.

The source of capital is high-income countries. The repartition among them depends on their past performances and an imposed movement toward higher surplus. The resulting trade surplus targets are proportionally adjusted so that the sum exactly corresponds to the cumulated trade deficit targets. As payments are balanced, the capital flows are equal to the trade balances with opposite sign. They vary from year to year and scenario to scenario.

3.2.4. The international linkage

A first round of exports from all the countries is calculated for an assumed set of world prices, and international market clearance is checked for each commodity. World prices are then revised using a nondifferentiable optimizing algorithm and transmitted to the national models. Next, these generate new domestic equilibria and adjust net exports for all countries. This process is repeated until the world markets are cleared in all commodities. At each stage of the iteration the domestic markets are in equilibrium. The procedure is shown schematically in *Figure 3.2*. It may be noted that any international agency – such as a buffer stock agency – can be represented as a country, and the effectiveness of its policies can be evaluated within a framework in which country policies react to the policies of the agency.

This process yields international prices as influenced by government policies. The outcome of this process is examined by governments that may change their policies for the next period. As agents in the model do not formulate expectations about government policies, issues of time consistency and the like do not arise in our models.

Since these steps are taken on a year-by-year basis, a recursive dynamic simulation results. Simulations over 15-year periods are used to project the consequences of various policies, not only for individual countries, but also for the entire system.

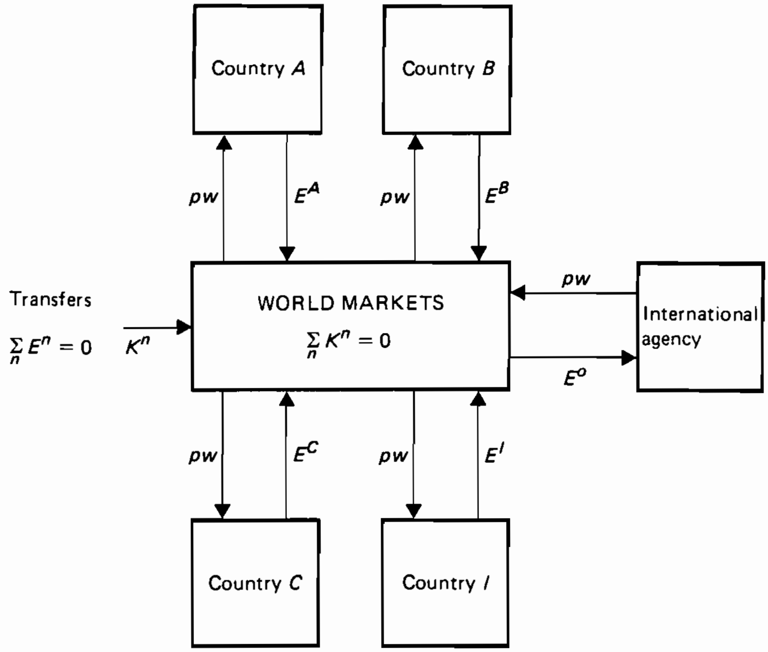


Figure 3.2. International linkage. K, trade deficit; E, net trade vector; pw, market price vector.

3.2.5. Data sources, parameter estimation, and validation

The basic data sources comprise the various publications of the FAO, the World Bank, and the International Labor Organization (ILO). In particular, the supply utilization accounts (SUA) of the FAO have been extensively used. For some countries, these data were examined by specialists from the countries and were replaced by more "reliable" domestically published data. The models of the USA and India, which do not follow the standard structure, were estimated using published national data.

To a large extent, the parameters were empirically estimated. The parameter estimations were carried out using mostly the time series of 1961–1976, but in some cases data covering longer periods were also used. The general equilibrium structure was not imposed, and all the parameters were not estimated simultaneously. However, parameters of a number of modules, such as the allocation model, were estimated simultaneously.

In validating and tuning the models, emphasis was placed on the fact that the BLS is a medium-term policy analysis model and not a short-term forecasting one. It does not incorporate short-term variations, such as those due to weather, nor any speculative behavior resulting from such variations. For policy analysis we want the BLS to track the central tendencies correctly.

The model system was "validated" in three phases. In the first phase, individual national models were tested in a stand-alone mode (i.e., unlinked to other models) with given world prices over the historical period 1970–1978. For each of some 70 endogenous state variables generated by each model, simulated values were regressed against the observed values. Ideally, the slopes of these regressions should be 1.0. The frequency distributions of the slopes were examined to judge the model. These distributions were considered satisfactory. In the second phase, the country models were run up to the year 2000, again in a stand-alone mode with given world prices. In the last phase of the validation process, a series of "linked runs" with full interaction between the individual national models within the global exchange system was carried out.

The objective in the second and third phases was to test whether the models behave reasonably. Since this is a very subjective notion, specifications and parameters were changed in individual models only in the case of extreme results.

Finally, it should also be noted that the fact that the BLS is an empirically estimated system lends a strength of objectivity to the system; but, by the same token, the data base is somewhat old (1961–1976, partly extended to 1980 for crucial variables). However, since the problems of structural change and agricultural adjustment are of a long-term nature, the observed functional relationships are likely to remain valid for a long time. Moreover, the system has been tested to reproduce reasonably the central tendencies observed over the period 1970–1980. This makes the model system suitable for policy analysis.

3.2.6. Exogenous and endogenous variables in the BLS

A number of important variables remain exogenous, though for a large and complex model system such as this the exogenous variables form only a small part of the total. The more important of these are summarized below:

(1) *Population* and its growth is taken from the latest UN and ILO sources (median projections), but for some individual countries, e.g., India, these have been adjusted by the latest national information and projections. Similarly, the participation rate in the total labor force is defined exogenously, but the allocation of the labor force between agriculture and the rest of the economy is endogenous.

(2) *Land* available for cultivation is exogenous, and the data are taken predominantly from FAO sources and from specific national estimates. This also includes the development of land over time.

(3) *Rates of total investment* as a share of the GDP are estimated from the historical period and, after a period of adjustment in the early 1980s, they are kept constant. Some exceptions occur, e.g., India, where the investment rate changes exogenously over time.

(4) A number of important exogenous assumptions are made for the Rest of the World, i.e., the residual countries that are modeled only in groups for inclusion in the system. These include growth rates for both agricultural and nonagricultural production, based on past performance. The outputs, however, do respond to changes in world prices.

3.2.7. Comparative advantage of BLS

Compared with other global policy models, the BLS is characterized by:

(1) It is a general equilibrium system empirically estimated (and not benchmarked on one year's data). As a general equilibrium model, it distinguishes a number of commodities, but it distinguishes more agricultural commodities than other general equilibrium models.
(2) Governments are important actors in the system, and a whole range of government policies is included.
(3) Government policy reactions are endogenous and can be modified in response to changes in world market prices. Thus, a change in policies of a government affects, through the world market prices, policies of other governments and, in turn, is affected by them. This is important as excess demand functions facing a country may change when policies change.
(4) It is a policy analysis tool that can explore simultaneous changes in a number of policies by different governments.

Of course, compared with commodity models, its strength lies in the fact that the reactions to policies by other commodity markets are also accounted for. However, it should be said again that the BLS is not meant to be a tool for short-term forecasting and hence it does not include any of the usual short-term phenomena.

3.3. The Scheme of Analysis

Evaluation of the impact of agricultural trade liberalization will be carried out by comparing the results of a number of policy scenarios generated using the BLS. To do this, it is necessary that the notion and scope of agricultural trade liberalization are defined clearly, a set of policy scenarios is identified, and an approach to interpretation of the scenario results is described. The high degree of interdependence in the BLS (interdependence among commodities and among countries as well as the general equilibrium consistency of physical and financial balances) makes interpretation of the results somewhat complex. Moreover, indicators relevant for welfare analysis need to be identified.

3.3.1. The scenarios

In the alternative scenarios of agricultural trade liberalization, different countries or groups of countries liberalize. These scenarios are designated by F-EC, F-USA, F-OECD, etc., where F refers to freer trade and the country/countries liberalizing are indicated in the designation. The results are compared with a reference scenario, which is designated by R0. *Table 3.3* gives the list of scenarios.

Table 3.3. List of scenarios.

Designation	*Description*
R0	Reference scenario
Agricultural trade liberalization by:	
F-OECD	All OECD countries, excluding Turkey
F-LDC	All developing countries, excluding China
F-EC	Only the EC
F-USA	Only the USA
F-ALLME	All market economies

In all the trade liberalization scenarios discussed, it is assumed that China and the CMEA do not participate in trade liberalization, though they do moderately modify their trade patterns in response to changing world prices.

All the scenarios are run from 1980 to 2000. Trade liberalization is gradually introduced over a five-year period, 1982–1986, so that 1986 is the first year of fully liberalized agricultural trade. In these scenarios, agricultural trade is liberalized *without* introducing any compensating lump-sum transfers either within countries or among countries.

3.3.2. The purpose and role of a reference run

For any policy analysis, a baseline scenario is required as a reference for evaluating the effect of policy changes. However, such a scenario depends itself, at least implicitly, on assumptions about how a certain set of policies affect economic performance. One may define a baseline scenario as a "no change in policies" or "business as usual" one, but it is not necessary that it be so. In this context, any predicted and continuing trends in such policies may also be incorporated in the reference scenario.

The primary role of the reference run is to serve as a "neutral" point of departure, so to speak, from which policy scenarios take off as variants, with the impacts of a policy being seen in the deviation of that policy run from the reference run. Neutrality will be achieved if the reference run by its very specification does not accentuate the impact of some policies while muting that of others. If the reference scenario is at one of these extremes, reactions to some policy changes may be muted and others accentuated. Of course, if fortuitously the scenario of continuing past trend also happens to be such a neutral scenario, it will be an obvious choice for a reference scenario owing to its aesthetic appeal.

It is important to be clear about the role of the reference run, the desiderata that it should possess, the pitfalls it should avoid, and above all its appropriate interpretation.

While neutrality is an important desideratum, short of doing sensitivity analysis with a number of alternative reference scenarios, obviously one cannot easily test whether neutrality has been achieved – some judgment is unavoidable. Should one go beyond this and require that the reference run produce results for the far future that do not conflict too much with "expert judgments"? We have not done this for several reasons: very often the so-called "expert judgments" are more in the nature of informed guesses than the results of analytical work. Many an expert would be hard put to provide a description of the analytical framework (if any) and the assumptions about the behavior of exogenous variables (particularly macroeconomic variables) as well as about policies that implicitly influence his judgment in his own area of expertise. It is extremely unlikely that "expert judgments" relating to different commodities and sectors are based on a mutually consistent and common set of macroeconomic assumptions, let alone on a consistent analytical framework. This is not to say that all judgments not based on formal models ought to be neglected. Indeed, informal and intuitive analyses of some experts may often be more flexible in synthesizing information than formal models. However, we considered it to be unwise to exaggerate the importance of expert judgments about the future in designing our reference run. Barring obviously absurd and incredible results, no attempt was made to tinker with the model to produce a reference run which reproduces, so to speak, a median, or whatever, of the distribution of expert judgments or forecasts. Having thoroughly reviewed the components of the model (and here, expert judgments were very helpful) and having accommodated a reasonable assessment of likely changes in policies relative to the past, we did not consider a reversal of past patterns of trade in projections with the model as necessarily indicating a need for revisions in the model.

The labeling of the reference run as an IIASA-FAP forecast should be resisted very firmly. This is because the model is not designed as a forecasting tool but only as a powerful analytical engine to explore and understand the impact of alternative policy packages in a logically consistent and complete, though aggregative, model of individual economies and the global trading system. Put another way, the expectation is that policy impacts calculated by the model system and expressed in some suitable relative or unit-free form are more robust than their absolute magnitudes. One way to test this is to carry out policy analysis with reference runs using alternative assumptions. This was indeed done and the qualitative results did not depend significantly on the assumptions of the reference run.

3.3.3. The notion of agricultural trade liberalization

The analysis of trade liberalization in this study is restricted to removal of distortions between trade prices and domestic prices at the level of the raw materials of the agricultural commodities. The scenarios do not remove *all* distortion-creating measures from all markets and production activities. Thus, they move toward free trade and not to total trade liberalization, so that one should characterize them as freer trade scenarios. The reason for restricting the analysis to removal of only border protection measures is the difficulty of obtaining accurate information on all trade-distorting measures.

For some countries, additional changes are introduced. In the case of the USA model, land set-aside programs are also removed in the scenarios in which the USA liberalizes trade. The wedges which exist between the consumer and producer prices for wheat, coarse grain, and bovine and ovine meat in Japan and for wheat in Nigeria are also set to zero when these countries liberalize; and in Canada the quotas imposed on dairy production in the reference run are removed when it liberalizes. The monetary compensatory amounts (MCAs) that are given to member countries of the EC under its CAP are still implicitly included in the producer prices as the EC is treated as one aggregated country. The kind of distortion resulting from this is very difficult to assess. Since, however, the MCAs are small in comparison to the EC's protection against third countries, one might argue that their impact is not very drastic. This is especially so if one works with the hypothesis that the MCAs only distort the (absolute) price levels between the EC member countries but not the relative prices of agriculture, which are the same in all member countries of the EC.

Thus, in our analysis of trade liberalization where these calculated tariff equivalents are removed, only the supports given at the border are abolished. The supports given to domestic production or/and consumption are not affected by the removal of tariff equivalents. This holds for all types of domestic assistance (e.g., input subsidies, storage subsidies, production quotas, consumer subsidies, transportation subsidies, marketing licensing, export credit, insurance).

Trade liberalization is partial in our analysis in yet another sense. Agricultural trade liberalization is achieved in the scenarios by removing protection from agricultural commodities as reflected in the estimated protection factors (see Appendix A2). As reliable information on the protection factor on nonagriculture is not available, it is not removed from the nonagriculture sector. As a consequence, trade liberalization here is partial. Relative distortions among agricultural commodities are removed, but the relative distortion between the agriculture and nonagriculture sectors is not fully removed and could even be reversed in some cases.

The protection factors as indicated by available crude estimates for the nonagriculture sector are much smaller than those for agricultural commodities in the developed market economies. Thus, nonremoval of distortion from the nonagriculture sector should have a small impact on the results when only these countries liberalize.

For the developing countries, the nonagricultural protection factors may be expected to be somewhat larger, but many of these countries play a comparatively modest role on the world market. Thus, here also, the effects on the results for the world market should be small. Of course, for individual countries the results can be significantly affected by total liberalization. In fact, model scenarios in which crudely estimated nonagricultural protection factors were also removed confirmed these expectations. The main results at the global level and the character of the scenarios did not change significantly. A significant impact on the size of efficiency gains and losses for some developing countries was seen, but that, too, was not dramatic; nor did it alter the qualitative picture. This could have been expected for yet another reason. Since nonagriculture is treated as a single aggregate sector, the gains from removing distortions within its subsectors cannot be captured in the BLS. However, the impact on the size of efficiency gains and losses does suggest the need for having better estimates of nonagricultural protection factors.

In treating all nontariff barriers as tariff equivalents, the benefits or costs of the protection measure do not accrue to the correct agent: e.g., an import quota increases the domestic price, and the rent from this quota goes to the importer, whereas the government gets the receipts from a tariff. However, for countries where explicit trade quotas are used, such as a quota on the import of bovine and ovine meat, removal of the quota does not lead to such a distortion in the distribution of costs and benefits of protection.

If agriculture as a whole is protected relative to nonagriculture, then this suggests that agricultural output will decrease with liberalization of trade. The reallocation of resources brought about by liberalization can be used to improve welfare as well.

On the other hand, if world market prices are affected by the trade liberalization of a country (while others do not change their protection levels), whether or not a *move toward* liberalization is welfare-improving for that country depends on whether such a move takes the country toward or away from levels of trade restriction which are optimal for it.

The relationship between world and domestic prices under a trade liberalization regime and the corresponding relationship under continuation of the distortionary reference policy regime are shown in *Figure 3.3*. For a given world market price of a commodity, the domestic price *under trade liberalization* depends upon whether the country is a net exporter or importer of the commodity. Thus, the domestic price can increase suddenly when a country becomes a net importer from being a net exporter. This knife-edge dependence of domestic price on the net trade status can be computationally troublesome. A smoothing relationship is introduced where the transition between the import and export prices is related to the self-sufficiency ratio defined as the ratio of domestic production to consumption. This is shown in *Figure A2.1*, Appendix A2. Such smoothing can be justified on the grounds that only net exports or net imports are considered in the system and that, owing to the composition differences in

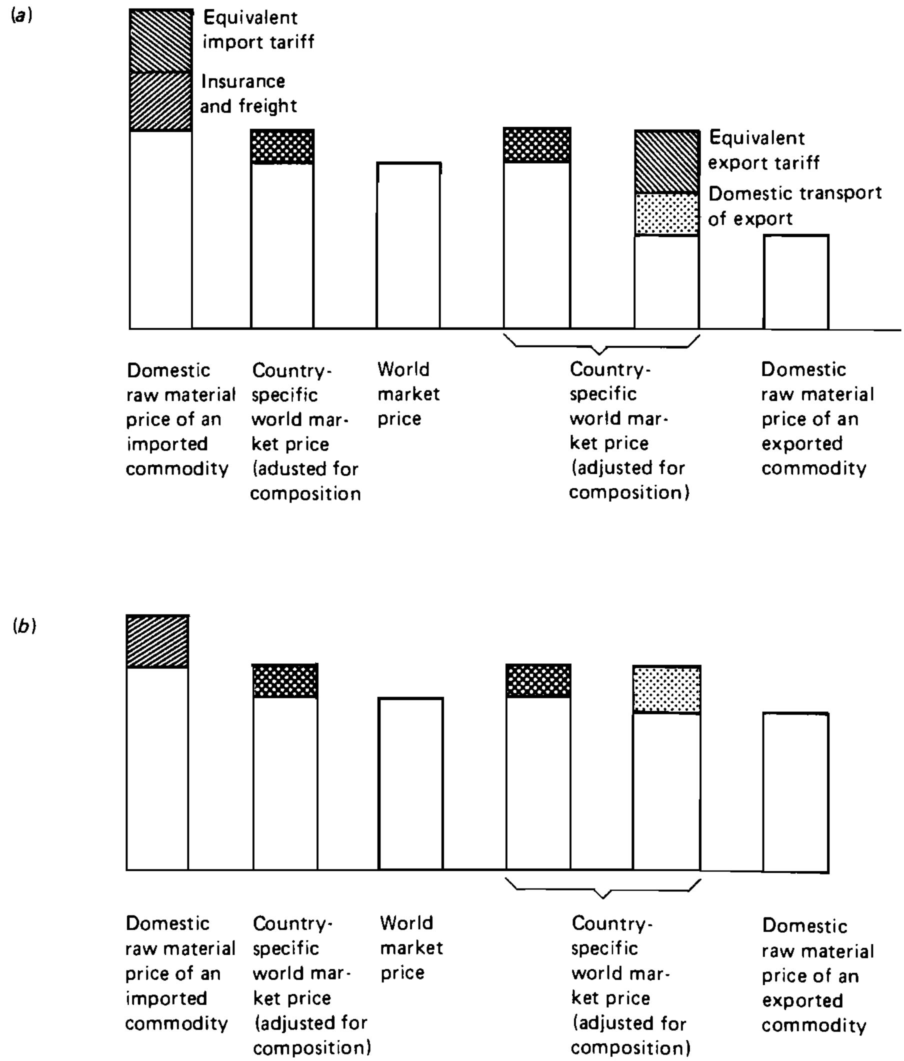


Figure 3.3. World and domestic raw material prices for an imported or an exported commodity: (*a*) under reference run policy and (*b*) under trade liberalization.

aggregate commodities and quality differences in relatively homogeneous commodities, some trade takes place even when a country is self-sufficient in a commodity.

The self-sufficiency ratio at which the relative domestic price equals the relative trade prices for an imported commodity (point *a* in *Figure A2.1*) is set at 0.90 for dairy products and other foods, and at 0.95 for all other commodities.

For exports, the corresponding self-sufficiency ratio (point *b* in *Figure A2.1*) is set at 1.05 for bovine and ovine meats, other animal products, and nonfood agriculture, and at 1.10 for all other commodities. In other words, only when the self-sufficiency ratio is equal to or lower than the values mentioned above is the relative domestic price equal to the relative trade price. Otherwise, the relative domestic price is interpolated. A similar procedure is used for the case of export.

The results of each scenario are most often expressed as a percentage change relative to the corresponding outcomes of the reference scenario. Sometimes they are expressed relative to other scenarios appropriate for such a comparison. Since a number of time lags are built into the various models of the BLS, several years of adjustment may be required to fully capture the impact of trade liberalization. The analyses of the scenarios, therefore, concentrate on a comparison of the trade liberalization results with those of the reference scenario around year 2000. Some comparisons are also made for the year 1990.

3.3.4. Comparing scenarios of a general equilibrium system: Simultaneity in a dynamic multisectoral world

In all general equilibrium systems, in principle, almost everything depends on everything else, and the interpretations of policy effects become very complex. Nonetheless, to understand the nature of the system and the results, and in a sense even to believe in the validity of the results, one would like explanations that are largely consistent with the intuition of an economist. Especially when the results are counter-intuitive, a persuasive explanation, still in the language of economists' conventional reasoning, is needed. Since much of economists' reasoning is based on partial equilibrium (in a *ceteris paribus* framework) comparative static analysis, it is in the language of such analysis that our explanation of the results will be offered. It should also be appreciated that, in spite of the feedbacks and simultaneity in the determination of all variables, not all feedbacks are equally important. Thus, partial equilibrium reasoning can sometimes be adequate to explain the results. Though it is hoped that such reasoning explains most of the results, it should, nevertheless, be emphasized that the explanations offered are only partial and that they are offered for expositional convenience.

The major feedbacks and interconnections in the system are such that world prices affect domestic prices, which affect domestic production and consumption, and therefore net exports of a country, affecting in turn the world prices themselves. Similarly, consumption demand affects domestic prices, which affect domestic production and resulting domestic income, and therefore demand itself. Moreover, these interactions are mostly simultaneous and cannot be described as lagged or sequential processes. This makes partial equilibrium explanations somewhat tentative.

Yet another feature of the system that makes it harder to explain its behavior is that the number of sectors is more than two. In a two-sector framework, there is only one relative commodity price, and shifts in resource allocation are easily predictable. For example, when the producer price of one sector increases relative to that of the other, one can expect an increase in its output. However, in a three-sector world, it could either increase or decrease.

Similarly, changes in demand for various commodities, when relative prices change simultaneously, cannot be predicted either, as the income effects may dominate the price effects.

Since net export is the difference between production and consumption, the ambiguity carries over to trade. Thus, net exports of the in-between commodity may increase or decrease.

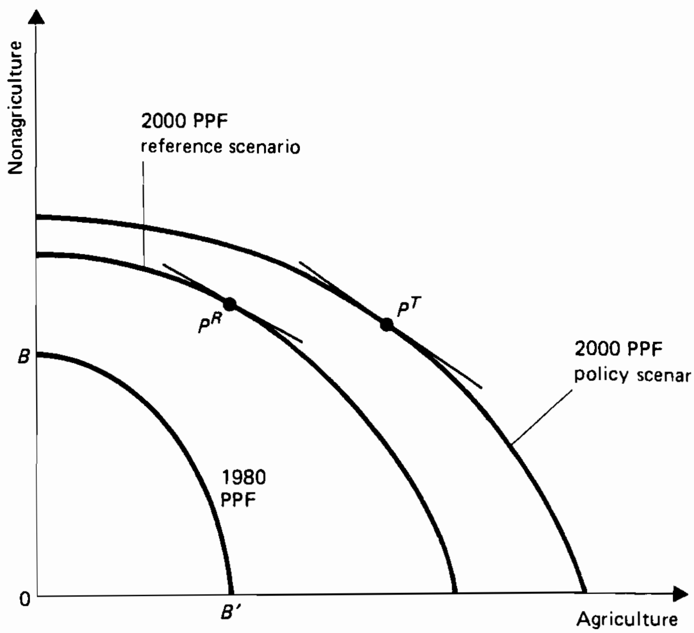


Figure 3.4. Comparison of two scenarios: price alone is inadequate when the production possibility frontier (PPF) changes.

The dynamic adjustments over time that are involved in the two scenarios make the outcomes even less predictable from the point of view of a qualitative and partial analysis. The production possibility frontier for an economy shifts outward as the economy expands through capital accumulation, increase in labor force, and technical progress. The way in which the production possibility curve shifts depends on the development path as determined by policies, prices, investments, and allocations. In different scenarios the curve shifts differently. Thus, in *Figure 3.4*, we see how the production possibility frontier (PPF) shifts from the base year 1980 in two alternative scenarios. The changes in production points P^T and P^R cannot be explained merely by looking at the differences in relative prices for the year 2000. As shown in the figure, the relative prices are the same at points P^T and P^R but the production levels are different. To explain this, prices, investments, and allocations over the period 1980–2000 have to be compared. To the extent that the changes in these variables over the entire period lead to effects that one would expect from looking at the price differences between the scenarios in the year 2000, such an explanation may appear plausible. Yet, one cannot rule out a counter-intuitive supply response to relative price shifts, particularly when one looks at the structure of production among different commodities within the agriculture sector.

In our models, as agriculture becomes more or less attractive, it draws more or less of labor and capital into it. These factors are then allocated to the production of different agricultural commodities. With different production possibility frontiers for agricultural production in two scenarios, it is possible (see *Figure 3.5*) that in the policy scenario the production point is on the segment ST on the production possibility frontier tt' whereas it was at point R in the reference scenario. In this case, the output of both the agricultural goods may

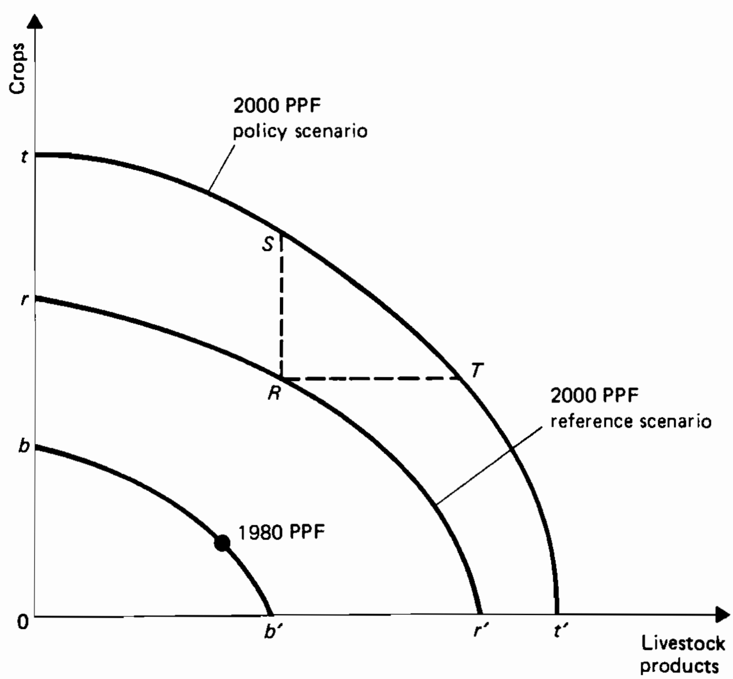


Figure 3.5. Changes in the structure of production over time in alternative scenarios (PPF, production possibility frontier).

increase compared to the reference run production at R, even when the price of one of the goods falls relative to that of the other between the scenarios. A move to free trade *accentuates* the welfare loss due to other distortions. This is shown formally in Appendix A1.

In spite of these complexities arising from simultaneity of a dynamic multisectoral general equilibrium system, the basic functioning of the national models and the system is not too complex to understand.

3.3.5. Welfare comparisons

In comparing alternative situations as represented by the outcomes in two scenarios, one has to recognize the variety of viewpoints from which the situations may be evaluated by different actors in the system. Moreover, a society has multiple objectives. A single-valued social welfare function in which the different objectives are integrated is not usually available. For this reason, a number of alternative indicators are generated so that the results may be evaluated from different perspectives.

The indicators used can be broadly grouped under three headings as those relating to:

(1) Economic development.
(2) Consumer welfare.
(3) Social welfare.

Indicators of Economic Development

Gross domestic product. GDP, with all its well-known limitations, is the most commonly used and widely known indicator of economic development. However, before comparing the GDPs of two scenarios, one should note that such a comparison suffers from all the well-known index number problems. The outcome of the comparison can be affected by the prices used. *Figure 3.6* shows how, depending on the prices used, the outcome changes.

In aggregating the GDPs of different countries, base-year (1970) world market prices are also used. Aggregation using 1970 domestic prices and exchange rates, in the reference run situation where countries have different protection levels on the same commodity, could lead to substantially different weights being given to similar production activities in different countries.

The following GDP indicators are calculated:

(1) GDP at constant domestic prices using the divisia price index (an index with changing weights) with 1970 as the base year.
(2) Per capita GDP in US dollars based on 1970 domestic prices and exchange rate.
(3) GDP at 1970 world prices in US dollars.

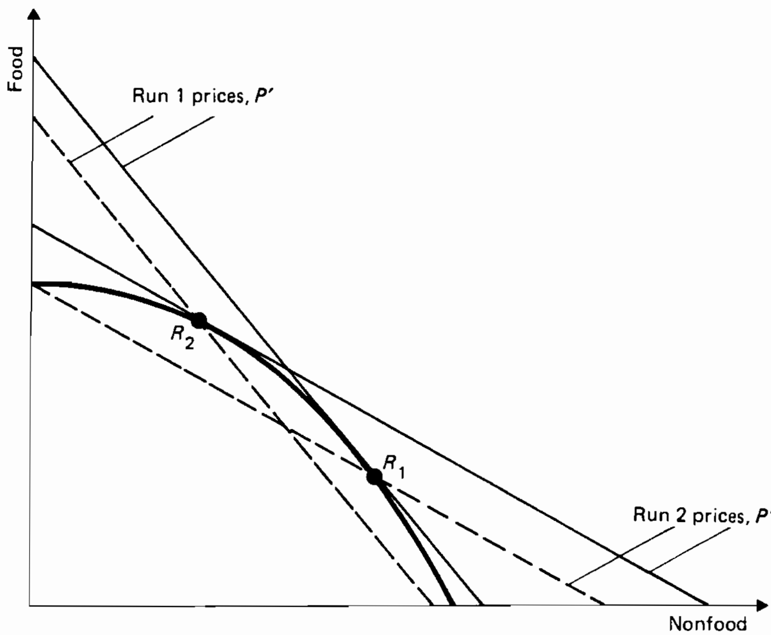


Figure 3.6. The problem of prices in comparing GDPs. R_1 has a higher value than R_2 when valued at P'; R_1 has a lower value than R_2 when valued at P''.

Production value comparison. Because of the index number problem with GDP indicators, to evaluate the impact on producers, GDPs in the two scenarios are calculated with both the sets of prices, and pair-wise comparisons are made. If GDP in a trade liberalization scenario calculated at the prices of the scenario exceeds the GDP corresponding to the production levels of the reference scenario but valued at the prices of the trade liberalization scenario, one can conclude that liberalization increases GDP and producer incomes. Similarly, if both the GDPs (that of trade liberalization and that of the reference scenario) are evaluated at the prices of the reference scenario, and one also finds that the liberalization scenario GDP has a higher value, one can say that producer incomes have definitely improved since, no matter which set of the two price sets is used, the value of GDP is higher. These calculations are analogous to those used for comparing consumer welfare (see below).

Agricultural self-sufficiency and self-consumption ratios. Many governments seem to strive to attain agricultural self-sufficiency. Some governments may even want to restrict dependence on imports for individual commodities and not just at the aggregate sectoral level. Two indicators are calculated to reflect these concerns:

(1) Agricultural self-sufficiency ratio is defined as the value of domestic agricultural production over the value of domestic agricultural demand, valued at current world market prices. This ratio will be greater than 1 if the country has a positive net balance of agricultural trade.
(2) The self-consumption ratio is defined as the ratio of the value of domestic agricultural demand met from domestic production to the value of domestic agricultural demand, valued at current world market prices. It differs from the self-sufficiency ratio in that in calculating the self-consumption ratio the value of agricultural exports is not included; therefore the ratio cannot exceed unity.

Indicators of Consumer Welfare

Since comparisons of GDP under alternative situations suffer from index number problems as well as the fact that GDP is not strictly a welfare measure, other indicators at the national level are also generated which better reflect different aspects of welfare.

For assessing consumer welfare, the two measures used are equivalent income and comparison of costs of consumption bundles in the two scenarios at the two sets of consumer prices.

To evaluate elements of social welfare not captured by the measures of consumer welfare described above, the number of persons in hunger and life expectancy at birth are calculated as described later based on cross-country regressions.

Equivalent income. Equivalent income corresponding to a consumption bundle is defined as the income required under a reference set of prices to obtain the same utility as is provided by the given consumption bundle. The notion of equivalent income is illustrated in *Figure 3.7.*

The equivalent income corresponding to alternative consumption bundles may be compared. The bundle that corresponds to a higher equivalent income provides a higher level of utility and thus indicates improvement in consumer welfare. If the consumer demand systems have an underlying utility function, e.g., a Cobb–Douglas utility function is implied by a linear expenditure system, equivalent income can be calculated. It may be noted that this notion is similar to the Hicksian equivalent variation measure.

"Revealed preference": consumption cost comparisons. Not all the national models of the BLS have demand systems with explicitly defined utility functions behind them. It is therefore not possible to calculate the equivalent income measure for all the national models. Because of this difficulty, a "revealed preference" comparison is also made between the costs of the consumption bundles purchased in the two situations or scenarios. If at the prices prevailing in a policy scenario – say, a trade liberalization scenario – the cost of the actual

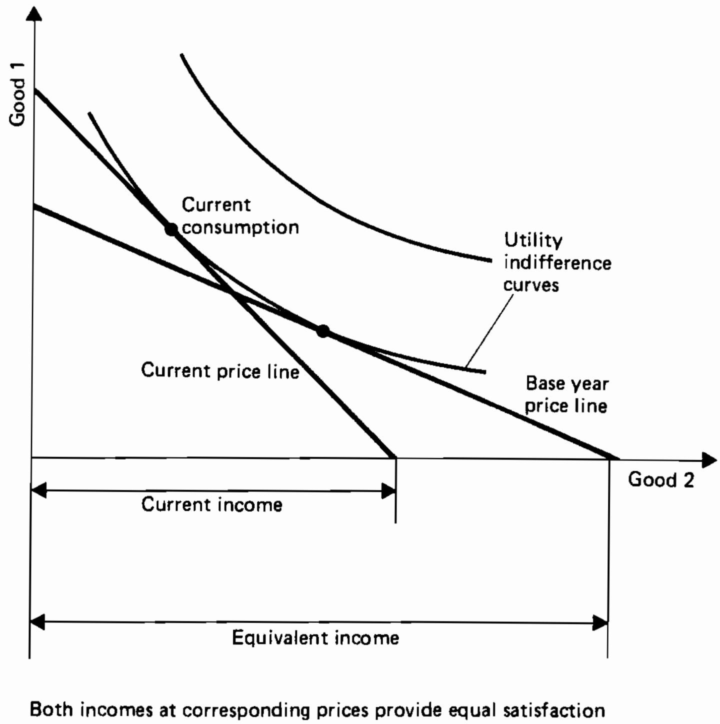


Figure 3.7. The notion of equivalent income.

consumption basket is greater than the cost of the consumption basket of the reference run, one can say that consumers are better off in the policy scenario. This is because they could have purchased the reference run consumption basket, had they wanted to. This is shown in *Figure 3.8.*

A similar comparison is also made at the reference run prices. The two comparisons should be consistent, otherwise an inconsistency in the demand system is indicated. Let P_t, P_r and C_t, C_r be prices and consumption in the policy scenario and reference scenario respectively. Then the following possibilities arise:

(1) If $P_tC_t > P_tC_r$ and $P_rC_t > P_rC_r$, then C_t is preferred to C_r.
(2) If $P_tC_t < P_tC_r$ and $P_rC_t > P_rC_r$, then the outcome is indeterminate and nothing can be said about preference between C_r and C_t.
(3) If $P_tC_t > P_tC_r$ and $P_rC_t < P_rC_r$, then the demand system is inconsistent.
(4) If $P_tC_t < P_tC_r$ and $P_rC_t < P_rC_r$, then C_r is preferred to C_t.

This is summarized in *Table 3.4.*

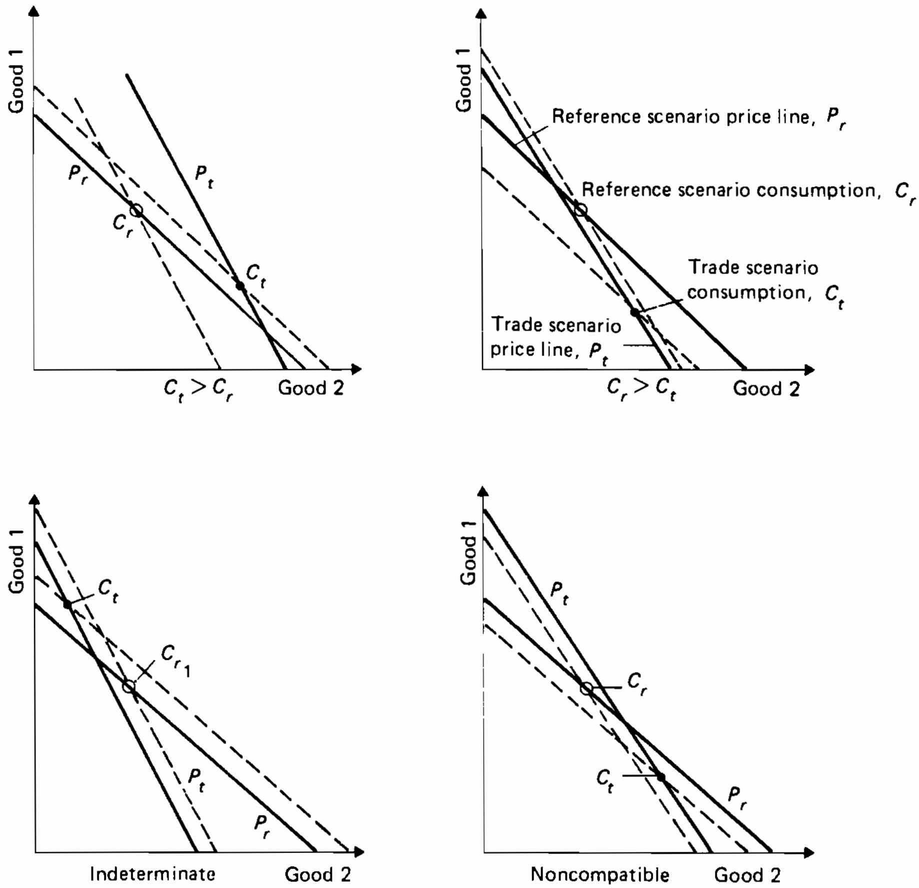


Figure 3.8. Consumption cost comparison for consumer welfare.

Table 3.4. Consumption cost comparison.

	$P_tC_t > P_tC_r$	$P_tC_t < P_tC_r$
$P_rC_t > P_rC_r$	C_t preferred to C_r	indeterminate
$P_rC_t < P_rC_r$	inconsistent	C_r preferred to C_t

Indicators for Social Welfare

The indicators for producer and consumer well-being at the aggregate level may not capture important social concerns regarding the prevalence of hunger, ill health, and malnutrition among the population and income distribution among socioeconomic groups.

Calorie and protein intakes per capita. Though average calorie and protein intakes do not by themselves give a precise indication of the nutritional status of the population, changes in them across scenarios do suggest the direction of change in the population.

Life expectancy at birth. Cross-country regression analysis was used (see Hrabovszky *et al.*, 1985) to identify relationships between life expectancy at birth and variables generated in the simulations. Data [1] from 108 developed and developing countries were used. The variables used are defined as follows: LEB, life expectancy at birth expressed in years; GNPC, gross national product per capita in 1981 US dollars; CALAR, calorie availability as a percentage of requirement, estimated using FAO food balance sheet information for availability and FAO and World Health Organization (WHO) nutritional standards minimum average requirements; NAPTOT, nonagricultural population as a percentage of total population, serving as an indicator for level of urbanization.

Regionally disaggregated analysis confirmed that the data do not belong to different populations and that the pooling of regional data is permissible.

The final equation chosen was selected on the basis of its explanatory power, agreement with hypothesized relations, and the statistical significance of the individual regression coefficients. The estimated equation is:

$$\begin{aligned} \text{LEB} \; = \; & \underset{(-2.16)^{**}}{-35.632} + \underset{(2.37)^{**}}{1.760 \ln \text{GNPC}} + \underset{(3.87)^{***}}{15.323 \ln \text{CALAR}} + \underset{(6.39)^{***}}{0.217\text{NAPTOT}} \\ & R^2 = 0.871 \qquad \text{DF} = 104 \end{aligned}$$

The numbers in parentheses show t-statistics, with levels of significance denoted by asterisks as follows: **, 5%; ***, 1%.

Population suffering from hunger. In order to evaluate the impact on hunger in different countries and in the world, it would be useful to generate an indicator. Except for the model of India, the models do not endogenize income distribution. Moreover, comparable estimates of persons in hunger are not available for most countries for more than a year or two. Thus, there are not adequate independent observations to postulate and estimate a relationship between the number of hungry persons based on the variables generated in the model. Nonetheless, to evaluate the impact of policies on social welfare, an indicator on hunger is needed.

Country-wise estimates of the number of hungry persons have been given by the FAO *Fourth World Food Survey* (FAO, 1977). The FAO estimates were obtained by stipulating that calorie consumption distribution in a country is skewed and can be represented by a beta distribution. The parameters of these distributions are estimated for each country based on certain assumptions, country-specific data, and some cross-country comparisons. The same procedure, in principle, can be embodied in the model to generate estimated numbers of hungry persons. Since the estimated parameters of the beta distributions are not reported in the FAO study and since the procedure uses judgment in some cases, it is difficult to use it in a simulation model.

Instead, what is done is to fit a cross-country regression to FAO estimates to recover the FAO methodology in a reduced form that can be easily used in simulation. Using the data for the years 1969–1971 for 58 countries for which the FAO provides estimates of the percentage of population in hunger, the following regression was estimated:

$$\text{HUNGRY} = \begin{cases} 0.01338(138.6 - \text{CALAR})^2 & \text{for CALAR} \leq 138.6 \qquad R^2 = 0.87 \\ 0 & \text{for CALAR} > 138.6 \end{cases}$$

where HUNGRY is the percentage of the population with calorie intake levels of less than 1.2 times the basal metabolic rate.

The functional form chosen implies that the percentage of population in hunger becomes zero when CALAR reaches 138.6. It may be noted that this value was estimated. The high value of R^2 should be no surprise as the left-hand side variable was generated in the first place by using the right-hand side variable.

Both these equations, for LEB and for HUNGRY, were used to generate indicators for life expectancy at birth and persons in hunger for the various scenarios. In doing so, the error term for each country in the estimated regressions was retained as reflecting country-specific features, such as income distribution and genetic and climatic characteristics, which may affect the indicators.

Income parity between agriculture and nonagriculture. Maintaining income parity between agriculture and nonagriculture is often the major social objective behind protection of agriculture; changes in income parity due to agricultural trade liberalization are therefore of particular interest. The parity indicator used calculates the ratio of GDP in agriculture per unit of labor to GDP in nonagriculture per unit of labor in nonagriculture. GDPs for this are calculated at current domestic prices.

For the model of India, the parity indicator refers to the ratio of per capita GDP in rural areas to per capita GDP in urban areas.

3.4. Summary and Concluding Comments

In this chapter the analytical approach needed to study the impact of agricultural trade liberalization is described. It is also argued that the BLS, briefly described in this chapter, is suited for such analyses. The complexity of the system is unavoidable if one is satisfactorily to account for the essential interdependences among commodities and countries.

The notion of agricultural trade liberalization is defined, and a scheme of analysis is outlined. An approach to interpret the results is described that helps in understanding the nature of the interdependences in the system, which should make the results of the system credible.

A number of indicators for welfare are described, which will be used to characterize the impact of agricultural trade liberalization. Policy evaluation can be based on these indicators, which together embody a variety of criteria. Naturally, only for a few countries is the impact of agricultural trade liberalization likely to be positive for all the indicators.

Though compensatory lump-sum transfers are not introduced in the scenarios, the notion of such transfers may be used to evaluate whether a country can, in principle, be better off under all the indicators when such transfers are used. Such an approach can provide clearer policy guidance for more countries.

Note

[1] The information for life expectancy at birth, per capita GNP, and ratio of calorie availability to requirements came from the *World Development Report* for 1981 of the World Bank (1981, Annex tables). The information on level of urbanization came from the 1981 *FAO Production Yearbook* (FAO, 1981b), and that on the percentage of the population suffering from malnutrition came from the *Fourth World Food Survey* (FAO, 1977).

CHAPTER 4

A Perspective on Agriculture until 2000: The Reference Scenario

4.1. Specification of the Reference Scenario

The reference scenario described in this chapter is basically a "business as usual" scenario. Past policy regimes, as embodied in the price transmission regressions, are continued in this scenario.

Apart from government policies, the other main exogenously prescribed variables in the system are population growth rates and some additional variables (to be discussed below) for the models of the CMEA, China, and country groups.

Population growth rates for all countries are prescribed exogenously based on the UN medium forecast (ILO, 1977). Labor participation rates are also taken from the ILO projections. This means that the time path of total labor force in a country is exogenously prescribed and does not change from scenario to scenario. It should, however, be noted that the allocation of total labor between agriculture and nonagriculture is still endogenous and responds to relative prices and incomes. For the model of India, which distinguishes rural and urban populations, both these are exogenously specified.

The overall growth of the world economy is an important attribute of a scenario. Agriculture is highly dependent for its performance on the development of the overall economy. This dependence is particularly high over the longer term, when not only demand plays its role, but also movements of production factors between agriculture and other sectors as well as technological developments have a profound impact on agricultural production.

Growth rates in most of the national models of the BLS are endogenously determined based on a savings function that depends only on GDP. However, for the simpler models of country groups, which together represent nearly 20% of the economy of the world, the central supply tendencies, for both agriculture and nonagriculture, are based on the middle scenario (scenario B) specifications of the FAO study *Agriculture: Toward 2000* (FAO, 1981a). The supplies, however, do adjust to the development of world prices; the demands also respond to world prices.

The models of the CMEA and China (which, in any case, do not liberalize agricultural trade in any of the scenarios) reflect the practice of the centrally planned economies of setting human consumption targets. Thus, these targets and some stipulated self-sufficiency ratios are analogous to the prescription of policies in other models. These may be considered as exogenous specifications. However, they are not varied across scenarios.

The reference scenario is a *projection* rather than a *forecast*. A *forecast* is a scenario and its outcome that are considered most likely to occur. A *projection*, on the other hand, is based on a number of assumptions, and in principle one can choose to project on any suitable set of assumptions, not necessarily the most probable from the point of view of their joint occurrence, even if one can specify such a joint probability distribution. Thus, one does not say what is the likelihood of the actual occurrence of the scenario. In this sense, the reference run is a projection into the future up to 2000 of the model system. This is not to suggest that the assumptions on which it is based are implausible. Indeed, the reference run is based on a model:

(1) Whose individual components were thoroughly validated.
(2) That was calibrated so as to be consistent with historical data.
(3) That incorporated policies as understood and translated by the authors into a form easily introduced in the model (i.e., in the form of price transmission regressions, with suitable modifications for anticipated policy changes).
(4) That was adequately tested to ensure that *a priori* unlikely and bizarre results did not emerge.

For reasons of exposition, growth rates of the economies, price developments, and changes in production structures and trade patterns are discussed in turn. The reader should, however, keep in mind that these developments are the outcome of simultaneous processes and decisions. Only for clarity are these variables discussed one after the other.

4.2. Growth Performance over 1980–2000 in the Reference Scenario

The reference scenario, which is designated by R0, provides a comparable view of overall economic growth in the world in relation to recent historical experience. The growth rates of some important aggregates are shown in *Table 4.1.*

Table 4.1. Growth rates[a] of population, GDP, agricultural value added and agricultural trade balances, 1960–2000[b]: reference scenario.

	World	*OECD*	*CMEA*	*Developing countries (excl. China)*
Population (% PA)				
1960–1970	1.9	1.1	1.1	2.6
1970–1980	1.9	0.9	0.8	2.5
1980–1990	1.8	0.8	0.8	2.5
1990–2000	1.7	0.7	0.7	2.3
GDP (% PA)				
1960–1970	5.7	5.1	6.7	5.7
1970–1980	4.0	3.2	5.4	5.8
1980–1990	4.1	3.5	4.8	5.4
1990–2000	3.7	3.0	4.0	5.5
GDP per capita (% PA)				
1960–1970	3.5	4.0	5.6	3.1
1970–1980	2.1	2.4	4.5	3.4
1980–1990	2.3	2.7	3.9	2.9
1990–2000	2.0	2.2	3.2	3.1
Agricultural value added (% PA)				
1960–1970	1.9	1.6	1.6	2.6
1970–1980	1.8	1.2	0.8	2.6
1980–1990	2.2	1.2	2.4	3.0
1990–2000	2.3	0.9	2.8	2.9
Agricultural balance (% of value added in agriculture)				
1980	0	6.3	−2.2	4.7
2000	0	9.9	−1.8	1.3

[a]Growth rates are based on values at constant prices.
[b]1980–1990 figures and 1990–2000 figures are from the model scenario; the figures for the 1960s and 1970s are from the *Yearbook of National Accounts Statistics – 1980, 1981, 1982* (UN).

Figure 4.1 shows shares of different regions in global population and GDP. The development of per capita GDP is shown in *Figure 4.2*. The growth rates referred to in this section are all for variables valued at constant 1970 prices.

The global GDP growth rates over the 1980s and 1990s fall in the reference scenario from the 5.7% per year realized over the 1960s, to become comparable to the level realized over the 1970s.

The baseline growth rate for the developing countries is about the same as that projected by a number of international organizations in recent years. For the OECD countries, the rate presented here is toward the lower end of most other projections.

Compared with the historical performance in the 1970s, the BLS growth rates are somewhat lower than the realized ones for developing countries as a

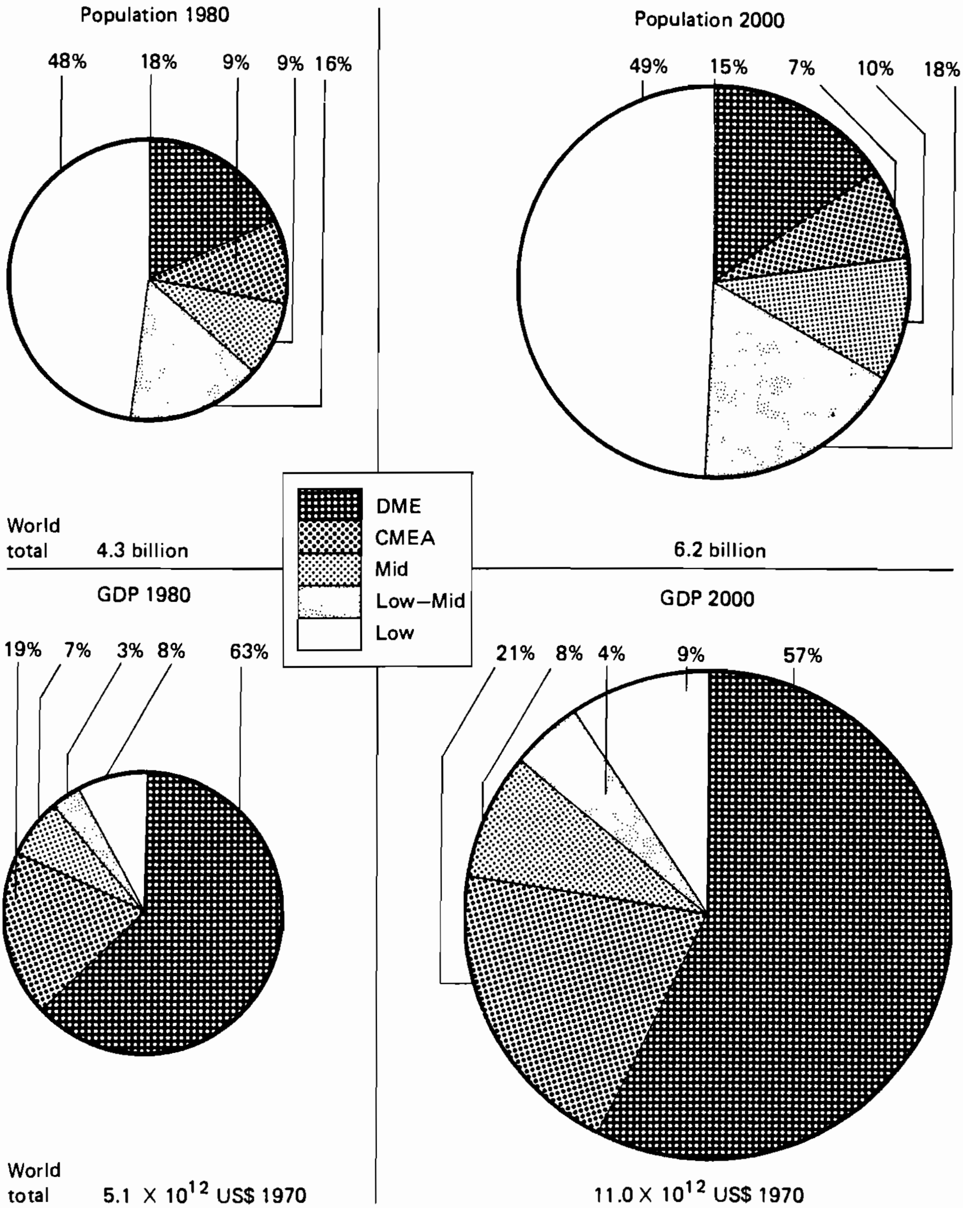


Figure 4.1. Population and GDP by country groups in the reference scenario, 1980 and 2000. DME, developed market economies; Mid, middle-income developing countries; Low–Mid, low–middle-income developing countries; Low, low-income developing countries.

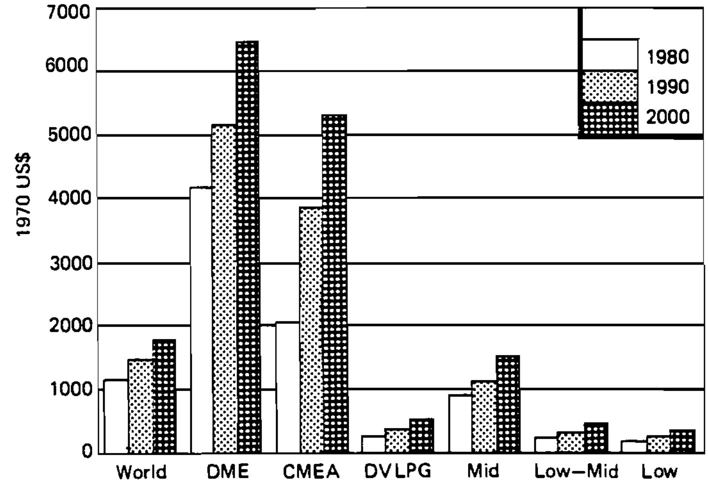


Figure 4.2. Development of per capita GDP in the reference scenario. DVLPG, developing countries; the rest as in *Figure 4.1*.

group and for the CMEA countries, but are very close to the realized one for the OECD countries.

The world agricultural value added accelerates over the 1980–2000 period above the growth rates of the 1960s and 1970s (see *Table 4.1*). The acceleration is mainly due to an increase in the CMEA growth rate of agriculture from –0.9% per year over the 1970s to 2.4% per year over the 1980s and 2.8% over the 1990s, but the increase in the growth rates of developing countries also contributes to it. The fall in the agricultural GDP growth rates of OECD countries may be expected as the result of two factors: slower population growth and a tendency toward food intake saturation with growing income. The growth rate of agricultural output in OECD countries could have thus been maintained only by increasing exports. And, in fact, the agricultural supply surplus of OECD countries increases by almost 50% from 6.3% of GDP agriculture in 1980 to 9.9% of GDP agriculture in 2000. Larger agricultural exports by the OECD would have depressed world market prices and hence lowered the incentives to maintain growth rates comparable to the high growth rates in agriculture observed in the 1970s. Moreover, in this scenario the EC pursues a "moderate" agricultural price policy and therefore labor migrates out of agriculture at a rather high rate and the capital stock in agriculture also grows slowly. The USA also shows a strong decline in agricultural growth for similar reasons.

Developing countries as a group accelerate their agricultural growth rate from 2.6% to 3% per year. This higher production growth is, however, not sufficient to meet demand, owing both to continued population growth of about 2.5% per year and sustained growth of income per capita of about 3% per year. Thus, one notes for developing countries, excluding China, a strong increase in their net imports of cereals, from 37 million tonnes in 1980 to 120 million tonnes in 2000 (a tonne is a metric ton). It should be noted that this expansion concerns effective imports, realizable within the balance-of-payments framework prescribed by the assumed trade deficit targets (developing country trade deficit being around 3% of their GDP). Since the trade deficits also include implicit aid through food aid, these imports include, in principle, concessional imports as well.

While their imports of cereals increase, the developing countries are unable to increase adequately their exports of tropical foods and fibers because of slow demand growth in the main export markets – namely, the developed countries. These developments result in a reduction of the agricultural trade balance of the developing countries, from a 4.7% net surplus in 1980 to a 1.3% surplus in 2000 expressed as a percentage of agricultural GDP.

4.3. World Market Price Trends in the Reference Scenario

The historical data as well as the resulting prices from the reference run are shown in *Figures 4.3–4.5*. The prices are given relative to the prices of nonagriculture. In the plots, the prices up to 1980 are actual prices, whereas the prices from 1981 onward are obtained from simulation.

The growth rates of world market prices over various periods are shown in *Table 4.2*, the last line of which shows the terms of trade for agriculture as a whole, which are a weighted average of commodity prices, weighted by the volumes produced.

As already mentioned, the terms of trade for agriculture relative to nonagriculture increase by 0.4% per annum over the period 1980–2000, considerably less than that observed from our data, which is 0.6%.

The development of prices over time is an outcome of the interplay between the changes in the demand and supply schedules. *Figure 4.6* shows how price trends over time may be mainly the outcome of supply and demand shifts, and less the result of the shape of these curves. With increases in population and income, demands increase (at least for commodities that are not inferior): i.e., more of a commodity will be demanded at a given price. Demand for commodities with higher income elasticities will increase relatively more than demand for other commodities. Demand schedules may also shift as a result of habits and changes in tastes. Some important determinants of demand shifts in the system are summarized in *Table 4.3*. These determinants of demand shifts are themselves functions of prices, especially income. It can be seen in *Table 4.3* that the upper ends of the income elasticity ranges are higher for the developing countries than for the developed market economies, and that the ranges for animal products are much larger than those for cereals and other foods. Thus, demands for animal products would increase more than those for crops.

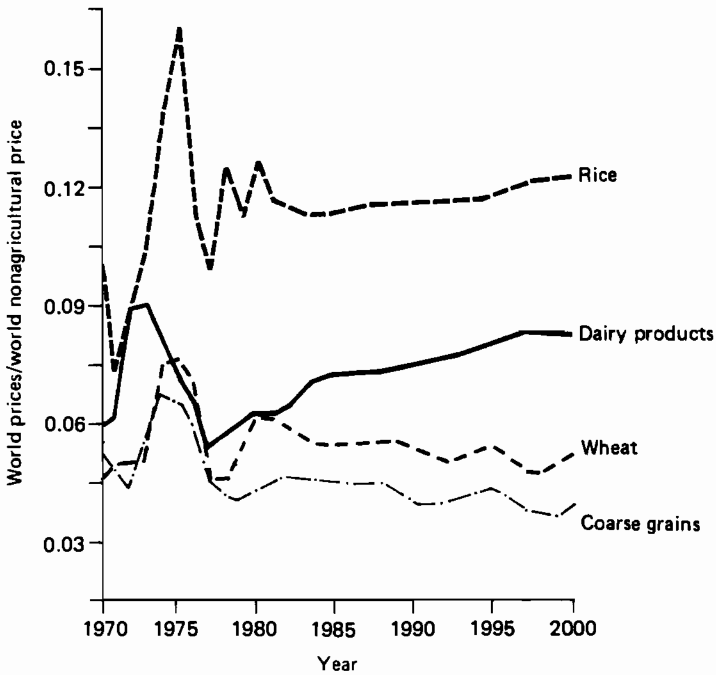


Figure 4.3. Relative prices in the world market in the reference scenario: rice, wheat, coarse grains, and dairy products.

Higher demands over time, however, do not necessarily imply increasing prices, as supplies also shift. Technical progress, land development, and capital accumulation result in larger supplies at a given price. Larger supplies may also result from a fall in input prices for a commodity, such as feed prices in animal production or fertilizer prices in crop production, increasing the profitability of that commodity. And, of course, it is possible that increases in input and factor prices may increase the cost of supplying a given quantity. This underlines the importance of relative prices and the need to look at a number of commodities together.

Table 4.4 shows, for selected countries, rates of technical progress that shift supply. The rates of technical progress cannot be calculated for other national models because of their specifications. (As a simple example, if in an estimated supply function *time* is used as a proxy for other variables, such as capital accumulation or fertilizer intensification, then the coefficient of time does not represent technical progress.) The rates shown in *Table 4.4* include purely exogenous technical progress, which depends only on time, and also embodied

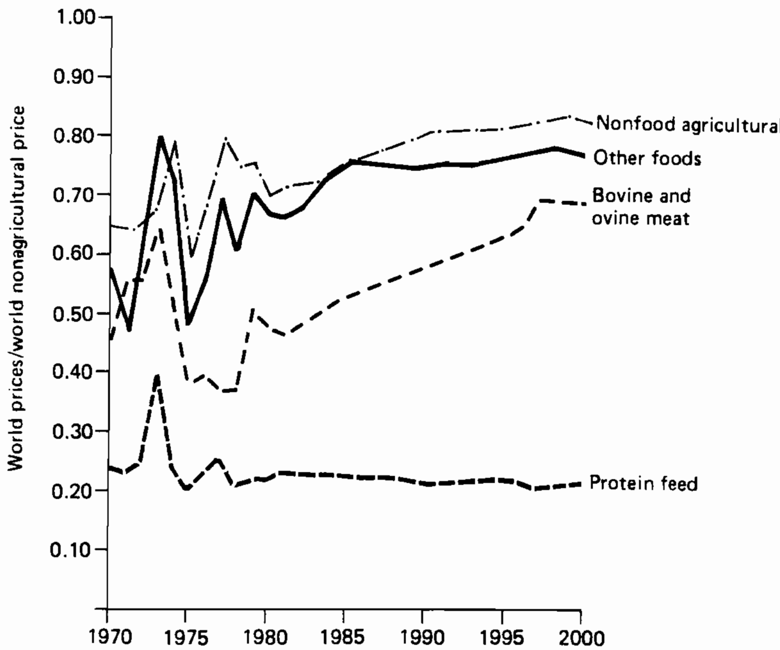


Figure 4.4. Relative prices in the world market in the reference scenario: other food, nonfood agriculture, bovine and ovine meat, and protein feed.

technical progress, which is a function of total capital and total labor employed in agriculture; both of these in turn are induced by the relative price and profitability of agriculture relative to nonagriculture.

Comparisons of data in *Tables 4.3* and *4.4* provide strong indications of why prices develop in the way they do in the reference scenario.

The most striking long-term trend of the world market prices (prices in all the scenarios presented herein, unless otherwise specified, are normalized prices and are thus real prices containing no inflation) in the period 1980–2000 is, according to the reference scenario, a price rise of the products of ruminants (meat and milk) amounting to about 2% per year in real terms (see *Table 4.2*). Two reasons can be given to explain this price rise. From the demand point of view, income elasticities for meat are high in the developing countries, where incomes grow at high rates, and are much larger than those for cereals in all groups of countries. On the supply side, in the important producing countries, the rates of technical progress for bovine and ovine meat and dairy products are much smaller than those for cereals.

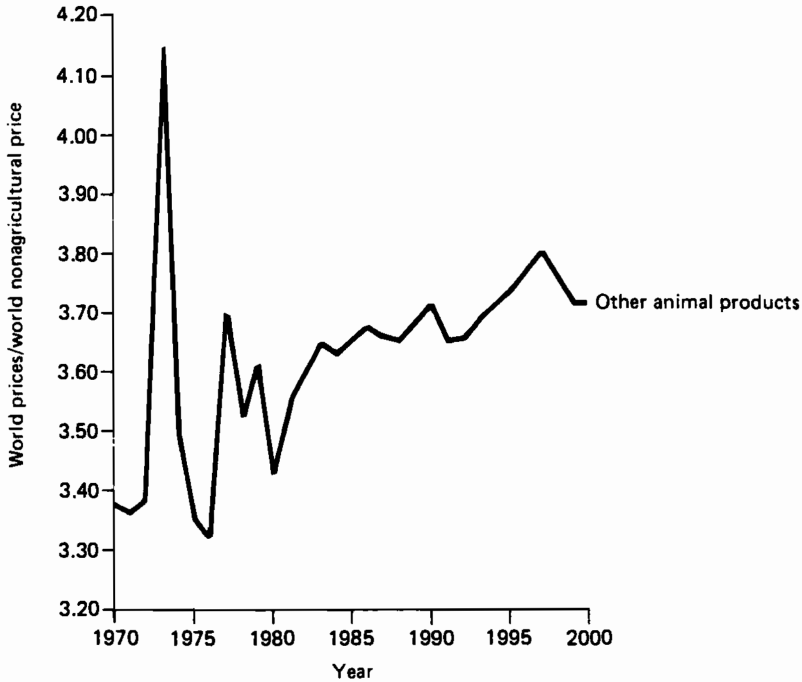


Figure 4.5. Relative prices in the world market in the reference scenario: other animal products.

Table 4.2. Changes in world market prices for agricultural products relative to nonagricultural prices over the period 1980–2000 according to the reference scenario (percent).

	Total price change			*Annual price change*
Commodity	*1980–1990*	*1990–2000*	*1980–2000*	*1980–2000*
Wheat	2	–10	–8	–0.4
Rice	–4	5	1	0.1
Coarse grains	1	–11	–10	–0.5
Bovine and ovine meat	28	20	53	2.2
Dairy	23	11	37	1.6
Other animal products	5	1	6	0.3
Protein feed	2	–4	–2	–0.1
Other food	1	4	5	0.2
Total agriculture[a]	5	3	9	0.4
Nonfood agriculture	20	4	25	1.1

[a]Aggregated using global production levels as weights.

Table 4.3. Some determinants of demand shifts in the reference scenario (elasticities calculated at 1980 income levels).

	1980 Population (10^6)	1980 GDP/cap (US$1970)	1980–2000 average growth rate (% PA): Population	1980–2000 average growth rate (% PA): GDP/cap	Weighted income elasticities for human consumption: Cereals	Bovine and ovine meat	Dairy	Other animal products	Other food
DME	807	4190	0.8	2.5	0.08	0.43	0.04	0.40	0.19
CMEA	375	2030	0.8	3.4	–	–	–	–	–
Developing	3159	280	2.1	3.2	0.53	0.50	0.86	0.73	0.55
Mid income	388	870	2.5	2.9	0.19	0.25	0.42	0.65	0.29
Low–middle	695	230	2.4	3.4	0.32	0.59	0.58	0.75	0.35
Low income	2076	185	1.9	3.1	0.75	1.02	1.27	0.80	0.93
World	4341	1166	1.8	2.0	0.43	0.46	0.33	0.51	0.43

Table 4.4. Rates of technical progress in selected countries[a]: Exogenous depending on time plus embodied in total agricultural capital and labor (percent per year over 1980–2000 in the reference scenario).

Country	Wheat	Rice	Coarse grains	Bovine and ovine meat	Dairy	Other animal products	Protein feed	Other food	Nonfood agriculture
Argentina	1.44		1.68	0.90					2.57
Australia	1.18		3.28	0.69	0.38				3.19
Brazil		1.09	1.28	0.90	1.60	3.23	2.36	1.81	1.29
Canada	2.23		2.19	1.41	1.77	1.92			
Egypt								1.76	
Indonesia		1.99							
Japan		–0.53				3.69	–0.09		0.91
Mexico			2.59					2.75	1.68
Nigeria			1.33					1.30	
Pakistan	4.47	3.08			1.38				2.62
Turkey	1.48		1.78					2.41	1.98
EC	1.81		2.08	0.36	0.29	0.99	1.55	–0.21	0.60

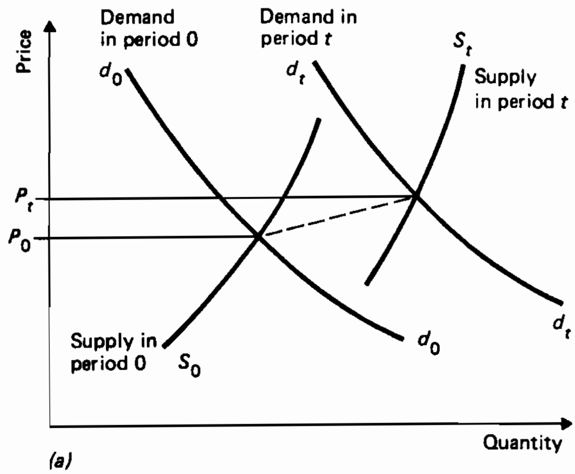
[a]Of the countries for which rates of technical progress were calculated, results are given for those countries that produced in 1980 more than 2% of global production of the commodity.

For example, the EC, which produces 15% of bovine and ovine meats and accounted for more than 20% of global dairy production in 1980, has rates of technical progress of 0.36 and 0.29, respectively, for these products. Moreover, production costs may be expected to go up relatively strongly in some land-scarce countries owing to an increase in feeding cost because the opportunity cost of land for roughage production moves up. Expansion of cropland encroaches upon the grassland that provides cheap fodder for the ruminants. The ensuing shift to more expensive feeds in the ruminant diet may cause an increase in the production cost. The price policy of the EC further contributes to the rather strong increase in the world market price of bovine and ovine meat. The EC policy of maintaining the relative domestic price using a variable levy results in a drop in its tariff equivalent on bovine and ovine meat from 61% in 1980 to 20% in 2000. As a consequence, production of this commodity hardly increases, and the growth of demand leads to a substantially higher import by the EC. Twenty-five percent of the additional world trade in bovine and ovine meat is imported by the EC [1].

The other country with a large increase in imports is Brazil, taking in 42% of the additional trade. Brazil has a negative protection on meat, which becomes larger, and hence its domestic price does not go up as much as the world market price, and production is outpaced by demand. Among the big exporters, only Argentina and Canada respond to the increases in world market price with substantially higher exports. The USA pursues a policy of trade restriction and maintains its self-sufficiency ratio in bovine and ovine meats.

While prices for bovine and ovine meats and dairy products rise significantly, prices of other animal products (pork, poultry, eggs, and fish) rise by a very small amount: only about 0.3% per year. For other animal products the rates of technical progress in the major producing countries are higher than even those for cereals and thus, in spite of high income elasticity of demand, the price increases only a little. Moreover, other animal products benefit from the relative decline in prices of the main feed items. In addition, developing countries are able to realize their potential for considerable productivity gains for this aggregate as such gains require less investment than those for ruminants. Hence the increase in production of other animal products is large enough to meet the increased demand with only a small increase in price.

Another interesting long-term trend is the continued fall in the relative prices of wheat and coarse grains, commodities that are of mainly temperate-zone origin. The fall is of the order of a half percentage point per year and is concentrated in the 1990s. The rate of technical progress in cereals in major producing countries exceeds the rate of increased demand due to population and income growth, and cereal prices can be expected to fall. The rice price does not fall, as technical progress in rice is smaller than that in wheat and coarse grains and is negative in Japan, which is a significant producer. (The negative



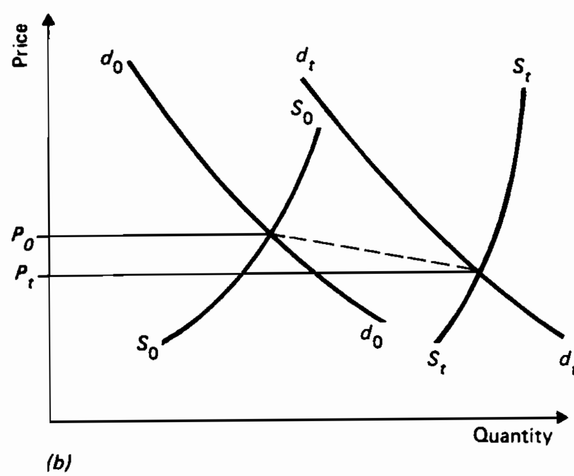


Figure 4.6. Demand and supply shifts dominate price trends: (*a*) price increases over time; (*b*) price decreases over time even with a very price-inelastic supply schedule.

technical progress in Japan is due to outmigration of labor from agriculture and is conceivable if the relatively more skilled move out of agriculture.) Protein feeds, on the other hand, show virtually no change in their price (a small reduction) in spite of the higher prices of animal products. The higher animal product prices do not get translated into a larger demand for protein feeds, the demand for which increases only modestly by 2% per annum. This is because cheaper feedgrains compete with protein feeds in pork and poultry production, while in ruminant production protein feeds are relatively expensive substitutes for roughage.

Nonfood products (i.e., fibers, hides and skins, tobacco, and others) show a clear upward price trend, particularly in the 1980s. The main reason is the quite strong expansion of demand from the centrally planned economies and the developing countries in the reference scenario, which materializes as a result of high overall economic growth in these countries. Prices of rice, other animal products, and other foods do not change significantly.

In summary, one could say that substitution possibilities in demand and supply are large enough in the world food system and that supplies are able to meet effective demand (i.e., demand backed up by purchasing power) at reasonable costs.

4.4. Shifts in Demand and Production Structures

As incomes change, the demand for some commodities changes more than that for others. Since in the reference scenario incomes and populations increase at different rates in different countries, one would expect changes in demand as well as in production and trade patterns.

The changing global pattern of demand can be seen in *Table 4.5*. The growth rates of demand for different agricultural commodities differ significantly from each other. Demand for other animal products grows at 2.3% per year, whereas the demands for bovine and ovine meats and dairy products grow at 1.6% per year as the latter are restrained by the increases in the prices of bovine and ovine meats and dairy products. The share of various country groups in global demand also changes significantly between 1980 and 2000. As can be derived from *Table 4.5*, the share of developing countries (including China) in global demand increases significantly for all commodities. Increase in demand in a country does not necessarily imply an increase in production, as trade could be adjusted to meet the higher demand. Nonetheless, many governments desire certain levels of self-sufficiency and consequently their policies tend to stimulate domestic production and/or restrain domestic demands when self-sufficiency tends to decline. Thus, much of the increase in demand for meat in developing countries is satisfied by local production. Only imports of dairy products expand substantially (doubling over the 20-year period: see *Table 4.10*). The dairy imports mainly increase in Nigeria and Pakistan, and to some extent in Brazil, Egypt, and India. Nigeria has a high income growth, and its dairy demand increase is the highest of all countries. Pakistan's dairy output falls because of a relative drop in the producer price of dairy products. However, developing countries generally seem to have a comparative disadvantage in producing feedgrain. Hence, almost all (90%) of the large increase in grains needed for feeding is imported. Developing countries excluding China increase feed consumption of

Table 4.5. Agricultural demand in the reference scenario.

	Global demand			% share in global demand							
				DME		DEV[a]		CMEA		China	
Commodity	*1980*	*2000*	*Growth* (% PA)	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*
Wheat (10^6 t)	439	635	1.9	23.6	21.3	27.5	37.5	33.4	26.7	12.3	11.4
Rice (10^6 t)	252	380	2.1	6.4	5.3	56.1	65.8	0.7	0.6	36.7	28.2
Coarse grains (10^6 t)	787	1109	1.7	42.4	43.7	20.4	27.0	23.5	18.7	10.0	9.5
Bovine and ovine (10^6 t)	63	86	1.6	49.3	43.3	28.9	36.1	16.9	15.0	5.9	5.9
Dairy (10^6 t)	470	642	1.6	44.5	39.0	23.1	31.6	30.1	26.6	1.4	2.0
Other animal products (10^6 t PE[b])	17	27	2.3	41.7	37.8	20.5	28.4	15.1	9.1	18.8	22.3
Protein feed (10^6 t PE[b])	42	62	2.0	50.2	48.5	14.7	21.1	8.9	6.2	11.7	12.6
Other food (10^9)[c]	228	344	2.1	21.8	18.0	42.4	52.6	15.1	11.1	15.8	14.4
Nonfood agriculture (10^9)[c]	26	41	2.3	35.4	26.1	30.4	30.7	26.8	30.5	14.7	17.3
Nonagriculture (10^9)[c]	5562	11513	3.7	78.8	71.3	9.0	13.9	7.8	8.8	4.1	5.8

[a]DEV, developing countries excluding China.
[b]PE, protein equivalent.
[c]US$ 1970.

Table 4.6. Agricultural production growth 1980–2000, and levels and distribution among major country groups in 2000: reference scenario.

Commodity	*World*	*NA+OCE*[a]	*DME*[b]	*CMEA*	*China*	*DEV*[c]
Volumes year 2000						
Wheat (10^6 t)	619	156	85	150	47	175
Rice (10^6 t)	362	9	15	2	90	244
Coarse grains (10^6 t)	1101	410	154	196	98	237
Bovine and ovine (10^6 t)	86	20	16	13	5	31
Dairy (10^6 t)	642	105	171	172	13	179
Other animal products (10^6 t PE[d])	27	3	8	2	6	7
Protein feed (10^6 t PE[d])	62	29	4	4	8	18
Other food (10^6)[e]	347	20	38	37	54	195
Nonfood agriculture (10^6)[e]	41	5	3	10	7	15
Growth rates, 1980–2000 (% PA)						
Wheat	1.9	2.8	1.1	0.8	1.1	3.3
Rice	2.1	3.4	0.7	2.1	0.6	2.9
Coarse grains	1.8	2.4	1.4	0.6	1.5	2.1
Bovine and ovine	1.5	0.9	1.0	0.9	1.4	2.8
Dairy	1.6	1.5	0.9	0.9	3.8	3.1
Other animal products	2.3	1.1	2.1	-0.3	2.9	3.9
Protein feed	1.9	1.7	1.6	1.3	1.8	2.8
Other food	2.1	1.4	0.9	0.4	1.7	3.1
Nonfood agriculture	2.3	1.3	0.7	3.0	3.2	2.3
Value share of total agriculture 2000 (%)						
Wheat	4.8	9.1	4.3	8.8	2.5	3.1
Rice	6.9	1.2	1.8	0.3	11.9	10.7
Coarse grains	6.6	18.6	6.1	8.9	4.1	3.3
Bovine and ovine	9.1	16.3	11.5	10.4	3.7	7.6
Dairy	8.2	10.2	14.4	16.6	1.2	5.3
Other animal products	15.6	14.6	29.1	10.7	23.9	10.0
Protein feed	2.0	7.1	0.8	0.9	1.7	1.3
Other food	41.6	17.8	29.8	33.4	44.7	54.1
Nonfood agriculture	5.3	5.0	2.3	10.1	6.3	4.5

[a]NA+OCE, North America and Oceania. [b]DME, Developed market economies (here excluding NA+OCE). [c]DEV, Developing countries excluding China. [d]PE, protein equivalent. [e]US$ 1970.

coarse grains alone by more than 60 million tonnes between 1980 and 2000, and their imports by 60 million tonnes.

The global structure of agricultural production changes to meet the changing structure of demand. The growth rates of production of various commodities differ from each other globally as well as for various country groups. *Table 4.6* shows the structure of production in year 2000 for various country groups and also indicates the commodity-wise growth rates over 1980–2000. Since production growth rates for a commodity vary across country groups, the shares of different country groups change over the years in the production of different commodities. Though the production patterns change, the country groups continue to remain dominant in particular commodities in which they were dominant. Thus, North America and Oceania remain as major producers of wheat, coarse grains, and protein feeds. Other developed countries continue to produce more than a quarter of the world's dairy production, and developing countries continue to remain as major producers of other food and nonfood agricultural products.

The production of wheat grows at an annual rate exceeding 3% and production of protein feeds at nearly 2.8% over 1980–2000 in the developing countries (excluding China), reflecting the potentials of "green revolution" that still remain to be exploited in these countries. Even then the developing countries increase their imports of wheat and coarse grains.

How the importance of specific commodities within a country group changes over time can be seen in *Figure 4.7*, which shows the value shares of total agriculture in 1980, 1990, and 2000.

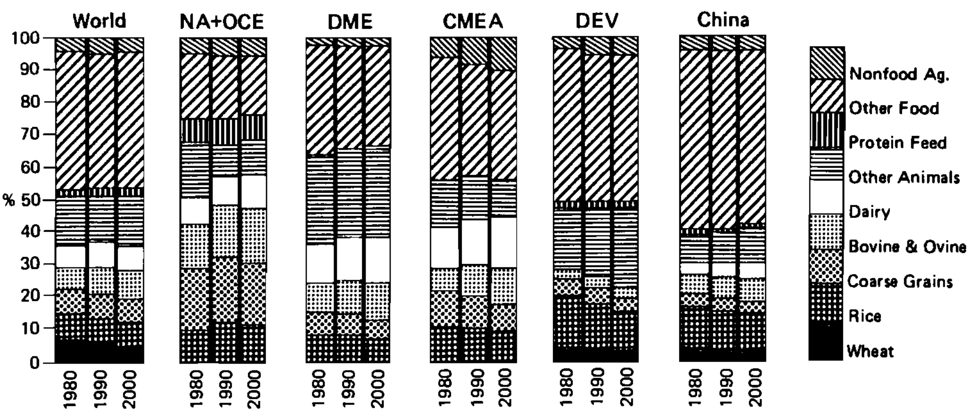


Figure 4.7. Value share of commodities in total agricultural production, globally and in various country groups, in 1980, 1990, and 2000: reference scenario.

The value shares of domestic agricultural production in world agricultural production, given in *Table 4.7*, show that the shares of most large countries or country groups, China, the CMEA, the EC and the USA, decline; those of Argentina, Brazil, and Japan more or less remain constant; and all other LDC producers improve their shares.

The general picture of agricultural production development that is described in our reference scenario shows no dramatic shifts in global specialization. However, the major producers increase their production at smaller rates than the rate at which global production rises, and the smaller countries do so at rates that are higher than the global rate.

Table 4.7. Value shares of domestic agricultural production in world agricultural production: reference scenario.[a]

Group	Value share (%) 1980	2000
North America and Oceania		
USA	12.0	11.1
Canada	0.9	0.9
Australia	1.0	1.0
New Zealand	0.3	0.3
Other developed countries		
Austria	0.2	0.1
EC	6.7	4.8
Japan	2.4	2.4
Others	4.9	4.5
Centrally planned economies		
CMEA	15.3	11.9
China	16.3	15.6
Developing market economies		
Argentina	1.6	1.5
Brazil	3.7	3.6
Mexico	1.1	1.5
Egypt	0.8	0.9
Kenya	0.3	0.4
Nigeria	1.9	2.4
India	8.3	10.0
Indonesia	2.0	2.3
Pakistan	0.7	1.0
Thailand	0.9	1.1
Turkey	1.4	1.5
Others	17.3	21.2
World	100.0	100.0

[a]Agricultural output valued at world prices. This is not GDP agriculture as value of feed is counted twice if used in the same country.

4.5. Changing Patterns of Trade

The past trends of changing trade patterns continue in the reference run. The importance of agricultural trade increases and the level of interdependence in the world increases in the sense that not only does the volume of traded commodities increase, but also the proportions of total global production of cereals and animal products that are traded increase in the reference scenario.

The pattern of global net exports reflected in *Table 4.8* shows that a major expansion of agricultural trade takes place in cereals and animal products, the commodities exported by the developed countries of North America and Oceania. The major exports of developing countries – namely, protein feed, other food, and nonfood agriculture – also expand, but at a slower rate.

Table 4.8. Global net exports, 1980, 1990, and 2000: reference scenario.

Commodity	Unit of account	Volumes 1980	Volumes 1990	Volumes 2000	% change over 1980: 1990	% change over 1980: 2000
Wheat	10^6 t	78.1	113.0	139.9	44.7	79.1
Rice	10^6 t	8.2	12.9	16.1	56.7	94.9
Coarse grains	10^6 t	82.9	113.4	172.1	36.8	107.6
Bovine and ovine	10^6 t	3.5	4.1	6.0	16.7	71.9
Dairy	10^6 t	16.8	21.1	29.0	25.6	72.7
Other animal products	10^6 t	0.9	1.1	1.4	25.6	59.3
Protein feed	10^6 t	16.7	20.6	23.7	23.4	42.1
Other food	10^9 US$ 1970	15.4	20.8	24.4	35.0	58.9
Nonfood agriculture	10^9 US$ 1970	5.3	6.1	7.0	15.3	31.0

The lower growths in trade of other food and nonfood agriculture may also be a result of the fact that these are aggregates involving a number of commodities each and that, for each national or country group model, only net exports (i.e., exports minus imports) are generated. Thus, the growth rates of the volume of net trade in these aggregates as generated in a scenario of models may underestimate gross volumes if the subaggregates are partly exported and partly imported. Though one may argue that, if the trade patterns of commodities within an aggregate were to remain the same, the growth rates should not be different, it is an unlikely assumption, and in the model scenarios the growth rates of traded volumes of these two sectors are likely to be underestimated.

The pattern of trade is affected by the trade deficits – for the economy as a whole – for the various countries. As was indicated in Chapter 3, the trade deficits are determined every year endogenously in a globally consistent way based on a notion of a sustainable level of deficit depending on the country's growth rate, export earnings of the previous year, and debt service. The resulting pattern of trade deficits are shown in *Table 4.9.*

The projected total net trade deficits show that the developed market economies increase their trade surplus, the CMEA and China are projected to maintain balanced trade, and most of the developing market economies increase their deficits or reduce their surpluses. The exceptions are Brazil, whose trade deficit of nearly US$ 2 billion (1970$) in 1980 turns into a similar surplus by the year 2000, and Mexico, Egypt, and Turkey, whose trade deficits decline modestly.

The country-wise pattern of agricultural trade is shown in *Table 4.10.* Here one sees significant changes in traded quantities, and also the changing importance of commodities in a country's trade. Reversals of trade direction for some commodities are noticeable. Though a number of countries reverse the direction of trade in commodities in which they were marginal traders, some major reversals are also seen. The major changes are as follows:

Table 4.9. Net trade deficits in the reference scenario (in 10^6 US$ 1970).[a]

Countries	*1980*	*1990*	*2000*
USA	265	–5476	–6559
Canada	116	–673	–912
Australia	11	–195	–209
New Zealand	289	88	–2
Austria	322	16	–57
EC	385	–4484	–6222
Japan	–2342	–3122	–5331
Argentina	–809	–289	–127
Brazil	1968 26	–489	–2001
Mexico	781	389	437
Egypt	1191	777	1046
Kenya	143	270	378
Nigeria	–349	–118	–124
India	1917	2966	5106
Indonesia	–170	–64	–40
Pakistan	1182	2055	2839
Thailand	355	478	677
Turkey	1227	742	875

[a]A minus sign implies a surplus.

(1) Wheat exporters and importers continue to remain so, with the exception of New Zealand, which becomes an importer by 2000 (in fact by 1990) from being a very small exporter in 1980.

(2) India turns from a small importer of rice in 1980 to a significant exporter by 2000, whereas Brazil turns from a small exporter in 1980 to a modest importer in 2000.

(3) Mexico turns into an importer of coarse grain from being a small exporter of it in 1980.

(4) Brazil, from being a small exporter of bovine and ovine meats in 1980, becomes a major importer by 2000.

(5) In dairy products, the USA becomes a major exporter by 2000, whereas in 1980 it was a modest importer. The US policy in this scenario of maintaining a constant level of protection for dairy products leads to this outcome. The EC continues to maintain its exports at more or less the same level, but its share in the global trade declines.

(6) Though the major exporters continue more or less to retain their shares of the market for particular commodities, some countries do change their shares significantly in some markets.

Table 4.11 shows the terms-of-trade indices for the countries for 1980 and 2000. The terms-of-trade index is calculated as a ratio of unit value of exports to unit value of imports relative to the same ratio prevailing in 1970. The fall in world market prices of wheat and coarse grains; the increase in the prices of

Table 4.10. Country-wise patterns of agricultural trade: reference scenario.[a]

Country	Year	*Wheat*	*Rice*	*Coarse grains*	*Bovine and ovine meat*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood*
					(10^6 t)				(10^9 US$ 1970)	
USA	1980	40.1	2.7	61.8	–1.2	–1.0	0.25	11.4	2.0	–
	2000	64.8	6.2	128.3	–1.3	9.1	0.01	16.2	3.0	–
Canada	1980	12.6	–0.1	4.8	–	0.0	0.14	–0.2	–0.3	0.1
	2000	25.5	–0.1	14.8	0.4	–	0.24	–0.3	–0.4	0.2
Australia	1980	8.5	0.2	1.9	0.7	1.6	0.03	0.1	0.3	0.6
	2000	15.8	0.2	12.5	0.5	1.8	0.02	0.2	0.6	0.8
New Zealand	1980	0.1	–	0.6	0.7	3.9	0.01	–	0.0	0.3
	2000	–0.1	–	0.2	1.2	5.3	0.01	0.1	–0.1	0.5
Austria	1980	–	–	0.3	–	0.4	–0.01	–0.1	–0.1	–0.1
	2000	0.1	–	0.4	–	0.7	–0.01	–0.2	–0.1	–
EC	1980	11.2	–0.3	–2.3	–0.4	10.0	0.05	–5.0	–4.2	–2.1
	2000	17.6	–0.2	–19.6	–1.0	8.7	0.08	–6.4	–7.2	–2.1
Japan	1980	–5.9	–0.4	–17.4	–0.3	–1.1	0.06	–2.3	–1.6	–1.2
	2000	–9.4	–0.8	–38.0	–0.3	–0.4	0.39	–3.7	–1.8	–1.4
CMEA	1980	–19.7	–0.7	–13.0	–	0.6	–0.00	–0.8	–0.3	–1.2
	2000	–19.2	–0.4	–12.0	–	0.8	0.01	–	–1.5	–2.1
China	1980	–7.3	1.8	–1.7	0.1	–0.6	0.10	0.4	1.2	–
	2000	–13.7	1.0	–1.8	–	0.4	–0.05	–0.1	2.1	–
Argentina	1980	4.3	–	9.3	0.5	–	–0.01	0.2	0.1	0.3
	2000	6.6	–	12.9	1.5	0.2	0.03	0.2	0.6	0.4
Brazil	1980	–3.0	0.4	–	0.1	–0.6	–0.09	2.8	1.6	0.3
	2000	–6.6	–1.0	–8.6	–1.0	–1.7	–0.22	4.8	0.9	0.3
Mexico	1980	–0.4	–	1.2	–	–0.3	0.03	–0.1	0.3	0.1
	2000	–2.3	–0.1	–5.7	–0.1	0.1	0.23	–0.8	0.6	–
Egypt	1980	–2.7	0.2	–	–0.2	–0.5	0.01	–	0.2	–
	2000	–5.0	–	–2.6	–0.3	–1.6	0.03	–	0.3	0.2
Kenya	1980	–0.1	–	–0.3	–	–0.1	–0.00	–	0.2	0.1
	2000	–0.3	–	–2.0	–	–	–0.00	–	0.6	0.3
Nigeria	1980	–1.0	–0.2	–0.6	–0.2	–0.6	–0.08	–	–0.2	–
	2000	–10.0	–1.9	–1.7	–0.5	–3.5	–0.33	–	–0.7	–0.1
India	1980	0.1	–0.4	–3.8	–	–0.1	0.00	0.6	1.2	0.1
	2000	6.1	4.0	–10.1	–0.1	–0.9	–0.03	0.8	–0.5	0.2
Indonesia	1980	–0.6	–0.8	–0.3	–0.1	–0.2	0.02	0.1	0.3	–
	2000	–1.6	–2.2	–1.3	–0.1	–0.4	–0.04	–0.1	–0.7	–0.1
Pakistan	1980	0.9	0.4	0.1	–	–1.5	0.01	–	–0.2	–0.1
	2000	3.2	1.1	0.7	–	–4.7	0.01	0.1	–0.2	–0.2
Thailand	1980	–0.1	0.4	2.2	–	–0.3	0.01	–	1.2	0.1
	2000	–0.3	1.1	2.4	0.1	–0.4	0.02	–	1.7	0.1
Turkey	1980	–1.2	–	–0.4	–	0.1	0.01	–	0.5	0.3
	2000	–2.7	–	–1.7	0.2	1.9	0.02	–	1.2	0.4

[a]Negative values mean imports. No figure (–) indicates a very small value; 0.0 is slightly larger, but still less than 0.05.

bovine and ovine meat, dairy products, and nonfood agricultural products; and changes in the traded quantities of these commodities mostly determine the changes in terms of trade. Brazil, Indonesia, Nigeria, and Pakistan either increase imports or decrease exports of those products that increase in price and thus suffer a loss of terms of trade. India, on the other hand, increases its imports of bovine and ovine meats and dairy products as well as its exports of wheat. The loss in terms of trade is partly compensated by its increased exports of nonfood agricultural products. Even then its terms of trade fall by around 8% from 1980 to 2000. Though the USA expands its export of dairy products substantially, the loss due to fall in prices of wheat and coarse grains, its major exports, results in a terms-of-trade loss of around 8%. The EC's loss in terms of trade is mainly due to its reduced exports of dairy products, while the CMEA's loss is mainly due to its increased imports of nonfood agriculture.

The countries that lose on their terms of trade, except for the USA and Canada, are also the countries whose balances of agricultural trade (also given in *Table 4.11*) decline. Most countries maintain their status as either having a surplus in agricultural trade or a deficit. The two exceptions are Brazil and Indonesia. Brazil's agricultural trade surplus changes into a modest deficit by the year 2000, whereas Indonesia's small surplus becomes a sizable deficit. The USA's agricultural trade surplus, in spite of its loss in terms of trade, continues to grow, and so does the EC's deficit. India's agricultural trade surplus declines, but it still remains a surplus country by the year 2000.

Agricultural self-sufficiency ratios, defined as the ratio of the value of agricultural production to the value of demand for agricultural products, are also shown in *Table 4.11*. These indicate that, among the net agricultural importers in 1980 shown in the table, the EC and Nigeria significantly and the CMEA and Egypt marginally increase their dependence on imports for agricultural products. The fall in the EC's agricultural self-sufficiency ratio is partly the outcome of the EC's CAP, which tries to maintain domestic relative prices through variable levies that insulate its farmers from the world market. As a result, when the world price of a commodity changes, the EC does not fully alter its trade. Some of the agricultural surplus countries do reduce their surplus from 1980 to 2000, but they remain as surplus countries, except for Indonesia, whose self-sufficiency ratio goes down to 0.9 from 1.02. Countries with substantial agricultural surpluses increase their surpluses, except for Brazil.

This overview of the development of trade patterns in the reference scenario thus shows the increasing importance of trade and interdependence, and the continuing of global specialization in most cases.

(*Note:* It should be recalled that net trade in the model system is the result of the interaction of estimated demand and supply modules which capture the persisting trends of the estimation period 1961–1976. Therefore, the trade figures for 1980 presented in *Table 4.10* obtained from the reference scenario do not in all cases reflect magnitude and/or sign of historical data.)

Table 4.11. Agricultural terms of trade, agricultural trade balance, and agricultural self-sufficiency: reference scenario.

	Terms of trade (1970 = 1.0)		*Trade balance* (10^9 US$ 1970)		*Self-sufficiency ratio*[a]	
Group	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*
North America and Oceania						
USA	0.98	0.90	9.6	15.8	1.25	1.35
Canada	1.00	0.98	1.2	2.8	1.33	1.67
Australia	1.05	1.10	1.6	2.8	1.66	1.90
New Zealand	1.04	1.44	0.8	1.1	2.20	2.04
Other developed countries						
Austria	0.97	0.98	–0.1	–0.3	0.91	0.96
EC	0.93	0.87	–4.0	–6.9	0.89	0.85
Japan	0.96	0.96	–3.4	–4.0	0.75	0.80
Centrally planned economies						
CMEA	0.98	0.88	–2.7	–3.7	0.96	0.95
China	1.09	1.23	0.9	0.5	1.02	1.01
Developing market economies						
Argentina	1.01	1.18	1.1	2.4	1.30	1.49
Brazil	1.05	0.90	1.5	–0.3	1.17	1.02
Mexico	1.10	1.18	0.3	0.6	1.08	1.07
Egypt	1.12	1.15	–0.1	–0.2	0.97	0.96
Kenya	1.15	1.28	0.2	0.4	1.23	1.28
Nigeria	0.95	0.88	–0.6	-2.9	0.91	0.82
India	1.11	1.02	0.8	0.1	1.03	1.00
Indonesia	1.06	0.88	0.1	1.1	1.02	0.90
Pakistan	1.00	0.92	–0.2	–0.2	0.94	0.97
Thailand	1.11	1.16	1.0	1.4	1.37	1.28
Turkey	1.14	1.28	0.4	1.1	1.08	1.12

[a](Value of agricultural production)/(Value of domestic demand for agricultural products).

4.6. Tariff in the Reference Scenario

Implicit in the price transmission equations that characterize government behavior in our models are the tariff factors, which relate the domestic prices to the border prices. These factors thus reflect the extent to which governments protect or tax domestic producers and consumers. Their evolution over time can be taken to reflect the evolution of protective policies over time and hence is an important attribute with which to characterize the nature of the reference scenario.

The tariff equivalents, summarized for 1980 and 2000 in *Table 4.12*, show that, in general, for most commodities and countries, these factors remain more or less stable. Thus, the reference scenario implies more or less a continuation of the historical levels of protection. However, as discussed in Section 4.3, the tariff equivalents for bovine and ovine meat and dairy products are somewhat

Table 4.12. Relative nominal tariff equivalents[a] of agricultural products in percent of the world market price using consumer prices (three-year averages for 1980–1982, 1998–2000): reference scenario.[b]

Country	*Year*	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine meat*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agriculture*
Argentina	1980	–21	7	–20	–27	–17	–22	–0	–32	–5
	2000	–20	11	–11	–28	–18	–16	2	–28	–10
Australia	1980	15	27	29	–5	–7	40	15	14	–4
	2000	23	25	39	–10	–7	27	19	22	–4
Austria	1980	42	–5	85	74	34	11	20	10	46
	2000	38	–6	83	22	–12	4	22	9	81
Brazil	1980	13	2	–16	–13	22	–36	–11	–18	–19
	2000	33	–20	–27	–19	–11	–35	–10	–24	–19
Canada	1980	13	–7	14	25	53	–1	–18	–12	15
	2000	19	–8	21	6	23	–11	–18	–12	–7
Egypt	1980	30	–6	21	72	14	83	1	–23	–29
	2000	33	–23	19	41	11	83	–4	–23	–39
Indonesia	1980	–2	–12	–17	3	10	15	–4	–16	–36
	2000	–0	–12	3	–1	5	–2	–19	–25	–45
Japan	1980	35	253	42	52	106	43	134	44	98
	2000	31	254	39	56	69	27	127	37	74
Mexico	1980	–7	12	7	12	–3	22	–11	17	–33
	2000	–4	27	–7	–8	–14	17	–11	18	–28
Nigeria	1980	44	76	15	42	51	106	–18	–12	–16
	2000	47	131	37	82	145	115	–26	–11	12
Pakistan	1980	23	68	50	37	28	31	–2	–17	–17
	2000	16	44	82	1	31	22	4	–18	–30
Turkey	1980	31	44	20	61	249	63	55	6	–5
	2000	30	40	34	11	172	29	40	0	–1
EC	1980	84	65	42	61	70	26	35	5	26
	2000	112	61	37	12	34	24	36	12	28
Kenya	1980	10	0	0	–25	25	5	–5	–10	–10
	2000	10	0	0	–25	25	5	–5	–10	–10
New Zealand	1980	0	0	0	0	0	20	0	0	0
	2000	0	0	0	0	0	20	0	0	0
Thailand	1980	0	–20	–10	–25	30	–10	–10	–5	–25
	2000	0	–20	–10	–25	30	–10	–10	–5	–25
India	1980	68	2	9	9	48	3	1	–28	–9
	2000	54	–7	13	30	43	31	–30	–25	–13
USA	1980	0	0	0	25	80	–5	0	5	25
	2000	0	0	0	25	80	–5	0	5	25

[a]These are calculated as the difference between border prices and domestic consumer raw material prices, depend on the direction of trade as explained in Appendix A2 and are calculated with absolute prices (not prices relative to the nonagricultural price).
[b]–0 means a small negative number, +0 a small positive one.

exceptional. They decline significantly in some countries and increase in Nigeria. The decline of tariff equivalents for bovine and ovine meats and, to a smaller extent, for dairy products, when the world market prices of these products rise, implies that policies in countries protecting these commodities are directed toward maintaining desired levels of domestic price for them and not certain levels of protection. This may be a reasonable policy.

As pointed out previously, maintenance and improvement of income parity is the objective of various groups pressing for protective policies. Thus, parity is a relevant indicator to see how well protective policies have worked in the scenario. The development of income parity between agriculture and nonagriculture is seen in *Table 4.13*. Here income parity is defined as a ratio of GDP agriculture per unit of agricultural labor to GDP nonagriculture per unit of nonagricultural labor. Also given in the table are the growth rates of income parity ratios, and the price and protection rate of agriculture relative to nonagriculture.

The income parity ratios as calculated may not represent the true income ratios in the economy, particularly for the developing countries. This is because in many countries the data on labor employed in agriculture may include many part-time workers who work outside of agriculture. Their earnings from the nonagricultural sector are not included with their agricultural income except in the model of India. Moreover, income from processing agricultural products is counted as a part of nonagricultural income in the models, and this, to the extent that such processing is done by many agricultural producers themselves, also understates agricultural incomes. Also, the way parity is arrived at here assumes that the factors land and capital are owned by those people who work in those sectors in which these factors are employed. This discrepancy in the calculation of parity ratios does not affect the outcome of the models as, except for India, income classes are not distinguished in the models. Though the level of the income parity ratios as calculated may not be too reliable, the parity ratios are calculated in a consistent manner so that their changes over time should be much more realistic.

The average labor productivity ratios in the developed countries seem to grow more slowly over the period 1980–2000, compared to their growth rates over the period 1961–1980. To some extent this reflects the fact that over the period 1961–1980 significant out-migration of labor from agriculture took place. From the lower agricultural population of 1980 compared to that of 1960, this rate of out-migration is likely to be much smaller over 1980–2000.

In general, the income parity ratios for the year 2000 seem to follow the trend of the ratios for 1961 and 1980. The changes in the parity ratios result from changes in relative prices consequent to changes in world market prices and relative protection rates, and average labor productivities. Changes in relative protection rates depend on the price transmission equation, which represents government policy in the model. Changes in average labor productivities are the outcome of labor migration from agriculture to nonagriculture, as well as technical progress and capital accumulation (which change labor/capital ratios).

Table 4.13. Income parity ratios and rates of change of parity, relative price in agriculture, and labor productivity, 1980–2000: reference scenario.

	Income parity ratio[a]			*% change per annum 1980–2000*		
Group	*1961*[b]	*1980*	*2000*	*Parity*	P_A/P_N[c]	*Labor productivity*[d]
North America & Oceania:						
USA	–	1.00	1.15	0.7	0.7	–
Canada	0.50	0.73	0.80	0.4	0.1	0.3
Australia	1.25	1.12	1.73	2.2	1.1	1.1
New Zealand	1.48	1.71	3.35	3.4	2.2	1.2
Other developed countries:						
Austria	0.42	0.41	0.40	-0.1	-0.2	0.1
EC	0.47	0.61	0.71	0.7	0.2	0.5
Japan	0.26	0.28	0.30	0.4	0.1	0.3
Centrally planned economies:						
CMEA	–	–	–	–	–	3.0
China	–	–	–	–	–	1.8
Developing market economies:						
Argentina	0.67	0.81	1.15	1.8	1.1	0.7
Brazil	0.16	0.14	0.13	-0.2	0.7	-0.9
Mexico	0.10	0.12	0.19	2.1	0.4	1.7
Egypt	0.25	0.32	0.27	-0.8	0.8	-1.5
Kenya	0.08	0.10	0.14	2.0	0.9	1.1
Nigeria	0.53	0.58	0.59	0.1	1.3	-1.2
India[e]	0.54	0.54	0.56	0.2	0.5	2.3
Indonesia	0.27	0.38	0.31	-1.0	0.4	-1.3
Pakistan	0.43	0.46	0.55	0.9	0.3	0.6
Thailand	0.08	0.07	0.04	-2.2	0.4	-2.6
Turkey	0.18	0.29	0.31	0.4	-0.3	0.7

[a](Agricultural GDP/Agricultural labor)/(Nonagricultural GDP/Nonagricultural labor) at current prices. [b]Based on FAP data base. [c]P_A/P_N (Price of agriculture)/(Price of nonagriculture). [d]Defined as the ratio of GDP per unit of labor at constant prices in agriculture to that in nonagriculture. [e]Parity figure for India refers to rural/urban rather than agricultural/ nonagricultural per capita incomes.

Though the various determinants of income parity ratios move differently, government policies reflected in the price transmission equations adjust domestic prices and the protection rates in ways that result in income parity ratios that are in general consistent with past trends.

What is worth noting is that, in a number of countries, income parity ratios improve over time in favor of agriculture, and yet, even by 2000, agricultural incomes are less than nonagricultural incomes in all but four countries shown in the *Table 4.13.*

In addition to the changes in tariff rates and parity ratios, changes in various agricultural price indices also characterize the nature of the price

Table 4.14. Price indices (1970 = 1.00): reference scenario.

	Country-specific world price of agriculture[a]		Index[b] of domestic producer price of agriculture P_A/P_N		Crop price index[c]		Food price index[c]	
Countries	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*
USA	1.02	1.14	1.00	1.15	–	–	1.96	6.06
Canada	1.01	1.10	1.17	1.20	1.07	1.01	1.07	1.19
Australia	1.05	1.27	0.84	1.04	0.91	0.91	0.93	1.13
New Zealand	1.05	1.40	0.98	1.53	1.34	1.34	1.24	1.44
Austria	1.05	1.19	1.00	0.96	0.96	0.89	1.04	1.12
EC	1.05	1.20	1.08	1.12	1.12	1.11	1.08	1.18
Japan	1.08	1.15	1.07	1.09	1.01	1.05	1.08	1.21
CMEA	1.06	1.17	1.00	1.00	–	–	–	–
China	1.09	1.14	1.00	1.00	–	–	–	–
Argentina	1.04	1.25	1.04	1.31	1.05	1.04	0.99	1.24
Brazil	1.10	1.21	1.30	1.50	1.16	1.19	1.16	1.36
Mexico	1.07	1.17	1.22	1.32	1.16	1.27	1.13	1.23
Egypt	1.09	1.19	1.28	1.51	1.19	1.20	1.17	1.29
Kenya	1.08	1.22	1.06	1.27	0.16	0.16	0.14	0.16
Nigeria	1.12	1.18	1.31	1.70	1.18	1.34	1.23	1.51
India	1.07	1.13	0.96	1.05	–	–	–	–
Indonesia	1.10	1.15	1.01	1.09	1.02	1.08	1.02	1.15
Pakistan	1.06	1.22	1.30	1.37	1.07	0.98	1.22	1.29
Thailand	1.09	1.15	1.07	1.16	0.05	0.05	0.05	0.05
Turkey	1.09	1.18	1.12	1.06	1.04	1.06	1.14	1.25
World			1.07	1.16				

[a]Laspeyres index of country-specific world prices weighted by domestic production. [b]These are divisia indices (which have changing weights), except for India, for which the indices are Laspeyres indices. [c]All prices are related to that of nonagriculture. The price index of crops excludes animal products. The price index of food includes all foods including animal products.

transmission policy functions and the reference scenario. The country-wise price indices given in *Table 4.14* show that the raw material producer price of agriculture relative to the price of nonagriculture, P_A/P_N, in different countries rises in general less than on the world market. This is what can be expected, as most countries try to insulate domestic prices from world prices to some extent or other. New Zealand, Argentina, and Nigeria show increases larger than the 13% increase in the world market relative price of agriculture, as these countries either increase their protection rates (Nigeria) or share of production (Argentina and New Zealand) of commodities that increase their prices (bovine and ovine meats, dairy products, and nonfood agriculture) over the 1980–2000 period. The only two countries showing a fall in the relative price of agriculture are Austria and Turkey. These two countries show substantial reduction in the protection rates of commodities that gain most in prices – namely, bovine and ovine meats and dairy products. In spite of this fall, the income parity ratio for Austria decreases only slightly (from 0.41 in 1980 to 0.40 in 2000), while the ratio for Turkey increases slightly (from 0.29 in 1980 to 0.31 in 2000).

The price indices of crops given in *Table 4.14* are for producer raw material prices relative to nonagriculture. Most of them show very little change or small declines. Once again, this is what can be expected as world prices of crops also decline over this period. The price indices for food in *Table 4.14* are consumer raw material prices and show that, in the reference scenario, food prices increase for consumers, reflecting the increased share of animal products in consumption.

In conclusion, the development of tariff factors, income parity ratios, and price indices in the reference scenario implies policy behavior in different countries that seems consistent with past trends and behavior.

4.7. Agriculture in the National Economies

Table 4.15 shows the share of agricultural GDP in total GDP as well as the allocation of factors and inputs to agriculture. It can be seen that the growth rates of GDP are higher for the developing countries, though the CMEA shows a growth rate of 4.4% and Japan shows one above 5%. The share of agricultural GDP declines in all countries. Comparing the shares of labor and capital used in agriculture with the share of agricultural value added, one can see the factor intensity in agriculture relative to the economy. When the share of labor in agriculture is higher and that of capital in agriculture is lower than the share of agriculture in total GDP, then one can conclude that the labor/capital ratio is higher in agriculture than in the economy as a whole. Thus, in 1980, the agricultural labor/capital ratio is higher in all the countries, except Australia and New Zealand, than the average ratio for the economy. Comparing the growth rates in the shares one sees that, for the developed market economies, the labor share declines faster than the capital share, which implies that the differences in the labor/capital ratios between agriculture and the economy reduce over time, whereas in most developing countries they increase.

The gross cultivated area increases over the period 1980–2000 in all countries except the EC and Japan, as would be expected for these two highly developed and densely populated regions.

Use of fertilizer grows at a faster rate in countries that begin with a relatively low intensity of fertilizer use. Among these are Australia and Canada, which have a relatively low level of fertilizer use in 1980 compared to other developed countries. In all countries the growth rates of fertilizer use are much larger than the growth rates of area expansion, showing increases in intensities of fertilizer applications.

Thus, the broad picture painted by the reference scenario of the development in agriculture is one of agricultural development accompanied by intensification of capital per unit of labor and of fertilizer per hectare.

Table 4.15. Some indicators of agricultural development in the national economies (absolute values and growth rates[a]), 1980–2000: reference scenario.

Countries	GDP[b] (10^9 US$ 1970)		AGDP/GDP[b] (%)		TLA/TL (%)[c] (%)		AgCap/TotCap[d] (%)		Area[e] (10^6 ha)		NF (1000 t)[f]	
	1980	*growth*	*1980*	*growth*	*1980*	*growth*	*1980*	*growth*	*1980*	*growth*	*1980*	*growth*
USA	1254.8	2.7	2.3	–1.4	NA[g]	NA[g]	NA[g]	NA[g]	147.9	0.6	NA[g]	NA[g]
Canada	124.7	3.4	2.9	–1.4	4.5	–1.6	3.8	–1.4	23.6	0.8	275	6.7
Australia	53.7	2.6	7.4	–0.7	5.6	–1.8	7.8	–0.3	16.6	1.3	649	5.2
New Zealand	9.9	3.2	15.4	–1.2	9.5	–2.4	14.5	–	–	–	67	–
Austria	18.0	3.9	5.0	–2.7	11.3	–2.7	16.6	–2.1	1.2	0.3	130	0.6
EC	824.4	3.1	4.9	–2.4	8.4	–2.8	5.7	–1.2	34.3	–0.2	5989	1.4
Japan	355.4	5.4	3.7	–3.6	13.0	–3.6	6.5	–1.5	4.4	–0.5	893	1.0
CMEA	977.2	4.4	14.6	–1.8	18.8	–4.2	15.1	2.0	–	–	78	3.4
China	264.8	5.2	14.3	–3.2	69.5	–2.3	20.7	–0.1	–	–	41	2.6
Argentina	36.0	2.5	10.7	–0.7	13.4	–1.2	12.3	–0.6	19.2	1.2	103	6.1
Brazil	96.9	6.2	6.0	–3.2	38.2	–1.7	9.5	–2.9	45.6	1.8	435	4.0
Mexico	53.9	5.1	8.1	–1.3	46.4	–1.9	11.1	–0.9	19.4	1.6	929	4.2
Egypt	10.7	4.7	21.0	–2.1	51.9	–0.5	33.6	–1.1	3.5	0.7	452	4.0
Kenya	2.5	4.4	25.0	–0.1	78.7	–0.3	15.0	–1.1	–	–	34	4.8
Nigeria	15.6	7.0	33.4	–3.5	53.0	–1.9	15.5	–3.1	33.2	0.2	100	12.9
India	68.3	5.1	42.3	–2.6	NA[g]	NA[g]	NA[g]	NA[g]	171.8	0.8	3000	6.1
Indonesia	12.5	5.2	35.9	–2.3	60.1	–0.8	35.4	–2.2	20.5	1.3	342	5.8
Pakistan	14.5	4.0	28.3	–0.6	52.7	–0.8	28.6	0.7	18.6	1.4	316	6.9
Thailand	9.8	5.3	19.8	–2.3	79.6	–	24.5	–1.4	–	–	76	3.5
Turkey	25.3	6.0	21.9	–3.0	52.3	–2.5	20.3	–4.1	17.8	0.8	468	5.1

[a]All growth rates are in percent per year over 1980–2000.
[b]GDP, gross domestic product; AGDP, agricultural gross domestic product; both in 1970 US$.
[c]TLA/TL, (Total agricultural labor)/(Total labor in economy).
[d]AgCap/TotCap, (Agricultural capital)/(Total capital).
[e]Gross cropped area.
[f]NF, nitrogen fertilizer in nutrient units.
[g]NA, not available.

4.8. Welfare and Hunger in the Reference Scenario

Some of the macroeconomic indicators of development and welfare in the various countries and country groups are shown in *Table 4.16.* Not all the indicators are available or calculated for all the national models.

Comparison of per capita GDP valued at domestic 1970 prices and converted into US dollars for different countries shows that the absolute difference between the developed and the developing countries widens over the period 1980–2000. Thus, for example, the difference in the per capita GDPs in 1970 US dollars between the USA and India in 1980 is around US \$5600 ($\cong$ 5731 – 104), which increases in 2000 to around US \$7800 (8017 – 181) even though the ratio of per capita GDPs declines over this period from 55 (5731/104) to 44 (8017/181).

The USA continues to remain the ~~country with~~ the highest (among the countries shown) per capita GDP, but Canada and Japan narrow the gaps to become close second and third. Japan overtakes the EC by far.

The equivalent incomes shown in *Table 4.16* are calculated using 1970 domestic consumer prices as reference prices. Equivalent income constitutes a better measure than per capita GDP for comparing welfare of consumers in alternative situations. The growth rate of equivalent income differs from the growth rate of the per capita GDP for the same country. For the developed market economies, the growth rates of per capita GDP and equivalent incomes are more or less the same. This can be expected as, in high-income countries, consumption expenditure on food is a relatively small part of the total consumption expenditure, food demand has relatively low price elasticity, and nonagriculture is just one aggregated commodity in the model, so that changes in the composition of the consumption bundle due to changes in prices are not too significant. The income effect of changing prices may be significant, but it is also captured by the per capita GDP valued at 1970 prices.

For the developing countries, the growth rates of equivalent incomes are significantly different from the growth rates of per capita GDP. Moreover, for some countries the former is higher; and for the others, the latter. This underlines the difficulties of using constant price per capita GDP for comparing alternative situations.

Per capita calorie intake, shown in *Table 4.16*, is an important indicator of welfare for developing countries. It shows an improvement over the period 1980–2000 in all developing countries, and the minimum national average in the reference scenario in the year 2000 is that for Indonesia.

Estimates of life expectancy at birth and number of people in hunger are derived using the results of the reference scenario and cross-country regressions as explained in Chapter 3. The relatively well-off countries of Argentina, Mexico, and Turkey show insignificant changes in the number of persons in hunger, and there is significant improvement in all other developing countries, with the exception of Kenya. Kenya has a relatively high growth rate of population and,

Table 4.16. Welfare and macroeconomic indicators in 1980 and 2000: reference scenario.

	GDP/capita[a] (US$ 1970)		*Equivalent income*[b] (US$ 1970)		*Calorie intake* (kCal/capita/day)		*Life expectancy* (years)		*People hungry* (10^6)		*Parity*[c]	
Countries	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*	*1980*	*2000*
USA	5731	8017	NA[d]	NA[d]	NA[d]	NA[d]	74	81	0	0	1.00	1.15
Canada	5207	7907	4108	6109	3566	3607	75	76	0	0	0.73	0.80
Australia	3671	4463	2965	3557	3832	3894	74	75	0	0	1.12	1.73
New Zealand	3086	4386	NA[d]	NA[d]	3519	3678	74	76	0	0	1.71	3.35
Austria	2337	4797	1792	3479	3448	3439	73	75	0	0	0.41	0.40
EC	3120	5212	2446	4015	3491	3604	75	77	0	0	0.61	0.71
Japan	3080	7554	1986	4612	2749	3029	76	81	0	0	0.28	0.30
CMEA	2345	4782	NA[d]	NA[d]	3619	3567	NA[d]	NA[d]	0	0	NA[d]	NA[d]
China	272	586	NA[d]	NA[d]	2487	2557	67	76	NA[d]	NA[d]	NA[d]	NA[d]
Argentina	1350	1795	1108	1438	3653	3656	71	72	1	1	0.81	1.15
Brazil	822	1818	594	1273	2860	3283	64	70	12	3	0.14	0.13
Mexico	798	1157	655	910	2487	2588	66	71	3	3	0.12	0.19
Egypt	266	448	245	384	2799	3134	57	60	1	0	0.32	0.27
Kenya	166	200	NA[d]	NA[d]	2495	2802	56	59	6	7	0.10	0.14
Nigeria	181	390	144	256	2254	3168	49	59	25	2	0.58	0.59
India	104	181	72	88	2141	2533	52	58	219	156	0.54	0.56
Indonesia	83	151	62	96	1840	2374	54	61	21	0	0.38	0.31
Pakistan	182	224	176	210	2460	2718	50	53	9	6	0.46	0.55
Thailand	219	423	NA[d]	NA[d]	2856	3235	63	66	8	4	0.07	0.04
Turkey	580	1231	471	912	3137	3219	61	67	1	1	0.29	0.31

[a]Calculated at domestic 1970 prices.
[b]Defined as the income required to buy a consumption bundle with domestic consumer prices of 1970 that would provide the same utility as provided by current consumption.
[c]Ratio of per capita GDP in agriculture to that in nonagriculture (except for India, for which it is the rural/urban GDP ratio).
[d]NA, not available.

though the improvements in per capita GDP and calorie intake result in a lower proportion of the population in hunger, the number of persons in hunger increases over the 1980–2000 period.

Table 4.17. Global incidence of hunger: reference scenario.

	1980	*1990*	*2000*
Population (10^6)			
World	4340	5190	6160
Developing countries[a]	2190	2800	3540
Hunger in developing countries[a]			
Percent of population	23	17	11
Persons (10^6)	510	470	400

[a]Excluding China.

Even though globally the number of hungry persons declines, it still constitutes a sizable number. The estimates of hungry at the global level are given in *Table 4.17.* While the incidence of hunger declines from 23% of population in 1980 to 11% of population of developing countries, excluding China, by 2000 there are still 400 million people in hunger, compared to 510 million shown in the scenario for 1980.

4.9. Concluding Observation

In conclusion, the reference scenario paints a perspective of development up to 2000 that can be characterized as follows:

(1) The economic growth rate is somewhat more optimistic than the historical trend over the 1960s and the 1970s.
(2) Although effective demand for food grows substantially owing to higher incomes and larger populations, the world food system meets this demand with very modest increase in overall agricultural prices, but with a decline in basic staples prices.
(3) The policies providing more or less stable protection levels are continued in the scenario. The importance of agricultural trade increases, reflecting the growing interdependence of the world.
(4) Considerable improvement in various indicators of welfare is shown. In particular, the proportion of the population of poor countries that is in hunger decreases significantly. Even then, however, the absolute number of hungry people declines only marginally, and a large number of people remain hungry even by the end of the century.

Finally, to appreciate the internal consistency of the scenarios generated by the BLS, the projection of the reference scenario may be compared with other projections made with less formal methods.

This projection for the year 2000 in the reference scenario can be compared with the projections made in the FAO's *Agriculture: Toward 2000* study (FAO, 1981a). The only two comparable commodity groups in AT 2000 and in our scenario are cereals and milk. The trend projections of AT 2000 (see *Table 4.18*) indicate a cereal surplus of 213 million tonnes for the developed countries but only a 165-million tonne deficit for the developing countries. These do not balance at the global level. Nor does milk trade balance. The FAO study notes, however, that these projected "imbalances would not materialize; spontaneous or policy induced adjustments will bring balance." However, the study indicates neither what this new balance would be, nor what would be the needed policies and price adjustments.

Table 4.18. AT 2000: Implied commodity balances of trend projections to 2000.[a]

Product	*Developed countries* (10^6 t)	*All developing countries* (10^6 t)
Cereals	+213	−165
Sugar	−13.5	+20.7
Citrus	−0.8	+10.0
Vegetable oils	−2.8	+6.0
Meat	+12.3	−3.0
Milk	+17.5	−25.0

[a]+, net exports; −, net imports. *Source*: FAO (1981a), Table 2.3.

Compared to that study, the reference projection described here provides a global balance and also respects the balance-of-trade constraints for individual nations. Thus, a consistent projection is made and the associated policy measures and regimes are identified. Thus, the RO scenario shows that the developed countries would export nearly 165 million tonnes of cereals and 26 million tonnes of dairy products (milk equivalent) compared to 213 million tonnes and 17.5 million tonnes, respectively, in the FAO trend projections. It should be noted that the numbers from our R0 scenario are rather close to the import levels projected by the FAO for the developing countries.

Note

[1] Actually, in the early 1980s the EC was a net exporter of bovine and ovine meat. The reader should not overweigh this deviation of model results from actual figures, since the reference run is not meant to be a forecast. Neither do the results of the policy analysis depend too strongly on the assumptions of the reference run.

CHAPTER 5

Reducing Trade Distortions in OECD Countries

5.1. Introduction

Among the OECD countries, agricultural protection is an important issue of trade negotiations. In fact, the OECD Council of Ministers has given the secretariat a mandate to study the impact of agricultural trade liberalization by OECD countries. Thus, a scenario to explore the impact of agricultural liberalization by OECD countries is of specific policy interest.

The countries of the OECD together are sufficiently large actors in world trade that, when they liberalize trade simultaneously, world prices will change, though the direction of change cannot be easily predicted. One cannot predict *a priori* whether, in the resulting equilibrium, a country within the OECD will gain or lose in welfare from trade liberalization. In describing the results of this scenario on trade liberalization, the following questions are addressed:

(1) How do the world market prices change?
(2) What is the impact on agricultural production and trade in the world and in the individual countries? How do market shares change?
(3) What is the welfare gain, if any, for the various OECD countries?
(4) How are farmer incomes and parity affected?
(5) What is the impact on other countries, particularly the developing countries, of trade liberalization by OECD countries?

5.2. Higher World Market Prices under Trade Liberalization by the OECD

With trade liberalization by the OECD countries [Australia, Austria, Canada, EC, Japan, New Zealand, and the USA, for which explicit models exist in the BLS (Turkey is excluded from liberalization as one of the less-developed OECD countries); the other OECD countries are included in a country group model and also liberalize], the world market prices of agricultural products relative to nonagriculture would be higher by 9% by the year 2000 compared to the reference run (see *Table 5.1*). This modest average increase, however, is misleading because its modest level is strongly influenced by the very small increase in the price of the commodity group with a high weight and facing relatively low protection in the OECD countries – namely, "other food", dominated by fruits, vegetables, and tropical products.

Table 5.1. Percentage changes in world market prices and global net exports in 2000 under OECD trade liberalization relative to the reference scenario.

Commodity	*Relative prices*	*Net exports*[a]
Wheat	18	–2
Rice	21	37
Coarse grains	11	–5
Bovine and ovine products	17	35
Dairy products	31	13
Other animal products	–0	17
Protein feed	13	5
Other food	5	10
Nonfood agriculture	–2	5
Total agriculture[b]	9	–
Nonagriculture	0	17

[a]Changes in quantities, except for net exports of total agriculture for which change in the aggregate export index weighted by 1970 world prices is reported. [b]Price weighted by production.

In fact, for the commodities of primary importance to the producers in OECD countries, such as cereals, protein feed, and animal products, the increases in world market price compared to the reference scenario are of the order of 10–20% and, for dairy products, more than 30%.

The movement of the index of relative prices (with 1980 as base) compared to the reference run is shown in *Figures 8.1–8.9*. These figures show that the transition to trade liberalization more or less stabilizes world market prices by the early 1990s.

The long-term development of prices in a scenario, as discussed in Chapter 4, is the outcome of the interplay of demand shifts due to population and income growths and supply shifts due to technical progress and factor allocations. Since the differences in income growth between the OECD trade liberalization and the reference scenario are relatively small (and population growths are the same), even at the country levels the demand shifts should be similar in the two runs. Explanations for the differences in the prices between the runs have thus to be sought mainly from the way supply shifts develop in response to changes in prices between the two runs.

5.3. Changes in Growth Patterns of National Economies

The macroeconomic indicators given for different countries in *Table 5.2* show how agricultural trade liberalization by OECD countries affects patterns of development.

As noted in the previous section, the relative price of agriculture on the world market increases by 9% in the year 2000, when commodity price changes are weighted by volumes of global trade. When commodity prices are weighted by production levels in a country, one obtains country-specific world prices of agriculture, which are more relevant for looking at the changes in domestic prices.

Since agricultural GDP is a small part of the economies of OECD countries, the increase in the relative price of agriculture resulting from trade liberalization has a relatively small impact on savings and real investment. The changes in total investment, and consequently in total capital, are also very small. Thus, GDP changes in OECD countries are 0.3% or less, except for New Zealand, whose GDP in 2000 increases by 1.6% over the reference run value. Agriculture is more important for New Zealand than for other OECD countries and the increases in the world prices are in commodities of particular interest to New Zealand. *Table 5.3* shows how changes in the relative price of agriculture affect investment and GDP in the OECD countries.

The small gains in the GDPs of the EC and Japan, in spite of lower capital stock, are the results of efficiency gains due to better allocation of resources. The small drop in Canada's GDP in spite of a larger capital stock is a consequence of an index number problem, as will be seen later in this chapter.

Thus, the main effect of agricultural trade liberalization is through changes in allocation of factors between agriculture and nonagriculture as driven by changes in the relative price of agriculture.

Table 5.4 shows the changes in factor availabilities and GDP in agriculture and nonagriculture. Relative prices of agriculture are also repeated in this table for convenience. The elasticities of value added with respect to relative price and factor availabilities shown in *Table A3.1*, give a fair indication in most cases of the changes in value added in agriculture and nonagriculture.

When looking at the individual country behavior at an aggregate level, one would, in general, expect countries with high protection to reduce production and countries with low protection to expand production of agricultural goods in a free trade scenario. The picture is quite clear for developed market economies: the EC and Japan reduce agricultural output in response to lower prices, and the economies in North America and Oceania expand output. The USA has, however, a neutral position in a number of commodities with very small changes in production (see *Table 5.8*). The fall in prices of 9–35% for the EC and Japan causes a reduction in agricultural value added (in constant prices) of the order of 5% owing to the moving out of both labor and capital from agriculture. In Canada and Oceania, prices increase by around 15%, these increases being

Table 5.2. Percentage changes of some macroeconomic and welfare indicators in 1990 and 2000 under OECD trade liberalization relative to the reference scenario.[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
GDP70	0.1	+0	0.3	0.3	0.2	–0	–0.2	–0.3	0.1	–0.1	–0.4	–1.1
GDPA70	8.1	13.9	1.7	2.5	–1.1	1.5	1.0	0.8	7.2	16.6	1.5	2.1
GDPNA70	–0.7	–1.4	0.2	0.1	0.2	–0.1	–0.2	–0.3	–0.1	–0.5	–0.8	–1.6
AG HCons at P70	–1.5	–0.5	–0.1	0.8	1.5	1.3	–1.1	–0.3	–1.2	–1.9	–0.1	–0.3
NAG HCons at P70	1.2	2.8	–0.5	–0.2	0.3	0.1	–0.9	–0.9	0.1	0.1	–0.4	–1.6
Trade deficit 70	–4.6	–3.2	–1.0	0.1	–7.4	1.3	–7.6	0.5	1.5	0.5	–3.0	–1.2
AG trade deficit 70	32.9	35.0	4.2	3.1	19.2	–31.7	33.5	–281.8	7.7	24.3	–86.1	–115.6
Trade/GDP at WP	57.7	57.6	22.5	23.2	44.6	42.9	20.6	–2.7	21.3	51.1	15.7	29.7
GDPA at WP70	8.1	11.1	1.8	1.3	2.2	5.4	2.4	4.1	2.0	5.2	3.0	5.5
Investment	2.7	2.0	1.8	1.2	0.3	0.3	0.6	+0	0.5	0.4	1.0	–0.5
Total capital	1.0	1.5	0.6	0.9	+0	0.3	0.3	0.1	0.1	0.1	0.4	0.1
AG vol. index WP70	8.1	12.5	2.0	1.7	–0.9	1.8	2.2	3.7	4.8	12.6	3.0	5.4
Net calories produced	7.9	–10.9	0.5	–12.6	–15.8	–21.9	5.1	7.7	–13.4	–19.4	3.3	7.0
Agricultural capital	10.4	20.4	9.4	13.7	–0.8	2.0	7.3	9.8	8.6	21.2	3.3	6.2
Agricultural labor	7.8	14.7	1.4	4.3	–1.7	2.1	0.3	0.8	6.2	19.8	1.4	1.8
Total acreage	10.3	1.4	–0.5	–0	+0	–0	3.3	4.4	2.8	2.4	0.4	3.2
N fertilizer	12.6	28.2	29.0	8.6	–8.4	–5.2	2.1	3.7	–1.7	15.4	3.7	6.5

Table 5.2. (Cont.)[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
P_A/P_N	17.3	12.1	22.6	14.5	1.1	7.5	11.3	7.8	11.3	15.5	8.5	5.4
AG CSWP index Y70	16.9	12.1	16.9	12.5	15.7	13.2	10.6	7.8	13.8	12.2	11.9	9.1
Crop price index	7.9	6.7	–6.4	–8.2	–10.3	–7.7	7.9	5.6	8.0	8.6	8.0	5.3
Food price index	13.5	7.7	18.1	12.1	–1.2	0.6	7.0	5.8	6.5	6.5	4.9	3.0
Terms of trade	19.4	19.8	16.8	19.7	23.6	52.9	7.2	–1.6	18.9	29.8	–2.7	–5.6
Terms of trade R	15.4	11.3	13.2	10.7	6.9	6.3	0.9	–7.1	7.9	9.4	–2.9	–8.1
AG SSR	8.1	9.3	–0.8	–1.0	–1.6	1.0	2.5	4.1	–2.5	–0.2	2.8	5.8
AG SCR	0.1	0	–0.9	–0.2	–4.7	–5.6	1.2	1.3	3.1	5.2	0.5	1.0
Parity	17.4	11.0	22.6	12.2	1.6	6.8	12.1	7.7	12.1	12.2	8.0	5.7
Equivalent income	0.7	2.1	–0.5	–0.1	0.4	0.2	–0.9	–0.9	–0	–0.1	–0.3	–1.2
Calories/capita	–0.9	–0.3	0.3	0.5	0.3	0.3	–0.9	–0.5	–0.4	–0.8	–0.2	–0.5
Protein/capita	–1.2	–0.6	0.3	0.6	0.4	0.3	–1.1	–0.4	–0.4	–1.3	–0.2	–0.5
Number hungry	18.4	6.7	–	–	–	–	10.1	12.3	–	–	–	–
Life expectancy	–0.5	–0.5	+0	0.1	0.1	+0	–0.2	–0.2	–0.1	–0.4	–0.3	–0.5

[a]The first figure given for each country is for 1990, the second for 2000.

[b]GDP70, GDP at 1970 prices; GDPA70, GDP agriculture at 1970 prices; GDPNA70, GDP nonagriculture at 1970 prices; AG HCons at P70, human consumption of agricultural products at 1970 prices; NAG HCons at P70, human demand for nonagricultural products at 1970 prices; Trade deficit 70, trade deficit at 1970 prices; AG trade deficit 70, deficit in agricultural trade at 1970 prices; GDPA at WP70, GDP agriculture at 1970 world prices; Investment, real investment; Total capital, capital stock at 1970 prices; AG vol. index WP70, volume index of agricultural production weighted with 1970 world market prices; Net calories produced, net calorie production; N fertilizer, nitrogenous fertilizer; P_A/P_N, agricultural price index relative to nonagriculture; AG CSWP index Y70, index of agricultural country-specific world market prices weighted with the 1970 production of the corresponding country; Terms of trade R, terms of trade using trade volumes of the reference run in corresponding years as the weights; AG SSR, agricultural self-sufficiency ratio, i.e., volume of agricultural production divided by volume of agricultural demand weighted with country-specific 1970 world market prices; AG SCR, agricultural self-consumption ratio, i.e., the sum of agricultural production minus net export weighted by country-specific 1970 world market prices divided by the sum of demand for agricultural products weighted by the same prices; Parity, agricultural GDP per person engaged in agriculture divided by nonagricultural GDP per person engaged in nonagriculture.

Table 5.2. (Cont.)[a]

Indicator[b]	*India*		*Indonesia*		*Japan*		*Kenya*		*Mexico*		*New Zealand*		*Nigeria*	
GDP70	0.2	0.1	–0.1	0.1	0.2	0.3	0.9	1.8	–1.0	–2.1	1.4	1.6	0.8	1.2
GDPA70	0.1	0.1	0.3	0.4	–5.7	–5.2	2.8	5.3	1.9	3.6	10.3	14.0	3.0	6.5
GDPNA70	0.2	0.1	–0.3	–0	0.3	0.4	0.4	0.6	–1.2	–2.4	+0	–0	0.1	0.1
AG HCons at P70	+0	–26.2	–0.2	–0.1	5.2	4.8	2.4	2.3	–1.3	–0.7	1.8	2.3	–0.3	0.3
NAG HCons at P70	0.2	0.2	–7.8	–3.5	0.6	0.8	0.3	2.6	–0.8	–2.1	3.8	3.5	1.7	2.9
Trade deficit 70	–1.1	0.4	1.9	0.9	6.6	4.1	–4.4	–1.4	–3.5	–4.3	–15.9	123.0	–0.9	0.8
AG trade deficit 70	18.7	211.9	–1.7	–2.6	38.8	48.9	–8.6	13.8	59.1	75.8	14.3	23.2	–14.4	–20.8
Trade/GDP at WP	3.9	5.7	13.8	3.9	41.8	44.7	–4.9	8.0	15.4	22.5	36.0	37.5	–7.6	–13.1
GDPA at WP70	–0.1	0.1	0.1	0.3	–2.3	–3.8	0.1	4.6	2.4	4.4	10.9	15.4	2.5	5.9
Investment	–0.5	0.3	1.1	0.6	–0.9	–0.4	5.6	5.1	–0.3	–2.1	7.4	5.6	2.7	2.2
Total capital	NA[c]	NA[c]	0.4	0.5	–0.4	–0.6	2.2	3.8	+0	–1.0	2.7	4.5	1.2	2.2
AG vol. index WP70	–0.1	0.1	0.2	0.3	1.0	1.4	0.1	4.4	2.4	4.2	7.9	12.5	2.6	6.1
Net calories produced	0.2	0.7	0.3	0.6	283.7	130.9	–0.8	4.9	12.2	15.9	9.5	20.5	3.2	5.9
Agricultural capital	NA[c]	NA[c]	1.2	2.0	–12.6	–21.9	6.5	11.8	2.4	3.4	17.1	29.9	3.9	8.5
Agricultural labor	NA[c]	NA[c]	0.1	–0	–3.8	–5.4	0	0	2.8	6.1	1.0	2.6	2.2	4.8
Total acreage	+0	–33.0	+0	–0	–10.6	–6.0	NA[c]	NA[c]	+0	–0	NA[c]	NA[c]	3.5	4.6
N fertilizer	0.8	3.9	0.1	0.7	–32.3	–46.1	–4.7	1.6	10.0	8.6	–7.3	–2.5	3.4	8.2
P_A/P_N	4.6	3.0	3.2	2.3	–36.1	–35.3	14.8	10.6	4.6	–0.7	25.2	15.8	4.8	0.3
AG CSWP index Y70	15.1	12.3	12.0	9.0	9.4	6.1	13.1	10.1	11.5	8.8	22.3	15.7	7.4	5.7
Crop price index	NA[c]	NA[c]	2.3	1.9	–41.7	–42.1	7.5	4.7	5.5	1.0	7.4	6.1	3.9	1.1
Food price index	NA[c]	NA[c]	1.8	1.4	–18.8	–19.2	12.9	10.4	2.1	–0.4	10.6	9.1	3.0	0.9
Terms of trade	11.1	14.6	–16.5	–8.6	–9.3	–9.7	8.2	4.3	5.1	1.4	24.2	16.6	–10.0	–7.8
Terms of trade R	8.6	13.9	–16.7	–8.6	–9.0	–7.6	4.8	2.3	1.0	–2.6	23.6	15.8	–10.2	–8.7
AG SSR	0.5	0.6	0.1	0.3	–7.9	–8.7	–1.8	2.6	3.6	4.7	7.2	10.9	2.8	5.9
AG SCR	0.2	0.4	0.1	0.3	–9.8	–12.6	0.7	–0	2.3	2.4	–2.4	–0.6	2.7	5.2
Parity	2.5	1.3	3.4	2.7	–37.3	–35.2	17.6	15.7	3.1	–3.4	36.6	28.5	3.8	–0.9
Equivalent income	–0.5	–0.2	–2.6	–1.5	1.1	1.1	NA[c]	NA[c]	–0.9	–1.9	NA[c]	NA[c]	+0	1.5
Calories/capita	–0.7	–0.9	–0.1	+0	4.2	3.8	1.9	1.8	–0.8	–0.5	0.4	0.5	–0.5	0.4
Protein/capita	–0.8	–1.0	–0.2	–0.1	3.6	3.7	2.3	2.1	–1.4	–0.9	0.4	0.5	–0.9	–0.4
Number hungry	3.1	5.6	1.0	0	–	–	–8.1	–8.8	12.4	8.8	–	–	4.0	–47.4
Life expectancy	–0.2	–0.2	–0.1	+0	0.9	0.8	0.5	0.5	–0.6	–0.9	0.1	0.1	–0.5	–0.5

[a]The first figure given for each country is for 1990, the second for 2000. [b]See footnote b to first part of table. [c]NA, not available.

Table 5.2. (Cont.)[a]

Indicator[b]	*Pakistan*		*Thailand*		*Turkey*		*USA*		*CMEA*		*EC*	
GDP70	0.3	–0.1	0.1	0.1	–0.1	–0.3	+0	0.1	–0.1	–0.4	0.1	0.2
GDPA70	2.0	3.2	1.6	2.7	3.1	5.7	1.4	1.8	–0.2	–0.4	-3.0	–7.1
GDPNA70	–0.3	–1.2	–0.2	–0.3	–0.6	–1.2	+0	0.1	–0.1	–0.4	0.2	0.4
AG HCons at P70	-1.8	–0.5	–0.9	–0.6	–0.5	–0.1	0.5	3.0	0.1	0.8	2.0	1.4
NAG HCons at P70	4.5	2.6	2.0	1.7	0.3	–0.1	0.4	1.1	+0	–0.1	0.1	0.2
Trade deficit 70	-2.4	–0.1	-3.2	–0.6	-2.4	0.2	2.9	2.3	0	0	3.5	3.0
AG trade deficit 70	–118.0	–147.2	14.5	23.2	13.6	29.0	4.6	1.9	6.9	27.3	42.7	46.8
Trade/GDP at WP	7.4	8.0	16.2	22.8	11.6	21.5	24.9	23.5	16.3	34.0	17.7	24.0
GDPA at WP70	2.8	3.9	4.0	5.8	1.0	4.0	2.0	2.6	–0.4	–2.2	–3.0	–7.3
Investment	1.8	0.2	2.6	1.2	1.3	–0.1	NA[c]	NA[c]	–0.4	–0.9	–0.2	–0
Total capital	0.5	0.5	0.7	1.0	0.8	0.5	NA[c]	NA[c]	–0.1	–0.3	–0.1	–0.1
AG vol. index WP70	3.3	4.1	2.9	4.4	2.1	4.2	1.7	1.8	–0.1	–0.3	–4.4	–8.4
Net calories produced	8.6	8.1	9.1	10.2	4.3	7.1	5.6	9.3	–0.4	–2.6	–15.5	–11.0
Agricultural capital	2.1	3.4	4.2	7.3	4.7	6.6	NA[c]	NA[c]	0.1	0.3	–1.8	–5.4
Agricultural labor	1.1	2.4	0	0	0.9	2.7	NA[c]	NA[c]	0	0	–5.8	–11.7
Total acreage	0.4	0.6	NA[c]	NA[c]	1.7	1.3	2.9	2.5	NA[c]	NA[c]	–1.8	–2.2
N fertilizer	13.2	7.8	4.0	5.9	1.7	4.2	NA[c]	NA[c]	4.0	6.0	–16.5	–16.9
P_A/P_N	4.9	0.6	12.1	7.7	7.3	1.4	2.8	–2.0	0	0	–10.5	–8.8
AG CSWP index Y70	16.8	13.7	13.1	9.1	10.1	8.3	14.5	11.5	13.1	11.1	14.8	12.2
Crop price index	4.2	1.5	13.7	10.1	6.6	3.9	0	0	NA[c]	NA[c]	–13.2	–14.6
Food price index	3.0	0.6	5.2	2.9	3.2	1.3	0.3	–3.2	NA[c]	NA[c]	–4.2	–3.7
Terms of trade	11.3	12.0	8.7	6.7	9.5	5.7	3.5	1.7	–8.2	–5.2	–9.1	–8.4
Terms of trade R	11.8	12.0	7.2	5.8	7.9	5.1	7.8	11.4	–8.1	–5.3	–4.7	–3.6
AG SSR	5.2	4.8	4.0	5.4	0.9	3.2	1.3	0.5	–0.3	–1.3	–6.0	–8.6
AG SCR	2.0	2.2	–0	–0	0.2	0.7	–1.8	–2.4	–0.3	–1.3	–2.0	–4.9
Parity	5.0	0.6	14.1	10.8	9.6	4.3	2.8	–2.0	NA[c]	NA[c]	–7.7	–4.0
Equivalent income	1.3	1.0	NA[c]	NA[c]	0.1	–0.1	NA[c]	NA[c]	NA[c]	NA[c]	0.3	0.3
Calories/capita	–1.9	–0.6	0.2	–0.1	–0.2	–0.1	NA[c]	NA[c]	+0	0.2	0.8	0.8
Protein/capita	–1.9	–0.6	+0	–0.2	–0.2	–0	NA[c]	NA[c]	+0	0.3	1.2	0.8
Number hungry	18.8	8.1	–1.3	1.0	4.6	1.7	–	–	–	–	–	–
Life expectancy	–0.8	–0.6	+0	–0	–0.2	–0.3	–0.2	–0.1	NA[c]	NA[c]	0.3	0.3

[a]The first figure given for each country is for 1990, the second for 2000. [b]See footnote b to first part of table. [c]NA, not available.

Table 5.3. Percentage changes in relative price of agriculture, investment and GDP in OECD countries in 2000 under OECD trade liberalization relative to the reference scenario.

Country	P_A^W/P_N^W [a]	P_A/P_N	*RIE*[b]	*RI*[c]	*TC*[d]	*GDP70*
High protection						
Japan	6	-35	0.01	-0.4	-0.6	0.3
EC	12	-9	-0.01	-0	-0.1	0.2
Austria	13	7	0.01	0.3	0.3	-0
Low protection						
USA	12	-2	–	–	–	0.1
Australia	13	14	0.05	1.2	0.9	0.3
Canada	12	15	0.00	0.4	0.1	-0.1
New Zealand	16	16	–	5.6	4.5	1.6

[a]World prices weighted by country's production. [b]RIE, real investment elasticity with respect to P_A/P_N, calculated around reference run values as described in Chapter 3 and given in *Table 3.4*. [c]RI, real investment. [d]TC, total capital.

associated with a similarly large expansion in output, backed up by higher investments and more labor input (see *Table 5.4*).

As developing countries do not change their protection policies in the OECD free trade scenario, the higher world market prices influence their domestic markets as determined by the price transmission mechanisms and the production structure. Hence, there is a great variation in the resulting domestic price increase, from a few percentage points in most cases to around 10% in some cases, such as for Argentina and Kenya.

5.4. Changes in Production and Trade in the World under OECD Trade Liberalization

Associated with the higher world market prices under trade liberalization is an expansion of world agricultural production and trade.

5.4.1. Production increases only modestly at the global level

Though production increases in all agricultural commodities except nonfood agriculture, the changes are rather modest (see *Table 5.5*). The largest increase, in bovine and ovine meats, is only 3.3% in the year 2000. These small changes in production, in spite of sizable changes in world prices, reflect the fact that demands for human consumption, particularly in the OECD countries, where the major price changes take place, are not very price elastic. The income changes between the reference scenario and the OECD trade liberalization scenario are

Table 5.4. Percentage changes in sectoral GDPs and factor use in 2000 under OECD trade liberalization relative to the reference scenario.

Countries	P_A/P_N[a]	*GDPA70*[b]	*GDPNA70*[c]	L_{ag}[d]	C_{ag}[e]	*TA*[f]	*TC*[g]
Positively protected developed countries:							
Japan	−35	−5	0.4	−5	−22	−6.0	−0.6
EC	−9	−7	0.4	−12	−5	−2.2	−0.1
USA	−2	2	0.1	–	–	2.5	–
Negatively protected developed countries:							
New Zealand	16	14	−0	3	30	–	4.5
Canada	15	17	−0.5	20	21	2.4	0.1
Australia	14	3	0.1	4	14	−0	0.9
Austria	7	1	−0.1	2	2	−0	0.3
Developing countries:							
Argentina	12	14	−1.4	15	20	1.4	1.5
Kenya	11	5	0.6	–	12	–	3.8
Brazil	8	1	−0.3	1	10	4.4	0.1
Thailand	8	3	−0.3	–	7	–	1.0
Egypt	5	2	−1.6	2	6	3.2	0.1
Turkey	1	6	−1.2	3	7	1.3	0.5
Pakistan	1	3	−1.2	2	3	0.6	0.5
Indonesia	2	0	−0	0	2	−0	0.5
India	3	0	0.1	0	–	0	–
Nigeria	0	7	0.1	5	8	4.6	2.2
Mexico	−1	4	−2.4	6	3	−0	−1.0

[a]Relative prices of agriculture. [b]Agricultural value added (at 1970 prices). [c]Nonagricultural value added (at 1970 prices). [d]Agricultural labor input. [e]Agricultural capital stock. [f]Total acreage. [g]Total capital.

small: demand shifts in a comparable way in the two scenarios. Thus changes in demands between the two scenarios are small, and so are the corresponding increases in production at the global level.

The production changes in the OECD countries, however, are substantial, particularly for the highly protected countries (see *Table 5.6*). The OECD countries with low levels of protection and the developing countries increase their productions to fill the gap created by the reduction in production by the highly protected OECD countries. In terms of agricultural GDP, the OECD countries with low protection gain more than twice as much as the developing countries do. The changes in production levels entail changes in agricultural GDPs, which imply changes in farm incomes as well.

Thus, what this scenario shows is that protection provided to farmers in OECD countries depresses agricultural production and agricultural incomes in developing countries and OECD countries with low levels of protection. The support provided to farmers in the highly protected OECD countries is at the

Table 5.5. Percentage changes in global trade, production, and human consumption under OECD trade liberalization relative to the reference scenario in 1990 and 2000.

	Production		*Trade*		*Consumption*	
Commodity	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
Wheat	1.1	0.5	-3.0	-1.5	-0.6	-0.8
Rice	1.2	1.2	42.8	37.4	-0.1	0.0
Coarse grains	0.7	1.7	-6.5	-4.5	-0.4	-0.4
Bovine and ovine	0.9	3.3	33.0	34.9	1.0	3.5
Dairy	0.8	1.9	19.9	12.5	0.9	1.0
Other animal products	0.4	0.8	6.2	16.8	0.3	0.7
Protein feed	2.5	2.0	5.1	5.0	-0.1	-0.2
Other food	0.3	0.2	4.2	10.1	0.4	0.3
Nonfood agriculture	0.2	-1.5	5.0	5.1	0.6	1.4
Nonagriculture	0.0	-0.0	15.4	17.0	0.2	0.4

cost of farmers in other OECD countries as well as those in the developing countries. Of course, as will be seen later, the consumers in food-importing developing countries are better off as a result of this protection.

5.4.2. Trade increases substantially

The modest increases at the global level in production, however, are associated with much larger increases in trade levels. This is as one would expect, since liberalization should increase specialization by countries exploiting their comparative advantage, leading to larger trade. As the major OECD countries remove protection, leading in general to lower domestic prices, domestic demand increases and domestic supplies fall, with imports increasing to fill the gap. Of course, the higher world market prices for agricultural products reduce imports by developing country importers as their demand falls and domestic production increases to the extent that world market prices are transmitted to consumers and producers in such developing countries. The sum total of the outcome is the expansion of world production and trade for most commodities, as is seen in *Table 5.5* and *Figure 5.1*. Trade expands in all commodities except wheat and coarse grains. The most striking percentage increase in trade occurs in rice. Global rice exports rise by 37% in 2000, mainly, as was pointed out in the previous section, as a result of increased imports by Japan. Since in this model different varieties of rice are not distinguished, an implicit assumption is made that either other countries will supply the type of rice Japanese like to eat (Japonica) or that the Japanese consumers will develop tastes for other types of rice. The world trade in animal products also increases by 12–35% in 2000.

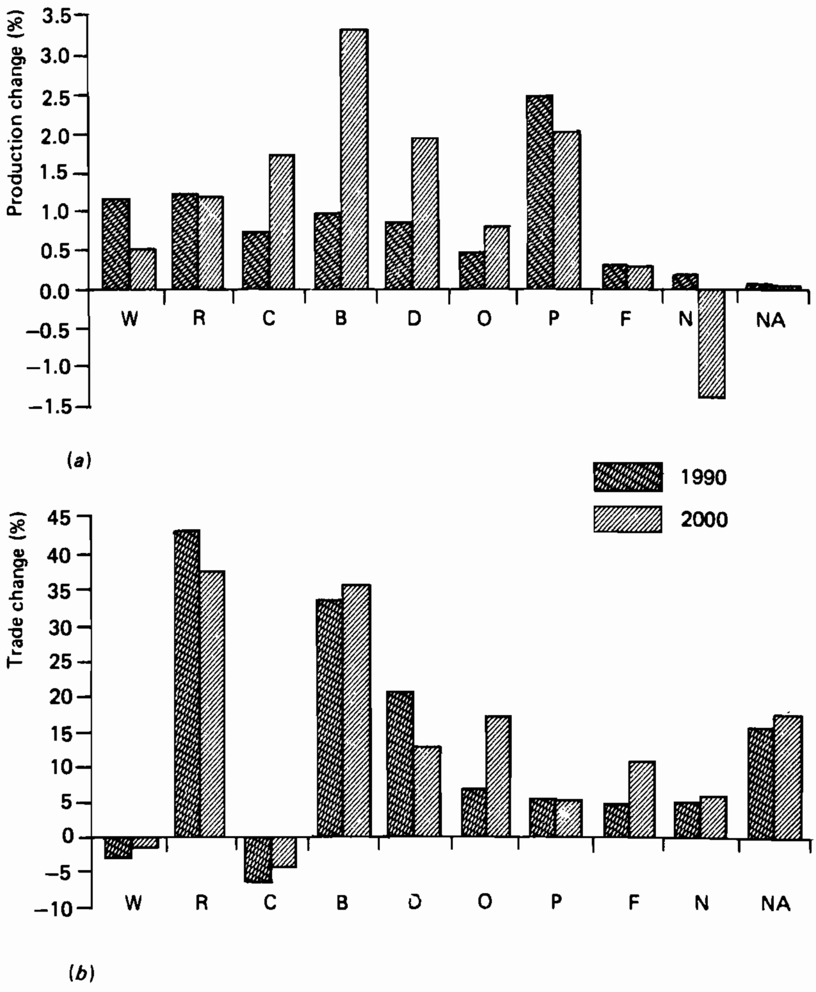


Figure 5.1. Percentage changes in (*a*) global production and (*b*) global trade under OECD trade liberalization relative to the reference scenario: W, wheat; R, rice; C, coarse grain; B, bovine and ovine meat; D, dairy; O, other animals; P, protein food; F, other food; NA, nonagriculture.

Table 5.6. Production changes in country groups in 2000 under OECD trade liberalization.

Commodity	Low-protected OECD: Reference scenario[a]	Low-protected OECD: Change under trade liberalization (%)	High-protected OECD: Reference scenario[a]	High-protected OECD: Change under trade liberalization (%)	Developing countries: Reference scenario[a]	Developing countries: Change under trade liberalization (%)
Wheat	85	7.7	66	–21.6	222	4.4
Rice	9	4.5	15	–31.8	335	2.6
Coarse grains	410	1.3	154	2.3	335	1.2
Bovine and ovine	20	6.3	16	–4.3	36	4.2
Dairy	105	5.1	171	–2.8	192	0.9
Other animal products	7.7	1.8	5.9	2.7	13.4	–0.1
Protein feed	28.7	2.8	3.6	–5.3	25.4	3.0
Other food	20	2.0	38	–6.7	249	1.8
Nonfood agriculture	5	0.3	3	–8.1	23	0.6
Nonagriculture	4634	0.1	3589	0.3	2238	–0.2
Agricultural GDP at 1970 prices	50	3.9	90	–4.6	260	1.5

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.

Table 5.7. Bovine and ovine meat under OECD trade liberalization (year 2000).

Country	R0, % share in global: Production	R0, % share in global: Export	R0, % share in global: Import	Tariff equiv.	% change in F-OECD over R0: Production	% change in F-OECD over R0: Demand	% change in F-OECD over R0: Trade	% change in F-OECD over R0: Retail prices	% change in F-OECD over R0: Producer prices
Australia	3.9	8.3	–	–10	9.8	–1.4	75	31	32
Canada	2.3	5.9	–	6	15.8	–4.5	108	11	12
Japan	0.9	–	5.7	56	–10.3	5.3	40	–26	–26
New Zealand	2.0	19.3	–	0	14.9	0.4	25	9	16
USA	15.1	–	22.4	25	2.7	13.1	114	–12	–11
EC	12.0	–	17.1	12	–7.6	0.3	79	1	2
World	100.0	100.0	100.0	–	3.3	3.4	35	–	–
Developing	41.9	52.0	54.7	–	4.2	–2.0	–	–	–
CMEA	15.0	0.4	–	–	5.9	5.9	0	–	–

5.4.3. Increased demands push up bovine and ovine meat trade; the USA produces more even when the producer price falls

The removal of protection from bovine and ovine meats by Japan, the USA, the EC, and other developed countries significantly lowers domestic retail prices for the consumers in these countries, who then demand more meat (see *Table 5.7*). This leads to higher imports by these countries, higher prices on the world market, and larger production by other countries. In the USA, in spite of the lower producer price, the production of bovine and ovine meat does go up compared to the reference scenario even though the US import quota on bovine and ovine meat is removed. This is the outcome of the fact that the producer price of dairy products falls even more and the comparative profitability of bovine and ovine meat increases even when its price falls. Since, in the USA, the dairy price falls by 27.5% and the bovine and ovine meat price falls only by 10.8% (see *Table 5.8*), a 2.7% increase in production of bovine and ovine meat occurs while dairy production falls.

5.4.4. Wheat and coarse grain trade decline as domestic feed use increases

Since wheat and coarse grain prices increase under OECD trade liberalization, the developing countries produce more and import less of these grains. Moreover, since bovine and ovine meat and dairy prices increase much more than the prices of wheat and coarse grain, they also increase their production of bovine and ovine meat and dairy products and reduce their imports.

The impact on the production and trade structures in the OECD countries of changes in relative prices differs from country to country depending on their former protection levels. Yet the general pattern is that (see *Tables 5.2, 5.7,* and *5.8*) the USA increases its specialization in producing and exporting more grains whereas the other major low-protected grain producers, Australia and Canada, reduce theirs. Moreover, Australia and Canada also increase their production of bovine and ovine meat and dairy products using more of their grains domestically for feeding. The high-protected EC and Japan reduce their total grain production, as well as their bovine and ovine meat and dairy production, importing more (exporting less) of the latter. The USA also increases its imports of bovine and ovine meat and reduces its exports of dairy products. Thus, the shift into meat production of major grain exporters, like Australia and Canada, and the reduction of both grain and meat production in the EC, reduces the net trade of wheat and coarse grains under OECD trade liberalization.

Table 5.8. The USA: Changes in production and trade in 2000 under OECD trade liberalization.

	Reference scenario (R0)[a]			*% change in F-OECD over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Export*[b]	*Feed*	*Retail prices*	*Producer prices*[c]
Wheat	103.5	64.8	13.0	11.4	-3.3	18.6	-9.5	18.4	18.7
Rice	8.2	6.2	–	4.7	0.1	6.3	–	20.8	20.9
Coarse grains	352.5	128.3	177.9	4.6	-0.8	12.1	-1.4	6.5	11.6
Bovine and ovine	12.9	-1.3	–	2.7	13.1	113.8	–	-12.4	-10.8
Dairy	76.7	9.1	1.1	-12.1	10.0	-176.7	-12.1	-28.0	-27.5
Other animal products	2.6	0.0	–	-0.1	-3.5	784.3	–	4.6	4.9
Protein feed	26.9	16.2	9.9	1.8	-0.4	3.2	-0.6	12.8	12.8
Other food	15.8	3.0	–	0.7	-0.7	6.6	–	-0.7	-0.4
Nonfood agriculture	3.0	0.0	–	-8.8	-8.4	-153.0	–	-16.7	-21.4
Nonagriculture	4292.6	-7.9	–	0.1	0.1	10.3	–	-2.9	-2.9

[a] In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagricultural commodities, which are 10^9 US$ 1970. [b] A negative change of more than 100% implies change in direction of trade; see also footnote a to *Table 5.11*. [c] Relative to nonagricultural price, except for price of nonagriculture, which is relative to its 1970 price.

Table 5.9. Shifts in trade patterns with OECD trade liberalization (figures show net exports).

		Low-protected OECD[a]			*High-protected OECD*			*Developing countries*[b]		
Commodity	*Unit*	*R0, 1980*	*R0, 2000*	*F-OECD, 2000*	*R0, 1980*	*R0, 2000*	*F-OECD, 2000*	*R0, 1980*	*R0, 2000*	*F-OECD, 2000*
Wheat	10^6 t	61.2	106.0	116.9	2.4	3.4	-14.2	-35.6	-76.5	-65.4
Rice	10^6 t	2.9	6.3	6.7	-2.1	-3.0	-12.6	-1.9	-4.6	4.5
Coarse grains	10^6 t	69.1	155.8	153.1	-26.1	-73.5	-69.4	-7.0	-63.8	-62.5
Bovine and ovine	10^6 t	0.2	0.7	0.2	-0.9	-1.2	-2.5	-0.3	-0.2	1.6
Dairy	10^6 t	4.6	16.2	14.0	8.8	9.0	5.0	-12.7	-23.5	-18.2
Other animal products	10^6 t	0.4	0.3	0.4	0.2	0.6	0.4	0.0	-0.2	-0.2
Protein feed	10^6 t	11.2	16.1	17.0	-9.2	-13.8	-15.2	4.6	4.6	5.3
Other food	10^9 US$ 1970	2.1	3.1	3.6	-5.5	-7.6	-11.2	11.4	15.9	19.9
Nonfood agriculture	10^9 US$ 1970	1.1	1.4	1.7	-3.9	-4.2	-4.6	1.8	2.8	2.9
Nonagriculture	10^9 US$ 1970	-13.8	-14.2	-18.1	-5.2	29.2	38.3	0.6	-33.1	-40.1
Agric. trade balance	10^9 US$ 1970	13.2	21.8	23.1	-9.1	-13.2	-19.9	7.4	5.9	16.1

[a] Includes Australia, Canada, New Zealand, and the USA. [b] Includes China.

5.4.5. Shifts in trade pattern

The most significant shift in the world trade pattern is that the highly protected OECD countries under trade liberalization reduce agricultural exports and increase their agricultural imports (see *Table 5.9*).

One would expect that the OECD countries with low protection would export a large part of the additional production stimulated by the higher prices under trade liberalization. However, this is the case only for wheat and protein feed. For bovine and ovine meat, as well as dairy products, exports even fall. The reason is that for these products the USA has a high protection (although its general protection level is low). When trade is liberalized, the lower beef and milk prices stimulate consumption in this country by more than 10%. Because of the large volumes involved, this more than offsets the fall in demand in other low-protected OECD countries.

The developing countries are thus able to export more of their traditional agricultural products – rice and other food – at higher prices. The LDCs also reduce their imports of wheat, coarse grain, and dairy products, and turn rice imports into exports; as a result, their agricultural trade surpluses in 2000 are nearly trebled compared to the reference scenario.

The increased volume of agricultural trade also results in increased trade of nonagriculture. In particular the developing countries as a group are able to expand significantly (by 21%) their imports of nonagriculture under OECD trade liberalization.

5.4.6. Trade patterns at country levels change significantly

The changes in trade patterns look even more dramatic when one looks at individual country shares in the trade of various commodities. *Figures 5.2–5.10* show these. *Table 5.10* depicts the trade patterns in 1980 and 2000, while percentage changes in 2000 relative to the reference scenario for different countries are given in *Table 5.11*.

When compared with percentage changes in global trade, the data in *Table 5.11* show which countries improve their market share as a result of trade liberalization by the OECD. From the point of view of balance of payments of a country, absolute levels of trade rather than market shares are important. Nonetheless, in international negotiations for trade liberalization, countries do emphasize market shares, and this may be worth a brief discussion here.

The USA increases its exports of crops – wheat, rice, coarse grains, protein feeds, other foods, and nonfood agriculture – as well as of other meats. In wheat and coarse grains, it improves its share in the world market and becomes even more dominant. Its imports of bovine meats increase and it reverses its trade direction for dairy products and nonfood agriculture compared to the reference scenario.

Table 5.10. Agricultural trade patterns in base year 1980 and under OECD trade liberalization scenario in 2000 (figures show net exports).[a]

Country	*Year*	*Wheat* (10^6 t)	*Rice* (10^6 t)	*Coarse grains* (10^6 t)	*Bovine & ovine* (10^6 t)	*Dairy* (10^6 t)	*Other animal products* (10^6 t)	*Protein feed* (10^6 t)	*Other food* (10^9 US$ 1970)	*Nonfood* (10^9 US$ 1970)
USA	1980	40.1	2.7	61.8	–1.2	–1.0	0.25	11.4	2.0	+0
	2000	76.9	6.6	143.8	–2.9	–7.0	0.10	16.7	3.1	–0
Canada	1980	12.6	–0.1	4.8	+0	+0	0.14	–0.2	–0.3	0.1
	2000	23.4	–0.1	3.1	0.7	9.6	0.32	–0.1	–0.1	0.2
Australia	1980	8.5	0.2	1.9	0.7	1.6	0.03	0.1	0.3	0.6
	2000	16.7	0.2	5.8	0.9	4.6	–0	0.2	0.6	0.9
New Zealand	1980	0.1	–0	0.6	0.7	3.9	0.01	+0	+0	0.3
	2000	–0.1	–0	0.4	1.4	6.8	+0	0.1	–0.1	0.5
Austria	1980	+0	–0	0.3	+0	0.4	–0.01	–0.1	–0.1	–0.1
	2000	0.1	–0	–0.4	+0	2.4	–0.01	–0.2	–0.1	–0
EC	1980	11.2	–0.3	–2.3	–0.4	10.0	0.05	–5.0	–4.2	–2.1
	2000	0.4	–0.4	–7.6	–1.8	3.4	–0.21	–5.6	–9.0	–2.3
Japan	1980	–5.9	–0.4	–17.4	–0.3	–1.1	0.06	–2.3	–1.6	–1.2
	2000	–9.6	–9.9	–41.5	–0.5	–0.9	0.59	–5.9	–3.0	–1.5
CMEA	1980	–19.7	–0.7	–13.0	–0	0.6	–0	–0.8	–0.3	–1.2
	2000	–23.0	–0.4	–12.9	+0	0.8	0.01	–0.1	–2.7	–2.0
China	1980	–7.3	1.8	–1.7	0.1	–0.6	0.10	0.4	1.2	–0
	2000	–13.7	1.0	–1.8	–0	0.4	–0.05	–0.1	2.1	+0

Table 5.10. (Cont.)

Country	*Year*	*Wheat* (10^6 t)	*Rice* (10^6 t)	*Coarse grains* (10^6 t)	*Bovine & ovine* (10^6 t)	*Dairy* (10^6 t)	*Other animal products* (10^6 t)	*Protein feed* (10^6 t)	*Other food* (10^9 US$ 1970)	*Nonfood* (10^9 US$ 1970)
Argentina	1980	4.3	+0	9.3	0.5	+0	–0.01	0.2	0.1	0.3
	2000	6.2	0.1	7.6	2.7	1.2	0.06	0.3	1.1	0.6
Brazil	1980	–3.0	0.4	–0	0.1	–0.6	–0.09	2.8	1.6	0.3
	2000	–6.7	–0.4	–7.9	–0.7	–1.3	–0.22	5.3	1.5	0.3
Mexico	1980	–0.4	–0	1.2	–0	–0.3	0.03	–0.1	0.3	0.1
	2000	–1.3	–0	–4.0	–0	0.7	0.23	–0.7	0.8	0.1
Egypt	1980	–2.7	0.2	–0	–0.2	–0.5	0.01	+0	0.2	+0
	2000	–4.6	+0	–2.6	–0.3	–1.5	0.03	–0	0.6	0.2
Kenya	1980	–0.1	+0	–0.3	–0	–0.1	–0	–0	0.2	0.1
	2000	–0.3	+0	–2.1	0.1	0.2	–0	+0	0.7	0.2
Nigeria	1980	–1.0	–0.2	–0.6	–0.2	–0.6	–0.08	+0	–0.2	–0
	2000	–9.9	–1.9	–1.3	–0.4	–3.5	–0.33	+0	0.1	–0.1
India	1980	0.1	–0.4	–3.8	+0	–0.1	+0	0.6	1.2	0.1
	2000	7.5	4.3	–8.0	–0.1	0.1	–0.04	0.8	–0.5	0.2
Indonesia	1980	–0.6	–0.8	–0.3	–0.1	–0.2	0.02	0.1	0.3	+0
	2000	–1.5	–2.2	–1.2	–0	–0.4	–0.04	–0.1	–0.7	–0.1
Pakistan	1980	0.9	0.4	0.1	–0	–1.5	0.01	+0	–0.2	–0.1
	2000	6.0	1.0	0.9	–0	–4.1	0.01	0.1	–0.1	–0.2
Thailand	1980	–0.1	0.4	2.2	–0	–0.3	0.01	+0	1.2	0.1
	2000	–0.3	2.6	2.7	0.1	–0.4	0.01	+0	1.9	0.1
Turkey	1980	–1.2	–0	–0.4	–0	0.1	0.01	+0	0.5	0.3
	2000	–1.5	+0	–1.9	0.2	2.4	0.02	–0	1.5	0.5

[a] –0, a small negative number, +0 a small positive one.

Table 5.11. Percentage changes in agricultural trade patterns in 2000 under OECD trade liberalization relative to the reference scenario.[a]

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Non-food*
USA	19	6	12	114	-177	+[b]	3	7	–[b]
Canada	-9	-4	-79	108	+[b]	36	-82	-79	30
Australia	5	-2	-53	75	150	-110	45	-3	15
New Zealand	-30	1	111	25	27	-85	53	18	18
Austria	-38	-2	-199	-43	235	137	-5	28	19
EC	-98	89	-61	79	-60	-363	-12	26	13
Japan	2	1173	9	40	128	50	57	68	5
CMEA	20	1	7	0	+[b]	0	–[b]	84	-5
Argentina	-6	58	-41	75	507	112	10	90	30
Brazil	1	-58	-8	-28	-22	1	11	65	-11
Mexico	-41	-74	-30	-98	+[b]	3	-12	39	72
Egypt	-8	+[b]	3	-8	-1	5	-162	84	7
Kenya	-14	+[b]	2	116	+[b]	58	142	9	-5
Nigeria	-1	-2	-24	-12	2	0	195	-116	-8
India	22	10	-21	-14	+[b]	20	0	+[b]	-9
Indonesia	-2	0	-9	-28	-13	-3	-3	-4	21
Pakistan	86	-4	33	-69	-12	2	3	-57	3
Thailand	0	148	14	41	0	-50	-1	14	-16
Turkey	-43	294	15	39	28	5	–[b]	24	3
World	-2	37	-5	35	13	17	5	10	5

[a]In all similar tables the percentage change figures for trade should be interpreted with care. A negative percentage change implies reduction in net exports or imports. A negative percentage change that exceeds 100 shows a reversal of trade direction. A positive percentage change shows an increase in traded quantity.

[b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus is used to indicate an increase in net exports (increased export or decreased import), and a minus is used to indicate a decrease in net exports.

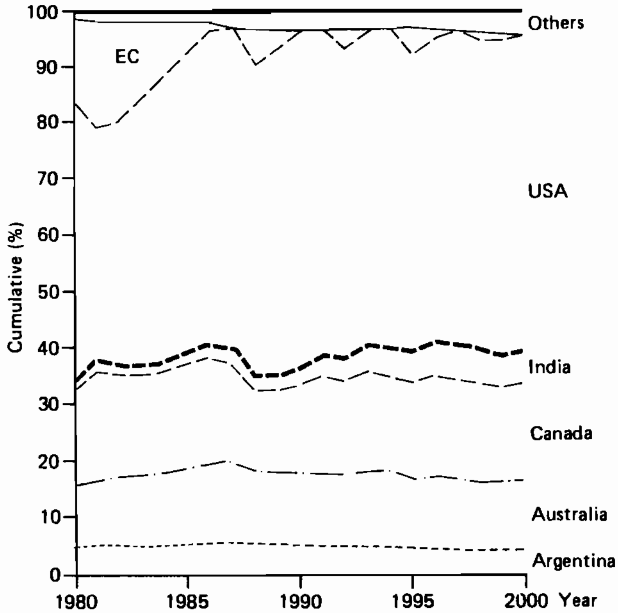


Figure 5.2. National shares in the global net exports of wheat under OECD trade liberalization.

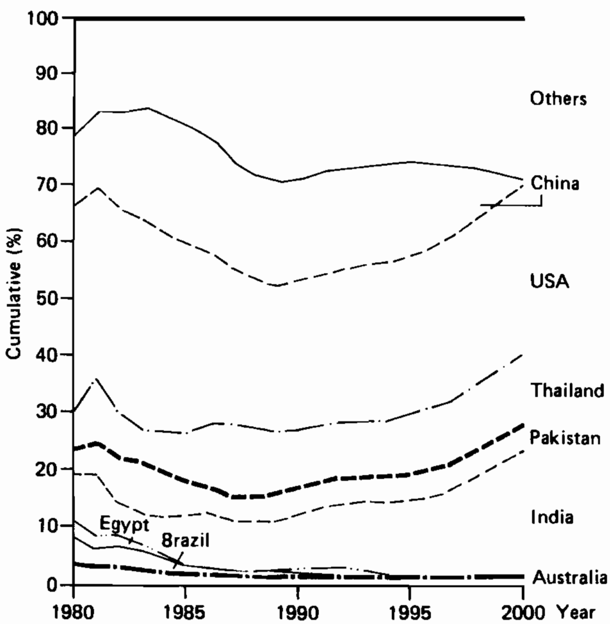


Figure 5.3. National shares in the global net exports of rice under OECD trade liberalization.

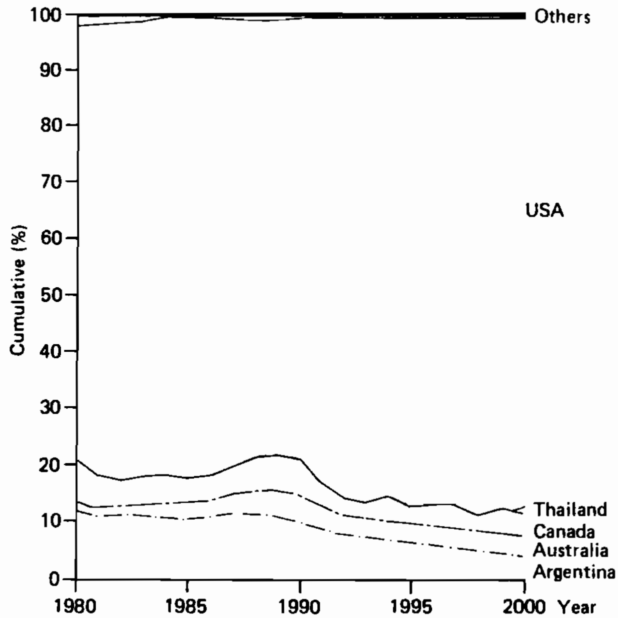


Figure 5.4. National shares in the global net exports of coarse grains under OECD trade liberalization.

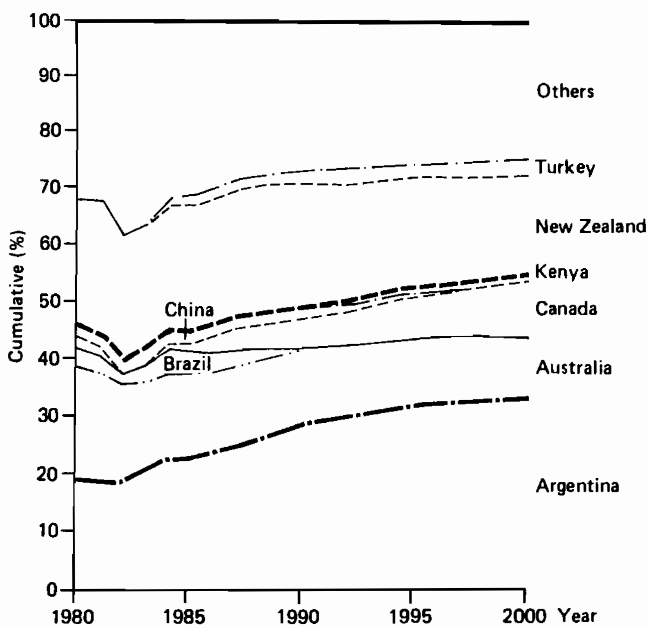


Figure 5.5. National shares in the global net exports of bovine and ovine meat under OECD trade liberalization.

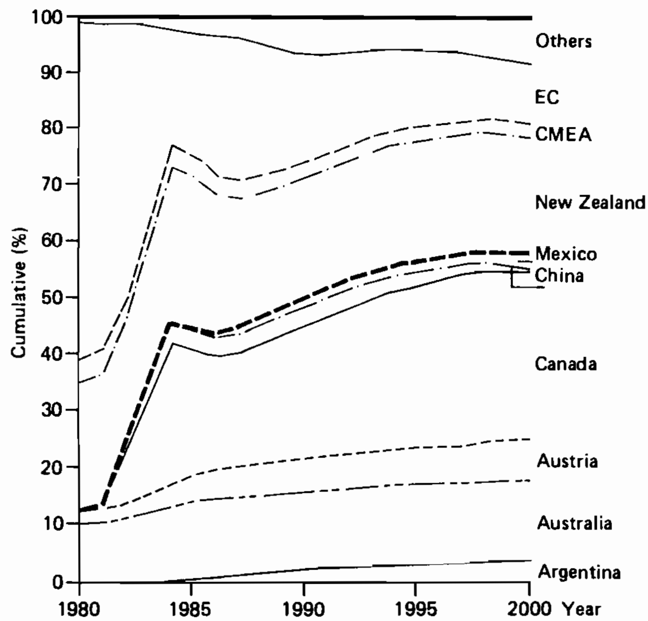


Figure 5.6. National shares in the global net exports of dairy products under OECD trade liberalization.

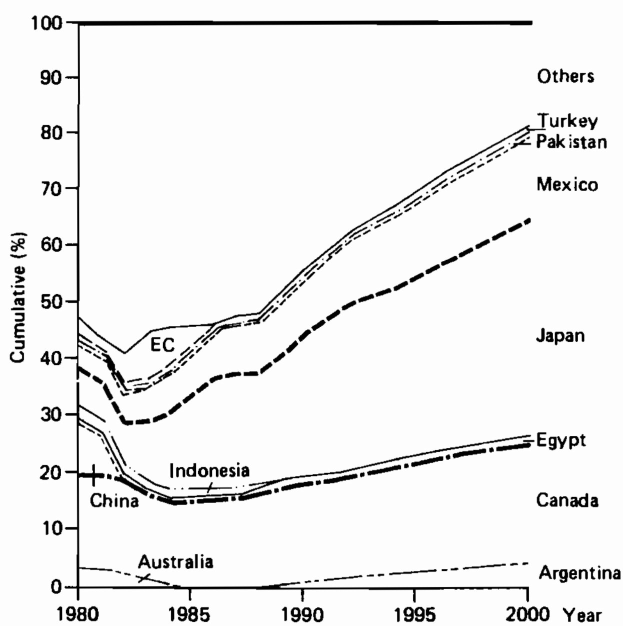


Figure 5.7. National shares in the global net exports of other animal products under OECD trade liberalization.

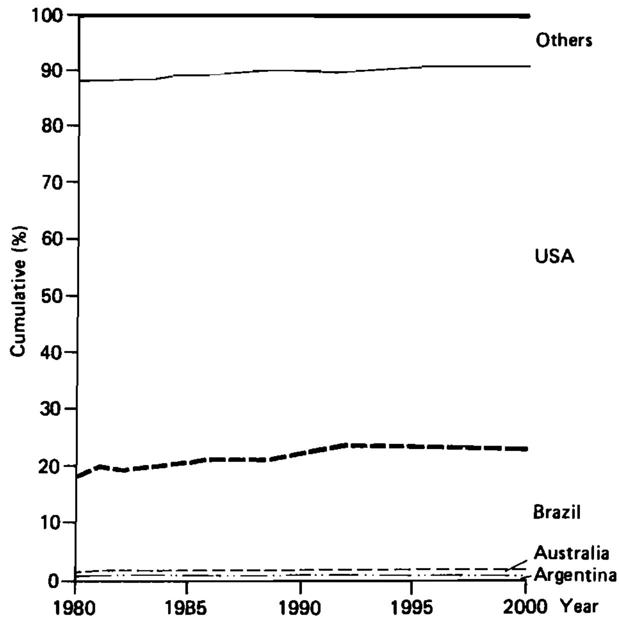


Figure 5.8. National shares in the global net exports of protein feed under OECD trade liberalization.

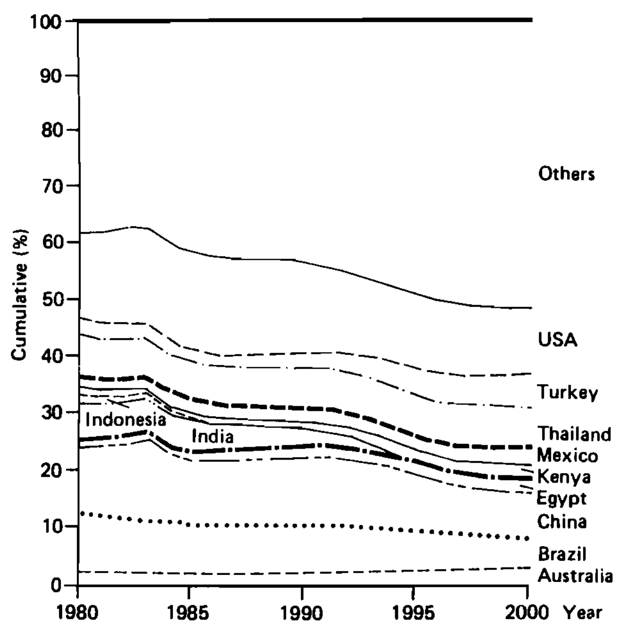


Figure 5.9. National shares in the global net exports of other food under OECD trade liberalization.

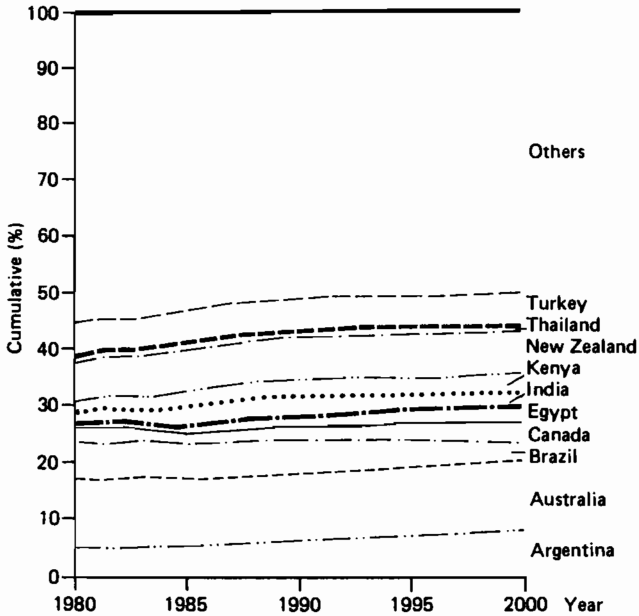


Figure 5.10. National shares in the global net exports of nonfood agriculture under OECD trade liberalization.

In general, the EC reduces its exports and increases its imports of agricultural commodities. The exceptions are protein feeds and ~~coarse grains~~ for which its imports are reduced as it reduces production of animal products. The EC loses market shares in all its exports.

Japan imports all agricultural commodities except other meats, of which it is a small exporter in the reference run for the year 2000. With OECD trade liberalization, it increases all its imports and also its lone agricultural export, other meats.

Canada reduces its exports of wheat and coarse grains and becomes a major exporter of dairy products, providing nearly 30% of global exports.

Both Australia and New Zealand improve their market shares in dairy products.

Even when the developing countries maintain the nature of their policy regimes as reflected in the price transmission equations, trade liberalization by OECD countries affects their trading patterns. Notable among these are expansion of wheat exports by India and Pakistan, and expansion of bovine and ovine meat exports by Argentina.

5.5. What Causes Changes in World Market Prices of Agricultural Commodities?

The movements of factors of production between agriculture and nonagriculture are mainly determined by the price of agriculture relative to nonagriculture. Given the availability of factors for agricultural production, the commodity pattern of production is determined by the relative profitabilities of different commodities, which in turn are determined by relative producer prices.

Changes in producer prices in different countries between the runs depend on the extent of protection that was provided to the producers in the reference run and on the changes in the world market prices. Together with the long-term supply responses to producer price changes, the changes in protection rates become important determinants of supply, quantity demanded, net trade, and consequently world market prices.

In these variables, one can look for explanations for the relatively high price increases for dairy products, bovine and ovine meats, and cereals.

5.5.1 Why does the dairy price rise?

The major producers and exporters of dairy products are the developed countries. Though India is a major producer, it is not an exporter. *Table 5.12* shows that the EC, the USA, and New Zealand ~~provide nearly 80% of the~~ exports of dairy products in the year 2000 in the reference scenario. When trade is liberalized, the US dairy producers receive a price that is lower by 27.5% compared to the reference scenario price, and consequently US milk production is reduced by 12%. A 28% fall in the consumer retail price of dairy products leads to a 10% increase in demand, and the USA turns into a major dairy importer from being a dairy exporter. The change of –177% in US exports shown in *Table 5.12* means that under OECD trade liberalization the USA imports 77% of what it exports in the reference scenario.

In the EC, under OECD trade liberalization, the (relative) producer prices for dairy products and bovine and ovine meat increase whereas all other agricultural prices go down. Yet production of dairy products and of bovine and ovine meat goes down in the EC by 6% and 8%, respectively, and dairy exports go down by 60%. This happens because the withdrawal of protection makes EC agriculture less profitable, and both labor and capital are withdrawn from agriculture. Thus, though dairy production attracts larger shares of capital and labor than in the reference run, these larger shares are from smaller total availabilities for the agricultural sector as a whole. This can be seen in *Table 5.13*.

Canada's reaction to dairy production under trade liberalization provides yet another example of the importance of looking at the development of the entire agriculture sector. Though the producer price for dairy products remains virtually unchanged, production increases by 108% (i.e., more than doubles)

Table 5.12. Dairy products: factors behind the price rise in 2000 under OECD trade liberalization.

	Reference scenario (R0), % share in global				*% change in F-OECD over R0*					
Country	*Production*	*Export*	*Import*	*Feed*	*Production*	*Demand*	*Export*[a]	*Feed*	*Retail prices*	*Producer prices*
Australia	1.6	6.4	0	1.3	28.7	2.5	150.3	9.0	18.4	42.8
Austria	0.6	2.4	0	0.9	34.0	–8.4	235.4	–34.4	21.4	51.6
Canada	1.5	0	0.1	1.0	107.8	4.4	+[c]	34.0	–0.0	–0.1
Japan	1.8	0	1.4	0.5	–0.5	3.7	127.9	5.7	–12.3	–20.7
New Zealand	1.3	18.4	0	1.3	18.5	3.9	27.1	10.4	17.9	30.7
USA	11.9	31.3	0	1.2	–12.1	10.0	–176.7	–12.1	–28.0	–27.5
EC	18.3	30.0	0	24.2	–6.2	–1.8	–60.4	–9.3	0.9	1.6
Argentina	1.0	0.7	0	0.2	15.6	0.7	506.8	20.1	2.7	6.5
Brazil	2.5	0	5.9	1.0	2.1	–0.2	–22.2	0.4	1.6	3.0
Egypt	0.4	0	5.4	0.6	0.2	–0.1	–0.8	2.4	1.1	1.5
India	9.0	0	3.2	0	–0.3	–1.9	+[c]	0	4.5	4.5
Indonesia	0.0	0	1.5	0.1	11.2	–6.7	–12.5	2.0	16.7	25.9
Kenya	0.3	0	0.1	0.0	15.1	4.6	+[c]	–4.8	20.0	30.7
Mexico	2.3	0.3	0	0.1	3.1	–1.3	+[c]	8.3	–0.4	–0.6
Nigeria	0.1	0	12.0	0.3	5.2	2.4	1.7	6.1	–1.7	–2.1
Pakistan	2.5	0	16.2	1.5	2.6	–0.6	–11.8	1.9	1.1	1.3
Thailand	0.0	0	1.5	0	16.6	0.2	–0.4	0	19.3	30.7
Turkey	1.6	6.5	0	0.9	5.7	1.0	27.6	2.1	5.4	8.3
World[b]	100.0	100.0	100.0	100.0	1.9	–0.0	12.5	9.1	NA[d]	NA[d]
Developing	29.9	0	81.1	12.1	0.9	–3.1	–22.4	1.1	NA[d]	NA[d]
CMEA	26.7	2.6	0	54.3	5.9	5.9	+[c]	20.4	0	0

[a]The percentage change figures for trade should be interpreted with care. A negative percentage change implies reduction in net exports or imports. A negative percentage change that exceeds 100 shows a reversal of trade direction. A positive percentage change shows increase in traded quantity. [b]The differences in percentage changes at world production and demand are due to stock change. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports. [d]NA, not available.

Table 5.13. Factor availability and allocation for dairy production in the EC in 2000.

Indicator	*Reference scenario (R0)*	*% change in F-OECD over R0*
GDP agriculture (10^6 1970 ECUs)[a]	45011	–7.15
P_A/P_N	1.12	-8.75
Agricultural capital (10^6 1970 ECUs)[a]	254380	–5.38
Total labor in agriculture (10^6)	5.7	–11.65
Total acreage (10^6 ha)	32.6	–2.19
Capital in livestock production/AGCAP[b]	0.83	1.96
Labor in livestock production/TLA[c]	0.77	4.40
Capital in livestock production (10^6 1970 ECUs)	210556	–3.26
Labor in livestock production (10^6)	4.4	–8.00

[a]ECU, European currency unit.
[b]AGCAP, total agricultural capital.
[c]TLA, total agricultural labor.

Table 5.14. Factor availability and allocation for dairy production in Canada in 2000.

Indicator	*Reference scenario (R0)*	*% change in F-OECD over R0*
GDP agriculture (10^6 1970 Can$)	5633	16.59
P_A/P_N	1.20	15.55
Agricultural capital (10^6 1970 Can$)	19938	21.24
Total labor in agriculture (10^6)	4.72	19.84
Total acreage (10^6 ha)	27.4	2.37
Capital in livestock production/AGCAP[a]	0.74	11.30
Labor in livestock production/TLA[b]	0.79	8.70
Capital in livestock production (10^6 1970 Can$)	14717	35.03
Labor in livestock production (10^6)	3.72	30.62

[a]AGCAP, total agricultural capital.
[b]TLA, total agricultural labor.

because of the removal of the production quota. Almost the entire additional output is exported and, from being a marginal importer of dairy products, Canada becomes a major exporter in the OECD trade liberalization scenario.

CANADA *

Agricultural trade liberalization increases agricultural prices in Canada by 16%; this makes agriculture relatively more profitable, and it draws in more resources of capital and labor. As seen in *Table 5.14*, in 2000, acreage is 2.5% bigger, agricultural capital 21% higher, and the agricultural labor force 20% larger than in the reference scenario. Agricultural GDP at constant prices is 17% larger. The price changes, however, differ from commodity to commodity, and the relative profitabilities of commodities change (see *Table 5.15*) leading to changes in factor allocations (see *Table 5.16*). Livestock operations get 30% more labor and 35% more capital, and large expansion in output takes place.

Table 5.15. Canada: Net revenue per hectare and per animal unit in the year 2000 under OECD trade liberalization compared to the reference scenario.

Commodity	*R0: absolute values*[a]	*F-OECD: % change over R0*
Wheat	0.09	11.9
Coarse grains	0.09	2.5
Protein feed	0.12	34.2
Other food	0.43	21.5
Nonfood crops	2.86	9.6
Fruits	0.48	23.0
Other animal products	2.95	19.0
Bovine and ovine	98.02	12.5
Milk animals	529.47	–0.2

[a] 10^3 × national currency per hectare for wheat, coarse grains, protein feed, other food, and nonfood crops; national currency per 1970 US$ for fruits; 10^3 × national currency per tonne of protein equivalent for other animal products; national currency per head for bovine and ovine and for milk animals.

Table 5.16. Canada: Percentage changes in factor allocation by groups of commodities in 2000 under OECD trade liberalization relative to the reference scenario.

Commodity group	*Capital use*	*Labor use*	*Fertilizer use*
Grains[a]	–55	–59	15
Other[b]	12	–2	34
Livestock[c]	35	30	–
Total	21	20	15

[a] Wheat + coarse grain.
[b] Protein feed + other food + nonfood crops + fruits.
[c] Bovine and ovine + dairy + other animal products.

5.5.2. Factors behind wheat price change

The reasons for the observed responses of world market prices of other products are somewhat obvious. Among the OECD countries, wheat is substantially protected mainly by the EC and Japan, their tariff equivalents in 2000 being more than 110% for the EC and more than 30% for Japan. In the year 2000 in the reference scenario, EC production is 10% of the total global output of wheat and its exports constitute 12.5% of the global exports. Japan is a negligible producer of wheat, but its imports of wheat amount to nearly 7% of global exports. Removal of protection reduces EC wheat production by 28% and its wheat exports fall by 98%, virtually eliminating them. Japan's imports of wheat change only marginally as in the end consumer prices fall only by 11% at the raw material level and 3% at the retail level. Wheat production increases mainly in the USA and Australia to fill the gap left by the EC but, of course, since these countries very moderately protect wheat, the additional output has to be stimulated through a higher price for wheat.

5.5.3. Rice price rise – mainly due to Japan

The price increase for rice is primarily due to Japan's removal of its very high (more than 250%) protection. Japan's rice production in the year 2000 in the reference scenario is 11 million tonnes (or 3%) out of a world production of 366 million tonnes. However, the world rice market is very thin, global exports in 2000 in the reference scenario being only 16 million tonnes. Under trade liberalization, Japan's production falls by nearly 40%, and its imports increase from less than a million tonnes in the reference run to nearly 10 million tonnes and constitute more than 42% of the global exports, which themselves increase by 37% because of the increase in Japan's imports. The removal of protection lowers the consumer price by 45%, increasing human consumption by 5%. The main increase in demand, however, comes from much larger use of rice for feeding purposes as the only agricultural commodity for which production in Japan goes up is other animal products (see *Table 5.17*).

5.5.4. Price of coarse grains: The EC's interesting response

The protection levels in OECD countries for coarse grains in the reference scenario are very similar to those for wheat. Yet the responses of countries to trade liberalization for coarse grains differ from those for wheat. Whereas only 25% of the global output of wheat is used for feeding, more than 60% of coarse grains output is so used. Thus, on the one hand, coarse grains provide greater opportunity for substitution by other feeds and, on the other, the development of the livestock sectors affects it much more than wheat. *Table 5.18* shows the changes in coarse grains production, trade, feed use, and prices in selected OECD countries and other country groups in 2000. The behavior of Australia, Japan, other developed countries, and developing countries shows, as expected, that production increases (decreases) in these countries when producer price rises (falls). Also, Canada's output of coarse grains decreases in spite of a small price increase because wheat receives a stronger price increase. Conversely, production of coarse grains in the EC *increases* by 8% under liberalization whereas the producer price for coarse grains *falls* by 22% because the price of wheat, the major competing crop, falls even more (see *Table 5.19*). This is also caused by the different responses of the yields of these two commodities to a price change. The revenue of wheat falls relative to that of coarse grains much more than does the price of wheat relative to the price of coarse grains.

Similarly, the CMEA countries increase their imports even when world market prices of coarse grains increase. In fact, the CMEA increases most of its

Table 5.17. Japan: Changes in production and trade in 2000 under OECD liberalization relative to the reference scenario.

	Reference scenario (R0)[a]			*F-OECD: % change over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Trade*	*Feed*	*Retail prices*	*Producer prices*
Wheat	0.6	–9.4	4.0	–11.3	0.5	1.9	1.1	–3.1	–11.8
Rice	11.0	–0.8	3.0	–38.8	41.3	1172.7	146.0	–45.1	–66.3
Coarse grains	0.9	–38.0	35.4	–15.2	8.3	9.1	8.7	–22.0	–22.9
Bovine and ovine	0.8	–0.3	–	–10.3	5.3	39.8	–	–26.1	–25.6
Dairy	11.7	–0.4	0.4	–0.5	3.7	127.9	5.7	–12.3	–20.7
Other animal products	2.8	0.4	–	13.7	7.8	49.6	–	–21.1	–20.9
Protein feed	1.2	–3.7	3.7	–7.5	40.7	56.9	54.9	–45.2	–45.2
Other food	6.8	–1.8	0.3	–10.4	6.0	67.7	20.2	–8.5	–22.8
Nonfood agriculture	0.7	–1.4	–	–8.4	0.4	4.9	–	–43.7	–43.7
Nonagriculture	996.7	9.6	–	0.4	0.1	32.8	–	–2.9	–2.9

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.

Table 5.18. Coarse grains production and trade in 2000 under OECD trade liberalization: Major influences.

	Reference scenario (R0), % share in global				*F-OECD: % change over R0*						
Country	*Production*	*Export*	*Import*	*Feed*	*Production*	*Demand*	*Trade*	*Feed*	*Retail price*	*Producer price*	*R0, Tariff equiv.*
Australia	1.6	7.2	–	0.5	–37.9	–0.5	–53.4	11.0	–15.6	–16.8	39
Canada	3.5	8.6	–	3.0	–10.9	29.7	–79.1	35.4	2.2	0.5	21
Japan	0.1	–	22.1	5.1	–15.2	8.3	9.1	8.7	–22.0	–22.9	39
USA	32.0	74.6	–	25.5	4.6	–0.8	12.1	–1.4	6.5	11.6	0
EC	8.0	–	11.4	12.7	8.5	–4.4	–61.5	–5.7	–20.9	–21.8	37
World	100.0	100.0	100.0	100.0	1.7[a]	–0.1[a]	–4.5	1.8	–	–	–
Developing	30.5	–	37.1	23.1	1.2	–0.2	–2.1	2.4	–	–	–
CMEA	18	–	7	21	2.8	3.1	7.4	3.5	0	0	–

[a]The difference between world production and demand is due to stock change.

Table 5.19. The EC: Changes in production and trade in 2000 under OECD trade liberalization relative to the reference scenario.

	Reference scenario (R0)[a]				*F-OECD: % change over R0*						
Commodity	*Production*	*Export*	*Feed*	*Revenue*[b]	*Production*	*Demand*	*Trade*	*Feed*	*Retail price*	*Producer price*	*Revenue*
Wheat	64.6	17.6	22.5	0.22	–28.0	–2.6	–97.6	–0.1	–8.0	–25.6	–45.0
Rice	1.0	–0.2	0.3	0.46	–18.7	–1.3	88.5	–9.3	–12.9	–26.3	–43.8
Coarse grains	88.4	–19.6	88.2	0.22	8.5	–4.4	–61.5	–5.7	–20.9	–21.8	–33.0
Bovine and ovine	10.3	–1.0	–	1.76	–7.6	0.3	78.6	–	1.1	1.9	–15.6
Dairy	117.4	8.7	21.3	1.82	–6.2	–1.8	–60.4	–9.3	0.9	1.6	–12.2
Other animal prod.	3.0	0.1	–	2.69	–8.2	1.5	–363.1	–	–9.6	–13.3	–30.0
Protein feed	1.3	–6.4	7.6	0.58	–5.4	–10.7	–11.8	–10.8	–17.9	–17.9	–12.2
Other food	16.2	–7.2	1.0	3.42	–10.2	0.9	25.6	–20.1	–3.8	–8.6	–8.6
Nonfood agric.	1.0	–2.1	–	190.28	–11.2	5.1	13.4	–	–23.4	–23.4	2.9
Nonagriculture	1481.8	14.2	–	500.27	0.4	0.1	33.6	–	–2.9	–2.9	6.3

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.
[b]Expected net revenue in $\$10^3$ per unit.

Table 5.20. The CMEA: Changes in production and trade in 2000 under OECD trade liberalization relative to reference scenario.

	Reference scenario (R0)[a]			*F-OECD: % change over R0*			
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Trade*	*Feed*
Wheat	150.2	–19.2	85.0	–0.2	2.1	19.9	4.2
Rice	1.8	–0.4	0.2	0.4	0.5	0.7	4.7
Coarse grains	195.6	–12.0	146.0	2.9	3.1	7.4	3.5
Bovine and ovine	12.9	–	–	5.9	5.9	0	–
Dairy	171.6	0.8	47.7	5.9	5.9	+b	20.4
Other animal products	2.4	–	–	–1.9	–1.9	0	–
Protein feed	3.8	–	3.2	–3.6	–0.7	–b	–0.3
Other food	36.8	–1.5	7.7	–3.9	–0.5	83.5	–1.9
Nonfood agriculture	10.4	–2.1	–	–5.0	–5.0	–5.0	–
Nonagriculture	1732.6	4.2	–	–0.4	–0.1	34.3	–

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970. [b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

agricultural imports as it is able to export more of nonagriculture (see *Table 5.20*), because the developing countries are able to import more of nonagriculture under OECD trade liberalization as a result of their being able to export more agricultural products at higher prices.

5.5.5. Importance of multicommodity multicountry interdependence

It is worth noting that the EC's increase in production of coarse grains under OECD trade liberalization would have been difficult to predict by looking at relative protection on different commodities in the EC. Coarse grains have the highest self-sufficiency protection rate except for rice, which is a very minor crop for the EC. Self-sufficiency protection rates, shown in *Table A2.9* are calculated with respect to world market prices. The protection rates shown in *Table 4.13*, on the other hand, are with respect to border prices [CIF (cost, insurance, and freight) for imported, and FOB (free on board) for exported commodities] adjusted for domestic transport charges. In the reference scenario wheat was exported and coarse grains were imported, and thus the protection rate with respect to FOB export price of wheat and CIF import price for coarse grains was higher for wheat than for coarse grains. Under trade liberalization whether the EC would continue to export wheat or not could not be predicted in advance. Were the EC to become an importer of wheat, the domestic producer price for wheat might fall less than that for coarse grains.

Nor could the increase in production of coarse grains have been predicted by looking at protection of coarse grains provided by different OECD countries (the EC and Japan have similar, and the highest, self-sufficiency protection rates). The outcome also depends strongly on the changes in the relative world market prices, i.e., on the protection rates on different commodities applied in different countries and what substitutions in supply and demand take place in different countries among these commodities under trade liberalization.

Another example of such interdependence is provided by Austria, whose agricultural producers get higher prices. A country having medium levels of protection like Austria may expand production under trade liberalization, because other, and agriculturally more important, countries had higher levels of protection, the removal of which changes world market prices in a favorable way for the country's producers.

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Similar explanations may be provided for price changes of other commodities. One should, however, recognize that, though these explanations try to identify the major influencing factors, it is the interactions of the behaviors of all the actors in the system that determine the behavior of the system.

5.5.6. Nominal and OECD-policy-adjusted levels of protection

The considerable price increases on the world market under OECD trade liberalization have an interesting implication as regards the "real" levels of protection in some of these countries. As indicated in Chapter 2, "real" protection levels may be defined with respect to world prices as they would be in the case of global free trade. The impact on world market prices of the removal of distortions by a subset of countries is defined here as adjusted levels of protection. Thus, when protection levels are calculated with the domestic prices and border prices of the reference scenario, these are nominal protection levels. However, when reference scenario domestic prices and OECD trade liberalization border prices are used to calculate protection level, one obtains OECD trade liberalization adjusted ("OECD-policy-adjusted", for short) protection levels. Measured thus, the OECD-adjusted protection levels are much lower than the nominal levels as observed at reference scenario world market prices. This also means that the adjustment of domestic prices in the protected countries that is required in a move toward trade liberalization is less far-reaching than might be feared from looking at the nominal levels only.

Table 5.21. Nominal and OECD-adjusted protection rates for the EC.

Commodity	*Nominal 1980* (%)	*Nominal 2000* (%)	*OECD-policy-adjusted 2000* (%)
Wheat	84	112	26
Coarse grains	42	37	22
Bovine and ovine meat	61	12	2
Dairy products	70	34	-2
Other animal products	26	24	13
Other food	5	12	9
Nonfood agriculture	26	28	23

An important example is the EC (see *Table 5.21*). As world market prices for the cereal–livestock complex would increase by 11–30% or more, the OECD-adjusted protection levels would be correspondingly lower. Compared to nominal protection rates of 12–112%, OECD-adjusted protection rates would range from -2% to 26%. There would also be a shift in the profitability ratios between animal products, as measured by the animal/feed price ratio, to the disadvantage of the products from ruminants. In introducing trade liberalization, wheat, coarse grain, bovine and ovine meat, and dairy production may seem to be the branches with the greatest adjustment problems in the EC. However, as is shown in *Table 5.18*, coarse grain production in fact increases, thus providing an example of the theoretically well-known results that nominal or even effective rates of protection do not provide an indication of the direction in which resources should be reallocated.

5.6. Welfare Gains and Distributions from OECD Trade Liberalization

Trade liberalization by OECD countries may be expected to improve incomes and welfare in the OECD countries, though one cannot rule out the possibility that some of them may actually be worse off. The non-OECD countries that do not themselves liberalize their trade are affected mainly through changes in their terms of trade, which can become significant as the relative world market prices show substantial changes in the OECD trade liberalization scenario.

In comparing the welfare of a country in alternative situations as represented by the two scenarios, the problems of finding a satisfactory measure or a consistent indicator are almost insurmountable. We have therefore used a whole range of indicators of welfare. Whether a country gains or loses cannot always be determined unambiguously.

5.6.1. Small impact on global GDP; assessment affected by prices

OECD trade liberalization increases global GDP calculated at 1970 world prices by 0.22% in the year 2000 (see *Table 5.22*). Though 0.22% is a small amount, it is not negligible. In absolute terms the 0.22% increase amounts to nearly US$24 billion (1970). Valued at 1980 US dollars, this would amount to US$50 billion, * whereas official development assistance ~~given~~ by OECD countries in 1980 was around US$27 billion. The gain for the OECD countries in GDP valued at 1970 world prices is 0.57% in 2000, which is nearly US$31 billion (1970). At these prices, the loss for developing countries is only 0.02% of GDP in 2000. development assistance

The small effect on the global GDP at constant prices can also be an outcome of the fact that agriculture in the OECD countries is a small part of the economy. The efficiency gains to be realized by removing agricultural trade distortions may be expected to be small. Though in the trade liberalization scenario all border distortions were removed, the one aggregate nonagriculture sector does not capture the gains that could be realized by reallocating factors among the different subsectors of nonagriculture.

5.6.2. Less consumption and more hunger in developing countries

Another indicator of global welfare that is generated in the scenarios is per capita calorie intake. The calorie intake calculations do not suffer from the index number problem to the same extent as the GDP measure does. As described in Chapter 3, based on per capita calorie intake and using a cross-country regression, an estimate of the number of people who are in hunger in each country is also made. These indicators, important mainly for the developing countries, are shown in *Table 5.23*.

Table 5.22. Impact of OECD trade liberalization on GDPs.[a]

GDP	*1990*	*2000*
World		
Reference scenario	7558	10841
% change in F-OECD	0.17	0.22
OECD		
Reference scenario	4034	5433
% change in F-OECD	0.30	0.57
CMEA		
Reference scenario	1218	1777
% change in F-OECD	–0.09	–0.40
Developing countries		
Reference scenario	1492	2503
% change in F-OECD	0.12	–0.02

[a]GDP calculated using 1970 *world* prices (10^9 US$ 1970).

Table 5.23. Per capita calorie intake and hunger in developing countries under OECD trade liberalization.

	1990		*2000*	
Indicator	*Reference scenario*	*% change for F-OECD*	*Reference scenario*	*% change for F-OECD*
Calorie intake (kcal/day)	2510	–0.13	2640	–0.3
Persons hungry (10^6)	470	3.3	400	3.6

The average per capita calorie intake in the developing countries decreases under agricultural trade liberalization by OECD countries, and consequently the incidence of hunger increases. Thus, for the developing countries as a group, such trade liberalization is not attractive unless additional efforts are undertaken to minimize the negative impact on the poor in developing countries.

The extent of the adverse impact on developing countries is not insignificant, but compensation schemes could be devised to ensure that they are not worse off under agricultural trade liberalization by the OECD. Nonetheless, the results do show that the trade policies of the developed countries affect the developing countries; thus, in the trade negotiations of the former, a mutual agreement among all nations is desirable.

5.6.3. Varied impact at national level

Though at the global level the impacts of trade liberalization by OECD countries are small, at the level of individual countries they could be significant. However, even at national levels, the largest change in per capita GDP (at 1970 domestic prices) is 2% (gains in New Zealand and Kenya and loss in Mexico).

Table 5.24. Comparison of production evaluated at different prices (percentage change under OECD trade liberalization relative to the reference scenario).[a]

	1985		*1990*		*1995*		*2000*	
Countries	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
USA	0.2	0.2	0.3	0.3	1.0	1.0	0.9	0.9
Canada	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.1
Australia	0.1	0.1	0.4	0.2	0.4	0.2	0.5	0.2
New Zealand	0.9	0.6	2.0	1.5	2.6	2.0	2.6	2.2
Austria	0.2	0.1	0.2	0.1	0.2	+0	+0	–0.1
EC	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.1
Japan	0.1	+0	0.3	+0	0.4	+0	0.4	+0
CMEA	–0	–0	–0.1	–0.1	–0.2	–0.2	–0.4	–0.4
China	0	0	0	0	0	0	0	0
Argentina	0.9	0.8	1.4	1.2	1.7	1.5	1.7	1.6
Brazil	–0.1	–0.1	–0.3	–0.3	–0.4	–0.4	–0.4	–0.4
Mexico	0.1	0.1	–0.7	–0.7	–1.5	–1.5	–1.8	–1.8
Egypt	0.3	0.3	0.3	0.2	–0.5	–0.5	–0.9	–0.9
Kenya	0.3	+0	1.1	0.8	1.8	1.5	2.2	1.9
Nigeria	0.5	0.5	1.6	1.6	2.0	2.0	2.2	2.2
India	0.1	0.1	0.1	0.1	+0	+0	0.1	0.1
Indonesia	–0.3	–0.3	–0.9	–0.9	–0.5	–0.5	–0.4	–0.4
Pakistan	0.9	0.9	2.2	2.2	1.6	1.5	1.4	1.4
Thailand	–0	–0.1	0.3	0.1	0.3	0.2	0.3	0.2
Turkey	0.5	0.4	0.5	0.4	0.1	+0	–0.2	–0.2

[a] A = (scenario supply at scenario prices)/(reference supply at scenario prices); B = (scenario supply at reference prices)/(reference supply at reference prices).

Country-wise information on a number of indicators of welfare is given in *Tables 5.2, 5.24*, and *5.25*. In *Table 5.26*, the impacts on various measures are qualitatively summarized. Not all the indicators are available for all the models. Even in terms of equivalent income, or cost of consumption comparisons, the gains or losses in the year 2000 are rather small. The largest change in equivalent income is a 2.6% loss for Indonesia in 1990 and a 2.1% gain for Argentina in 2000. The highest gain in cost of consumption comparison is for New Zealand. (The equivalent income measure is not available for New Zealand.)

5.6.4. All OECD countries, except Canada, show clear gain

Among the OECD countries, the EC and Japan gain in production value comparisons, GDP, equivalent incomes, as well as consumption cost comparisons, showing that these countries benefit from OECD trade liberalization.

New Zealand and the USA show gain in both production value and consumption cost comparisons. One could thus conclude that these countries also gain from trade liberalization by OECD countries.

Table 5.25. Consumption cost comparison (OECD trade liberalization compared to reference scenario).[a]

	1985		1990		1995		2000	
Countries	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
USA	0.4	0.4	0.4	0.4	1.4	1.4	1.3	1.4
Canada	0.3	0.3	+0	+0	–0.1	–0	–0.1	–0.1
Australia	0.8	0.8	0.4	0.5	0.5	0.5	0.6	0.6
New Zealand	2.5	2.5	3.5	3.5	3.4	3.4	3.3	3.3
Austria	0.4	0.4	0.4	0.4	0.3	0.3	0.1	0.1
EC	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3
Japan	0.6	0.6	1.1	1.2	1.0	1.1	0.9	1.0
CMEA	0	0	+0	+0	0.1	0.1	+0	+0
China	–0	–0	+0	+0	+0	+0	–0	–0
Argentina	0.8	1.0	1.5	1.6	1.8	1.9	2.1	2.2
Brazil	–0.1	–0.1	–0.5	–0.5	–0.4	–0.4	–0.4	–0.4
Mexico	+0	+0	–0.9	–0.9	–1.5	–1.5	–1.8	–1.8
Egypt	–0.2	–0.2	–0.2	–0.2	–0.7	–0.7	–1.1	–1.1
Kenya	+0	0.1	1.1	1.0	1.9	1.9	2.5	2.5
Nigeria	–0.3	–0.3	0.1	0.1	0.7	0.7	1.0	1.0
India	–0.4	–0.4	–0.9	–0.8	–0.3	–0.3	–0.1	–0.1
Indonesia	–0.7	–0.7	–2.0	–2.0	–1.2	–1.2	–1.1	–1.1
Pakistan	0.6	0.6	0.8	0.8	0.7	0.8	0.8	0.8
Thailand	0.5	0.5	1.3	1.4	1.1	1.1	1.2	1.2
Turkey	0.2	0.2	–0	–0	–0.1	–0.1	–0.1	–0.1

[a]A = (scenario consumption at scenario prices)/(reference consumption at scenario prices); B = (scenario consumption at reference prices)/(reference consumption at reference prices).

Austria shows either gain or insignificant change in all available indicators. Thus, it also benefits from OECD trade liberalization.

Australia and Canada are the only OECD countries (except Turkey, which does not liberalize in this scenario) that show losses on equivalent incomes. The comparisons of costs of consumption bundles, however, show gains for Australia but losses for Canada for 1995 and 2000. Both these countries show gains in production value comparisons. Even though the losses are very small, Canada's loss is surprising and needs an explanation, which is given later.

The conflicting indicators for equivalent income and consumption cost comparison for Australia imply an inconsistency between the demand systems for Australia approximated for the year 2000 in the reference scenario and in the OECD trade liberalization scenario. Note that equivalent incomes are calculated at 1970 prices for each scenario. If the 1970 prices are very different from the scenario prices, then these calculations may involve the utility indifference curves implied by the demand system parameters, at a distance from the actual consumption point. Since the demand system is approximated by a linear expenditure system every year around an expected consumption point, such a discrepancy between equivalent income calculation with a base-year price and

Table 5.26. Gains and losses on welfare and macroeconomic indicators for 2000 under OECD trade liberalization relative to the reference scenario.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consumption cost*	*People hungry*	*Life expect.*
USA	G	L	–	G	–	NS
Canada	L	G	L	L	–	L
Australia	NS	G	L	G	–	NS
New Zealand	G	G	–	G	–	NS
Austria	NS	G	G	G	–	NS
EC	G	L	G	G	–	G
Japan	G	L	G	G	–	G
CMEA	L	–	–	ID	–	–
China	–	–	–	ID	–	–
Argentina	G	G	G	G	L	L
Brazil	L	G	L	L	L	L
Mexico	L	L	L	L	L	L
Egypt	L	G	L	L	–	L
Kenya	G	G	–	G	G	G
Nigeria	G	L	G	G	G	L
India	G	G	L	L	L	L
Indonesia	L	G	L	L	–	NS
Pakistan	G	G	G	G	L	L
Thailand	G	G	–	G	L	NS
Turkey	L	G	L	L	L	L

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

consumption cost comparison is possible (though fortunately this happens only for Australia). Because of this, consumption cost comparisons may be considered more reliable, and hence Australia may be considered, on balance, to be a gainer from agricultural trade liberalization by OECD countries.

5.6.5. Some clear losers and gainers among developing countries

Brazil, Mexico, Egypt, and Turkey show losses in terms of all indicators and so must be treated as clear losers under OECD trade liberalization. Similarly, Indonesia is a loser as it either loses or shows insignificant changes in all indicators.

India should also be considered a loser on balance, as it loses on all indicators except GDP. The very small gains in GDP and production value comparisons may be considered to be negligible as all the consumer and social welfare indicators show losses.

By contrast, Kenya shows a clear gain on all indicators.

Nigeria may be considered a gainer as it gains on all except the life expectancy measure.

Argentina may be considered a qualified gainer as on the consumer welfare indicators, namely equivalent income and consumption costs comparison, it shows gains. Its losses on the social welfare indicators, number of hungry people and life expectancy, affect a small number of people as Argentina is a relatively well-off country where the projected level of hunger in the reference scenario is very small and life expectancy relatively high. In principle, Argentina should be able to compensate the poor who become worse off from the large income gains at the aggregate level.

Pakistan and Thailand gain on some indicators and lose on others, and thus they are not unequivocal gainers or losers.

5.6.6. Why do countries gain or lose?

The welfare gains of OECD countries are easy to understand. These countries remove distortions, and thus domestic resources are allocated more efficiently. These gains in production efficiency could have been lost by changes in terms of trade consequent on trade liberalization by the OECD countries. This does not seem to have happened for most countries. In fact, terms of trade improve for all OECD countries except the EC and Japan, for both of which consumption cost comparisons are still favorable.

On top of the efficiency gains, consumers also gain when consumer prices fall. As can be seen in *Table 5.27*, the relative price of agriculture, as well as the food price index, falls more than terms of trade in the EC and Japan. As a consequence, consumers gain in welfare, and this is reflected in their equivalent incomes.

Thus the OECD countries with high protection, the EC and Japan, show under trade liberalization gains in production efficiency that are not fully negated by loss in terms of trade, and improvement in consumer welfare as consumer prices for food also fall.

Austria, which has a moderately high protection, does not gain significantly in production, but has a very large gain in terms of trade. The food price index remains almost unchanged, and thus consumers benefit, as reflected in consumption cost comparisons.

The USA has relatively low nominal protection rates, but policies such as land set-aside provide a much greater degree of protection, and the USA behaves in a way somewhat similar to that of highly protected countries. It shows significant gains in production value (*Table 5.24*), only a 1.7% change in its terms of trade, and a 2% fall in the relative price of agriculture. US consumers thus gain.

The OECD countries with low protection rates, Australia, Canada and New Zealand, not only show production efficiency gains but also show gains in

Table 5.27. Changes in terms of trade for OECD countries in 2000 due to OECD trade liberalization.

	Terms of trade[a]		*% change over R0*	
Country	*Reference run (R0) value*	*% change over R0*	P_A/P_N	*Food price index*
Australia	1.1	10.8	14.5	12.1
Austria	0.98	6.3	7.5	0.6
Canada	0.98	9.5	15.5	6.5
Japan	0.96	–7.6	–35.3	–19.3
New Zealand	1.44	15.8	15.8	9.1
USA	0.90	11.4	–2.0	–3.2
EC	0.87	–3.6	–8.8	–3.7

[a](Unit value index of exports)/(Unit value index of imports) with trade weights from the reference scenario.

terms of trade. However, the production value increases are associated with increases in domestic prices. Though all three countries show an increase of around 15% in the relative price of agriculture, the production value gains compared to the reference run differ across these countries depending on the structure of protection in the reference scenario. New Zealand protected only one commodity, namely, other animal products (by 20%), whose price in 2000 does not change under liberalization on the world market. Thus, domestic producer prices of all other products change by almost the same amount as the world prices. As a result, New Zealand shows the largest increase in value of its production, and consumers are better off in spite of higher prices.

Australia and Canada, with similar aggregate agricultural protection levels, show quite a different pattern of protection across commodities. For example, Canada has positive protection for dairy products while Australia has negative protection. When dairy prices increase under trade liberalization, Australian producers gain a substantial price increase, whereas producer prices for dairy products in Canada remain the same. Thus, the percentage increase in the value of production is higher for Australia than for Canada (column *A* for 2000, *Table 5.24*). The consumers in Australia gain, whereas the consumers in Canada gain in early years, but lose in later years, when costs of consumption baskets are compared across the two scenarios.

The impact on developing countries is through the changes in the world market prices. Under OECD trade liberalization, agricultural prices rise, and it is easy to see why food-importing developing countries could lose – in terms of consumer welfare, as reflected in consumption cost comparisons and equivalent incomes, and also in social welfare, as reflected in calorie intake and population in hunger. Even if the domestic producer prices were completely insulated from world price rise, less food would be imported and less would be available for consumption. To the extent that domestic prices are allowed to increase, consumers will be even worse off, though the increase in domestic production will counter the price increases. And, if the increased producer prices stimulate enough domestic investment and agricultural production, they may even lead to improvement in consumer welfare over the years.

For agricultural surplus developing countries, the higher agricultural prices on the world market mean higher incomes from exports. If the domestic prices are completely insulated, even then the country will gain. If higher prices stimulate higher exports and increased production, clearly the producers will gain, but the higher prices may lower somewhat the gain for consumers.

These arguments are of a static nature. The dynamic effects of these changes can, particularly in the presence of domestic distortions and rigidities, reverse some of the effects.

The impact of OECD trade liberalization on most of the developing countries can be explained by the following arguments.

The aggregate of relative price of agriculture and the food price index increase in all developing countries (see *Table 5.28*), except Mexico where they drop slightly. The agricultural surplus countries, Argentina, Kenya, and Thailand, all show gains in value of production and consumption cost comparisons (see *Table 5.26*).

The countries with low agricultural self-sufficiency as well as low self-consumption ratios are Egypt, Nigeria, and Indonesia. Of these, Egypt and Indonesia show, as expected, loss of consumer welfare. However, Nigeria surprisingly shows improvement in production as well as consumption (see *Table 5.26*). This is because higher agricultural prices draw more investment and land into agriculture in Nigeria, the domestic production of agriculture increases, and the volume of agricultural output is 6% higher. The index of price of agriculture relative to nonagriculture in Nigeria rises more in the early years after OECD trade liberalization, and in 1990 it is 5% above the reference scenario value. The resulting additional investment in agriculture moderates the price rise, and by 2000 the price index is only 0.3% above the reference scenario value. Thus, the dynamic effect of higher investment in Nigeria results in gains of most welfare indicators under OECD trade liberalization. Pakistan, which also has a low agricultural self-consumption ratio comparable to that of Indonesia but a higher agricultural self-sufficiency ratio of 0.97, behaves as Nigeria. Agricultural production is stimulated, and the agricultural volume index is higher by 4% in 2000. Thus, the production value and consumption cost comparisons show gains for Pakistan. However, the calorie intake falls. Thus, though Pakistan in general gains, its poor are worse off, with an increase in the number of hungry persons.

India, which is nearly self-sufficient, shows expected behavior in that production increases, but the higher prices adversely affect consumer and social welfare.

Brazil, Mexico, and Turkey, all with agricultural self-sufficiency ratios exceeding 1.0, show in 2000 loss in the production value comparison (see *Table*

Table 5.28. Changes in terms of trade, producer prices, and food prices in developing countries for 2000 under OECD trade liberalization relative to the reference scenario (R0).

	Absolute values in R0			*% change in F-OECD over R0*		
Country	*Agricultural trade surplus* (10^9 US$ 1970)	*SSR*[a]	*SCR*[b]	*Terms of trade*[d]	P_A/P_N	*Food price index*
Argentina	2.4	1.49	1.00	11.3	12.1	7.7
Brazil	–0.3	1.02	0.90	–7.1	7.8	5.8
Mexico	0.6	1.07	0.93	–2.6	–0.7	–0.4
Egypt	–0.2	0.96	0.86	–8.1	5.4	3.0
Kenya	.4	1.28	0.92	2.4	10.6	10.4
Nigeria	–2.9	0.82	0.82	–8.7	0.3	0.9
India	0.1	1.00	0.98	13.9	3.0	NA[c]
Indonesia	–1.1	0.90	0.90	–8.6	2.3	1.4
Pakistan	–0.2	0.97	0.91	12.0	0.6	0.6
Thailand	1.4	1.28	0.99	5.8	7.7	2.9
Turkey	1.1	1.12	0.97	5.1	1.4	1.3

[a]SSR, self-sufficiency ratio for product i is defined as $SSR_i \equiv production_i/demand_i$ and for the aggregate is defined as the demand-value-weighted sum for agricultural products.
[b]SCR, aggregate self-consumption ratio is defined as weighted sum of Min(1.0, SSR_i).
[c]NA, not available.
[d](Unit value index of exports)/(Unit value index of imports) with trade weights from the reference scenario.

5.24). The explanation lies in the fact that labor movement out of agriculture is slowed down in these countries, and the marginal product of labor is much higher in nonagriculture than in agriculture. These differences in marginal product, which get narrowed over time, are historically observed ones and reflect various rigidities in the labor flows between sectors. Since this behavior produces much more striking results when these countries themselves liberalize, it is treated in greater detail in Chapter 8.

In Argentina as well as Brazil (and to a lesser extent Mexico), *Table 5.2* shows substantial *percentage* increases in hunger. However, in these countries the level of hunger in the reference scenario is rather low. Thus small changes in the number of hungry persons translate into large percentage changes.

In summary, this look at why some countries gain and some lose has often shown the impacts of trade liberalization that could have been expected. However, it has also shown surprising effects, which can be explained. The dynamic effect, as well as rigidity, are shown to produce these results.

5.7. Impact on Farm Incomes and Parity

Since maintenance of farm income in relation to nonfarm income is an important motivation for protecting agriculture in the developed countries, impacts on farm incomes and parity are of considerable importance in determining the acceptability of liberalization. If agricultural trade liberalization by OECD countries lowers farmers' incomes, then the farmers will oppose it, unless they are suitably compensated in other acceptable and nondistorting ways.

Since, in the developing countries, agricultural prices rise and income parity increases in all countries (except Mexico and Nigeria, where it increases initially but falls in 2000), there is no need to look at them.

Table 5.29 shows changes due to agricultural trade liberalization in income parity, agricultural labor, and agricultural volume indices for the OECD countries explicitly identified in the BLS.

Income parity actually improves in favor of the agricultural producers for Australia, Austria, Canada, and New Zealand. These are the countries that have a very small average degree of protection in the reference scenario, and the gains in income parity for the farmers due to higher world prices are understandable.

What is somewhat surprising, however, is that, for the USA, Austria, the EC, and Japan, removal of their much higher protection levels results in comparatively very small declines in income parities. The explanation, of course, lies in three things: increases in world market prices, adjustment of production structure, and movement of labor out of agriculture. The last factor is important to keep in mind, as a large movement out of agriculture may be politically as unacceptable as a fall in income parity.

Austrian farmers have a small initial drop in relative income, but in the long run the farmers gain in relative income. The labor outflows are also very small.

US farmers gain initially but over time show a decline (2% in 2000) in relative income. However, since the USA shows an increase in GDP (see *Table 5.26*), and an increase in agricultural volume index of 2%, US farmers' incomes remain unaffected by trade liberalization. Information on labor outflow from agriculture is not available for the USA. However, one can assume it to be virtually unaffected by the liberalization as the relative price changes so little.

These small changes in parity for Austria and the USA have to be interpreted with some care. Even when farm incomes on the average increase a little, farmers who specialize in a particular commodity that becomes less profitable, and who are unable to shift to the production of a more profitable commodity, may indeed substantially lose income. Of course, to that extent, other farmers, who can adopt, will gain more income.

The countries where income parity ratios decline substantially for agricultural producers are Japan and the EC. Even then the declines are much less than the degree of protection removed. One of the reasons for the small loss in income parity is migration of labor out of agriculture. Though in the F-OECD

Table 5.29. Percentage changes in income parity, agricultural labor, volume index, and relative price under OECD trade liberalization relative to the reference scenario and degree of protection (in percent) in OECD countries in the reference scenario.

OECD country	*1985*	*1990*	*1995*	*2000*
Australia				
Parity	14	23	17	12
Agricultural labor	+0	1	3	4
Agricultural volume index[a]	–0	2	3	2
P_A/P_N	15	23	17	15
Degree of protection[b]	–6	–6	–6	–4
Austria				
Parity	–3	2	3	7
Agricultural labor	–1	–2	–1	2
Agricultural volume index[a]	–1	–1	–1	2
P_A/P_N	–4	1	2	8
Degree of protection[b]	22	19	14	13
Canada				
Parity	7	12	10	12
Agricultural labor	1	6	13	20
Agricultural volume index[a]	1	5	9	13
P_A/P_N	6	11	12	16
Degree of protection[b]	–5	–7	–10	–11
Japan				
Parity	–25	–37	–37	–35
Agricultural labor	–1	–4	–5	–5
Agricultural volume index[a]	1	1	1	1
P_A/P_N	–25	–36	–37	–35
Degree of protection[b]	102	95	88	82
New Zealand				
Parity	32	37	33	29
Agricultural labor	+0	1	2	3
Agricultural volume index[a]	3	8	11	13
P_A/P_N	26	25	19	16
Degree of protection[b]	2	2	1	1
USA				
Parity[c]	3	3	0	–2
Agricultural labor	NA[d]	NA[d]	NA[d]	NA[d]
Agricultural volume index[a]	+0	2	1	2
P_A/P_N	3	3	–1	–2
Degree of protection[b]	12	12	13	14
EC				
Parity	–10	–8	–8	–4
Agricultural labor	–0	–6	–7	–12
Agricultural volume index[a]	–1	–4	–6	–8
P_A/P_N	–9	–10	–11	–9
Degree of protection[b]	30	28	24	23

[a]Agricultural volume index is calculated using 1970 world prices. [b]Degrees of protection for the reference run are calculated using producer prices. [c]Parity for the USA is calculated assuming labor in agriculture does not change between scenarios. [d]NA, not available.

scenario more labor is used in the nonagriculture sector, increased migration of labor out of agriculture may be troublesome politically.

In conclusion, under OECD trade liberalization, farm incomes increase in most countries. Significant reductions in farm incomes in the EC and Japan occur, but these losses are still much less than what might be expected from their present levels of protection. To ensure income parities in the EC and Japan, lump-sum transfers needed are less than 0.5% of GNP for the EC and less than 1% of GNP for Japan. These levels of expenditure are smaller than the budgetary outlays on farm support measures in the EC and Japan.

5.8. Previous Studies of Agricultural Trade Liberalization by OECD Countries

Although protectionism in OECD agriculture has been of interest to economists for a long time, hardly any quantitative studies have been made. A number of studies have explored the consequences of the CAP of the EC, including the impact of liberalizing the CAP. However, the impact of simultaneous liberalization by the OECD countries has not been explored before except in two studies, one by Valdés and Zietz (1980) and the other by Anderson and Tyers (1984).

Valdés and Zietz follow a partial equilibrium approach. Demand and supply elasticities are specified from a literature search, and the same value of elasticity per commodity is specified for demand as well as supply in all countries. Moreover, only 50% of agricultural protection is removed by all OECD net importers of a commodity. Presumably, if an OECD country protects a commodity so much that it has become a net exporter of that commodity, protection from that commodity is not reduced. Though protection is removed from a number of agricultural commodities, the interaction between commodities is only partially accounted for in the Valdés and Zietz study. Thus, neither the methodology nor the notion of liberalization is comparable with those of the present study.

Though the Anderson and Tyers study has a multicountry multicommodity framework, it also uses a partial equilibrium approach. One of their scenarios considers trade liberalization by all developed market economies for grains and meat products. It is thus more comparable to the present scenario than is the Valdés and Zietz study.

Changes in world prices of some commodities due to reduction in protection by OECD countries in the two studies are compared with the current scenario in *Table 5.30.*

The price changes in the Valdés and Zietz study are quite different from those in the other two studies, as could be expected. Anderson and Tyers show price changes that are comparable to, and somewhat larger than, the price changes in the present scenario. This is in spite of the fact that the tariff rate estimates may be different in the two studies. As shown later in Chapter 6, the

Table 5.30. Percentage increases in world prices due to reduction in agricultural protection by OECD countries in various studies.

Commodity	*F-OECD*[a] *(2000)*	*Valdés and Zietz*[b] *(1975–1977)*	*Anderson and Tyers*[c] *(1990)*
Wheat	18	5	20
Rice	21	0	16
Coarse grains	11	2[d]	14
Beef and veal	17[e]	7	24
Mutton and lamb		4	
Pigmeat	-0[f]	9	1[g]
Poultry		3	
Fish		–	
Sugar	5[h]	8	
Vegetable oils		5[i]	

[a]All border protection from all agricultural commodities is removed over 1982–1986 and the results for 2000 compared. [b]50% of protection from a commodity of which the OECD country was a net importer is removed. 1975–1977 comparative static analysis. [c]Protection is removed by developed market economies from grains and meats in 1981 and an annual simulation carried out till 1990. [d]Corn. [e]Bovine and ovine meat. [f]Other animal products. [g]Pigs and poultry. [h]Other foods. [i]Groundnut oil.

estimates for the EC, which are the only estimates Anderson and Tyers report, differ from those in the present study.

5.9. Summary of Results and Policy Implications

The results of the scenario on agricultural trade liberalization by OECD countries presented and analyzed in this chapter point to certain methodological and policy conclusions.

5.9.1. Summary of substantive findings

The major substantive results can be summarized as follows:

(1) Since OECD countries on the whole protect their agriculture, when they liberalize agricultural trade, the world market price of agriculture rises relative to that of nonagriculture by about 10%. The largest increases in relative prices are for bovine and ovine meats and dairy products.

(2) Changes in global agricultural output are small for all commodities. Demand for agricultural products in the OECD countries, though not very price-elastic, increases somewhat due to modest welfare gains in these countries and reduction of food retail prices, especially in OECD countries with

high protection, the EC and Japan. Global output adjusts to satisfy global demand.

(3) However, agricultural production patterns in different countries change significantly as a result of changes in the relative prices of commodities, and trade in agricultural, as well as in nonagricultural, products expands significantly.

(4) Though index number problems cloud estimation of efficiency gains, efficiency gains at the global level due to better allocation of resources are small but not insignificant. The global GDP measured at 1970 world market prices increases by around 0.20%. This may seem a small gain but in absolute terms it amounts to US$30–50 billion at 1980 prices per year. Moreover, as a percentage of the agricultural GDP in the OECD countries, which is the part of the economy from which trade distortions are removed, the gains amount to 20–25%.

(5) The efficiency gains accrue to the countries that liberalize agricultural trade, namely, the OECD countries. The CMEA countries show lower GDPs, owing to terms-of-trade loss, while the developing countries as a group show no significant gain.

(6) Indicators of consumer welfare (equivalent income and consumption cost comparison) as well as those of social welfare (persons in hunger, life expectancy at birth, and income parity) show gains for a number of countries, losses for some, and a mixed picture for others.

(7) In general, the countries of the OECD show gains on the available measures, except for income parity in the EC and Japan, where it declines. Even then, the EC and Japan show clear improvement on all other indicators of economic development and consumer welfare. Thus, agricultural trade liberalization by OECD countries can be considered to be beneficial to those countries.

(8) Though the agricultural producers in the EC and Japan lose income relative to nonagricultural income, the losses in income are much less than might have been inferred from the degree of protection that was removed, because of the increases in world prices, production adjustments by these countries to suit the new set of relative prices, and migration of labor out of agriculture.

(9) The values of the lump-sum transfers needed to compensate fully the loss in agricultural incomes in the EC and Japan are significantly smaller than the efficiency gains to these economies. At less than 0.5% of GDP for the EC and 1.0% of GDP for Japan, the costs of the transfers are less than the budgetary outlays on farm support measures in the EC and Japan.

(10) The developing countries in general are worse off, though some developing countries do gain. The higher world market prices of cereals and ruminant products hurt many food-importing developing countries, and the level of hunger increases in them. Even some exporting countries that gain in

terms of economic development show a marginally adverse impact on the level of hunger due to higher food prices.

(11) The lump-sum transfers needed to compensate developing countries and groups within these countries who lose are smaller than the global efficiency gains, which mainly accrue to the OECD countries.

5.9.2. Policy conclusions

The policy implications of these results are clear:

(1) Provided that compensating lump-sum transfers can be arranged for farmers in the EC and Japan and for the groups in developing countries who lose, OECD countries should liberalize their agricultural trade. Compensation to farmers in the EC and Japan may be politically necessary and socially justifiable. Compensation to developing countries may be justified on the ground that the present production patterns in many developing countries may have been affected by the present protective policies of OECD countries. Perhaps, concern for the poor in the developing countries should be reason enough for such compensation.

(2) The adverse impacts on the developing countries of trade policy changes by the OECD countries suggest that the interests of developing countries should be represented in trade policy negotiations among the developed countries.

5.9.3. Methodological findings

From an analytical and methodological point of view, these scenario results provide interesting insights that include some policy implications. The major methodological findings are as follows:

(1) It is important to account for the interdependence among commodities and countries. These interdependencies produce apparently counterintuitive responses, which are described in economic textbooks as curiosities of possible responses. Among these are the following:

   (a) Supply of a commodity increases even when its price goes down.
   (b) Supply response depends not only on the relative protection across commodities within a country but also on protection rates for that commodity in different countries.
   (c) Terms of trade improve but still a country loses.
   (d) Short-term gains get reversed in the long term.

(2) Nominal protection rates, or even effective protection rates, can be misleading indicators of the real protection provided by a country. The changes in the world market prices consequent on removal of protection by a large country, or a number of small countries together, cannot be easily predicted; neither can the new relative prices or the new production responses be predicted without an analytical framework, such as the BLS, that accounts for the various interdependencies.
(3) Trade shares of countries change when agricultural trade is liberalized. Thus, the assumptions of constant trade share matrices that are often made in economic analysis may be a misleading simplification.

5.9.4. Policy implications

These methodological findings have some policy implications:

(1) Trade policy negotiations, such as GATT negotiations, should be carried out not for one commodity at a time but for a whole range of commodities simultaneously.
(2) It is possible that negotiating positions of countries in trade negotiations that do not account for the unpredictability and interdependence highlighted above are not in the best interest of the countries themselves. A model such as the BLS can contribute significantly in such negotiations.
(3) Determination of "fair market shares" referred to in GATT procedures requires the use of a system such as the BLS.

The results and policy implications of this scenario raise some questions. If trade liberalization by OECD countries improves their welfare, should not OECD countries such as the EC or the USA liberalize unilaterally? Should the developing countries also liberalize by themselves? Or should they liberalize along with the OECD countries? These questions are taken up in the chapters that follow.

CHAPTER 6

Unilateral Trade Liberalization by the EC or the USA

6.1. Unilateral Trade Liberalization by the EC

6.1.1. Why trade liberalization by only the EC?

The CAP of the EC is often regarded as a policy that distorts global agricultural trade significantly. Since, as seen in Chapter 5, the OECD countries gain from agricultural trade liberalization, it is of interest to see what would be the impacts of a unilateral trade liberalization by the EC, globally and on its domestic situation. However, to appreciate the impact of the removal of the currently pursued CAP by the EC, one first needs to know the objectives of the CAP. These are (Commission of the EC, 1958):

(1) To increase agricultural productivity by developing technical progress and by ensuring the national development of agricultural production and the optimal utilization of the factors of production, particularly labor.
(2) To ensure thereby a fair standard of living for the agricultural population, particularly by increasing the individual earnings of persons engaged in agriculture.
(3) To stabilize markets.
(4) To guarantee regular supplies.
(5) To ensure reasonable prices in supplies to consumers.

In pursuance of these objectives the CAP has become more and more inward-looking and protectionist, attracting criticism from both inside and outside the EC. [A detailed discussion of the CAP can be found, e.g., in Engels *et al.* (1984), Buckwell *et al.* (1982), and the literature quoted therein.] In addition, an evaluation of the CAP must also consider Article 112 of the Rome Treaty, which asks for international harmony in trade relations of the EC with the other countries.

Judged only from the EC's point of view, it is argued that the misallocation of resources due to distorted prices leads to welfare losses. Moreover, the CAP leads to income transfers that are not always intended: e.g., countries that are net importers of agricultural goods transfer financial assets to those countries that are net exporters of these goods (Ritson and Tangermann, 1979), and such transfers between countries are not intended by the CAP. In addition, though the CAP tries to ensure a minimum income to the agricultural sector as a whole, within the sector there is no provision for a guaranteed minimum income to individual farmers. Nor is income distribution within the agricultural sector considered as an important variable to be influenced. In fact, only some kind of "representative" income of farmers is used as a yardstick (von Witzke, 1979). In more recent years, another problem has surfaced: the EC has difficulties in raising the necessary money to pay for the increasing cost of the CAP.

Third world countries criticize the EC, especially for the impact that the CAP has on the world market and because it restricts entrance into the EC market. The rather rigid price policy of the EC under the CAP, which stabilizes domestic prices mainly through a system of variable levies, leads to a situation where the world market has to absorb to a large extent the annual changes within the EC in supply and demand balances in many agricultural products. In other words, the variations in quantities produced domestically are more or less exported by the EC on the world market as domestic prices are maintained, and demand for agricultural products adjusts but little in the EC. The impact of these policies on world market price stability varies from commodity to commodity. Empirical work indicates, however, that there are more destabilizing effects than stabilizing ones (see Schmitz, 1985, and the literature quoted therein). In order to sell the surplus quantities resulting from its high-price policy on the world market, the EC has to pay rather high export subsidies. This often makes it very difficult or even impossible for efficient exporting countries to compete with EC exporters.

Several attempts have been made to quantify the economic costs of the currently pursued CAP. One of the first to identify the cost of the CAP were Koester and Tangermann (1976), who calculated the costs for the Federal Republic of Germany (FRG) only. Their result indicates that about 0.3% of the national income is the cost of the CAP for the FRG (Koester and Tangermann, 1976, p. 198). More recent estimates are not confined to the FRG. Buckwell *et al.* (1982) estimate the welfare gains from a "free market" policy at 11051 million European Units of Account for 1980, which is approximately equal to 0.5% of GDP in that year (Buckwell *et al.*, 1982, p. 90, Table 6.2). In a recent study, de Veer (1985) estimates the benefits from liberalized trade of the EC to be 0.38% of the GDP (de Veer, 1985, p. 11, Table 2.5). Engels *et al.* (1984) assess the cost of the CAP to the consumer alone to be on the order of 36 billion ECU for 1982 by assuming an average protection for agriculture of 25% and using the value of production of this year, which was 144.8 billion ECU (Engels *et al.*, 1984, p. 17). This figure, amounting to 1.3% of GDP for this year, is only a rough estimate since costs (or benefits) to the producer and taxpayer were not accounted for. A recently published study by Matthews (1985) goes one step further than those mentioned so far: it analyzes the impact of EC trade liberalization in an international framework. The advantage of this approach is that changes in the world market prices are taken into account when the gains and losses from a liberalized EC trade are calculated. Matthews does not provide numbers on the costs of the CAP, but analyzes the impact on other countries and arrives at the conclusion that both other developed countries and the less developed countries would lose from the elimination of EC agricultural protection (Matthews, 1985, p. 141).

These estimates are made using different methodologies, all of which are based on a partial equilibrium approach. The general equilibrium adjustments within the EC as well as in other countries consequent on a liberalized CAP can be significant. A study by Burniaux and Waelbroeck (1985) follows the general equilibrium approach. These authors compare the results of free agricultural trade in Europe with two reference scenarios: one in which relative agricultural prices on the world market decline annually by 2.5% (low-price scenario) and one where they increase annually by 0.6% (high-price scenario). According to their results, real income (defined as GNP adjusted for the terms of trade) in the EC (the results of the region Europe are taken as being representative for the member countries of the EC) increases after abolition of the CAP by 2.7% in the low-price scenario and by 1.0% in the high-price scenario (Burniaux and Waelbroeck, 1985, Tables 7.3 and 7.6). The impact of this altered policy on LDCs is shown to be positive in the sense that real income increases and food demand is higher in these countries.

In this section, we describe the consequences of a liberalized CAP both for the EC and for other countries, generating a scenario using the BLS. The specification of agricultural trade liberalization in this scenario, called F-EC, is the same as that discussed in Chapter 5, except that in the present scenario only the EC liberalizes its agricultural trade, while all other countries continue to pursue their policy regimes of the reference scenario.

6.1.2. Trade liberalization by only the EC increases world market prices

A removal of the EC's protectionist policies leads to a price increase on the world market of about 5% (*Table 6.1*). This effect is more pronounced in the initial years of the new policies than in the later ones when the other countries have had time to adjust to the new situation. All relative agricultural prices increase, but the strongest rise occurs for dairy products (about 15%), the commodity that the EC protects most. It is therefore not surprising that bovine and ovine meat indicates the next-strongest price increase, because in many countries of the EC

Table 6.1. Percentage changes in prices[a] and volumes traded on the world market, and in global production, in 1990 and 2000, due to a unilateral trade liberalization by the EC compared to the reference scenario.

	World market prices		Global trade[b]		Production volume	
Commodity	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
Wheat	6.8	8.7	-3.4	-2.2	0.9	0.6
Rice	5.9	1.5	1.2	-1.8	0.1	0.1
Coarse grains	7.4	3.7	-6.6	-5.0	0.5	0.6
Bovine and ovine	11.1	6.9	12.5	14.4	-0.1	0.7
Dairy	18.9	14.9	-9.7	1.9	-0.8	-0.5
Other animal products	4.8	5.2	-1.1	5.2	-0.4	-0.6
Protein feed	2.9	0.3	0.4	-0.6	0.5	0.2
Other food	3.2	2.4	1.6	6.7	-0.1	+0
Nonfood agriculture	6.6	2.0	2.8	3.1	0.3	0.1
Nonagriculture			10.0	10.1	-0	-0
Total agriculture	6.2	4.5			-0	0

[a]Relative to the nonagricultural price.
[b]Sum of net exports.

the dual-purpose cow is prevalent: i.e., the production of milk and beef is interwoven so that assistance to dairy production also means assistance to beef production. Among the prices that increase more than the average in 2000 is that of wheat. This is again not surprising, since its protection level is relatively high (see *Table 4.12*) and the EC has a rather high share of the total volume traded in this product. The world market prices of all other commodities increase, but less than the average.

6.1.3. Volume of global trade is only slightly affected and global production changes are marginal in EC trade liberalization

Trade in grains contracts as a result of the EC's reduction of exports of wheat and import of coarse grains. Dairy products are traded substantially less in the initial period, but later the trade volume is slightly higher than in the reference run. This is a result of the rather sharp drop in the EC's dairy exports, which is not taken up by other countries. Initially, many importing countries increase their dairy production, reducing global trade, but over the long run dairy trade increases. As can be seen from *Table 6.1*, production contracts as well, but by a very small amount.

The largest percentage increase in trade volume is shown by bovine and ovine meat. Again, this is a direct impact of the EC, which imports considerably more of this commodity because of lower production and higher demand.

Production at the global level changes only marginally. Since demand is rather price inelastic and income does not change noticeably in the developing countries, where income elasticity of food is high, total consumption does not change. Therefore, production cannot increase. The non-EC countries need the price increase on the world market as an incentive to increase their production to compensate for the reduction in the EC. Even for those commodities that are largely used as feed (coarse grains and protein feed), no substantial change in global demand can be observed. The quantities used as feed change by less than 1% (coarse grains up and protein feed down). This also indicates that the shift in production of animals does not lead to a drastic change in the feeding ratios.

The global response in the volumes traded and produced does not reflect the substantial changes that occur at the country level. *Table 6.2* indicates how the trade pattern of a selected set of countries changes by 2000 as a result of trade liberalization by the EC. The EC's share in wheat trade drops almost to zero because of a substantial reduction in its wheat production and a simultaneous increase in demand. EC exports of wheat drop by 16.5 million tonnes. This is absorbed as follows: Australia, Canada, and the USA increase their exports, respectively, by 2.3, 4.8, and 3.5 million tonnes, which amounts to 64% of the reduction in the EC's volume. An additional 17% is taken up by a large number of other countries, each of which indicates only a small increase. The world trade in wheat is cut back by about 18% of the EC's reduction. There are also adjustments of small magnitude among the importers of wheat covering many countries.

Regarding coarse grains, the situation is substantially different. The reduction in imports of coarse grains by the EC is matched almost completely by a global lowering of exports. Many countries alter their import of coarse grains. The strongest change occurs in Japan, which reduces its import by more than a million tonnes, and in the country groups that increase their imports by slightly more than Japan's reduction. The countries forced to cut back their exports substantially are Argentina (2.1 million tonnes), Canada (1.2), and the USA (5.6). Together with Australia, these nations face the largest adjustments in the volume of grains (wheat and coarse grains) traded. All of them increase their trade share both in wheat and in coarse grains.

A different situation occurs for bovine and ovine meat. The EC increases its imports by 152%, of which 55% represents additional export quantities sold mainly by Argentina and 45% consists of reductions in imports elsewhere, notably by the USA. The case is similar in dairy products where the EC becomes an importer of 3 million tonnes instead of exporting 8.7 million tonnes. Twenty percent of this additional import is matched by additional exports, and 80% by reductions of imports, mostly by developing countries. India cuts its imports most. The increased volume globally traded and the quantities given up by the EC are sold mainly by the USA (76%). New Zealand and Argentina also increase their exports by small amounts. Canada continues to remain absent from the world market because it is assumed not to change its dairy policy of

Table 6.2. Changes in trade structure (percentages and volumes) worldwide and in selected countries in 2000 due to unilateral liberalization of agricultural trade in the EC, relative to the reference scenario.

Commodity	*World-wide*	*EC*	*Austra-lia*	*Argen-tina*	*Japan*	*Canada*	*USA*
Wheat[a]							
% in trade	−2	−94	15	−1	−3	19	5
Volume: export	−3.04	−16.48	2.32	−0.05	–	4.83	3.47
Volume: import	–	–	–	–	−0.30	–	–
Rice[a]							
% in trade	−2	163	+0	32	−32	−0	+0
Volume: export	−0.29	–	+0	+0.01	–	–	+0
Volume: import	–	0.32	–	–	−0.25	−0	–
Coarse grains[a]							
% in trade	−5	−43	2	−17	−3	−8	−4
Volume: export	−8.59	–	0.25	−2.14	–	−1.23	−5.64
Volume: import	–	−8.38	–	–	−1.27	–	–
Bovine and ovine meat[a]							
% in trade	14	152	17	32	−10	37	−23
Volume: export	0.86	–	0.8	0.49	–	0.13	–
Volume: import	–	1.57	–	–	−0.03	–	−0.30
Dairy products[b]							
% in trade	2	–[c]	+0	240	−44	–[f]	77
Volume: export	0.55	−8.70	+0	0.46	–	–	7.02
Volume: import	–	2.97	–	–	−0.18	−0	–
Other animal products[d]							
% in trade	5	–[c]	19	56	−5	8	–[f]
Volume: export	0.07	−0.08	+0	+0.02	−0.02	0.02	0.07
Volume: import	–	0.13	–	–	–	–	–
Protein feed[d]							
% in trade	−1	−6	−1	−4	−2	22	−2
Volume: export	−0.14	–	−0	−0.01	–	–	−0.28
Volume: import	–	−0.39	–	–	−0.08	0.07	–
Other food[d]							
% in trade	7	30	23	42	−4	−18	3
Volume: export	1.64	–	0.15	0.24	–	–	0.09
Volume: import	–	2.18	–	–	−0.07	−0.07	–
Nonfood agriculture[e]							
% in trade	3	13	4	15	−1	11	–[f]
Volume: export	0.22	–	0.03	0.07	–	0.02	+0
Volume: import	–	0.28	–	–	−0.01	–	–
Nonagriculture[e]							
% in trade	10	41	19	28	+0	32	21
Volume: export	6.03	5.76	–	–	0.01	–	–
Volume: import	–	–	0.51	0.77	–	0.62	1.62

[a]Volume in 10^6 t. [b]Volume in 10^6 t of milk equivalent. [c]In the case where a country switches its trade position, changes in percent are not given. [d]Volume in 10^6 t of protein equivalent. [e]Volume in 10^9 US$ 1970. [f]No percentage change is given when the volume traded in the reference scenario does not exceed 2% of domestic disappearance.

maintaining a 100% self-sufficiency level. Otherwise, it could be expected to take up some of the exports, as it does in the OECD trade liberalization scenario.

Trade in other animal products is also strongly affected by the EC. From being a net exporter in the reference run with a share of 6% of the world market, the EC becomes an importer and holds a share of about 2% under EC trade liberalization. Again, the USA replaces most (88%) of the EC's exports, with Argentina, Canada, and other developing countries also contributing to the increased global exports. The necessary cut in imports occurs only in the LDCs.

With regard to protein feed, the USA loses an important market and cuts back its exports when the EC liberalizes trade. Some of the world market share lost by the USA is taken up by Brazil. As expected, the EC's increase in imports of other food opens up the market for LDCs. They make up for two-thirds of the additional import by the EC, 18% comes from reduced imports by other countries (mainly Nigeria), and the remainder comes from adjustments in other developed countries.

Table 6.3. Percentage changes in agricultural trade deficit[a] at current prices in 2000 under EC trade liberalization relative to the reference scenario.

Country	*Change*	*Country*	*Change*	*Country*	*Change*
EC	69 D	China	–3 S	Mexico	34 S
		CMEA	15 D	New Zealand	17 S
Argentina	27 S	Egypt	–69 D	Nigeria	–5 D
Australia	17 S	India	11 S	Pakistan	–33 D
Austria	–50 D	Indonesia	0 D	Thailand	5 S
Brazil	–64 D	Japan	–1 D	Turkey	21 S
Canada	23 S	Kenya	8 S	USA	12 S

[a]D, deficit in reference scenario; S, surplus in reference scenario.

In summary, one can say that the EC influences the international trade structure quite substantially, as evidenced by the changes in trade that occurs as a result of its trade liberalization. Since all countries except China, the CMEA, and the EC improve their agricultural trade balances – the surplus countries increase their positive balance and the net importers of agricultural goods decrease their deficit – nonagricultural products are increasingly imported (see *Table 6.3*). To pay for its larger deficit in agricultural trade, the EC has to export approximately 40% more of nonagriculture. These additional exports, plus some more from the CMEA, are shared as increased imports by almost all countries. Brazil and Nigeria are an exception in this respect because they reduce their trade deficit in agriculture strongly so that they also have to cut back their exports of nonagriculture in order to match the overall trade balance, which shows only marginal changes for all countries between the EC trade liberalization and reference scenarios. However, in general, most LDCs increase their imports of nonagriculture.

6.1.4. EC's welfare improves in spite of a worsening of its terms of trade

As might already be expected, the terms of trade change unfavorably for the EC (see *Table 6.4*). The nearly 70% increase in the agricultural trade deficit of the EC is caused not only because the EC imports more of agricultural commodities but also by higher agricultural world market prices. Yet, the EC gains in welfare, as several indicators show. Equivalent income increases and so does life expectancy. Also, the nutritional status goes up. These improvements are due to a decline of the food price index and to a simultaneous increase in income.

The gains in equivalent income for the EC (the costs of the CAP) are approximately 0.4% in 2000. This number is quite similar to what was found in the other studies mentioned above. The work by Burniaux and Waelbroeck (1985) shows a considerably higher number than this 0.4% for the low-price scenario but not for the high-price scenario that is more comparable with the reference run, considering the changes of the relative agricultural prices on the world market.

The income increase for the economy as a whole comes in spite of a constant total labor force, a marginally reduced capital stock, and a reduction in acreage used. Hence, the income gain is due to a reallocation of resources to more productive uses. This shows how much the domestic market has misallocated its resources owing to price distortions, which were quite substantial, as can be seen from the fact that agricultural prices drop by more than 10% when they align with those of the world market. The crop price index falls even more than the one for all agricultural products. The worsening of the domestic terms of trade for agriculture leads to a redirection of investment and accelerated migration of labor out of agriculture, resulting in a 15% smaller agricultural labor force by 2000. The agricultural capital stock declines by about 7%. Fertilizer application is reduced by 23% while cultivated acreage goes down marginally by 2%.

The overall impact is a strong reduction of value added in agriculture of around 9%. The implicit price elasticity for GDP agriculture (at 1970 prices) is 0.74.

6.1.5. Farm sector is adversely affected: Income parity declines and out-migration increases

Income parity (ratio of current-price GDP in agriculture per worker to GDP in nonagriculture per worker) falls by 13.6% in 1990 and 5.7% in 2000 (see *Table 6.4*). The lower reduction in parity in 2000 than in 1990 can be mainly explained by a continued and fast out-migration of labor from agriculture in the 1990s. The reduction in agricultural GDP at current prices, which comprises both a loss in agricultural volume and a fall in agricultural prices, exceeds 20% in both 1990 and 2000.

Table 6.4. Percentage changes of some macroeconomic and welfare indicators in 1990 and 2000 under EC trade liberalization relative to the reference scenario.[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
GDP70	0	0	0.2	0.2	–0	–0.1	–0	–0.1	–0	–0.1	–0	–0.8
GDPA70	2.7	6.4	2.9	5.2	0.5	1.7	0.2	0.3	3.6	4.9	0.3	1.9
GDPNA70	–0.2	–0.6	–0	–0.1	–0	–0.2	–0.1	–0.1	–0.1	–0.2	–0.1	–1.3
AG HCons at P70	–0.6	–0.2	–0.3	–0.4	0.1	0.1	–0.8	–0.5	–0.1	0.3	–0.1	–0.2
NAG HCons at P70	0.4	1.1	0.1	0.2	0	–0.1	–0.4	–0.3	0.1	0.1	0	–1.0
Trade deficit 70	–0.6	–0.7	0.6	1.0	3.4	0.8	–3.8	0.8	0.9	1.0	–1.2	–0.5
AG trade deficit 70	12.0	16.5	6.8	11.0	–2.4	–21.0	13.2	–136.8	4.9	13.3	–0	–18.5
Trade/GDP at WP	21.5	25.7	13.3	17.0	4.4	–3.5	6.4	–0.6	12.5	21.5	2.6	18.0
GDPA at WP70	3.0	5.4	3.1	4.9	0.1	1.1	0.6	1.8	2.8	4.7	0.5	3.2
Investment	1.1	0.8	0.7	0.6	–0	–0.1	0.3	0	0.2	0	0.7	–0.4
Total capital	0.3	0.6	0.2	0.4	–0	–0	0.1	0.1	0	–0	0.2	0.1
AG vol. index WP70	2.9	5.9	3.1	5.0	0.4	1.3	0.6	1.7	2.9	6.2	0.6	3.3
Net calorie produced	4.1	–3.8	12.5	8.4	2.4	0.9	1.9	2.1	1.8	9.2	1.7	5.0
Agricultural capital	3.6	8.3	3.5	7.9	0.2	1.1	2.1	4.4	4.3	5.7	1.3	3.9
Agricultural labor	2.8	6.8	0.3	1.4	0.5	2.0	0.1	0.3	3.2	6.0	0.3	2.3
Total acreage	4.6	1.4	1.3	0	0	–0	1.1	1.7	3.0	1.5	0.4	3.2
N fertilizer	3.4	11.4	23.5	17.3	2.5	2.2	0.4	1.6	3.0	25.1	1.1	4.6
P_A/P_N	7.9	5.4	7.8	5.4	1.5	0.7	5.2	3.8	4.8	2.1	5.2	4.1
AG CSWP Index Y70	8.1	5.5	8.8	6.3	8.7	6.9	5.3	3.7	7.9	6.4	5.7	3.9
Crop price index	4.6	3.1	6.8	6.7	2.1	2.1	3.5	1.9	5.0	3.2	4.3	2.4
Food price index	5.5	3.3	4.9	3.9	0.7	0.5	3.4	2.5	2.1	0.3	2.9	1.7
Terms of trade	8.8	9.1	6.4	5.5	3.9	6.3	1.7	–3.7	7.1	7.9	–0.4	–1.2
Terms of trade R	7.7	5.1	7.4	5.3	3.2	3.1	–0.4	–5.4	5.7	6.0	–0.7	–1.9
AG SSR	3.0	4.4	2.5	4.3	0.2	0.9	0.9	1.7	–0.7	3.3	0.6	3.3
AG SCR	0.1	0	0	0	–0	0.8	0.8	0.7	0.2	0.7	0.4	0.7
Parity	7.8	4.9	10.7	9.5	1.5	0.4	5.2	3.8	5.2	1.0	4.9	2.9
Equivalent income	0.2	0.9	0.1	0.2	0	–0.1	–0.4	–0.3	0	0.1	–0.1	–0.7
Calories/capita	–0.4	–0.2	–0.1	–0.2	0.1	0.1	–0.6	–0.4	0	0.2	–0.1	–0.1
Protein/capita	–0.4	–0.1	–0.1	–0.2	0.2	0.1	–0.7	–0.4	0.1	0.3	–0.1	–0.1
Number hungry	8.0	3.4	–	–	–	–	6.8	7.8	–	–	–	–
Life expectancy	–0.2	–0.2	–0	–0.1	0	0	–0	–0.1	–0.1	–0	–0	0

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*.

Table 6.4. (Cont.)[a]

Indicator[b]	*India*		*Indonesia*		*Japan*		*Kenya*		*Mexico*		*New Zealand*		*Nigeria*	
GDP70	0.1	0	–0	0	–0	–0.1	0.3	0.7	–0.5	–0.8	0.4	0.6	0.2	0.5
GDPA70	0.1	0.1	0.1	0.2	0.3	1.2	0.7	2.1	0.7	1.8	2.9	4.7	0.8	3.3
GDPNA70	0.1	0	–0.1	–0	–0	–0.1	0.1	0.3	–0.6	–1.0	0	0	0	–0.1
AG HCons at P70	0	0.2	0.1	–0.1	–0	–0.1	0.9	1.0	–0.8	–0.6	0.5	0.7	–0.3	–0
NAG HCons at P70	0.2	0.2	–2.3	–0.4	–0.2	–0.3	–0	1.2	–0.3	–0.5	1.6	1.4	0	0.8
Trade deficit 70	–0.3	0.7	1.9	0.9	1.7	1.0	–2.3	–0.4	–1.3	–1.4	–5.3	–166.9	0.8	0.4
AG trade deficit 70	8.4	83.5	1.0	–2.9	–0.6	–3.3	–6.7	5.3	32.7	32.1	4.3	8.4	–4.3	–10.3
Trade/GDP at WP	0.9	1.3	5.0	–0.4	4.6	–0.2	–4.0	3.1	5.8	16.1	14.8	14.8	0.6	–6.5
GDPA at WP70	0	0.1	–0	0.2	–0.1	0.4	–0.6	1.8	1.1	1.9	3.3	5.4	0.5	2.7
Investment	–0.1	0.4	0.5	0.2	0.1	–0.1	2.6	2.4	0	–0.8	3.0	2.2	0.8	1.1
Total capital	NA[c]	NA[c]	0.1	0.2	0	0	0.8	1.7	0	–0.5	1.0	1.8	0.3	1.0
AG vol. index WP70	0	0.1	0	0.2	–0.3	–0.3	–0.6	1.8	1.1	1.9	2.5	4.7	0.5	2.8
Net calories produced	0.2	0.4	0	0.3	–31.9	–17.4	–0.5	1.7	9.9	2.8	2.9	6.1	0.9	2.7
Agricultural capital	NA[c]	NA[c]	0.4	0.9	0.4	1.9	2.4	5.3	1.1	2.0	6.0	11.8	0.9	3.8
Agricultural labor	NA[c]	NA[c]	0.1	0	0.5	2.1	0	0	1.3	2.1	0.4	1.1	0.5	2.2
Total Acreage	0	0	0	0	0	0.8	NA[c]	NA[c]	–0.0	0	NA[c]	NA[c]	1.4	2.5
N fertilizer	0.7	1.9	–0.1	0.4	1.4	2.0	–2.7	0.7	6.1	1.9	–2.9	–1.1	0.6	3.7
P_A/P_N	2.4	1.5	1.7	1.1	4.0	2.7	8.1	5.8	3.5	0.6	13.1	8.4	2.2	0.6
AG CSWP Index Y70	6.1	3.7	4.4	2.6	5.1	4.0	6.7	4.8	6.3	4.6	11.3	7.8	4.0	2.9
Crop price index	NA[c]	NA[c]	1.1	0.5	2.8	1.4	4.5	2.7	3.9	0.7	4.2	2.9	1.5	0.8
Food price index	NA[c]	NA[c]	1.0	0.6	2.6	2.0	6.3	4.8	1.6	0.1	5.8	5.2	1.5	0.9
Terms of trade	4.8	2.8	–5.5	–3.2	–5.1	–2.3	5.1	2.5	3.8	3.9	11.8	7.7	–6.2	–5.3
Terms of trade R	3.8	2.6	–5.8	–3.3	–5.0	–2.3	3.5	2.0	2.4	2.9	11.8	7.7	–6.2	–5.5
AG SSR	0.2	0.2	–0.1	0.3	0.1	0.6	–1.3	1.0	2.0	2.0	2.0	3.7	0.7	2.9
AG SCR	0.2	0.2	–0	0.3	–0.1	1.1	0.8	0.2	1.7	0.4	–1.2	–0.2	0.7	2.9
Parity	1.4	0.7	1.7	1.2	3.8	1.8	8.7	7.8	2.7	0.3	15.8	12.2	2.1	0.4
Equivalent income	–0.3	–0.2	–0.6	–0.2	–0.2	–0.2	NA[c]	NA[c]	–0.4	–0.5	NA[c]	NA[c]	–0.3	0.3
Calories/capita	–0.2	–0.2	0.2	–0.1	–0	0	0.9	1.0	–0.5	–0.3	0.1	0.2	–0.4	–0.1
Protein/capita	–0.3	–0.2	0.1	–0.1	–0.3	–0.3	1.0	1.0	–0.8	–0.6	0.1	0.1	–0.7	–0.3
Number hungry	1.1	1.3	–3.1	0	–	–	–3.7	–4.6	7.4	5.4	–	–	3.4	3.5
Life expectancy	–0.1	–0.1	0	–0	–0	–0	0.2	0.3	–0.3	–0.3	0	0	–0.2	–0.3

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.* [c]NA, not available.

Table 6.4. (Cont.)[a]

Indicator[b]	*Pakistan*		*Thailand*		*Turkey*		*USA*		*CMEA*		*EC*	
GDP70	0.2	0	–0	0.1	0.1	–0.2	–0	–0	–0.1	–0.3	0.1	0.2
GDPA70	1.0	1.6	0.2	1.0	1.7	3.6	1.1	2.4	–0.2	–0.1	–3.1	–8.9
GDPNA70	–0	–0.5	–0	–0.1	–0.2	–0.7	–0.1	–0	–0.1	–0.3	0.2	0.5
AG HCons at P70	–1.1	–0.5	–0.6	–0.8	–0.4	–0.1	–2.2	–0.8	0.1	0.4	2.8	1.9
NAG HCons at P70	2.3	1.4	0.3	0.3	0.3	–0	–0.1	0.1	0	–0.1	0.1	0.2
Trade deficit 70	–1.0	0.7	–1.4	0.2	–1.0	0.7	1.7	1.3	0	0	3.2	2.6
AG trade deficit 70	–71.5	–83.4	0.3	3.1	10.3	18.3	6.4	4.5	6.9	11.8	49.3	60.0
Trade/GDP at WP	5.8	4.7	2.4	4.2	5.3	13.3	12.6	12.1	12.8	15.4	16.9	29.1
GDPA at WP70	1.7	2.1	–0.3	0.2	0.7	2.5	0.8	1.3	–0.4	–0.8	–2.7	–9.1
Investment	1.0	0.1	1.1	0.6	0.9	–0.1	–0	–0	–0.3	–0.6	–0.5	–0.1
Total capital	0.2	0.3	0.2	0.4	0.4	0.3	NA[c]	NA[c]	–0	–0.3	–0.2	–0.2
AG vol. index WP70	2.0	2.2	–0.1	0.6	1.2	2.6	0.9	1.5	–0.1	–0.1	–4.6	–10.0
Net calories produced	5.9	4.5	0.7	0.1	6.0	4.2	0.5	0.3	–0.4	–1.3	–20.7	–18.7
Agricultural capital	0.9	1.6	1.2	2.9	2.3	3.8	0	0	0.1	0.2	–2.4	–7.2
Agricultural labor	0.4	1.1	0	0	0.3	1.5	NA[c]	NA[c]	0	0	–6.2	–14.9
Total acreage	0.5	0.3	NA[c]	NA[c]	1.1	0.7	0.9	0.3	NA[c]	NA[c]	–1.8	–2.2
N fertilizer	6.9	4.0	–0.4	0.1	1.4	2.8	NA[c]	NA[c]	–0.6	–0.1	–22.4	–22.7
P_A/P_N	2.6	0	6.0	4.4	4.8	0.1	6.6	3.8	0	0	–16.5	–12.1
AG CSWP Index Y70	8.4	6.1	4.9	2.8	5.6	4.2	7.7	5.7	7.4	5.9	8.2	6.6
Crop price index	2.3	0.5	4.6	2.1	3.7	1.8	0	0	NA[c]	NA[c]	–15.3	–17.8
Food price index	1.6	0.1	2.9	2.3	1.9	0.4	3.8	1.6	NA[c]	NA[c]	–7.1	–5.3
Terms of trade	4.1	3.2	3.7	2.3	5.5	3.2	7.3	7.2	–5.4	–3.1	–6.8	–7.5
Terms of trade R	3.7	3.1	3.6	2.3	5.0	3.4	4.3	3.5	–5.3	–3.4	–2.5	–1.2
AG SSR	3.1	2.7	0.1	0.7	0.7	2.1	2.0	1.4	–0.3	–0.6	–6.7	–10.8
AG SCR	0.8	1.2	–0.0	0	0.5	0.4	0.8	0.4	–0.3	–0.6	–2.4	–6.7
Parity	2.9	0.2	6.3	5.6	6.3	2.1	6.6	3.8	NA[c]	NA[c]	–13.6	–5.7
Equivalent income	0.6	0.5	NA[c]	NA[c]	0.1	–0	NA[c]	NA[c]	NA[c]	NA[c]	0.4	0.4
Calories/capita	–1.2	–0.5	–0.1	–0.2	–0.1	–0.1	NA[c]	NA[c]	0	0.1	1.2	1.0
Protein/capita	–1.2	–0.5	–0.2	–0.3	–0.1	–0	NA[c]	NA[c]	0	0.2	1.8	1.1
Number hungry	11.7	6.9	.8	1.7	3.1	1.6	–	–	–	–	–	–
Life expectancy	–0.4	–0.3	–0	–0	–0.1	–0.2	–0.1	–0.1	NA[c]	NA[c]	0.3	0.4

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*. [c]NA, not available.

Though the loss in farm income may seem high in percentage terms, it is in fact smaller than the level of protection removed. In order to protect the income of farmers, not only does income have to be maintained, but those who move out of agriculture have to be absorbed productively in the nonagricultural sector. Since the per capita GDP increases, those who migrate out are indeed absorbed in the nonagricultural sector, which yields them a higher income on average. Those remaining in agriculture may be compensated for their loss in income parity through nondistorting means such as lump-sum transfers.

Though the out-migrants are absorbed in the nonagricultural sector in the model scenario, one should not underestimate the hardship caused by the migration of the agricultural labor force to other sectors of the economy. The 15% fewer people working in agriculture by 2000 amount to 0.8 million. This increases the average annual rate of out-migration by 35% above the reference scenario (from 2.3% in the reference run to 3.1% in the present scenario). Though this many jobs may be available in nonagriculture, the particular farmers being driven out may not have the ability to acquire the skills needed for these jobs. Thus, in reality they may suffer hardships not indicated in the scenario and may require special measures to support their standard of living.

Although enforcing this scenario would be very difficult, its results might shed some light on the extent to which the CAP of the EC fulfills its objectives. This is examined below in turn for the various objectives.

Objective (1). To increase agricultural productivity by developing technical progress and by ensuring the national development of agricultural production and the optimal utilization of the factors of production, particularly labor.

The CAP does not lead to optimal utilization of factors of production, particularly labor. This is clear from the fact that GDP increases, as does the shadow price of labor in agriculture, when the CAP is liberalized. The extent to which the CAP induces technical progress cannot be determined from the scenario, as induced technical progress is not so modeled.

Development of agriculture as measured by a volume index of agricultural production is indeed stimulated by the CAP. However, the loss in volume of production with removal of the CAP is about 10% by the year 2000.

Objective (2). To ensure thereby a fair standard of living for the agricultural population, particularly by increasing the individual earnings of persons engaged in agriculture.

Though the agricultural sector as a whole loses income when the CAP is liberalized, it is not obvious that the CAP increases the individual earnings of persons with small holdings engaged in agriculture. Since, when the CAP is liberalized, the shadow prices of labor and capital go up by 5% but that of land falls by 50%, it is quite likely that the loss of income suffered by the small farmers will be very small, if indeed they do suffer a loss.

Objective (3). To stabilize markets.

Though market stability has not been analyzed, as was pointed out earlier, the literature indicates that the CAP can have both stabilizing and destabilizing effects.

Objective (4). To guarantee regular supplies.

The agricultural self-sufficiency ratio falls by nearly 11% in 2000 when the CAP is removed. The EC's ability to command such additional agricultural imports is indeed very large. Thus, regular supplies could be guaranteed for EC consumers by relying on the world market rather than on domestic production. Thus, though the CAP can be said to ensure regular supplies through domestic production, the CAP is not needed to ensure regular supplies.

Objective (5). To ensure reasonable prices in supplies to consumers.

In this, clearly, the CAP has failed, as removal of it will result in lower prices for consumers.

In summary, the results of the scenario indicate that agricultural trade liberalization by the EC would not be contradictory with the objectives of the CAP.

6.1.6. Changes in structures of production and demand in the EC

The price decline for EC farmers occurs across all commodities, but with different intensities (see *Table 6.5*). Most severely affected are the crops; the price drop is considerably less for livestock products. The differences in farm price reductions in different commodities are due not only to the varying levels of protection removed but also to the fact that on the world market the prices of different commodities change differently. Thus, the prices of bovine and ovine meat and, especially, dairy products increase on the world market more than the prices of other commodities and, consequently, the EC producer prices fall least for these two products. The decline in domestic grain prices gives livestock products another advantage through lower feed costs. By 2000, the ratio of average feed costs to average gross revenue of all animals falls by 12%. Since feed concentrates become relatively cheaper, the yield level of dairy cattle rises by 3%. In addition, beef cattle are slaughtered at a slightly higher weight. All

Table 6.5. The EC: Production, export, and feed in 2000 under EC trade liberalization compared to the reference scenario.

	R0: absolute values[a]			*F-EC: % change over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Export (net)*	*Feed*	*Retail price*	*Producer price*
Wheat	64.56	17.64	22.46	–25.1	–0.4	–93.5	4.3	–10.5	–33.7
Rice	1.01	–0.19	0.34	–31.1	0.4	162.5	–9.0	–23.0	–37.2
Coarse grains	88.35	–19.62	88.24	4.1	–4.5	–42.7	–5.8	–25.6	–26.2
Bovine and ovine	10.31	–1.03	0.01	–12.1	2.8	152.9	–7.1	–3.5	–6.7
Dairy	117.39	8.70	21.26	–11.2	–1.3	–134.1	–8.7	–3.6	–6.9
Other animal products	3.03	0.08	0	–6.1	0.9	–263.9	0	–7.1	–9.7
Protein feed	1.28	–6.39	7.60	–6.1	–6.1	–6.1	–6.1	–26.1	–26.1
Other food	16.20	–7.17	0.98	–11.9	1.1	30.4	–22.8	–4.7	–10.6
Nonfood agriculture	1.04	–2.05	0	–13.1	4.6	13.4	0	–20.5	–20.5
Nonagriculture	1481.76	14.19	0	0.5	0.1	40.6	0	–3.8	–3.8

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.

these facts lead to a drastic shift in the revenues per animal compared to net revenue per hectare of the various crops (see *Table 6.6*). The decline of net revenues of crops exceeds that of the corresponding prices because of a drop in yield levels caused by lower fertilizer application rates.

Table 6.6. The EC: Net revenue per hectare and per animal unit in 2000 under EC trade liberalization compared to the reference scenario.

Commodity	*R0: absolute values*[a]	*F-EC: % change over R0*
Wheat	0.22	–57.6
Rice	0.46	–60.7
Coarse grains	0.22	–40.3
Protein feed	1.76	–19.7
Other food	1.82	–14.7
Nonfood crops	2.69	–25.9
Fruits	0.58	–15.0
Other animal products	3.42	4.3
Bovine and ovine	190.28	–6.3
Milk animals	500.27	–3.2

[a] 10^3 × national currency per hectare for wheat, coarse grains, protein feed, other food, and nonfood crops; national currency per 1970 US$ for fruits; 10^3 × national currency per tonne of protein equivalent for other animal products; national currency per head for bovine and ovine and for milk animals.

Based on the changes in net revenue, one might expect that animal production is increased while crop production decreases. As *Tables 6.5* and *6.6* reveal, this is not the case. The net revenue figures in these tables do not account for the shadow prices of agricultural factors: labor, capital, and land. In determining the changes in production structure, the changes in the shadow prices of these factors are also important. Production of all three livestock products goes down, and among the crops only coarse grains are produced in larger quantities. The latter phenomenon can be explained by the high cross-price elasticity between wheat and coarse grains, as was done in the previous chapter. Livestock production is cut back because its relatively high capital and labor intensities make it more difficult to compete for the scarcer resources, labor and capital. The shadow prices of both labor and capital increase by about 5%. That the competitiveness of crops is not reduced as much as indicated by the drop in net revenues is also due to the sharp fall in shadow price of land (50% in 2000).

Retail prices for coarse grains, protein feed, nonfood agriculture, and nonagriculture fall as much as their counterparts at the producer level. All other retail prices fall less. The pattern of demand, however, does not shift drastically. These changes are caused also by the altered feed uses which, in general, go down, except for wheat. Wheat is substituted for coarse grains because it gets relatively cheaper.

The EC becomes, in general, more dependent on the world market for agricultural products. This is especially evident for livestock products, and less so for the grain sector. Agricultural self-sufficiency goes down by approximately 11% (see *Table 6.4*).

6.1.7. Impact on other countries

Welfare Loss for Most Developing Countries in Spite of Terms-of-trade Gains

The effect of trade liberalization by the EC on other countries may be broadly summarized as follows (see *Table 6.7*). The developing countries lose from such a policy whereas the developed countries gain in terms of the welfare indicators of equivalent income, number of people hungry, and life expectancy. However, a few exceptions exist to this more general observation. Among the developing countries, Argentina, Nigeria, and Pakistan gain on equivalent income but lose on the other two indicators while Kenya gains with respect to people hungry, life expectancy, and the consumption cost comparison. Among the developed countries, Austria and Japan lose with respect to equivalent income and do not indicate any change with respect to life expectancy.

If one looks for an explanation of why the LDCs are in general worse off under EC trade liberalization, then one must first note that in all of them the agricultural price rise observed for the world market is transmitted to the domestic market, but with various intensities (see *Table 6.4*). As a result, value added by agriculture increases. However, the response of total GDP to an agricultural price increase is mixed. In only two LDCs (Kenya and Nigeria) is this response positive, in most it is insignificant, and in some even negative. Among the latter are Brazil, Egypt, Mexico, and Turkey. In those countries the increase in agricultural GDP is more than offset by a decrease in nonagricultural GDP. The reason is that agriculture's increased competitiveness attracts more resources, which are drawn from nonagriculture although their marginal productivity is higher in nonagriculture. This behavior reflects the reverse of what happened in the past when resources were retained in agriculture in spite of a higher return in nonagriculture.

The higher agricultural prices lead also to an increase in food prices. Together with the lack of additional income, this leads to a lowering of food consumption. Therefore life expectancy goes down, and the number of hungry people rises.

From a trade point of view, it is interesting to see that the terms of trade improve under EC trade liberalization for almost all LDCs (see *Table 6.4*). Brazil, Egypt, Indonesia, and Nigeria are exceptions to this rule. All four of them have a very low self-sufficiency ratio for wheat (the ratio for Indonesia and Nigeria is zero). As already mentioned, the wheat price increases the most of all crop prices on at the world market, and only dairy products have a stronger rise.

Table 6.7. Gains and losses on some welfare and macroeconomic indicators in 2000 under EC trade liberalization relative to the reference scenario.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consump-tion cost*	*People hungry*	*Life expect.*
USA	NS	G	–	ID	–	NS
Canada	NS	G	G	G	–	NS
Australia	G	G	G	G	–	NS
New Zealand	G	G	–	G	–	NS
Austria	NS	G	L	L	–	NS
EC	G	L	G	G	–	G
Japan	L	G	L	L	–	NS
CMEA	L	–	–	L	–	–
China	NS	–	–	ID	–	–
Argentina	G	G	G	G	L	L
Brazil	L	G	L	L	L	L
Mexico	L	G	L	L	L	L
Egypt	L	G	L	L	–	L
Kenya	G	G	–	G	G	G
Nigeria	G	G	G	G	L	L
India	NS	G	L	L	L	NS
Indonesia	NS	G	L	L	–	NS
Pakistan	G	G	G	G	L	L
Thailand	NS	G	–	G	L	NS
Turkey	L	G	NS	L	L	L

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

The USA Improves its Market Shares

A large share of the changes in the EC's trade pattern is taken up by the USA. This underlines the importance of the USA as an exporter of agricultural products, but also the competition between the EC and the USA for shares of the world market. It is especially interesting that the USA expands its wheat export while it cuts that of coarse grains. This can be explained by the improvement of the wheat price relative to that of coarse grains as observed on the world market (see *Table 6.1*). Accordingly, US wheat production is increased while US coarse grain production remains unchanged. Since animal production is increased, and thereby feed consumption of grains, the new export pattern results. However, the USA cannot prevent the world market prices of the two grains from diverging rather strongly under EC trade liberalization and reaching a gap reflecting the more distant past. The export subsidies for wheat that the EC grants its exporters depress the wheat price on the world market in the reference scenario.

A similar observation can be made for dairy products. The relative price increase for dairy products on the world market under EC trade liberalization is a result of the drop of the export restitutions. The changed volumes of dairy products traded by the EC cannot be compensated by other countries, although all countries except India react with an increase in dairy production, especially the USA. But, as mentioned earlier, the assumption that Canada does not change its policy of supply management to remain just self-sufficient may also contribute to the rise of the world market price. If Canada were to mobilize its production potential for dairy products, the price increase might be much smaller.

6.1.8. Comparison with other studies

As mentioned already above, the costs of the CAP calculated in this scenario are found to be quite similar with numbers from other studies, except perhaps the study by Burniaux and Waelbroeck (1985). *Table 6.8* provides an additional comparison. The changes in agricultural world market prices due to trade liberalization by the EC are shown for those studies that endogenize the international terms-of-trade effects in their analysis.

As usual, the comparison is made difficult owing to differences in the approach followed, in commodity aggregation, in the number of countries included, in the transmission of world market price changes on the domestic market, and in the level of protection assumed for the EC. Anderson and Tyers (1984) and Matthews (1985) use a static partial equilibrium approach while Burniaux and Waelbroeck (1985) employ a dynamic general equilibrium type of model. Anderson and Tyers consider five agricultural commodities and disaggregate the world into 24 countries; Matthews analyzes the trade impact for 11 agricultural commodities and 191 countries; and Burniaux and Waelbroeck distinguish 13 agricultural and five nonagricultural aggregates and break the world up into nine regions of which one is Western Europe (neither Anderson and Tyers nor Matthews covers the agricultural sector).

Burniaux and Waelbroeck indicate the largest price increases on the world market when the EC liberalizes agricultural trade. This might be an outcome of the assumption made with regard to the development of the world market prices in their reference scenario (which fall 2.5% annually in the low-price scenario) and of the EC prices. To maintain income parity between rural and urban labor, EC agricultural prices increase in their reference scenario relative to those prevailing on the world market, moving the protection level up as well. This, in turn, leads to a substantial contraction of the agricultural sector in the EC when tariff equivalents are removed (rural GNP declines by 12.4%). To compensate for the EC's output reduction, other countries need a substantial price incentive at the domestic level. With a price transmission elasticity below unity, the world market prices must increase even more than prices at the national levels. [In

Table 6.8. The impact of EC trade liberalization on world market prices: A comparison of FAP results with other studies.[a]

Commodity	*FAP*[b]	*Anderson and Tyers*[c]	*Matthews*[d]	*Burniaux and Waelbroeck*[e]
Wheat	8.7 (112)	13 (110)	0.7 (16)	
Rice	1.5 (61)	5 (47)	0.1 (36)	
Coarse grains	3.7 (37)	16 (83)		
Barley			2.9 (27)	
Maize			0.5 (34)	
All grains				13.4
Ruminant meat	6.9 (12)	17 (94)		17.3
Beef			3.9 (35)	
Mutton			5.0 (72)	
Dairy products	14.9 (34)			16.3
Butter			10.5 (70)	
Skim powder			7.5 (43)	
Other animal products	5.2 (24)			
Nonruminant meat		1 (40)		
Pork			4.0 (30)	
Poultry			3.2 (30)	
Protein feed	0.3 (36)			
Oilcake			-7.9	
Other food	2.4 (12)			
Sugar[f]			6.0	
Vegetable oil[f]			5.0	
Fruit and vegetables[f]				16.3
Average protection in reference scenario	27[g]	NA[h]	NA[h]	77

[a]The numbers are percentage changes in world market prices due to agricultural trade liberalization by the EC. The bottom row gives the weighted average protection rate in the reference run (in %). The figures in parentheses are the protection rates (in %).
[b]Figures are for the year 2000 (see *Table 6.1*).
[c]Anderson and Tyers (1984), Table 2.
[d]Matthews (1985), Table 7.1.
[e]Burniaux and Waelbroeck (1985), p 131. The comparison is made with a base run in which the relative agricultural world market prices fall annually by 2.5%. Results are given for 1995. The authors do not provide commodity-specific protection rates.
[f]Matthews assumes a production cut of 3.5 million tonnes for sugar, a consumption reduction of 7.0 million tonnes for oilcakes, and an increase in the world market price of vegetable oils of 5%.
[g]Weights are based on the values of production in 2000.
[h]NA, not available.

their paper, Burniaux and Waelbroeck (1985) state that the price changes at the world market are not fully passed through to the domestic level.]

The results of Anderson and Tyers and of Matthews are not directly comparable with those obtained by either the FAP or Burniaux and Waelbroeck because of the difference in the approach. All four studies show, however, some striking differences in the protection rates underlying their results. But these also cannot strictly be compared. Those of the FAP and of Burniaux and Waelbroeck are the outcome of assumptions about future price policies, while Anderson and Tyers use protection rates prevailing in 1980, and Matthews (1985, p. 113) took averages over the years 1978–1982. Their impact on EC prices under EC trade liberalization and, hence, on output can explain to some extent the different effects on world market prices.

One important difference in the results between the study by Burniaux and Waelbroeck and the present one is the impact of the CAP on LDCs (not shown in *Table 6.8*). The former indicates gains for LDCs while the FAP results imply losses when the EC liberalizes agricultural trade. Since both these studies use a general equilibrium approach and arrive at somewhat opposing conclusions, the Burniaux and Waelbroeck study is discussed in some detail here. The summary statement about the impact of an EC trade liberalization on LDCs is based on real income and food demand in the analysis by Burniaux and Waelbroeck, and on equivalent income, calorie intake, and number of hungry in the present study. Although these indicators are not fully comparable, their differences cannot explain the difference in the result. [Food demand changes were also aggregated using 1970 retail prices in the present study. All countries but India showed the same direction of movement in food demand as in calories intake.] Burniaux and Waelbroeck argue that the EC's trade liberalization raises world agricultural prices relative to the world's manufactured goods prices; this improves the terms of trade for developing countries and makes investment goods cheaper, so that their economies expand. More gross value added and improved terms of trade lead to larger real income (GNP adjusted for terms of trade), and finally to more effective food demand. The gain in food consumption is not equally distributed over the entire population. In all regions except the oil-exporting countries, the urban population suffers from the high food prices and consumes fewer food products. The rural population, however, increases food consumption to such an extent that, on the average, food intake improves for the entire population. Only in Southeast Asia and the Mediterranean LDCs does the food intake decline. The latter countries also face a drop in real income.

In the national models of the BLS also, a higher relative price of agriculture stimulates investments and growth. However, in some of the countries showing higher growth, the number of hungry persons increases. Thus, in the model of India, which distinguishes five rural and five urban income classes, in spite of higher GDP, improvement in terms of trade, and larger household consumption of agriculture on the average, calorie intake on the average goes down and the poorest classes in both rural and urban areas are worse off. Moreover, the terms of trade for a number of developing countries decline as a result of liberalization of the CAP.

Whether the growth effect offsets the price effect depends on the parameters of the models. This emphasizes the need to estimate empirically parameters in such models, as has been done for most parameters in the BLS. The parameters of the demand systems (an extended linear expenditure system) in the study by Burniaux and Waelbroeck lead to a somewhat puzzling outcome. For example, for the regions Latin America and Southeast Asia, rural GNP goes up by 0.9% and 0.3% and food intake per capita by 2.2% and 4.0%, respectively. At the same time, urban GNP goes up in the former region by 2.6% and by 1.0% in the latter, resulting in a decline of per capita food intake of 0.1% and 1.7%, respectively. Assuming that the food price changes are equal in both the rural and the urban sectors, this implies that the marginal propensity to consume food with respect to real income is *positive* for the rural population (as one would expect) but *negative* for the urban population (as one would not expect in developing countries).

The case of India and the fact that the terms-of-trade effect varies from country to country underline the importance of looking at national rather than regional levels and of accounting in some way for income distribution effects in assessing the results, as has been attempted in the present analysis through calculation of changes in the number of hungry persons.

The BLS result that higher food prices adversely affect the poor in many developing countries is consistent with what some scholars of developing country food policy argue (see Mellor, 1982).

6.2. Unilateral Trade Liberalization by the USA

The protection level of the USA is considerably lower than that of the EC. The tariff equivalents calculated for the USA in the reference run are also constant over time (see *Table 4.12*). The products for which the USA imposes protectionist measures are mainly ruminant products, and here especially dairy products. (In recent years, the USA used protectionist measures for wheat, coarse grains, rice, and cotton, which are even higher than those used for dairy products.) Import quotas are used in both cases, amounting to a tariff equivalent in 2000 of 80% for dairy products and 28.5% for bovine and ovine meat. In addition to ruminant products, the aggregate nonfood agriculture is protected with a tariff equivalent of 28% and other food with a tariff equivalent of 5%. Other animal products, of which the USA is an exporter in the reference run, are charged an export tax of 5%.

A unilateral trade liberalization by the USA – the scenario called F-USA – results in an average increase of world market prices of approximately 5% (see *Table 6.9*). Although this figure is similar to the one obtained when the EC unilaterally liberalizes its agricultural trade, the price changes of the individual commodities are substantially different. Grain prices in the year 2000 hardly differ from the values obtained in the reference run. The prices of ruminant products increase substantially (more than 14% for bovine and ovine meat and approximately 40% for dairy products), while other animal products and nonfood

Table 6.9. Percentage changes in prices[a] and volumes traded on the world market, and in global production, in 1990 and 2000, due to unilateral trade liberalization by the USA, relative to the reference scenario.

	World market prices		*Global trade*[b]		*Production volume*	
Commodity	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
Wheat	–0.4	1.6	0.7	2.3	–0.1	0.6
Rice	–1.0	0.2	0.1	–1.3	0.1	–0
Coarse grains	–1.5	0.8	5.0	0.7	0.1	1.0
Bovine and ovine meat	18.8	14.3	31.3	25.2	0.6	2.7
Dairy products	28.8	39.0	9.9	–2.1	0.4	1.3
Other animal products	–3.3	–2.2	1.6	0.4	0.1	–0.4
Protein feed	0.9	0.3	–1.1	–0.7	–0.5	0.3
Other food	0.3	1.1	–0.4	2.4	–0	–0.1
Nonfood agriculture	–1.9	–5.8	0.5	–0.4	–0.4	–1.9
Total agriculture	3.2	4.6			0.1	0.2
Nonagriculture			–0.5	0.6	0	–0

[a]Relative to the nonagricultural price.
[b]Sum of net exports.

agriculture become somewhat cheaper. The remaining products – protein feed and other food – hardly change their world market prices.

By and large, the changes in world market prices follow the protection levels that the USA imposes in the reference run. The removal of a positive (negative) protection measure decreases (increases) the domestic price and hence stimulates (reduces) domestic demand while simultaneously cutting (increasing) production. As a result, the world market prices increase (decrease) but with differences in magnitude depending on the response of the other countries to a world market price change. The only exception to this rule is nonfood agriculture. In spite of a change in the US trade position from an exporter to an importer, other countries respond to the changed structure of all world market prices, and the world market price of nonfood agriculture goes down.

The price changes translate into only small production adjustments. Global production of all agricultural products except bovine and ovine meat is hardly changed. In other words, the global output responds only marginally to price changes. This, of course, is also influenced by the elasticity of the transmission of world market price variations to domestic prices.

Bovine and ovine meat is the only product that generates significant changes in global trade. All other commodities are traded globally at approximately the same volume. The 25% increase in the volume of bovine and ovine meat traded globally is caused mainly by the USA, which imports 163% more than in the reference run (see *Table 6.10*). This increased import comes partly (70%) from additional export and partly (30%) from decreased imports of other countries, mainly developing ones. Argentina provides half of the additional export (0.8 million tonnes), which makes the developing countries as a group a net exporter of bovine and ovine meat in 2000 under this scenario. The increased world market price leads to a 4% higher production and a 1% lower consumption in this group.

Dairy products also indicate a substantial change in trade pattern. The USA become an importer of this commodity. The export share of the USA is taken up, first of all, by the EC and by New Zealand, the latter exporting an additional 1.3 million tonnes of dairy products, but also by a number of LDCs, especially India, which switches from an importing to an exporting position. Canada continues to remain absent from the world market because of its policy of staying self-sufficient.

The reason for the rather strong increase of the world market price for dairy products is the price policy of most countries. Changes in the world dairy price are transmitted to the domestic price in many countries only to a small degree. Small changes in the volume traded lead under these conditions to rather strong price variations on the world market. This price transmission elasticity is, according to the specifications used, much higher in the USA than in the EC. (These elasticities, implicit in the model, can be calculated from the results of the two scenarios discussed in this chapter. The results of the current scenario yield an elasticity of 0.07 for the EC, and the results of the EC trade liberalization indicate an elasticity of 0.98 for the USA. In each case results for the year 2000 were used.) The world dairy price therefore increases more when the USA liberalizes than when the EC removes its protection. In the latter case, the USA responds with an additional export of 7 million tonnes of milk equivalents, while in the current scenario the EC responds with only 2.5 million tonnes although the increase of the world dairy price is almost three times higher. Changes in feed cost do not explain this difference in production response. Feed costs change only marginally for the EC farmer under US trade liberalization, whereas they increase for the US farmer under EC liberalization.

All other commodities show much smaller changes in their trade pattern. The USA increases its exports and its world market shares of wheat and coarse grains because of the reduction in feed use. The additional exports are mainly imported by developing countries.

As could be expected, the adjustments that take place in both the EC and the USA are larger when each liberalizes trade than when the other country does so. Among the countries listed in *Table 6.10* (and also in *Table 6.2*), Argentina adjusts more when the USA liberalizes, and Australia and Canada more when the EC removes protection. The impact on Japan, on the other hand, is difficult to predict. Considering, in addition, the changes in the agricultural trade balance, Japan adjusts in both scenarios in a somewhat similar way (see *Tables 6.3* and *6.11*).

According to *Table 6.11* trade liberalization by the USA also leads to an improvement of the agricultural trade balance for almost all developing countries. Only Egypt increases its trade deficit significantly. All others either

Table 6.10. Changes in trade structure (percentages and volumes) worldwide and in selected countries in 2000 due to unilateral liberalization of agricultural trade by the USA, relative to the reference scenario.

Commodity	*World-wide*	*EC*	*Austra-lia*	*Argen-tina*	*Japan*	*Canada*	*USA*
Wheat[a]							
% in trade	2	7	+0	–11	–3	–1	3
Volume: export	3.16	1.29	0.06	–0.72	–	–0.18	1.84
Volume: import	–	–	–	–	–0.31	–	–
Rice[b]							
% in trade	–1	–1	+0	40	–31	+0	1
Volume: export	–0.21	–	+0.0	0.02	–	–	0.04
Volume: import	–	–0	–	–	–0.24	+0	–
Coarse grains[a]							
% in trade	1	13	–0	–22	–6	1	3
Volume: export	1.11	–	–0.02	–2.8	–	0.20	3.61
Volume: import	–	2.61	–	–	–2.37	–	–
Bovine and ovine meat[a]							
% in trade	25	–16	27	52	–10	43	163
Volume: export	1.51	–	0.13	0.80	–	0.15	–
Volume: import	–	–0.17	–	–	–0.04	–	2.19
Dairy products[b]							
% in trade	–2	28	1	414	–99	–[f]	–
Volume: export	–0.61	2.5	0.1	0.8	–	–	–9.07[c]
Volume: import	–	–	–	–	–0.39	–	5.45
Other animal products[d]							
% in trade	+0	–17	4	70	–20	1	–[f]
Volume: export	0.01	–0.01	+0	0.02	–0.08	+0	0.11
Volume: import	–	–	–	–	–	–	–
Protein feed[d]							
% in trade	–1	–1	6	–0	–8	–0	–2
Volume: export	–0.18	–	0.01	–0	–	–	–0.32
Volume: import	–	–0.05	–	–	–0.30	–0	–
Other food[d]							
% in trade	2	–1	11	53	–5	–9	–7
Volume: export	0.58	–	0.07	0.31	–	–	–0.21
Volume: import	–	–0.09	–	–	–0.09	–0.03	–
Nonfood agriculture[e]							
% in trade	–0	1	4	17	+0	4	–
Volume: export	–0.03	–	0.03	0.08	–	+0	–[f]
Volume: import	–	0.03	–	–	+0	–	+0
Nonagriculture[e]							
% in trade	1	–4	10	40	+0	9	–35
Volume: export	0.37	–0.54	–	–	0.03		
Volume: import	–	–	0.28	1.10	–	0.18	–2.79

[a]Volume in 10^6 t. [b]Volume in 10^6 t of milk equivalent. [c]In the case where a country switches its trade position, changes in percent are not given. [d]Volume in 10^6 t of protein equivalent. [e]Volume in 10^9 US$ 1970. [f]No percentage change is given when the volume traded in the reference scenario does not exceed 2% of domestic disappearance.

Table 6.11. Percentage changes in agricultural trade deficit[a] at current prices in 2000 under US trade liberalization relative to the reference scenario.

Country	*Change*	*Country*	*Change*	*Country*	*Change*
USA	–19 S	China	2 S	Kenya	3 S
		CMEA	25 D	Mexico	13 S
Argentina	38 S	EC	–7 D	New Zealand	33 S
Australia	9 S	Egypt	25 D	Nigeria	–1 D
Austria	–81 D	India	77 S	Pakistan	–1 D
Brazil	–25 D	Indonesia	1 D	Thailand	2 S
Canada	7 S	Japan	–0 D	Turkey	14 S

[a]D, deficit in reference scenario; S, surplus in reference scenario.

decrease their deficit or increase their surplus in agricultural trade. Among the industrialized countries, it is to be noticed that Austria decreases its deficit in agricultural trade by 80%. In this respect, Austria is in a much better situation under liberalization by the USA than under EC trade liberalization, because of higher export earnings from trade in ruminant products. The EC reduces its deficit marginally while the USA has a lower surplus.

The adjustments in production and in demand that take place in the USA are indicated in *Table 6.12*. The producer prices of bovine and ovine meat, dairy products, and nonfood agriculture fall relative to the other agricultural commodities. A noticeable reduction in output is observed for milk and nonfood agriculture while all other commodities are produced in nearly the same amounts. On the demand side, dairy products are consumed at a higher level. The strongest increase, however, occurs in demand for bovine and ovine meat, while demand for nonfood agriculture goes down in spite of the decline of its retail price. The reason for this decline is that demand for fibres, the dominating commodities in this aggregate, follows supply; and supply drops because of the decline of the producer price.

Table 6.13 shows the adjustments in production and demand for the EC. Here, it can be seen that the large price increases of ruminant products on the world market are hardly transmitted into the EC market. The producer prices for bovine and ovine meat and for dairy products increase in the year 2000 by only 2.0% and 2.7%, respectively, while the corresponding world market prices go up by 14.3% and 39.0%. A high price-transmission elasticity in the EC exists for nonfood agriculture. The price decrease on the world market is almost completely transmitted onto the domestic market. By and large, producer prices and retail prices do not change very strongly in the EC when the USA liberalizes trade. Therefore, the adjustments on both production and demand are of small magnitude. The trade structure, of course, changes more because production and demand adjust in opposite directions.

GDP goes up in the USA under this scenario (*Table 6.14*), while the US agricultural GDP declines. Compared to the decline of agricultural prices, the

Table 6.12. The USA: Production, export, and feed in 2000 under US trade liberalization compared to the reference scenario.

	R0: absolute values[a]			*F-USA: % change over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Export (net)*	*Feed*	*Retail price*	*Producer price*
Wheat	103.46	64.79	13.00	1.8	−1.2	2.8	−3.6	1.4	1.8
Rice	8.24	6.20	0	0.6	0.6	0.7	0	−0.3	0.1
Coarse grains	352.53	128.35	177.88	1.5	−0.4	2.8	−0.8	−0.8	1.5
Bovine and ovine	12.91	−1.34	0	−0.1	15.3	163.7	0	−15.3	−13.1
Dairy	76.65	9.07	1.07	−12.1	7.7	−160.1	−12.1	−23.5	−22.8
Other animal products	2.57	0.01	0	1.6	−2.7	+[b]	0	2.3	2.7
Protein feed	26.94	16.18	9.93	−1.1	0.2	−2.0	0.4	0.3	0.3
Other food	15.79	2.95	0	−0.9	0.5	−7.1	0	−4.1	−3.9
Nonfood agriculture	2.96	0.01	0	−8.3	−7.9	−[b]	0	−21.0	−24.7
Nonagriculture	4292.64	−7.90	0	0.1	0.1	−35.4	0	−0.2	−0.2

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970. [b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table 6.13. The EC: Production, export, and feed in 2000 under US trade liberalization compared to the reference scenario.

	R0: absolute values[a]			*F-USA: % change over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Export (net)*	*Feed*	*Retail price*	*Producer price*
Wheat	64.56	17.64	22.46	2.2	−0.2	7.3	−0.8	0.3	0.8
Rice	1.01	−0.19	0.34	0.1	+0	−1.1	+0	+0	0.1
Coarse grains	88.35	−19.62	88.24	−2.4	0.3	13.3	0.4	0.1	−0.2
Bovine and ovine	10.31	−1.03	0.01	1.0	−0.6	−16.5	−0.5	1.1	2.0
Dairy	117.39	8.70	21.26	1.9	−0.1	28.2	−0	1.4	2.7
Other animal products	3.03	0.08	0	−0.4	0.1	−18.0	0	−0.4	−0.5
Protein feed	1.28	−6.39	7.60	0.2	−0.6	−0.8	−0.6	0.2	0.2
Other food	16.20	−7.17	0.98	0.3	−0.1	−1.3	−0.4	−0	+0
Nonfood agriculture	1.04	−2.05	0	−0.3	0.9	1.5	0	−5.4	−5.4
Nonagriculture	1481.76	14.19	0	−0	+0	−3.8	0	−0.2	−0.2

[a]In the reference scenario, units = 10^6 t for all but other food, nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.

Table 6.14. Percentage changes of some macroeconomic and welfare indicators in 1990 and 2000 under US trade liberalization relative to the reference scenario.[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
GDP70	+0	–0	+0	0.1	–0	–0	–0.1	–0.1	–0	–0.1	–0.2	–0.2
GDPA70	4.3	9.3	–0.1	1.1	0.3	0.4	0.3	0.1	0.8	1.2	0.4	0.2
GDPNA70	–0.4	–1.0	+0	–0	–0	–0.1	–0.1	–0.1	–0.1	–0.1	–0.3	–0.3
AG HCons at P70	–1.0	–0.5	–0.4	–0.2	+0	+0	0.1	+0	–0.9	–0.6	–0.1	–0.3
NAG HCons at P70	0.4	1.5	–0.2	–0.2	+0	0.1	–0.4	–0.4	–0.1	–0	–0.4	–0.8
Trade deficit 70	–5.1	–2.5	–0.8	0.1	–1.5	0.8	–0.1	0.5	–0.1	0.7	–0.2	0.2
AG trade deficit 70	17.6	22.9	0.8	4.8	–3.4	–8.9	4.5	–67.9	–0.2	3.6	–16.8	–17.3
Trade/GDP at WP	27.3	36.1	4.7	9.1	–1.7	–3.2	–0.5	–1.3	0.2	5.7	1.5	1.4
GDPA at WP70	3.9	7.2	–0.2	2.0	0.4	0.5	0.3	1.0	–1.3	1.2	0.4	0.6
Investment	1.3	1.3	0.4	0.4	+0	–0	0.1	+0	+0	–0	–0.2	–0.2
Total capital	0.5	0.9	0.1	0.3	+0	–0	0.1	0.1	+0	–0	+0	–0.1
AG vol. index WP70	4.1	8.0	–0	2.1	0.2	0.5	0.4	0.9	–0.5	1.6	0.4	0.5
Net calories produced	1.9	–6.6	–4.3	1.1	–1.3	–0.1	–0.6	2.1	–7.2	1.6	–1.0	1.6
Agricultural capital	5.6	12.2	2.1	4.3	0.3	0.5	2.4	3.1	2.4	2.5	0.5	0.4
Agricultural labor	4.5	10.0	0.4	1.4	0.5	0.7	0.1	0.3	2.2	3.0	0.6	0.3
Total acreage	4.1	1.4	–0.3	–0	–0	–0	0.6	1.2	–0.2	0.6	0.3	1.2
N fertilizer	8.2	16.0	–1.5	5.7	–0.3	0.7	–0.4	0.4	–7.2	4.5	–0	0.7
P_A/P_N	9.2	8.2	5.8	5.8	0.3	0.3	2.8	2.8	1.6	2.3	–0.3	0.1
AG CSWP index Y70	8.0	8.0	8.2	8.9	8.2	11.8	2.8	3.6	4.7	7.2	2.7	3.6
Crop price index	–0.7	0.4	–0.2	2.2	–0.1	0.7	–0.4	–0.1	–0.7	0.6	–0.6	–0.1
Food price index	8.4	6.4	6.2	6.1	0.1	0.3	2.4	2.4	1.7	1.3	0.2	0.6
Terms of trade	8.2	12.6	4.3	4.4	15.1	20.4	1.8	–2.8	1.2	2.8	–5.1	–7.9
Terms of trade R	4.6	5.1	3.1	3.0	10.8	13.8	–1.1	–5.6	–0.9	0.8	–5.6	–8.0
AG SSR	4.3	6.0	0.7	1.0	0.2	0.4	0.5	0.9	1.0	–0.8	0.5	0.9
AG SCR	0.1	0	0	0	0.1	0.3	0.4	0.5	0.4	0.4	0.1	0.5
Parity	8.9	7.3	5.3	5.5	0.1	+0	3.1	2.6	0.2	0.5	–0.7	–0.1
Equivalent income	0.1	1.1	–0.2	–0.2	+0	0.1	–0.3	–0.3	–0.1	–0.1	–0.3	–0.6
Calories/capita	–0.4	–0.2	–0.2	–0.2	+0	+0	+0	–0.1	–0.4	–0.3	–0.1	–0.3
Protein/capita	–1.1	–0.7	–0.3	–0.3	–0	+0	–0.1	–0.1	–0.7	–0.6	–0	–0.2
Number hungry	8.1	4.5	0	0	0	0	–0.2	1.9	0	0	0	0
Life expectancy	–0.2	–0.4	–0	–0.1	–0	–0	–0	–0	–0.1	–0.1	–0.1	–0.1

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*.

Table 6.14. (Cont.)[a]

Indicator[b]	*India*		*Indonesia*		*Japan*		*Kenya*		*Mexico*		*New Zealand*		*Nigeria*	
GDP70	+0	+0	–0	–0	–0	–0.1	0.4	0.9	–0.2	–0.4	0.9	1.0	0.2	0.3
GDPA70	0.1	+0	0.1	0.1	0.1	0.7	1.1	2.6	0.3	0.5	6.7	8.5	0.9	1.2
GDPNA70	–0	+0	–0.1	–0	–0	–0.1	0.1	0.3	–0.2	–0.4	+0	–0	–0	0.1
AG HCons at P70	–0	0.1	–0	–0.1	+0	–0.1	0.7	1.5	0.2	–0.1	1.9	2.8	+0	+0
NAG HCons at P70	+0	0.1	–0.2	–0.4	–0.1	–0.1	–0.2	0.7	–0.2	–0.4	2.4	2.8	0.1	0.2
Trade deficit 70	–0	0.4	–0.3	0.7	0.2	0.8	–1.4	–1.3	–0.6	–0.4	–9.9	1.5	–0.9	0.7
AG trade deficit 70	1.6	50.8	–1.5	–0.2	–0	–1.5	–8.4	–1.4	0.5	14.9	7.9	13.4	–4.4	–4.7
Trade/GDP at WP	–0.7	–0.7	–0.7	0.7	–0.7	–3.6	–5.4	0.4	0.1	4.5	22.7	28.7	–2.8	–1.7
GDPA at WP70	0.1	0.1	+0	–0	–0	–0.3	–1.1	0.6	0.2	0.8	6.9	10.0	0.8	1.3
Investment	+0	0.3	0.1	0.1	–0	–0.1	2.0	3.2	–0.2	–0.3	4.4	4.3	0.6	0.5
Total capital	NA[c]	NA[c]	0.1	0.1	–0	–0	0.9	2.0	–0	–0.1	1.6	3.1	0.4	0.5
AG vol. index WP70	0.1	0.1	+0	–0	–0.1	–1.5	–1.1	0.6	0.3	0.8	4.8	8.0	0.8	1.3
Net calories produced	–0	0.2	–0.1	+0	–1.0	–27.3	–4.5	–0.9	–3.2	3.1	–2.2	8.4	0.7	1.3
Agricultural capital	NA[c]	NA[c]	0.3	0.4	0.3	1.1	2.6	6.3	0.4	0.6	10.2	20.5	1.2	1.8
Agricultural labor	NA[c]	NA[c]	0.1	+0	0.4	1.0	0	0	0.4	1.1	0.7	1.8	0.8	1.2
Total acreage	+0	+0	–0	+0	–0	0.2	NA[c]	NA[c]	–0	+0	NA[c]	NA[c]	0.4	1.3
N fertilizer	–0.5	0.9	–0.1	–0.1	0.5	1.3	–5.0	–3.5	–0.2	2.4	–9.6	–5.5	1.3	1.5
P_A/P_N	0.3	0.8	0.3	0.6	–0	0.5	6.5	8.0	0.3	0.3	16.3	15.2	0.4	0.3
AG CSWP index Y70	2.4	4.0	0.1	0.8	+0	1.2	5.6	6.9	3.6	5.0	14.4	15.5	0.9	1.7
Crop price index	NA[c]	NA[c]	–0	0.2	–0	–0.7	–0.4	–0.2	–0.3	–0.3	0.1	1.4	0.1	–0.1
Food price index	NA[c]	NA[c]	0.3	0.5	0.2	0.6	7.5	9.5	0.4	0.6	9.4	11.9	0.2	0.2
Terms of trade	0.6	1.0	–0.8	–1.1	–0.5	–0.6	2.0	2.9	–1.3	0.6	16.1	16.7	–2.1	–3.8
Terms of trade R	–0.5	–1.0	–1.3	–1.5	–0.7	–0.5	–1.1	–0.5	–2.6	–1.6	15.4	15.8	–2.5	–4.1
AG SSR	+0	0.1	0.1	+0	–0.1	+0	–1.6	–0.6	+0	0.9	3.5	5.5	0.9	1.3
AG SCR	+0	0.2	0.1	+0	0.3	1.7	0.1	–0.7	–0.2	0.4	–2.3	–1.2	0.9	1.3
Parity	0.2	0.4	0.2	0.6	–0.3	0.1	7.5	10.5	0.1	–0.3	23.2	22.6	–0.2	–0.5
Equivalent income	+0	–0	–0.1	–0.2	–0.1	–0.1	NA[c]	NA[c]	–0.2	–0.4	NA[c]	NA[c]	+0	0.1
Calories/capita	0.1	–0	–0	–0	+0	–0.1	0.6	1.4	0.1	–0.1	0.3	0.5	+0	–0
Protein/capita	0.1	–0.1	–0	–0	+0	–0.1	0.7	1.6	0.1	–0.2	0.3	0.5	+0	–0
Number hungry	–0.7	0.2	0.4	0	–	–	–2.3	–6.7	–1.5	1.8	–	–	–0.2	1.0
Life expectancy	+0	–0	–0	–0	–0	–0	0.2	0.4	–0	–0.2	0.1	0.1	–0.1	–0.2

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.* [c]NA, not available.

Table 6.14. (Cont.)[a]

Indicator[b]	*Pakistan*		*Thailand*		*Turkey*		*USA*		*CMEA*		*EC*	
GDP70	0.0	–0.1	–0.0	–0.1	–0.1	–0.2	0.1	0.1	–0.0	–0.3	–0.0	–0.0
GDPA70	0.4	1.0	–0.3	–0.6	0.7	1.8	–1.2	–0.4	–0.1	–0.5	0.3	0.3
GDPNA70	–0.1	–0.5	–0.0	0.0	–0.3	–0.5	0.1	0.1	–0.0	–0.2	–0.0	–0.0
AG HCons at P70	–0.5	–0.6	0.1	–0.0	0.0	0.1	3.4	4.1	0.1	0.8	–0.1	–0.1
NAG HCons at P70	1.2	1.4	0.0	0.1	0.2	–0.0	0.1	–0.2	0.0	0.1	0.0	0.0
Trade deficit 70	–0.4	0.0	0.1	0.4	–0.3	0.3	0.3	1.3	0.	0.	–0.1	0.9
AG trade deficit 70	–16.9	–55.5	0.4	0.8	–0.5	8.4	–8.0	–9.0	3.7	27.8	–2.3	–2.6
Trade/GDP at WP	–2.3	–0.2	0.7	1.8	3.6	9.8	1.6	–2.4	2.4	25.0	–0.9	–0.2
GDPA at WP70	0.1	1.1	0.2	0.3	–0.3	1.1	–0.7	–0.6	–0.3	–2.3	0.3	0.4
Investment	0.3	0.2	–0.2	–0.1	0.1	–0.1	–0.0	–0.0	–0.1	–0.9	–0.0	–0.0
Total capital	0.1	0.2	–0.0	–0.1	0.2	0.1	NA[c]	NA[c]	–0.0	–0.2	–0.0	–0.0
AG vol. index WP70	0.2	1.2	0.0	–0.0	0.2	1.4	–0.8	–0.6	–0.0	–0.3	0.2	0.4
Net calories produced	–0.1	2.0	0.0	0.9	–2.4	1.2	2.8	1.9	–0.3	–2.8	–1.9	–0.5
Agricultural capital	0.6	1.2	–0.1	–0.6	1.6	2.8	NA[c]	NA[c]	0.0	0.2	0.4	0.6
Agricultural labor	0.6	1.6	0	0	0.5	1.4	NA[c]	NA[c]	0	0	1.0	0.8
Total acreage	–0.1	0.2	NA[c]	NA[c]	0.1	0.4	0.0	0.0	NA[c]	NA[c]	–0.2	–0.1
N fertilizer	1.1	2.1	0.1	0.4	–0.5	0.8	NA[c]	NA[c]	–0.7	–0.3	–0.1	1.0
P_A/P_N	1.5	1.3	–1.0	0.0	1.7	1.7	–5.6	–6.4	0.	0.	0.3	0.9
AG CSWP index Y70	7.1	9.4	–0.4	0.2	2.8	3.9	5.5	7.3	5.3	7.8	7.4	10.3
Crop price index	–0.3	0.2	–0.4	0.2	0.3	0.5	0	0	NA[c]	NA[c]	–0.8	0.1
Food price index	1.0	0.7	–0.8	–0.3	0.9	0.9	–4.3	–4.7	NA[c]	NA[c]	0.1	0.4
Terms of trade	–3.1	–3.3	0.1	0.9	3.3	4.8	–12.0	–15.1	1.3	2.1	2.2	2.7
Terms of trade R	–3.6	–3.6	–0.4	0.4	2.0	3.8	–1.9	1.2	1.3	2.2	1.0	1.0
AG SSR	0.7	1.8	0.1	0.2	–0.1	0.9	–2.4	–2.6	–0.2	–1.4	0.3	0.4
AG SCR	0.8	1.2	0.0	0.0	–0.3	–0.1	–3.4	–2.9	–0.2	–1.4	0.1	0.0
Parity	0.9	–0.0	–1.3	–0.6	1.9	2.1	–5.6	–6.4	NA[c]	NA[c]	–0.4	0.4
Equivalent income	0.3	0.3	NA[c]	NA[c]	0.1	–0.0	NA[c]	NA[c]	NA[c]	NA[c]	0.0	0.0
Calories/capita	–0.4	–0.5	0.0	–0.0	0.0	0.0	NA[c]	NA[c]	0.0	0.2	0.0	–0.0
Protein/capita	–0.4	–0.6	0.1	–0.0	0.0	0.0	NA[c]	NA[c]	0.0	0.4	–0.1	–0.1
Number hungry	3.6	6.6	–0.2	0.1	–0.1	–0.1	–	–	–	–	–	–
Life expectancy	–0.2	–0.4	0.0	–0.0	–0.1	–0.1	0.1	0.1	NA[c]	NA[c]	–0.0	–0.0

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*. [c]NA, not available.

Table 6.15. Gains and losses on some welfare and macroeconomic indicators in 2000 under US trade liberalization relative to the reference scenario.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consump- tion cost*	*People hungry*	*Life expect.*
USA	NS	L	–	G	–	NS
Canada	NS	G	L	L	–	NS
Australia	NS	G	L	G	–	NS
New Zealand	G	G	–	G	–	NS
Austria	NS	NS	G	G	–	NS
EC	NS	G	NS	ID	–	NS
Japan	NS	G	L	L	–	NS
CMEA	L	–	–	G	–	–
China	NS	–	–	ID	–	–
Argentina	G	G	G	G	L	L
Brazil	L	G	L	L	L	NS
Mexico	L	L	L	L	L	L
Egypt	L	NS	L	L	–	L
Kenya	G	G	–	G	G	G
Nigeria	G	L	G	G	L	L
India	NS	G	NS	G	NS	NS
Indonesia	NS	G	L	L	–	NS
Pakistan	G	NS	G	G	L	L
Thailand	NS	L	–	G	NS	NS
Turkey	L	G	NS	ID	NS	L

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

contraction of agricultural value added is relatively small, indicating a low supply elasticity. In terms of the welfare indicators available, the USA and Austria gain from trade liberalization (see *Table 6.15*). The other developed market economies indicate no changes in equivalent income (New Zealand, EC) or a loss (Australia, Canada, and Japan). Among the LDCs, gains are rare. Most LDCs either lose or indicate no change in their welfare indicators.

6.3. A Brief Comparison of Both Unilateral Trade Liberalization Scenarios (F-EC and F-USA) with Overall OECD Trade Liberalization (F-OECD)

As might be expected from the previous discussion, the impact of a unilateral trade liberalization either by the EC or by the USA has a smaller impact on international prices and international trade than an all-OECD-countries trade liberalization. World market prices average 4% lower, and volumes traded are also generally lower (see *Table 6.16*). The F-EC scenario shows two commodities with higher prices than the F-OECD scenario: other animal products and nonfood agriculture. All other products are priced lower on the world market, some of them by more than 10% (rice, milk, and protein feed). The rice price in the F-EC scenario is lower because of Japan's continued protection of rice and, therefore, small import needs. The dairy price increases much less owing to a strong production response of the USA and in spite of the protection decline in the EC. Protein feed is imported much less by Japan and therefore its price on the world market is 11% lower.

Table 6.16. Percentage changes in world market prices, global trade volumes, and global production in 2000 between a unilateral liberalization of agricultural trade by the EC (F-EC) and by all OECD countries (F-OECD) and between a unilateral liberalization by the USA (F-USA) and by all OECD countries (F-OECD).

	World prices		*Trade volumes*		*Production*	
Commodity	*F-EC to F-OECD*	*F-USA to F-OECD*	*F-EC to F-OECD*	*F-USA to F-OECD*	*F-EC to F-OECD*	*F-USA to F-OECD*
Wheat	–8.1	–14.2	–0.7	3.8	0.1	0.1
Rice	–16.1	–17.2	–28.5	–28.2	–1.1	–1.2
Coarse grains	–6.6	–9.2	–0.5	5.4	–1.0	–0.7
Bovine & ovine meat	–8.7	–2.3	–15.2	–7.2	–2.5	–0.6
Dairy products	–12.1	6.4	–9.4	–13.0	–2.4	–0.6
Other animal products	5.3	–2.1	–9.9	–14.0	–1.4	–1.2
Protein feed	–11.1	–11.1	–5.3	–5.5	–1.8	–2.2
Other food	–2.3	–3.6	–3.1	–7.0	–0.2	–0.3
Nonfood agriculture	3.8	–4.2	–1.9	–5.2	–1.3	–0.4
Total agriculture	–4.4[a]	–4.4	–	–	–0.8	–0.6[b]

[a]Index of world prices relative to nonagriculture weighted with global production volumes of 1970. [b]Index of agricultural production weighted with 1970 world prices.

The volumes traded internationally are all reduced by the year 2000, especially those of rice, bovine and ovine meat, dairy products, and other animal products. Global production is lower for all commodities except wheat. The volume index of agricultural production indicates a 0.8% lower output, a level which is comparable with the reference run.

A comparison of the unilateral trade liberalization by the USA with the one by all OECD countries shows generally a pattern of differences similar to that between F-EC and F-OECD. A few exceptions exist, however. Production of wheat is higher in F-USA by 2000, and all global export quantities except those of wheat and coarse grains are smaller. The quantity of rice traded indicates the largest difference because of Japan's protection (as under F-EC). Prices of cereals are much lower in F-USA than in F-OECD. The lower rice price is a result of Japan's protection, while the reduced prices of wheat and coarse grains are caused by the USA, since it exports more. Dairy products have a higher price than in F-OECD. In spite of this price increase on the world market, production is lower. The reason for this is, as explained above, that the increase of the world market prices is only marginally transmitted onto the domestic market in some key countries, e.g., the EC. And Canada maintains its policy of supply management, so that output of dairy products is lower.

Table 6.17. Gains and losses on some welfare and macroeconomic indicators in 2000 in F-EC compared to F-OECD.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consumption cost*	*People hungry*	*Life expect.*
USA	L	G	–	L	–	NS
Canada	G	L	G	G	–	G
Australia	G	L	G	L	–	L
New Zealand	L	L	–	L	–	NS
Austria	NS	L	L	L	–	NS
EC	NS	L	G	G	–	NS
Japan	L	G	L	L	–	L
CMEA	G	–	–	L	–	–
China	NS	–	–	ID	–	–
Argentina	L	L	L	L	G	G
Brazil	G	L	G	G	G	NS
Mexico	G	G	G	G	G	G
Egypt	G	L	G	G	–	NS
Kenya	L	L	–	L	L	L
Nigeria	L	G	L	L	L	G
India	NS	L	NS	L	G	G
Indonesia	G	L	G	G	–	NS
Pakistan	L	L	L	L	NS	G
Thailand	L	L	–	L	L	NS
Turkey	G	L	G	G	NS	G

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

Table 6.17 shows the comparison of income and some other indicators in the F-EC scenario with those of F-OECD. The EC itself is not better or worse off if it unilaterally liberalizes trade or does so jointly with all OECD countries. The other OECD members also do not gain in this scenario compared to F-OECD. The only exception is Canada, which indicates gains in equivalent income and consumer costs.

Among the developing countries Brazil, Mexico, and Egypt indicate a clear improvement in F-EC over F-OECD. (All three are worse off when one compares F-EC with the reference run.) The other developing countries are, in general, slightly better off, although some losses are clearly indicated. They improve most with regard to life expectancy.

Table 6.18. Gains and losses in some welfare and macroeconomic indicators in 2000 in F-USA compared to F-OECD.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consumption cost*	*People hungry*	*Life expect.*
USA	L	L	–	L	–	G
Canada	G	L	NS	ID	–	G
Australia	NS	L	L	L	–	L
New Zealand	L	L	–	L	–	NS
Austria	NS	L	L	L	–	NS
EC	L	G	L	L	–	L
Japan	L	G	L	L	–	L
CMEA	G	–	–	G	–	–
China	NS	–	–	ID	–	–
Argentina	L	L	L	L	G	G
Brazil	G	L	G	G	G	G
Mexico	G	G	G	G	G	G
Egypt	G	L	G	G	–	G
Kenya	L	L	–	L	L	L
Nigeria	L	G	L	L	L	G
India	L	L	G	G	G	G
Indonesia	G	L	G	G	–	NS
Pakistan	L	L	L	L	G	G
Thailand	L	L	–	L	G	NS
Turkey	G	L	G	G	G	G

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

The comparison of a unilateral trade liberalization by the USA alone with F-OECD indicates that it is in the interest of the USA to persuade all other OECD countries to join in trade liberalization (see *Table 6.18*). Most developing countries, such as Brazil, Mexico, Egypt, India, Indonesia, and Turkey, benefit in F-USA relative to F-OECD, while Kenya loses and the remaining countries show some mixed results.

CHAPTER 7

Trade Liberalization by Developing Countries

7.1. Relevance of the Scenario

The case for liberalization and removal of protection is in some senses stronger, and in others weaker, for the developing countries. The increased efficiency of allocation to which liberalization leads should be especially important for a poor country. The directly unproductive rent-seeking activities that are encouraged by distortionary protective policies waste real resources, including entrepreneurial talents, which are particularly scarce in developing countries.

The value of increased competition in domestic markets, which improves the quality and efficiency of production, can be substantial for poor countries. Though outward orientation makes a country more vulnerable to external shocks, Srinivasan (1986) has argued, on the basis of the post-oil-shock experience of developing countries (Balassa, 1981a, 1983a,b), that outward orientation seems to increase a country's capacity to absorb and adjust to these shocks as well.

On the other hand, many of the arguments for protection are also of greater relevance for the developing countries. These include protection of infant industry to permit learning by doing; optimal or scientific tariffs on exports since many developing countries exporting primary commodities hold market power as major exporters facing often inelastic demands; noneconomic objectives such as special emphasis on the nutritional status of the poor; industrialization; attainment of self-sufficiency, not only for political reasons but also for providing income to the poor who depend on agriculture (Baldwin, 1952; Caves and Jones, 1973; Johnson, 1953–1954, 1960, 1968).

Notwithstanding the argument for protection, however, many developing countries, facing balance-of-payments problems, are advised by the IMF and the World Bank to liberalize. Whereas the IMF and the World Bank advocate liberalization by all countries, they have relatively little clout with the developed countries to make them liberalize trade. Thus, even though some of the gains from trade liberalization mentioned above cannot be captured using the BLS, it is of considerable policy relevance to examine the impact of trade liberalization by the developing countries alone. Developing countries are often given supplemental aid in the form of additional loans, sometimes at concessional terms, by the IMF and the World Bank to help them adjust to liberalization. The results of a scenario of trade liberalization by developing countries can provide indications as to the wisdom of liberalization or the adequacy of such aid.

Thus, in this chapter, the outcome of trade liberalization by developing countries alone is described. The results are analyzed primarily in terms of gains and losses for the different countries, with a particular emphasis on welfare in developing countries.

7.2. The Specification of the Scenario

Once again it should be emphasized that only those protection (positive or negative) measures are removed that are captured in the calculated tariff equivalents. Thus, only border distortions are removed. As was discussed in Chapter 3, these include tariff equivalents (positive or negative), quotas, and subsidies for domestic transport of exports. Other distortions, introduced through subsidy or taxes on factor and input prices, production quotas, consumer subsidies of many kinds, etc., are not removed. Whereas one may argue that such nonborder distortions are not significant for agricultural commodities in developed market economies (except for the land set-aside program in the USA, which is also removed in the various trade liberalization scenarios in which the USA liberalizes), one cannot say this for developing economies. Yet systematic data on such distortions are not easily available, and in this scenario these distortions are not removed. One may add here that these distortions are not explicitly modeled in the national models of the BLS, but are only implicitly accounted for in the estimated parameters of the system. Thus, it would have been difficult to remove such distortions, even if data were available on them.

This scenario is designated by F-LDC. Though all developing countries liberalize trade, China does not do so. Also, as in other scenarios, liberalization is carried out over five years from 1981 through 1985 so that 1986 is the first year when trade is fully liberalized.

7.3. Impact on the World Market

Agricultural trade liberalization by the developing countries triggers in this scenario the changes in the world market prices. However, these changes in turn also determine the way the different national economies react and develop over time.

7.3.1. A slight drop in world market price, but larger declines for developing country exports

As can be seen in *Table 7.1*, the aggregate price of agriculture relative to nonagriculture falls by 1–2% compared to the reference run. The changes in world prices consequent on agricultural trade liberalization by the developing countries can be understood mainly by the levels of distortions removed and the consequent changes in production and trade in the developing countries shown in *Table 7.2*.

Table 7.1. Percentage changes in world market prices and global net exports under LDC trade liberalization relative to the reference scenario.

	Relative prices		*Net exports*	
Commodity	*1990*	*2000*	*1990*	*2000*
Wheat	2	5	5	3
Rice	3	1	–5	–12
Coarse grains	3	4	2	0
Bovine and ovine products	3	–3	22	27
Dairy products	11	12	18	24
Other animal products	1	1	–4	–4
Protein feed	2	1	–1	–1
Other food	–5	–6	–1	–2
Nonfood agriculture	–15	–14	0	0
Total agriculture	–1	–2		
Nonagriculture	0	0	–1	–3

The only significant price drops are in nonfood agriculture and other food. This is as might be expected since developing countries are the major exporters of these commodities and many of them tax their exports. Removal of these negative protection measures (see *Table 4.12*) leads to lower prices. On the other hand, though the price of other food drops by 6%, developing country exports increase by 14%. A more than 20% increase in the protein feed exports of developing countries results from a world market price increase of only 1%. The only commodity to show significant price increase is dairy products. Developing countries are major importers of dairy products, and many of them protect domestic producers. Removal of these protections increases imports and pushes up the world price of dairy products.

Though in percentage terms, trade of bovine and ovine meat increases over the reference scenario level even more than trade of dairy products, its price actually falls. The developing countries as a group were nearly self-sufficient in the reference scenario. Though removal of protections stimulates demand in many developing countries, Argentina, the largest exporter in the world, because of its large supply response, more than doubles its exports of bovine and ovine

Table 7.2. Impact of trade liberalization by LDCs (excluding China) on their production and trade for 2000.

	Reference scenario R0					*F-LDC: % change over R0*			
Commodity	*Production*[a]	*Net exports*[a]	*Value share (%) in total agriculture*[b]	*Share (%) in global production*	*Share (%) in global net exports (imports)*	*Relative price world market (%)*	*Production (%)*	*Net trade*[c]	*Change in net exports*
Wheat	222	–77	3.1	36	(55)	5	–3	15	–11
Rice	334	–5	10.7	93	(28)	1	1	6	–0
Coarse grains	335	–64	3.3	31	(37)	4	–3	16	–10
Bovine & ovine	36	–0.1	7.6	42	(3)	–3	4	–224	+0.3
Dairy	192	–24	5.3	30	(81)	12	–2	30	–7
Other animal products	13	–0.2	10.0	50	(16)	1	+0	–10	0.1
Protein feed	26	5	1.3	41	19	1	6	30	1
Other food	249	16	54.1	72	65	–6	+0	14	2
Nonfood agriculture	22	3	4.5	55	41	–14	1	6	0.2
Total agriculture	–	–	100.0	–	–	–2	–	–	–

[a]In the reference scenario, units = 10^6 t for all commodities except other food and nonfood agriculture, which are 10^9 US$ 1970.
[b]Excluding China.
[c]Percentages calculated before rounding off net export figures.

meat in the year 2000 compared to the reference scenario. This lowers the world price of bovine and ovine meat in this scenario.

The small increases in world market prices of wheat result from reduced production (3%) and increased imports (15%) by the developing countries as a group. Within the group, the major wheat exporters of the reference scenario, Argentina, India, and Pakistan, all reduce their exports and the major importers, Brazil, Egypt, and Nigeria, increase their imports.

Similar behavior in the coarse grains production and trade leads to the small increase in coarse grains price.

7.3.2. Volume of agricultural trade increases: Larger imports of cereals by developing countries

The developing countries increase their cereal imports in 2000 by more than 20 million tonnes (about 15%) from 146 million tonnes in the reference run, and their dairy product imports by 7 million tonnes (30%) from 24 million tonnes in the reference run. They reduce their imports of meats and increase their exports of protein feed (30%), other food (14%), and nonfood agriculture (6%). Thus, developing countries increase the volume of their agricultural trade.

7.3.3. Terms-of-trade loss and fall in agricultural balance of trade

The four agricultural commodities that the developing countries as a group export are protein feed, other food, nonfood agriculture, and bovine and ovine meat, in the last one of which the group turns from a net importer (in the reference scenario) into a net exporter under trade liberalization. Except for protein feed, which gains 1% in price, the world market prices in these products drop. Also, these products together account for two-thirds of the total value of agricultural production of developing countries. In spite of a drop of 14–15% in the relative price of nonfood agriculture, developing countries increase their net exports by 6%. This implies that developing countries export 6% more of nonfood agriculture but suffer an export earning loss of about 8–9%. Though developing countries export more of nonfood agriculture and earn less from it, on the whole their export earnings increase, as other food is their major export item.

However, the prices of commodities that developing countries import – cereals, dairy products, and other animal products – all increase, and developing countries also increase their imports of cereals and dairy products. Thus, as one would expect, the developing countries suffer a terms-of-trade loss when they liberalize agricultural trade. This, however, does not necessarily imply that the developing countries suffer a welfare loss. It could also imply that their earlier production and trade patterns were not to their best comparative advantage.

Table 7.3. Impact on LDCs' agricultural balance of trade in 2000 under LDC trade liberalization relative to the reference scenario.

	Reference scenario, R0 (10^9 US$)	*F-LDC: % change over R0*
Agricultural balance of trade of developing countries:		
at 1970 relative prices	3.2	18
at current relative prices	5.9	–16

Yet, this loss in terms of trade is reflected in the agricultural balance of trade of the developing countries as a group. As shown in *Table 7.3*, their surplus on the agricultural balance of trade at current prices falls by 16%. The agricultural balance of trade calculated at constant 1970 relative prices shows that the volume of developing countries' net exports increased by 18%, but they earned 16% less for them.

7.4. Price Changes and Growth Patterns at National Levels

The changes in domestic prices for the developing countries depend upon the size of the protection removed. Thus, though the aggregate price of agriculture relative to nonagriculture drops marginally at the world market level, at national levels it increases in many developing countries (see *Table 7.4*). Thus, the agricultural price increases substantially in Argentina, Brazil, Indonesia, and Thailand, and modestly in Kenya. These countries have negative protection on agriculture in the reference scenario. On the other hand, countries with relatively high positive protection in the reference scenario – Nigeria, Pakistan, and Turkey – show a decline in the relative price of agriculture. Mexico, Egypt, and India show small changes in prices.

The changes in real investments resulting from these price changes are somewhat larger for the developing countries than they were for the developed countries (compare *Tables 5.3* and *7.4*) as, in general, agriculture constitutes a larger share of the economies of developing countries. In general, changes in investment and total capital follow the changes in domestic prices. The one exception is Brazil where, in spite of an 18% increase in the relative price of agriculture, investment and total capital stock increase negligibly. As discussed later, this is the outcome of the fact that, when agricultural prices increase, labor movement out of agriculture slows down; and for Brazil this can lower its GDP, which in turn can lower real investment.

The changes in real GDP for the year 2000 shown in *Table 7.4* do not follow changes in total capital stocks, as the changed allocation of factors between the two sectors, when trade distortions are removed, can be more efficient. In fact, total capital stocks decline for Pakistan and Turkey, both of which show

Table 7.4. Impact of LDC agricultural trade liberalization on prices, investment, capital stock, and GDP in various LDCs in 2000.

		F-LDC: % change over R0				
Current agricultural policy	*R0: ANPL*[a]	*Country-specific world prices*[b] *of agriculture* P^W_A/P^W_N	*Domestic relative price of agriculture* P_A/P_N	*Real invest-ment*	*Total capital stock*	*GDP at 1970 prices*
Protecting:						
Turkey	26	-4	-13	+0[c]	-1	2
Pakistan	12	-1	-10	1	-0[d]	3
Nigeria	11	-5	-9	-4	-3	-2
Egypt	9	-4	1	1	1	2
Mexico	5	-2	-5	-2	-1	-2
India	4	-2	-2	-0[d]	NA[e]	-0[d]
Taxing:						
Argentina	-23	-2	31	6	3	+0[c]
Brazil	-21	-4	18	+0[c]	+0[c]	-1
Indonesia	-15	-3	13	4	3	1
Thailand	-12	-3	14	2	2	+0[c]
Kenya	-7	-3	7	4	2	1

[a]ANPL, aggregate nominal protection level (%) in 2000.
[b]World prices weighted by domestic consumption volumes.
[c]+0 implies small positive change of less than 0.5%.
[d]-0 implies small negative change of less than 0.5%.
[e]NA, not available in the model in a comparable way.

relatively large percentage increases in GDP. Similarly, Egypt shows a percentage increase in GDP that is larger than the increase in its total capital.

On the other hand, Argentina, Brazil, Indonesia, Thailand, and Kenya show percentage increases in GDPs that are lower than the increases in their capital stocks. These countries are agricultural exporters with a positive degree of agricultural protection in the reference scenario. Trade liberalization leads to loss in terms of trade for Thailand and Kenya, and to relatively more capital-intensive production in these countries.

Nigeria and Mexico show the highest reduction of 2% in GDP in the year 2000. In both these countries agricultural prices fall, and capital moves out of agriculture into nonagriculture where the capital output ratio is higher than in agriculture. The lower capital stocks resulting from lower real investments in these countries are not compensated by improvement in allocative efficiency.

Table 7.5 shows changes in factor availabilities and GDPs in agriculture and nonagriculture for the year 2000. The changes in the sectoral GDPs in general follow the pattern that could have been predicted from the variable elasticity mini-models described in Chapter 3 and the supply elasticities given there.

Table 7.5. Impact on sectoral factor allocation and GDP (at 1970 prices) in 2000 due to LDC agricultural trade liberalization: percentage changes relative to the reference scenario.

Current agricultural policy	*Agricultural sector*				*Nonagricultural sector*		
	GDP	*Capital*	*Labor*	*Acreage*	*GDP*	*Capital*	*Labor*
Protecting:							
Turkey	–14	–20	–11	–1	4	1	5
Pakistan	–9	–10	–11	–2	7	4	9
Nigeria	–7	–10	–5	–12	–1	–2	3
Egypt	–4	–2	–5	–7	3	1	5
Mexico	–3	–6	5	–1	–1	–0	–2
India	–1	NA[a]	NA[a]	–0[c]	–0[c]	NA[a]	NA[a]
Taxing:							
Argentina	29	43	28	1	–3	–2	–3
Brazil	6	24	2	8	–1	–1	–1
Indonesia	4	13	1	–0[c]	–0[c]	0	–1
Thailand	4	11	NA[a]	NA[a]	–0[c]	–1	NA[a]
Kenya	4	7	NA[a]	NA[a]	+0[b]	2	NA[a]

[a]NA, not available in the model in a comparable way.
[b]+0 implies small positive change of less than 0.5%.
[c]–0 implies small negative change of less than 0.5%.

Thus, countries that had negative protection on agriculture show agricultural price increases under liberalization. All of them draw more capital into agriculture and increase their agricultural GDP at 1970 prices. The implicit "supply elasticities with respect to price" range among these countries from 0.3 for Thailand to 0.95 for Argentina for the year 2000. These are not partial supply elasticities in the conventional sense, but elasticities between two different situations where not just the price but also many other things have changed.

In general, the changes in agricultural GDP in the year 2000 follow changes in relative price of agriculture. Egypt, which shows a fall in agricultural GDP while its price increases, appears to be an exception. However, the relative price of agriculture is lower in most of the years prior to 2000 for Egypt.

In *Table 7.6* are summarized percentage changes over reference run values of some important macroeconomic variables and welfare indicators for the years 1990 and 2000 for the various countries.

7.5. Changes in Production and Trade Patterns

Behind the aggregate price changes lie the changes in prices of various commodities. These changes alter the relative price patterns, profitability, and production structures. As an illustration, *Table 7.7* shows the production and trade pattern changes in Argentina for the year 2000. Argentina is interesting to look

Table 7.6. Percentage changes of some macroeconomic and welfare indicators for selected countries for 1990 and 2000 under LDC trade liberalization relative to the reference scenario.[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
GDP70	0.2	0.1	+0	−0.1	0.1	0.2	−0.3	−0.6	−0	−0	0.4	1.8
GDPA70	12.6	28.5	0.4	−1.2	−0.6	−2.1	3.6	6.3	0.8	0.8	−1.3	−4.4
GDPNA70	−1.1	−2.9	−0	−0	0.1	0.3	−0.5	−0.8	−0	−0	0.8	2.8
AG HCons at P70	−3.4	−2.6	0.2	0.4	0.3	0.3	−2.9	−3.0	−0.3	+0	2.8	3.2
NAG HCons at P70	−0.8	1.1	−0.3	−0.2	0.2	0.3	−0.1	−0.7	+0	+0	0.2	1.3
Trade deficit 70	−16.9	−13.7	−0.8	−0.4	−1.5	−0.2	0.7	−3.9	−1.2	−1.1	0.5	2.2
AG trade deficit 70	53.7	72.6	−0	−3.1	10.8	40.4	64.0	−655.0	−0.4	5.1	−153.8	−42.1
Trade/GDP at WP	61.7	83.3	−2.4	−6.0	3.4	8.3	11.0	−28.2	3.1	9.0	54.0	29.0
GDPA at WP70	12.0	21.8	0.1	−1.2	−0.9	−2.1	4.0	8.2	0.3	2.3	6.6	3.6
Investment	5.1	5.9	−0.1	−0.5	−0	0.1	0.9	0.4	+0	−0	0.1	1.4
Total capital	1.4	3.2	−0	−0.2	−0	−0	0.4	0.4	−0	−0	−0	0.5
AG vol. index WP70	12.6	24.9	0.4	−0.8	−0.5	−1.8	4.9	8.8	0.3	2.4	5.4	2.6
Net calories produced	7.4	−19.6	6.1	5.8	1.5	2.1	4.7	11.1	0.2	8.7	−1.6	−1.0
Agricultural capital	16.5	43.0	−0.4	−3.3	−0.4	−1.7	14.1	24.2	0.7	0.4	−0.2	−2.2
Agricultural labor	11.2	28.1	−0	−0.5	−1.1	−3.4	0.5	1.7	0.4	0.4	−2.2	−5.3
Total acreage	11.1	1.4	0.2	−0	+0	−0	4.3	8.3	1.0	0.3	−10.8	−6.9
N fertilizer	35.7	73.1	15.1	10.9	0.2	−1.2	3.7	7.6	−1.2	14.3	11.3	11.1
P_A/P_N	33.3	31.4	−2.9	−5.9	−2.0	−2.7	18.7	18.2	+0	−0.4	0	0
AG CSWP index Y70	−0.2	−2.2	−0.9	−2.0	1.7	1.3	−3.0	−4.1	1.7	1.6	−2.7	−3.6
Crop price index	24.8	25.4	−3.4	−5.9	−2.7	−4.2	10.7	10.6	−0.1	0.7	12.4	15.0
Food price index	21.8	16.2	0.6	−2.0	−0.8	−0.9	10.5	12.5	−0.1	−1.0	−8.5	−7.5
Terms of trade	2.5	6.8	−2.4	−3.0	9.0	6.3	−1.5	0.8	2.3	2.4	−9.0	−11.1
Terms of trade R	−0.7	−2.3	−2.0	−1.8	9.2	8.9	−5.1	−3.3	2.0	2.9	−7.7	−8.6
AG SSR	13.6	20.4	−0.7	−2.4	−0.8	−1.7	4.5	8.4	−1.7	−1.7	5.8	2.8
AG SCR	0.1	0	0	0	−1.2	−1.9	3.1	4.3	−0.7	−0.9	−4.9	−4.1
Parity	34.8	31.4	−2.5	−6.5	−1.5	−1.3	22.5	23.6	0.5	0.1	1.4	4.2
Equivalent income	−1.3	0.5	−0.2	−0.2	0.2	0.3	−0.4	−0.9	−0	+0	0.9	1.7
Calories/capita	−1.7	−1.2	+0	0.1	0.2	0.1	−1.2	−1.4	−0.1	−0	0.7	0.6
Protein/capita	−2.7	−2.0	−0.1	−0	0.1	+0	−1.7	−1.6	−0.3	−0.2	1.6	1.6
Number hungry	35.2	24.1	–	–	–	–	14.3	34.1	–	–	–	–
Life expectancy	−0.7	−1.1	+0	+0	0.1	0.1	−0.3	−0.5	−0	−0	0	0

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.*

Table 7.6. (Cont.)[a]

Indicator[b]	*India*		*Indonesia*		*Japan*		*Kenya*		*Mexico*		*New Zealand*		*Nigeria*	
GDP70	+0	–0.2	0.4	0.8	+0	+0	0.6	1.3	–0.2	–1.6	0.1	–0.2	–0.5	–1.7
GDPA70	+0	–0.5	1.8	4.4	–0.2	–0.3	2.1	4.3	–1.8	–3.2	0.6	–1.7	–0.7	–6.5
GDPNA70	–0	–0.1	–0.2	–0.3	+0	+0	0.2	0.4	–0.1	–1.4	+0	–0	–0.4	–0.7
AG HCons at P70	–0.2	–0.6	–0.4	0.6	–0	–0.2	1.4	1.6	0.9	0.6	1.8	1.9	1.5	1.7
NAG HCons at P70	–0.1	–0.1	–0.3	0.4	0.1	0.1	–0.7	0.4	–0.7	–2.0	0.1	–0.3	–2.8	–4.4
Trade deficit 70	–0.2	0.2	–12.5	–7.2	–1.2	–1.0	–2.0	–0.9	0.5	–2.6	–1.3	–17.6	2.5	1.9
AG trade deficit 70	10.0	–4.7	–41.7	–49.2	1.1	0.6	0.1	10.2	–28.4	–22.3	–0.4	–3.2	7.8	23.0
Trade/GDP at WP	9.8	3.8	–35.6	–51.5	–2.2	–2.7	–3.8	2.4	–29.4	–27.8	1.0	–3.6	10.8	28.1
GDPA at WP70	0.1	–0.4	2.5	5.5	–0.4	–0.7	1.1	3.4	–1.0	–1.2	0.9	–1.0	0.5	–3.9
Investment	–0.2	–0	4.6	4.1	+0	+0	3.1	3.7	–0.4	–1.9	0.3	–1.0	–2.0	–3.6
Total capital	NA[c]	NA[c]	1.3	3.0	+0	+0	1.0	2.4	–0.1	–0.8	0.2	–0.1	–0.6	–2.6
AG vol. index WP70	0.1	–0.3	2.3	5.3	–0.4	–1.0	1.0	3.2	–2.2	–2.7	0.4	–0.9	–0.1	–4.6
Net calories produced	–0.3	–1.2	1.6	3.4	–8.2	–11.5	–2.3	1.5	11.7	19.3	0.4	3.1	–1.1	–6.8
Agricultural capital	NA[c]	NA[c]	4.5	13.0	–0.3	–0.4	3.1	7.4	–2.7	–5.6	1.4	–0.5	–2.3	–10.0
Agricultural labor	NA[c]	NA[c]	0.9	1.0	–0.2	–0.7	0	0	0.9	4.7	0.1	+0	–0.2	–4.9
Total acreage	–0	–0	–0	–0	+0	+0	NA[c]	NA[c]	–0	–1.2	NA[c]	NA[c]	–4.0	–11.5
N fertilizer	–2.0	–5.7	4.6	11.9	–0	–0.5	–3.9	0.3	–7.8	–5.9	–3.6	–0.2	–2.9	–5.0
P_A/P_N	–1.9	–2.1	12.3	13.0	–0.2	–0.9	7.9	7.1	–5.0	–4.8	+0	–3.1	–7.9	–8.8
AG CSWP index Y70	–0.8	–1.5	–2.2	–3.4	–1.0	–1.6	–1.5	–2.8	–1.6	–2.4	0.8	–0.8	–4.1	–5.2
Crop price index	NA[c]	NA[c]	16.0	14.9	–0.5	–1.7	2.8	2.3	–3.2	–3.7	–3.5	–4.3	1.4	2.2
Food price index	NA[c]	NA[c]	6.0	6.0	0.4	0.3	7.5	6.9	–4.0	–3.8	4.0	3.1	–8.1	–9.3
Terms of trade	–2.6	3.4	0.6	6.0	3.3	2.8	–8.1	–7.1	–2.3	–0.9	0.8	–1.2	–1.5	–1.7
Terms of trade R	–3.7	–0.1	–0.9	2.7	3.4	3.1	–9.3	–8.8	–3.4	–2.4	0.7	–1.1	–0.8	–0.6
AG SSR	0.2	–0	3.1	5.5	–0.4	–0.3	–0.2	1.9	–1.8	–1.5	–1.0	–2.3	–0.6	–5.1
AG SCR	–0.5	–0.2	2.8	5.5	–0.3	0.1	–0.6	–0.7	2.4	3.3	–1.1	–0.4	–0.6	–5.2
Parity	–0.8	–0.9	12.2	15.8	–0.2	–0.5	10.0	11.3	–8.0	–12.6	0.5	–4.7	–7.9	–7.2
Equivalent income	0.7	0.9	–0.4	0.5	+0	0.1	NA[c]	NA[c]	–0.5	–1.7	NA[c]	NA[c]	0.6	–0.5
Calories/capita	1.9	1.5	+0	0.3	–0	–0.1	1.0	1.3	0.4	0.3	0.3	0.3	1.5	1.3
Protein/capita	3.2	3.3	–0.6	0.7	–0.1	–0.2	1.3	1.5	0.2	–0	0.3	0.3	2.9	2.7
Number hungry	–8.0	–9.1	0.1	0	–	–	–4.3	–6.3	–6.3	–5.5	–	–	–11.6	–59.6
Life expectancy	0.5	0.4	–0.2	–0.1	–0	–0	0.3	0.4	–0	–0.5	0.1	0.1	0.4	0.9

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.* [c]NA, not available.

Table 7.6. (Cont.)[a]

Indicator[b]	*Pakistan*		*Thailand*		*Turkey*		*USA*		*CMEA*		*EC*	
GDP70	1.5	3.3	+0	0.1	0.7	1.6	+0	+0	+0	–0.1	+0	0.1
GDPA70	–3.5	–8.9	1.2	3.5	–6.1	–14.2	0.1	0.3	–0	–0	–0.3	–0.8
GDPNA70	3.4	7.4	–0.2	–0.4	2.0	3.7	+0	+0	+0	–0.1	+0	0.1
AG HCons at P70	2.9	3.5	–1.7	–1.9	0.8	0.4	–0.1	0.2	0.2	0.3	0.1	+0
NAG HCons at P70	0.9	2.5	–0.3	–0	2.8	2.8	0.2	0.5	+0	0.3	0.1	0.1
Trade Deficit 70	3.8	5.0	–2.9	–1.7	3.0	1.5	–1.2	–1.1	0	0	–1.1	–0.9
AG trade deficit 70	81.5	337.7	3.8	12.6	–35.9	–80.9	0.2	+0	2.4	3.6	2.2	2.1
Trade/GDP at WP	–4.9	–12.5	0.2	6.5	–21.9	–57.3	1.6	3.9	–2.4	–2.3	–0.9	–0.5
GDPA at WP70	–0.8	–6.6	0.3	2.0	–2.1	–10.0	–0.2	0.1	–0.2	–0.4	–0.7	–1.0
Investment	–1.5	0.7	2.7	2.1	–2.8	0.3	NA[c]	NA[c]	–0	–0.6	+0	+0
Total capital	–0.6	–0.4	0.8	1.5	–1.7	–1.1	NA[c]	NA[c]	+0	–0.1	–0	+0
AG vol. index WP70	–1.2	–8.0	0.6	2.5	–4.5	–12.1	+0	0.1	+0	0.1	–0.1	–0.4
Net calories produced	–5.4	–14.9	4.4	6.3	6.3	5.2	0.7	2.4	–0.2	–0.1	3.2	6.0
Agricultural capital	–4.4	–10.2	4.6	10.7	–10.6	–19.9	NA[c]	NA[c]	–0	–0.1	–0.1	–0.6
Agricultural labor	–3.5	–10.5	0	0	–4.4	–10.8	NA[c]	NA[c]	0	0	–0.8	–1.9
Total acreage	–1.9	–1.9	NA[c]	NA[c]	–0.8	–1.0	–0	–0.1	NA[c]	NA[c]	0.3	0.5
N fertilizer	3.5	–15.0	–0.4	1.3	–1.0	–9.3	NA[c]	NA[c]	–0.7	0.8	3.1	4.0
P_A/P_N	–12.7	–9.9	15.0	14.0	–22.4	–13.2	0.3	–0.1	0	0	–0.4	–0.4
AG CSWP index Y70	–0.5	–0.9	–1.7	–2.8	–3.1	–3.8	1.3	0.4	–0.1	–0.5	1.2	0.6
Crop price index	–0.8	5.3	11.8	10.6	–14.0	–9.6	0	0	NA[c]	NA[c]	–1.1	–1.5
Food price index	–8.9	–7.3	6.7	6.3	–9.9	–4.9	1.4	1.4	NA[c]	NA[c]	–0.2	–0.2
Terms of trade	–1.2	–7.0	–4.3	–4.9	–10.5	–12.3	1.7	3.7	5.1	6.3	6.3	6.4
Terms of trade R	2.7	2.9	–4.3	–5.1	–6.8	–6.0	0.8	2.6	5.0	6.3	6.3	6.7
AG SSR	–3.6	–10.7	1.1	2.9	–2.2	–8.8	+0	0.2	–0.1	–0.2	–0.3	–0.4
AG SCR	–2.3	–7.2	–0	–0	–0.1	0.6	0.2	+0	–0.1	–0.2	–0.9	–1.3
Parity	–12.8	–7.2	16.6	18.4	–23.0	–15.4	0.3	–0.1	NA[c]	NA[c]	+0	0.7
Equivalent income	2.0	3.1	NA[c]	NA[c]	2.0	2.1	NA[c]	NA[c]	NA[c]	NA[c]	0.1	0.1
Calories/capita	2.3	2.7	–0.1	–0.4	0.2	0.1	NA[c]	NA[c]	+0	0.1	0.1	+0
Protein/capita	2.8	3.3	–0.5	–0.7	0.3	0.1	NA[c]	NA[c]	0.1	0.1	–0	–0.1
Number hungry	–20.6	–31.9	1.1	4.0	–5.1	–2.1	–	–	–	–	–	–
Life expectancy	1.4	2.7	–0	–0.1	0.6	1.1	–0	–0	NA[c]	NA[c]	+0	+0

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*. [c]NA, not available.

at as it plays a dominant role in this scenario in determining the changes in the world market.

Large changes in the structure of producer prices, production, and trade pattern take place in Argentina. Wheat output falls by 7% even when the producer price for wheat increases by 32%, which is the second-largest increase in producer price of any commodity, the largest increase being 36% in bovine and ovine meat.

The allocation of factors to the production of the different commodities shown in *Table 7.8* indicates why the production pattern changes as it does. The increased profitability of agriculture in this scenario draws more capital and labor into agriculture relative to the additional land that is brought under use in agriculture. The opportunity cost of land, its shadow price, would thus increase relative to those of capital and labor. The net revenues shown in *Table 7.8* do not include factor costs, so, when the changed opportunity costs of the factors are taken into account, relative profitability shifts away from cereals – wheat and coarse grains – and toward animal products. In particular, one-fifth of the land is shifted from these cereals, which together account for three-quarters of land in the reference scenario, to roughage production. This kind of shift of land use has in fact been observed in the past in Argentina when cereal/livestock price ratios have changed. An interesting finding in *Table 7.8* is that the rice area increases even when the percentage fall in net revenue among all commodities is highest for it. Once again, this can happen since, when factor costs are subtracted, rice becomes a relatively more profitable crop compared to wheat and coarse grains.

The changes in production structures in different countries get reflected in changes in trade patterns. Since the developing countries move to agricultural trade liberalization in this scenario, changes in their trade patterns are quite significant (see *Table 7.9*). Many countries change trade volumes severalfold in a number of commodities, and for some commodities also change the direction of trade. Turkey, the country with the highest protection level among the developing countries in the reference run, reverses direction of trade in rice, bovine and ovine meat, dairy products, other meats, and protein feed. These changes are better seen in *Table 7.10*, which gives changes in agricultural trade volumes.

The impact on the trade of developed countries is not very large, as they do not change their protection policies in this scenario. As was noted earlier in *Table 7.2*, developing countries in 2000 increase their imports of wheat by 11 million tonnes, of coarse grains by 10 million tonnes, and of dairy products by 7 million tonnes. This leads the EC and Canada to increase their wheat exports and the USA to increase its exports of coarse grains and dairy products.

One can summarize the production and trade changes in the developing countries when they liberalize agricultural trade as follows:

(1) The world market prices of their agricultural exports go down, those of their imports go up, and the aggregate price falls so marginally that one can say it is nearly unaffected.

Table 7.7. Argentina: Production and trade in 2000 under LDC trade liberalization relative to the reference scenario.

	Reference scenario (R0)[a]			*F-LDC: % change over R0*					
Commodity	*Production*	*Export*	*Feed*	*Production*	*Demand*	*Export (net)*	*Feed*	*Retail price*	*Producer price*
Wheat	11.91	6.61	1.03	–6.9	3.6	–16.2	26.7	6.8	32.4
Rice	0.31	0.04	0.04	15.7	8.9	65.1	39.2	–7.9	–8.8
Coarse grains	25.15	12.86	10.39	–23.8	27.3	–72.7	36.1	21.0	21.2
Bovine and ovine	5.31	1.53	0	37.0	–3.2	136.1	0	23.7	35.8
Dairy	6.45	0.19	0.20	24.4	1.6	775.9	43.6	1.9	4.5
Other animal products	0.19	0.03	0	42.3	–3.6	288.5	0	14.9	22.3
Protein feed	0.60	0.24	0.32	33.9	58.9	–4.7	62.6	4.7	4.7
Other food	3.12	0.58	0.03	41.1	2.8	210.5	27.4	10.4	30.7
Nonfood agriculture	0.87	0.45	0	29.8	2.2	55.9	0	–5.0	–5.0
Nonagriculture	55.42	–2.75	0	–1.4	2.9	88.6	0	1.6	1.6

[a] In the reference scenario, units = 10^6 t for all but other food nonfood agriculture, and nonagriculture, which are 10^9 US$ 1970.

Table 7.8. Argentina: Net revenues in 2000 under LDC trade liberalization relative to the reference scenario.

Commodity	*Reference scenario, R0*[a]	*F-LDC: % change over R0*
Wheat	0.05	36.8
Rice	0.29	−10.5
Coarse grains	0.05	24.3
Protein feed	0.13	67.6
Other food	0.80	59.1
Nonfood crops	0.35	−9.9
Fruits	0.16	46.2
Other animal products	3.70	28.2
Bovine and ovine	48.48	34.2
Milk animals	147.92	9.7

[a] 10^3 × national currency per hectare for wheat, coarse grains, protein feed, other food, and nonfood crops; national currency per 1970 US$ for fruits; 10^3 × national currency per tonne of protein equivalent for other animal products; national currency per head for bovine and ovine and for milk animals.

(2) The developing countries as a group reduce their agricultural production and increase their agricultural imports of grains and dairy products. Though their agricultural export volumes also go up, their agricultural trade balances at current relative prices go down, so that their imports of nonagriculture go down.

(3) The pattern of production and trade in individual developing countries changes a lot, and in a number of commodities many countries change their direction of trade.

What, however, is the impact on welfare at the global level as well as in the developing countries? This question is taken up in the next section.

7.6. Impact on Welfare of Agricultural Trade Liberalization by the Developing Countries

As in the previous chapter, the impact on welfare is examined at the global level in terms of GDP measured at world prices and number of persons in hunger.

If total global GDP increases, one may argue that, in principle, the gains due to agricultural trade liberalization are adequate to compensate those who lose under it. In this sense, with lump-sum transfers, one would expect that a movement toward trade liberalization would be welfare-improving. Keyzer (1985) has shown that, even under a variety of other distortions, this should be so. Of course, from theoretical considerations alone, one would not be able to say how much or how little the gain would be.

Table 7.9. Percentage changes[a] in agricultural trade patterns in 2000 under LDC trade liberalization relative to the reference scenario.

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine and ovine*	*Dairy*	*Other animal products*	*Feed*	*Other food*	*Nonfood*
USA	3	1	6	1	70	+[b]	-8	-29	–[b]
Canada	10	0	7	-4	–[b]	1	20	12	-3
Australia	8	2	8	-9	-2	-6	-7	-37	-4
New Zealand	-17	0	52	-8	5	11	-4	12	-5
Austria	7	0	20	-30	0	9	-1	39	6
EC	37	6	9	9	-1	-13	0	6	5
Japan	-1	-24	-3	4	-13	-6	-2	4	1
CMEA	2	0	1	0	+[b]	0	–[b]	14	-2
Argentina	-16	65	-73	136	776	289	-5	210	56
Brazil	22	-61	-17	-29	-29	-80	19	113	-2
Mexico	-24	198	-69	-69	+[b]	-30	-26	-59	122
Egypt	16	+[b]	19	42	23	-129	956	121	26
Kenya	13	–[b]	5	197	+[b]	75	208	6	-7
Nigeria	3	48	60	68	19	17	194	20	46
India	-80	-51	25	363	–[b]	100	1	+[b]	-60
Indonesia	4	-87	123	18	-2	19	-15	-83	-73
Pakistan	-46	-101	-449	578	90	-44	169	12	-43
Thailand	2	132	8	75	0	195	-43	-11	17
Turkey	-61	-395	-92	-206	-104	-150	+[b]	-70	-38

[a]The percentage change figures for trade should be interpreted with care. A negative percentage change implies reduction in net exports or imports. A negative percentage change that exceeds 100 shows a reversal of trade direction. A positive percentage change shows an increase in traded quantity.

[b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table 7.10. Changes in agricultural trade volumes in 2000 under LDC trade liberalization relative to the reference scenario values.

Country	Wheat	Rice	Coarse grains	Bovine and ovine	Dairy	Other animal products	Protein feed	Other food	Nonfood
	10^6 t							10^9 US$ 1970	
USA	1.677	0.042	7.785	–0.008	6.335	0.015	–1.310	–0.854	–0.004
Canada	2.629	–0.000	1.053	–0.015	–0.014	0.001	–0.064	–0.045	–0.005
Australia	1.225	0.004	1.003	–0.044	–0.039	–0.001	–0.011	–0.236	–0.033
New Zealand	0.022	0	0.100	–0.090	0.278	0.001	–0.002	–0.009	–0.023
Austria	0.007	–0	0.080	–0.008	–0	–0.001	0.002	–0.026	–0.002
EC	6.540	–0.012	–1.857	–0.094	–0.047	–0.011	–0.012	–0.432	–0.104
Japan	0.102	0.191	1.279	–0.015	0.053	–0.024	0.089	–0.065	–0.011
CMEA	–0.335	–0.001	–0.124	0	0.013	0	–0.017	–0.214	0.052
China	0	0	0	0	0	0	0	0	0
Argentina	–1.070	0.026	–9.349	2.086	1.475	0.088	–0.011	1.213	0.249
Brazil	–1.467	0.630	1.471	0.288	0.492	0.175	0.903	1.040	–0.005
Mexico	0.543	–0.117	3.905	0.055	0.459	–0.069	0.207	–0.333	0.054
Egypt	–0.813	0.491	–0.484	–0.140	–0.365	–0.039	0.061	0.422	0.044
Kenya	–0.039	–0.003	–0.096	0.092	0.069	–0.002	0.001	0.037	–0.018
Nigeria	–0.320	–0.927	–1.005	–0.342	–0.650	–0.056	0.010	–0.146	–0.061
India	–4.939	–2.015	–2.546	–0.236	–1.405	–0.031	0.008	1.502	–0.124
Indonesia	–0.060	1.939	–1.635	–0.010	0.009	–0.007	0.009	0.618	0.081
Pakistan	–1.478	–1.101	–3.102	–0.195	–4.220	–0.006	0.086	–0.028	0.099
Thailand	–0.006	1.413	0.180	0.051	–0.002	0.031	–0.016	–0.190	0.012
Turkey	1.665	–0.042	1.539	–0.349	–1.953	–0.033	0.006	–0.855	–0.165

7.6.1. Global GDP increases marginally; hunger decreases

Table 7.11 shows that the global GDP increases, but by a very small amount. A 0.05% increase in the year 2000 amounts to US$5.4 billion (1970), which is almost one-fifth of the gain that resulted from agricultural trade liberalization by the OECD countries. This is understandable as the developing countries, as a rule, distort agriculture less than the developed countries (see *Figure 1.1*). Thus, gains from removal of distortions can be expected to be smaller.

Table 7.11. Percentage changes in global GDP and hunger under LDC trade liberalization relative to the reference scenario.

	GDP at 1970 world prices		*Persons in hunger*	
Region	*1990*	*2000*	*1990*	*2000*
World	0.05	0.05	−4.7	−4.6
DMEs[a]	0.08	0.18	–	–
CMEA	0.01	−0.11	–	–
Developing without China[b]	0.25	−0.01	−7.2	−8.8
Mid income[c]	0.17	−0.45	9.8	14.5
Low-mid income[d]	0.47	0.68	−5.0	−7.9
Low income[e]	0.26	0.31	−8.5	−10.0

[a]Australia, Austria, Canada, Japan, New Zealand, USA, and the EC.
[b]Countries with a separate national model, except China: i.e., those listed in footnotes c to e.
[c]Argentina, Brazil, and Mexico.
[d]Egypt, Indonesia, Kenya, Nigeria, Thailand, and Turkey.
[e]India and Pakistan.

The global-level changes in GDP are somewhat misleading in the system, because of the way the models of the CMEA, China, and country groups behave. As already pointed out, China does not participate in trade liberalization. Production in the model of the CMEA responds to prices only marginally since much of its behavior is determined by plan targets that are not revised as the world market conditions change. Similarly, the responses of the country group models to changing prices also do not fully exploit the possibilities of a more efficient reallocation of resources under trade liberalization. As a consequence, GDP at 1970 world prices goes down for most of the country groups in this scenario. Thus, in *Table 7.11*, the figures for changes in GDP for the various categories are given only for the countries explicitly modeled in the system.

The explicitly modeled developed market economies (DMEs), even though they do not liberalize agricultural trade in this scenario, increase their GDP by 0.18% in 2000, i.e., by about US$10 billion (1970). This is the outcome of the fact that terms of trade improve significantly for Austria, Canada, the EC, and the USA and decline only marginally for Australia and New Zealand, and changes in factor allocation for production consequent on the changes in the world market prices are favorable.

In 1990, the GDP for all categories of developing countries in *Table 7.11* shows improvement; this improvement reverses in 2000 for the mid-income countries Argentina, Brazil, and Mexico, but continues for the others. The dynamics of growth and factor allocations in the middle-income countries leads to a relatively more inefficient allocation of factors under the F-LDC scenario.

Hunger in the world is reduced somewhat when the developing countries liberalize agricultural trade. The low-income countries, India and Pakistan, show a reduction of 8–10% in number of people in hunger. The reduction in the number of hungry in most of the developing countries may suggest that the combined effects of changes in income, due to changes in producer prices and production, and of changes in food prices are beneficial to the poor in these countries.

The impact on welfare may be better explained at the level of individual countries.

7.6.2. Many developing countries gain

The indicators of producer, consumer, and social welfare that are used in this study are summarized in *Table 7.12* for the different countries.

Egypt, Kenya, Indonesia, Pakistan, and Turkey gain on all available indicators; and one could conclude that these countries benefit from agricultural trade liberalization.

Though the indicators for the other developing countries do not show uniform gains or losses, one could still pass a judgment on some of them. Thus, Argentina, which gains in production value as well as in all consumer gain indicators but loses on hunger and life expectancy, may still be considered a gainer, as Argentina has a very small proportion of its population (less than 2%) in hunger and a high life expectancy in the reference scenario.

Similarly, India may be considered a gainer as it shows improved consumer welfare indicators as well as social indicators of hunger and life expectancy. The small decline in value of GDP and parity can be considered as unimportant compared to the 8–9% reduction in hunger. The 1% reduction in rural/urban income parity does not affect the equivalent income of the rural population adversely, and agricultural trade liberalization seems to benefit all rural and urban classes in the country (see *Table 7.13*).

7.6.3. But some developing countries lose, too

Among those countries that may be considered losers under agricultural trade liberalization, Brazil is a clear case, as it shows losses on all available indicators.

Table 7.12. Gains and losses on some macroeconomic and welfare indicators in 2000 under LDC trade liberalization relative to the reference scenario.[a]

Countries	*GDP70*	*Parity*	*Equiv. income*	*Consump-tion cost*	*People hungry*	*Life expect.*
USA	G	L	–	G	–	NS
Canada	NS	NS	NS	ID	–	NS
Australia	NS	L	L	L	–	NS
New Zealand	NS	L	–	L	–	NS
Austria	G	L	G	G	–	NS
EC	NS	G	G	G	–	NS
Japan	NS	L	G	G	–	NS
CMEA	L	–	–	G	–	–
China	–	–	–	ID	–	–
Argentina	G	G	G	G	L	L
Brazil	L	G	L	L	L	L
Mexico	L	L	L	L	G	L
Egypt	G	G	G	G	–	G
Kenya	G	G	–	G	G	G
Nigeria	L	L	L	ID	G	G
India	L	L	G	G	G	G
Indonesia	G	G	G	G	–	NS
Pakistan	G	L	G	G	G	G
Thailand	NS	G	–	L	L	NS
Turkey	G	L	G	G	G	G

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

Table 7.13. Class-wise impact in India in 2000 of LDC agricultural trade liberalization: Percentage change in F-LDC relative to the reference scenario.

	Expenditure[a] *class*				
Calorie intake per capita	<$29	<$45	<$69	<$120	<$120
Rural	3	2	2	2	1
Urban	4	2	1	+0[b]	–0[c]

[a]Expenditure in 1970 US$ per capita per year.
[b]+0 means a small increase.
[c]–0 means a small decrease.

Thailand should also be considered a loser as it shows a loss for consumption cost comparison as well as for people in hunger. The gains in production value and income parity of the farmers seem to be more than offset by the increase in the food price index and the loss of terms of trade.

Mexico and Nigeria show losses in production value and in the consumer welfare indicators, equivalent income, and consumption cost comparisons. However, both of them show a reduction in hunger. The fall in food prices increases calorie intake even though the modified consumption bundles may not be considered as desirable as the reference scenario bundles by consumers on the average. The desirability of the outcome of trade liberalization for these two countries thus remains ambiguous.

7.6.4. Small impact on developed countries

Among the developed countries, the agricultural importers, Austria, the EC, and Japan, gain in production value, equivalent income, and consumption cost comparisons.

The USA, an agricultural exporter, gains on both production value and consumption cost comparisons.

The impact on Canada is insignificant on all the available indicators.

However, Australia and New Zealand both lose in terms of production value and available consumer welfare indicators. Income parity also declines significantly in these countries.

The different impacts on the agricultural exporters of North America and Oceania arise from the commodity composition of their trade and the way in which world market prices of different commodities change. Thus, whereas both the USA and Canada improve their terms of trade, both Australia and New Zealand suffer from a decline in their terms of trade and consequently in the domestic relative price of agriculture as well.

7.6.5. Why do some gain and some lose?

Among the developing countries, there is no easily discernible pattern as to who gains and who loses. This can be seen in *Table 7.14*, where the countries are classified as to whether they had an agricultural trade surplus or deficit and whether they protected (a positive degree of protection) or penalized (a negative degree of protection) agriculture in the reference scenario.

The explanations lie in the dynamics of the way countries react and adjust. Even among the losing countries the dynamics are not uniform. In Brazil and Thailand investment increases, whereas in Mexico and Nigeria it goes down. These processes vary from country to country and have to be looked at on a case by case basis.

The gainers do not need much of an explanation, as this is what one would expect from economic theory. Trade liberalization would remove distortions, improve allocational efficiency, increase gains from trade, and increase consumer well-being.

What needs explanation is why some countries lose.

Table 7.14. Classification of gainers and losers in 2000 among developing countries under LDC trade liberalization.

Current agricultural policy and status	*Gainers*	*Losers*
Protecting agricultural exporters	India Turkey	Mexico[a]
Penalizing agricultural exporters	Argentina Kenya	Thailand
Protecting agricultural importers	Egypt Pakistan	Nigeria[a]
Penalizing agricultural importers	Indonesia	Brazil

[a]Considered as losers, though the outcome on hunger is beneficial for these countries.

Before offering such explanations, one may note that the essential structures of the models are similar for most national models, and the specific characteristics of a country are embodied in the estimated parameters. The explanations given below are thus based on the differences in parameter values and starting positions of different countries and not on differences in the structures of the models. The explanations may appear to be *ad hoc*, but the same arguments and analysis systematically applied to other countries do not lead to similar outcomes because of differences in parameter values.

7.6.6. Brazil loses because of other domestic distortions

Under agricultural trade liberalization in Brazil, the relative price of agriculture increases by almost 20%; more capital (24%), labor (2%), and land (8%) are brought into agriculture; and income parity goes up by 24% compared to the reference scenario in the year 2000.

However, the ratio of agricultural GDP per unit of labor to nonagricultural GDP per unit of labor has been historically very low – at times less than 0.15. In the reference scenario outcome, the parity ratio remains at more or less this level.

This low parity ratio signifies a distortion in the labor market. Why does agricultural labor not move out and into the nonagriculture sector and bring down the inequality in income? Costs of movement, differences in skills, protected labor markets, social and cultural costs of movement, etc., may be behind this low income parity.

When agricultural trade is liberalized, the income parity ratio improves and marginally slows down the movement of labor out of agriculture into nonagriculture (see *Table 7.15*). This lowers the nonagricultural output and also the total GDP (see *Table 7.12*). The reduction in total GDP, along with 12.5% higher food prices, results in loss on all indicators other than income parity.

Table 7.15. Brazil: Ratios of sectoral factor allocation, shadow prices, GDPs, and incomes.

		Reference scenario		F-LDC	
Ratio[a]	*1980*	*1990*	*2000*	*1990*	*2000*
$GDP70_A/GDP70_{NA}$	0.06	0.05	0.04	0.05	0.04
Income parity ratio	0.14	0.14	0.13	0.17	0.16
TL_A/TL_{NA}	0.61	0.47	0.37	0.47	0.38
$\lambda L_A/\lambda L_{NA}$	0.16	0.17	0.16	0.21	0.20
K_A/K_{NA}	0.11	0.08	0.06	0.09	0.10
$\lambda K_A/\lambda K_{NA}$	0.70	0.60	0.56	0.63	0.57

[a] TL_A/TL_{NA}, ratio of labor in agriculture to that in nonagriculture; $\lambda L_A/\lambda L_{NA}$, ratio of shadow price of labor in agriculture to that in nonagriculture; K_A/K_{NA}, ratio of capital in agriculture to that in nonagriculture; $\lambda K_A/\lambda K_{NA}$, ratio of shadow price of capital in agriculture to that in nonagriculture.

7.6.7. Thailand loses because of terms-of-trade decline

A rice-exporting country that taxes rice exports and had in general negative protection on agriculture, Thailand, under F-LDC, shows higher agricultural prices, increased investment, higher production, higher food prices, a loss in terms of trade, and a consequent loss in calorie intake, increase in the number of hungry, and a loss in consumption cost comparison.

For Thailand, a major rice exporter in a relatively thin world rice market, a tax on rice exports may be an optimal policy. In the reference scenario in 2000, the value of its agricultural trade surplus constituted 5% of its GDP. A drop of 5% in terms of trade would mean a loss in income of 0.25% of GDP. The gain in GDP at 1970 prices that Thailand shows under F-LDC in 2000 is 0.1%. Of course the gain in GDP takes place in spite of the loss in terms of trade, but part of the cost of loss in terms of trade is borne by consumers who lower their consumption. Also a food price increase of 6% with a GDP increase of only 0.1% would leave consumers who spend a large part of their income on food, as consumers do in Thailand, worse off.

Thailand's loss under agricultural trade liberalization can thus be explained mainly by a loss in terms of trade due to removal of what may be an optimal tariff, by a country whose agricultural exports are a sizable part of its GDP.

7.6.8. Mexico and Nigeria lose because of lower real investments

Mexico and Nigeria both protect their agriculture. When the protection is removed, the relative price of agriculture goes down in these countries.

In most of the country models, including those of Mexico and Nigeria, savings depend on GDP at current prices. The real value of investment made from these savings depends on the price of nonagriculture. A fall in agricultural prices, relative to the nonagriculture price, reduces the real value of investment. In the case of Mexico and Nigeria, the reduced investments lower GDP growth rates, which do not recover following the more efficient allocation of resources that can be expected as a result of trade liberalization, as they do for a number of other countries such as Pakistan and Turkey, which also share a fall in the relative price of agriculture and an initial drop in investment, but recover to show in time higher investments and higher production.

Thus, one could say that Mexico and Nigeria lose because of the rigidities in their domestic capital markets, which do not reallocate capital sufficiently rapidly to more efficient uses.

The lower food prices in both Mexico and Nigeria, as already mentioned above, do lead to higher calorie intake and reduction in hunger, though comparison of consumption costs and equivalent incomes indicate an adverse impact of agricultural trade liberalization.

7.6.9. A comment on developing countries that lose

To what extent can the losses of Brazil, Mexico, and Nigeria be considered as realistic and to what extent merely an outcome of the way the models are constructed? The rigidities in the labor movement or resource allocation efficiencies that lead to these results are not farfetched. It is conceivable that they exist in real life. To the extent that the model equations pertaining to these movements and allocation are consistent with past observations, one cannot rule out that they reflect empirical reality. On the other hand, as in all econometric estimations, here also one can never establish that, in fact, they do so.

7.7. Summary and Policy Implications

Agricultural trade liberalization by the developing countries results in a generally favorable outcome for many developing countries.

Not only does agricultural production go up in many of them, but also consumers are better off and the level of hunger in the world goes down. However, the reduction in the number of hungry is only 5% (or 9% if one considers the impact on only the explicitly modeled developing countries in the system); and agricultural trade liberalization does not touch the heart of the hunger problem and cannot be looked upon as a solution to it.

Though the percentage improvements in production values and consumer gains are small, for many developing countries, agricultural trade liberalization does seem a desirable policy.

This conclusion, however, needs to be qualified and cannot be generalized to all developing countries as the impacts on Thailand, Brazil, Mexico, and Nigeria show.

The adverse impact on Thailand resulting from terms-of-trade loss can also be important for other developing countries. Such adverse effects on terms of trade in the present study are somewhat understated, as many commodities exported by developing countries are a part of the aggregated commodities sectors "other food" and "nonfood agriculture". Thus, countries that depend significantly on exports of commodities that are part of these aggregated sectors should seriously examine the possibilities of terms-of-trade loss before adopting agricultural trade liberalization.

Similarly, the rigidities and distortions in domestic labor and capital markets that cause losses for Brazil, Mexico, and Nigeria in this scenario are also not uncommon in developing countries. Thus, countries that are not able to remove some of these rigidities and distortions before embracing agricultural trade liberalization should also carefully examine the possibilities of losing under it.

Finally, the impact on the developed countries is marginal except for the reduction in income parity in Australia and New Zealand. This is, of course, also influenced by the assumption that the EC and the USA do not reduce their protectionist measures in this scenario. Since the OECD countries gained under trade liberalization by themselves, it is worth exploring the impact of trade liberalization by all – OECD countries as well as developing countries.

CHAPTER 8

Agricultural Trade Liberalization by All Market Economies

8.1. The Scenario F-ALLME

As we have seen in the preceding chapter, the countries liberalizing agricultural trade, in general, seem to gain from it. However, the countries that do not liberalize are often affected adversely. In particular, a number of developing countries lose when the OECD countries liberalize agricultural trade, though some of them gain when they themselves liberalize. It is thus interesting to see what happens when both OECD countries and the developing countries liberalize agricultural trade together.

When more countries remove distortions, the scope for exploiting comparative advantage increases, and global gains in efficiency should also increase. However, in the absence of lump-sum transfers, an individual country may be worse off if the changes in world market prices substantially worsen its terms of trade. To estimate the magnitude of global gains and assess the extent to which losses to some countries are offset by gains to others under agricultural trade liberalization by all market economies, developed as well as developing, this scenario is generated.

The scenario is designated F-ALLME as the centrally planned economies of the CMEA and China do not liberalize. As in other scenarios, only border distortions are removed over a five-year period, 1982–1986, so that agricultural trade is fully liberalized in 1986, when domestic relative prices in a country equal its trade prices.

As in earlier chapters, the results of this scenario are discussed in the following sequence. First, changes in world market prices are described and compared with the corresponding changes under F-OECD and F-LDC. How these changes in world market prices affect domestic prices, the growth process, and factor allocation is described next. Following this, how factor availability and domestic relative prices affect production and trade patterns is highlighted. This is then used to explain why world market prices change the way they do. Finally, the impact on welfare is examined. Here the global efficiency gains as reflected in world GDP at constant prices and changes in the number of hungry people in the world are examined first. The country-wise impacts on production, consumer welfare, and social welfare, as reflected in extent of hunger and life expectancy at birth and income parity, are discussed to assess which countries gain and which ones lose.

8.2. Changes under Agricultural Trade Liberalization by All Market Economies

8.2.1. Changes in world market prices under F-ALLME

The changes in the world market prices under this scenario are shown in *Table 8.1.* In *Figures 8.1–8.9* the index of relative world prices of the various commodities with 1980 prices as base is plotted for the various trade liberalization runs. The price changes for many commodities are similar to what can be predicted from the changes in prices under the F-OECD and F-LDC scenarios. The aggregate agricultural price in the year 2000 relative to the nonagricultural price increases by 5% over the reference scenario. Most of the commodity prices rise, but those of nonfood agriculture and other food decline. Other animal products show a very small decline of 1%. Dairy products show the highest price rise of 34%, as compared to the increases under F-OECD of 31% and under F-LDC of 12%. The price increases in 1990 are generally larger than in 2000, as by 2000 adjustments in production structures are more fully realized.

Table 8.1. Percentage changes in world market prices and global net exports under various trade liberalization scenarios relative to the reference scenario.

	Relative prices				*Net exports*			
	1990	*2000*			*1990*	*2000*		
Commodity	*ALLME*	*ALLME*	*OECD*	*LDC*	*ALLME*	*ALLME*	*OECD*	*LDC*
Wheat	16	23	18	5	1	3	–2	3
Rice	22	16	21	1	35	36	37	–12
Coarse grains	17	13	11	4	–4	–3	–5	0
Bovine and ovine meat	26	11	17	–3	52	69	35	27
Dairy products	38	34	31	12	30	24	13	24
Other animal products	3	–1	–0	1	3	14	17	–4
Protein feed	11	13	13	1	5	4	5	–1
Other food	–1	–3	5	–6	4	10	10	–2
Nonfood agriculture	–11	–17	–2	–14	5	6	5	0
Total agriculture	9	5	9	–2	–	–	–	–
Nonagriculture	0	0	0	0	13	13	17	–3

The relative price indices for all agricultural commodities, plotted in *Figures 8.1–8.9* show that the major price increases are in dairy products and in bovine and ovine meats; the other prices change relatively very little.

Global trade expands. The most significant expansion of trade takes place for bovine and ovine meat, which grows more than in other trade liberalization scenarios.

The global trade/production share indices plotted in *Figures 8.10–8.18* for the four trade liberalization scenarios show clearly that, except for bovine and ovine meat and dairy products, the trade shares in F-ALLME remain similar to those in the F-OECD scenarios.

8.2.2. Changes in growth patterns under F-ALLME

The changes in world prices get transmitted to domestic prices under agricultural trade liberalization. Once again, the driving forces behind the development patterns of the various national economies can be understood in terms of processes initiated by these price changes.

Table 8.2 shows changes in the world relative price of agriculture weighted by the 1970 production volumes of each country, changes in domestic producer price, investment, capital stock, and GDP at 1970 prices for the year 2000. The country-production-weighted changes in world relative prices vary from country to country, and for Nigeria there is even a decline of 2%. This shows the importance of the pattern of price changes across commodities in analyzing reactions to trade liberalization.

Increases in the domestic relative price of agriculture make investment goods cheaper and lead to higher real investment. This results in a larger total capital stock, whereas a lower price results in a lower capital stock. Moreover, a higher price for agriculture also draws in more resources to agriculture. This reallocation results in more efficient use of resources for a number of countries that show larger GDPs at 1970 prices in the year 2000.

Thus, the developed economies – those that protect as well as those that tax agriculture – increase their GDPs. The one exception is Canada. However, this apparent loss in GDP at 1970 prices for Canada results from an index number problem and in fact, as can be seen in *Table 8.3*, the value of output increases for Canada, too, when pair-wise comparisons are made of production values in two situations.

Among the developing market economies with a national model in the system, six countries show higher GDPs and the others show lower GDPs. The largest reduction in GDP is for Mexico. Mexico follows a factor allocation pattern similar to that in the F-LDC scenario, and its GDP falls as a result of rigidities in domestic factor movements between sectors. Such rigidities result in suboptimal allocation of factors between sectors and, as was indicated in Chapter 7, agricultural trade liberalization slows down the movement toward more efficient factor allocations.

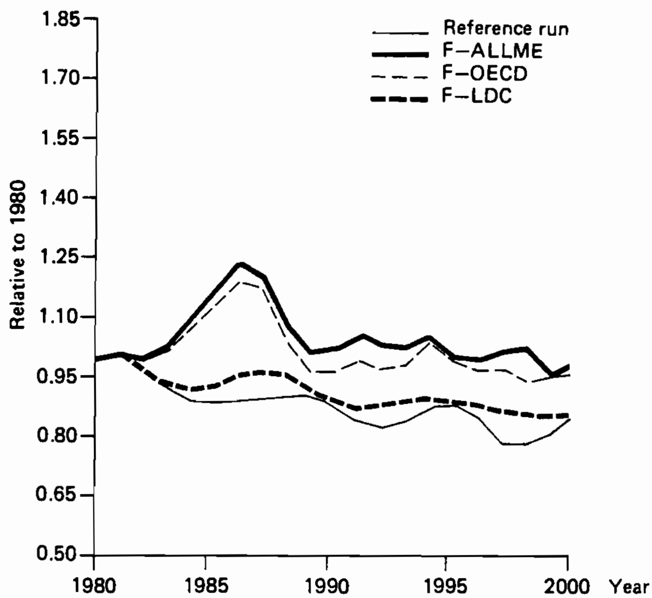

Figure 8.1. Index of relative prices of wheat on the world market under various trade liberalization scenarios.

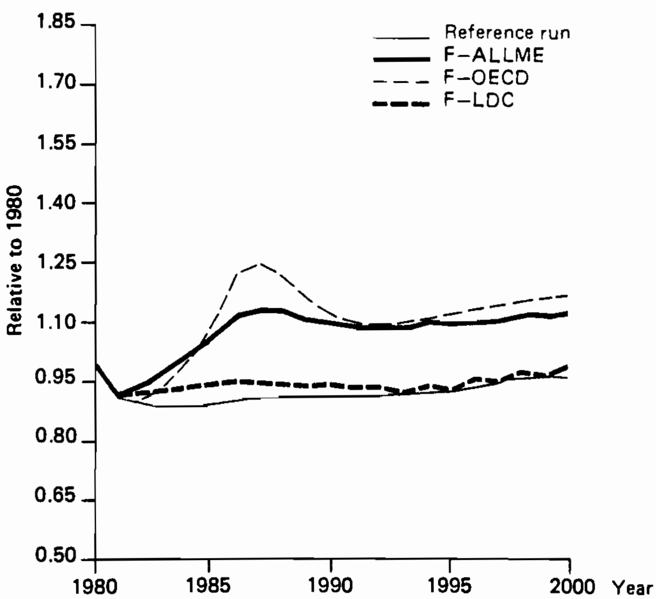

Figure 8.2. Index of relative prices of rice on the world market under various trade liberalization scenarios.

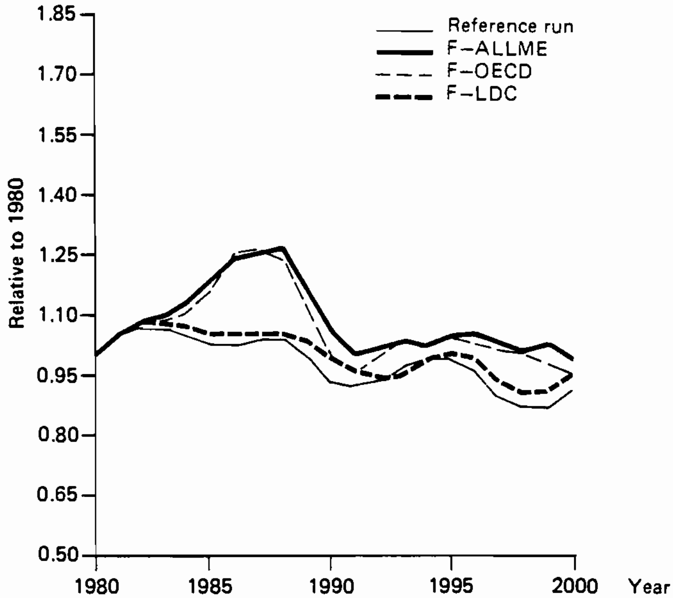

Figure 8.3. Index of relative prices of coarse grains on the world market under various trade liberalization scenarios.

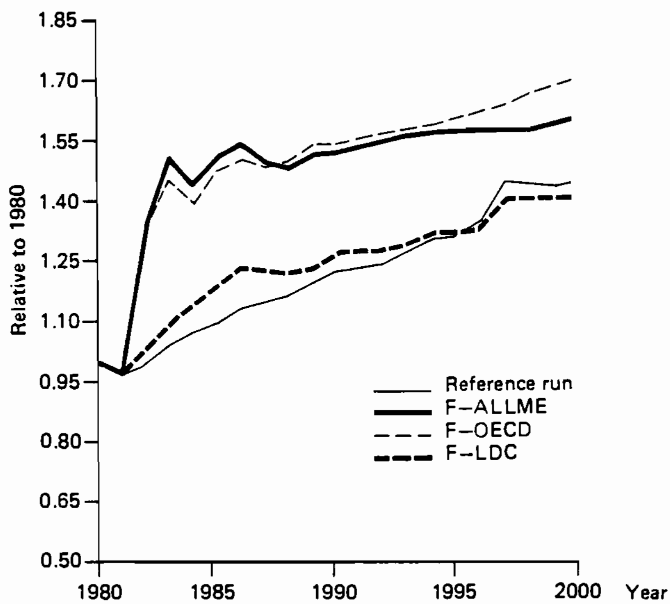

Figure 8.4. Index of relative prices of bovine and ovine meat on the world market under various trade liberalization scenarios.

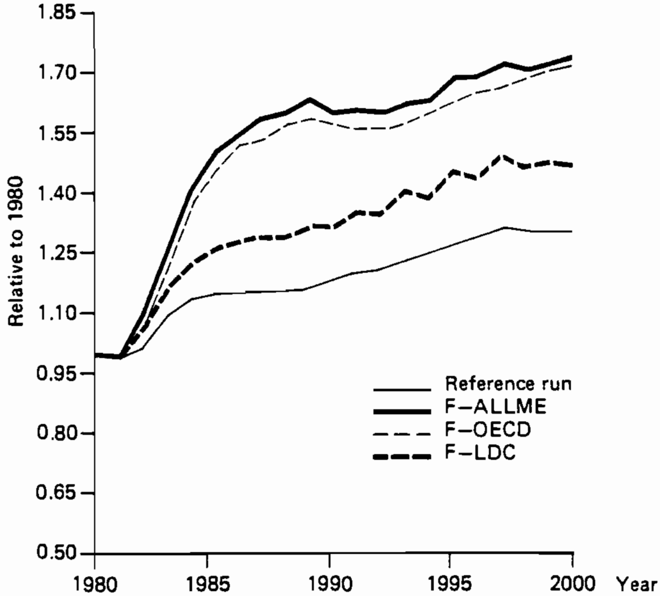

Figure 8.5. Index of relative prices of dairy products on the world market under various trade liberalization scenarios.

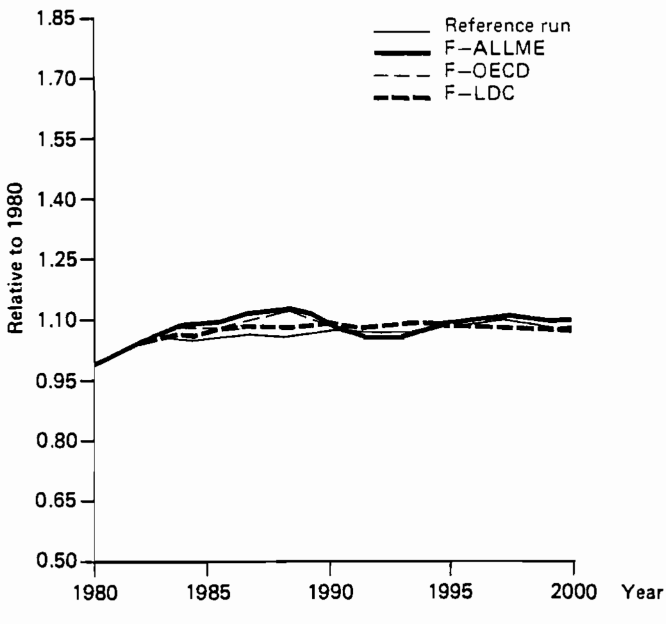

Figure 8.6. Index of relative prices of other animal products on the world market under various trade liberalization scenarios.

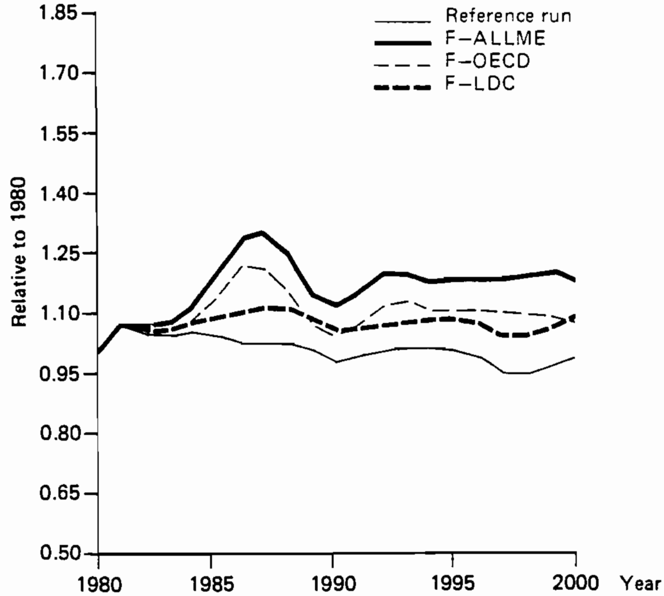

Figure 8.7. Index of relative prices of protein feed on the world market under various trade liberalization scenarios.

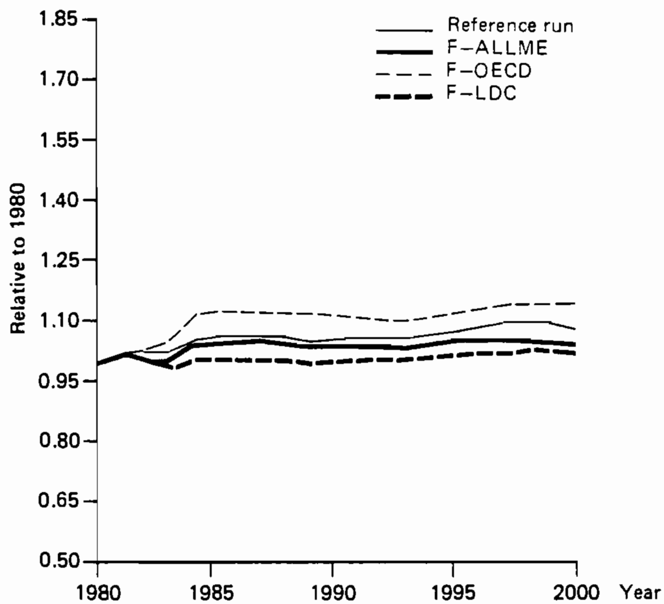

Figure 8.8. Index of relative prices of other food on the world market under various trade liberalization scenarios.

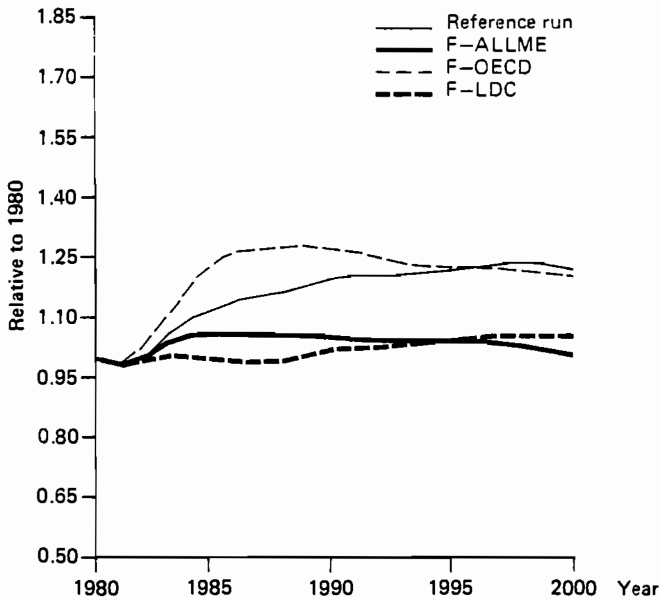

Figure 8.9. Index of relative prices of nonfood agriculture on the world market under various trade liberalization scenarios.

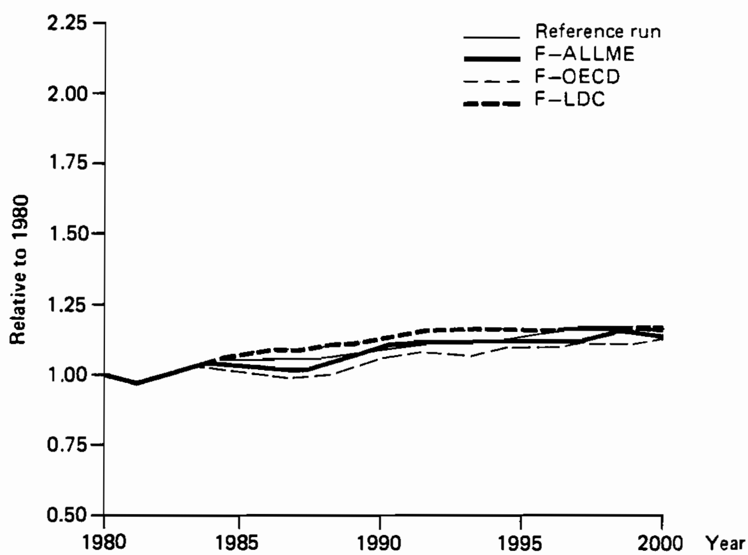

Figure 8.10. Index of (global net export)/(global production) (1980 = 1) for wheat under various liberalization scenarios.

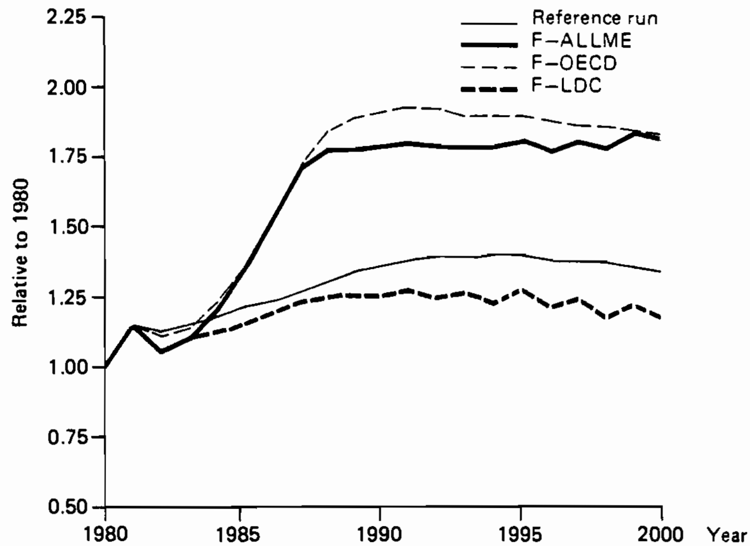

Figure 8.11. Index of (global net export)/(global production) (1980 = 1) for rice under various liberalization scenarios.

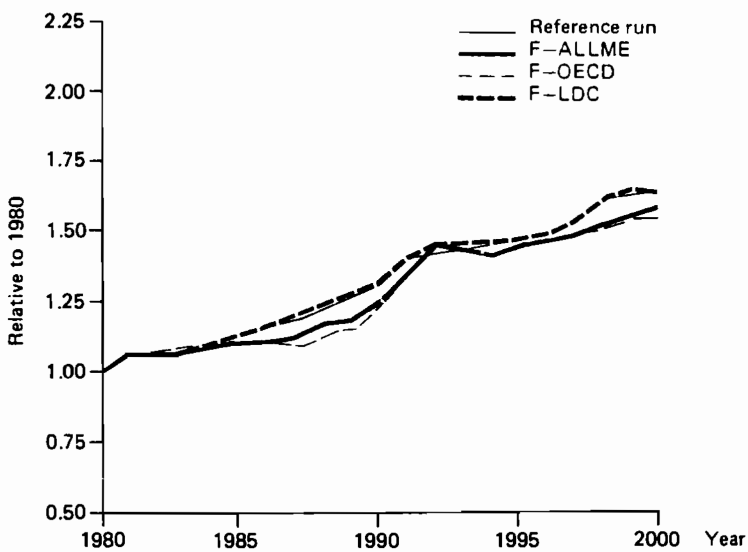

Figure 8.12. Index of (global net export)/(global production) (1980 = 1) for coarse grains under various liberalization scenarios.

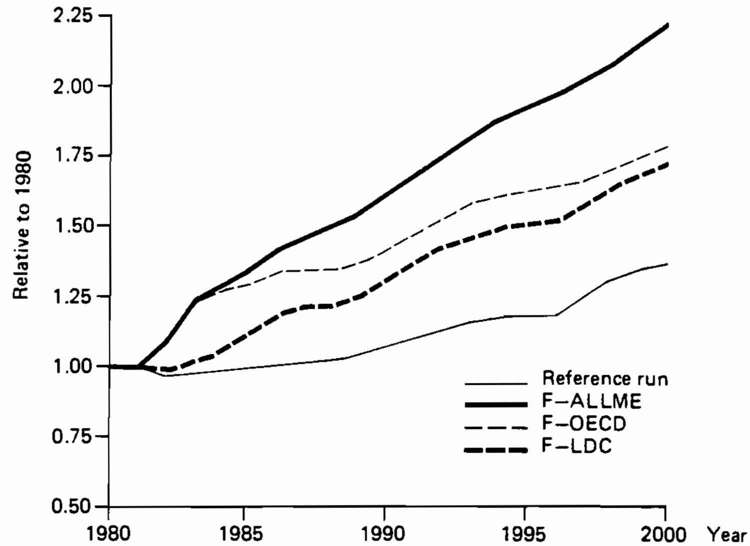

Figure 8.13. Index of (global net export)/(global production) (1980 = 1) for bovine and ovine under various liberalization scenarios.

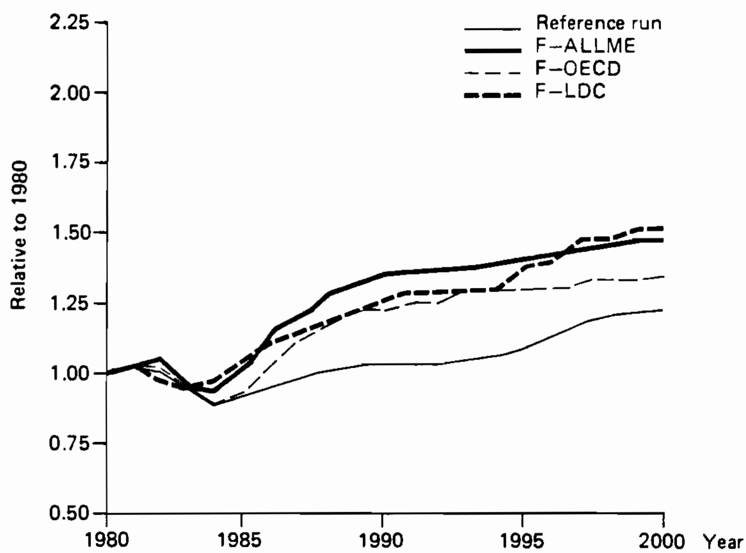

Figure 8.14. Index of (global net export)/(global production) (1980 = 1) for dairy under various liberalization scenarios.

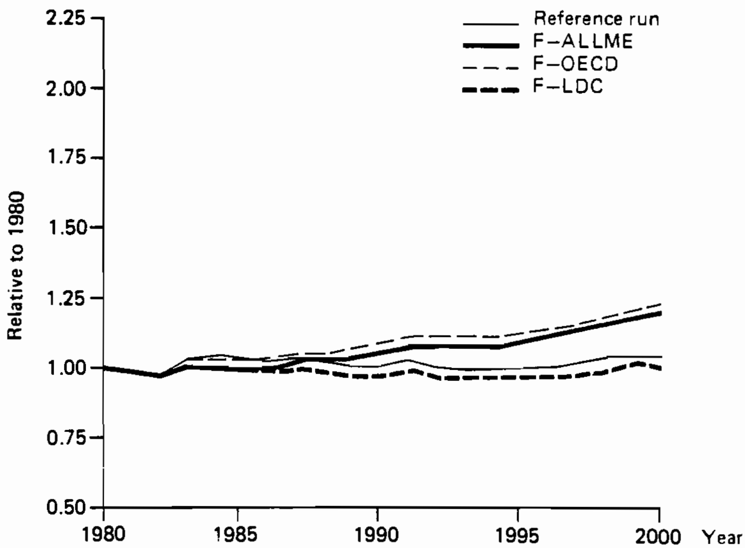

Figure 8.15. Index of (global net export)/(global production) (1980 = 1) for other animal products under various liberalization scenarios.

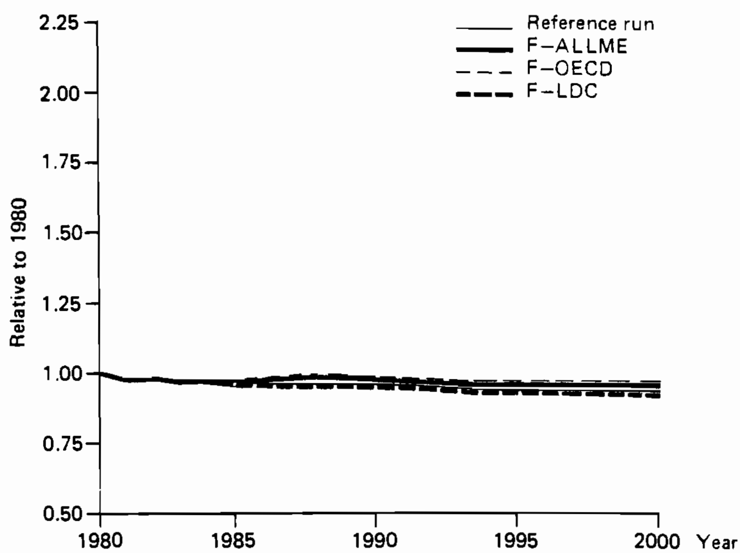

Figure 8.16. Index of (global net export)/(global production) (1980 = 1) for protein feed under various liberalization scenarios.

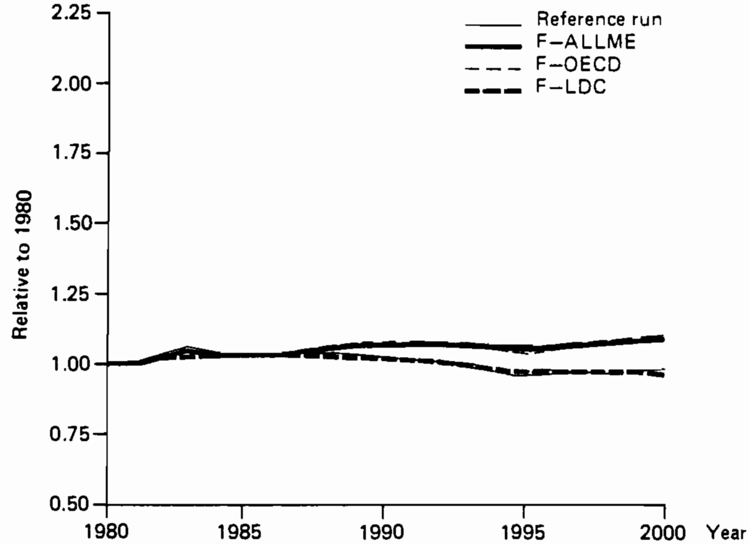

Figure 8.17. Index of (global net export)/(global production) (1980 = 1) for other food under various liberalization scenarios.

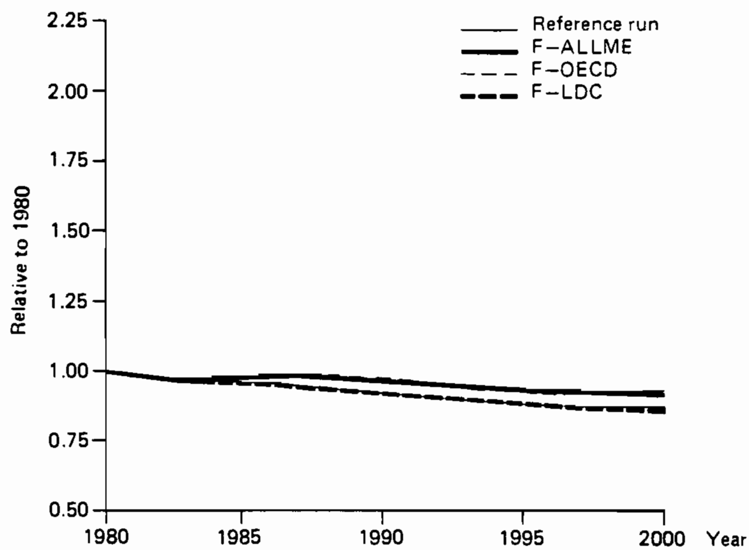

Figure 8.18. Index of (global net export)/(global production) (1980 = 1) for nonfood agriculture under various liberalization scenarios.

Table 8.2. Percentage changes in economic growth in 2000 under agricultural trade liberalization relative to the reference scenario.

Types of protection/ market economy	*F-ALLME* *CWPA*[a] (P_A^W/P_N^W)	*DRPA*[b] (P_A/P_N)	*Real invest-ment*	*Total capital stock*	*GDP*[c]	*F-LDC GDP*[c]	*F-OECD GDP*[c]
Positive/developed:							
Japan	2	−39	−0[d]	−1	+0[e]	+0[e]	+0[e]
EC	9	−12	−0[d]	−0[d]	+0[e]	+0[e]	+0[e]
USA	9	−5	NA[f]	NA[f]	+0[e]	+0[e]	+0[e]
Negative/developed:							
New Zealand	11	8	4	4	1	−0[d]	2
Canada	11	13	+0[e]	+0[e]	−0[d]	−0[d]	−0[d]
Australia	8	9	1	1	+0[e]	−0[d]	+0[e]
Austria	11	6	+0[e]	+0[e]	+0[e]	+0[e]	−0[d]
Positive/developing:							
Turkey	2	−10	+0[e]	−1	1	2	−0[d]
Pakistan	9	−1	3	1	3	3	−0[d]
Nigeria	−2	−9	−2	−1	−1	−2	1
Egypt	3	8	−2	−0[d]	−3	2	−1
Mexico	4	−5	−4	−2	−4	−2	−2
India	7	3	+0[e]	NA[f]	+0[e]	−0[d]	+0[e]
Negative/developing:							
Argentina	7	48	10	6	−0[d]	+0[e]	0
Brazil	1	25	1	1	−1	−1	−0[d]
Indonesia	3	17	6	4	1	1	+0[e]
Thailand	3	20	3	3	+0[e]	+0[e]	+0[e]
Kenya	4	15	9	6	3	1	2

[a]CWPA, country's world price of agriculture, weighted by 1970 production volumes of the country.
[b]DRPA, domestic relative price of agriculture (divisia index of domestic producer prices, with 1970 as base year).
[c]GDP at 1970 prices.
[d]−0 means a decrease of between 0.005% and 0.5%.
[e]+0 means an increase of between 0.005% and 0.5%.
[f]NA, not available in the model.

Egypt also shows a large fall in GDP. Egypt's loss of 3% in its GDP is surprising as, when only the developing countries liberalized in the F-LDC scenario, it showed an increase of 2% in the year 2000. This is because the changes in the prices of commodities in the F-ALLME scenario are different from those in F-LDC and, as a result, domestic prices in Egypt are different. Whereas the relative price of agriculture hardly changes for Egypt in F-LDC, in this scenario it goes up by 8%, drawing in more resources for agriculture, and

Table 8.3. Production value comparisons between F-ALLME and the reference scenario.[a]

	1985		1990		1995		2000	
Countries	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
USA	0.2	0.2	0.5	0.5	1.3	1.3	1.3	1.3
Canada	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Australia	0.1	0.1	0.3	0.1	0.3	0.1	0.3	0.1
New Zealand	1.0	0.7	1.9	1.4	2.1	1.7	1.9	1.6
Austria	0.2	0.1	0.3	0.1	0.2	0.1	0.1	-0.1
EC	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Japan	0.1	+0	0.3	-0	0.4	+0	0.4	+0
CMEA	-0	-0	-0	-0	-0.1	-0.1	-0.3	-0.3
China	0	0	0	0	0	0	0	0
Argentina	1.1	1.0	3.2	2.1	4.7	2.9	5.8	3.8
Brazil	0.5	0.5	0.2	+0	-0.2	-0.3	-0.4	-0.5
Mexico	0.2	0.1	-1.5	-1.6	-2.8	-2.9	-3.9	-4.0
Egypt	0.3	-0	-0.1	-1.2	-1.4	-2.4	-2.3	-3.3
Kenya	0.6	-0	2.2	1.2	3.5	2.4	4.1	3.3
Nigeria	0.2	0.1	0.9	0.6	0.3	-0.1	-0.3	-0.9
India	0.2	0.2	0.1	0.1	+0	+0	-0	-0.1
Indonesia	-0	-0.1	-0.1	-0.4	0.1	-0.3	0.4	0.1
Pakistan	0.9	0.7	1.9	1.5	2.0	1.5	2.1	1.6
Thailand	-0	-0.2	0.4	-0	0.6	0.1	0.6	0.2
Turkey	0.6	0.5	1.0	0.8	1.3	1.1	1.4	1.3

[a] $A=100[(\sum P_i^s Y_i^s)/(\sum P_i^s Y_i^r)-1]$ and $B=100[(\sum P_i^r Y_i^s)/(\sum P_i^r Y_i^r)-1]$ where P_i^r and P_i^s are prices of commodity i in the reference and policy scenarios, respectively, and Y_i^r and Y_i^s are production of commodity i in the reference and policy scenarios, respectively.

agriculture has lower marginal productivities for both labor and capital than nonagriculture in Egypt.

Argentina, even with a 6% larger capital stock in the year 2000, shows a marginal decline in its GDP measured at 1970 prices. The reduction in the GDP of Argentina, as in the case of Canada, is due to the index number problem. Production value comparisons in *Table 8.3* show a gain of 4–6% in the value of production compared to the reference scenario. The changes in GDP at 1970 prices, therefore, do not provide a reliable indication of whether the GDP of a country increases or decreases under agricultural trade liberalization.

In summary, the changes in aggregate GDP in this scenario, where all market economies liberalize, are in general the sum total of changes in GDP under trade liberalization by only developed countries (F-OECD) and under liberalization by only developing countries (F-LDC).

The changes in factor allocations and sectoral GDPs are shown in *Table 8.4*. The broad pattern is that, when agricultural prices increase, countries put more factors into agricultural production. The allocation patterns of countries

Table 8.4. Percentage changes in sectoral factor allocations and GDP (at 1970 prices) under trade liberalization by all the market economies: Percentage changes relative to the reference scenario.[a]

	Agricultural sector				*Nonagricultural sector*		
Countries	*GDP*	*Capital*	*Labor*	*Acreage*	*GDP*	*Capital*	*Labor*
Japan	-6	-24	-5	-6	+0	+1	+0
EC	-8	-6	-12	-2	+0	+0	+1
USA	1	NA	NA	3	+0	NA	NA
New Zealand	11	24	2	NA	-0	+0	-0
Canada	17	20	19	2	-1	-1	-1
Australia	1	10	4	+0	+0	-0	-0
Austria	+0	2	1	-0	+0	+0	-0
Turkey	-9	-14	-8	-1	3	1	4
Pakistan	-1	-3	-3	-1	4	3	3
Nigeria	-1	-4	-1	-6	-1	-0	1
Egypt	5	11	5	3	-4	-5	-4
Mexico	1	-1	12	-2	-4	-2	-6
India	-0	NA	NA	+0	+0	NA	NA
Argentina	47	77	49	1	-5	-3	-6
Brazil	7	33	2	12	-1	-1	-1
Indonesia	6	20	1	-0	-0	-0	-1
Thailand	6	18	0	NA	-1	-1	NA
Kenya	10	19	NA	NA	1	4	NA

[a]NA, not available.

are similar to those already described in for F-OECD (Chapter 5) and F-LDC (Chapter 7).

Percentage changes in these macroeconomic and other variables for 1990 and 2000 relative to the reference scenarios are summarized for the various countries in *Table 8.5.*

8.3. Changes in Patterns of Production and Trade

8.3.1. No significant changes in global production

The changes in global production levels are, as in other agricultural trade liberalization scenarios, modest (see *Table 8.6*). The largest change is a 5% increase in the year 2000 in the production of bovine and ovine meat. As pointed out earlier, the global production levels have to be consistent with global demand, and the changes in demands for agricultural products due to trade liberalization are rather small. The low price elasticities in the richer countries and the small changes in income for the poorer countries result in small changes in demand.

Although global production levels do not change much, the pattern of production across countries and groups of countries does change. The changes in

Table 8.5. Percentage changes of some macroeconomic and welfare indicators for selected countries in 1990 and 2000 under trade liberalization by all the market economies, relative to the reference scenario.[a]

Indicator[b]	*Argentina*		*Australia*		*Austria*		*Brazil*		*Canada*		*Egypt*	
GDP70	0.3	–0.2	0.2	0.1	0.2	0.1	–0.4	–0.8	0.1	–0.1	–0.7	–2.6
GDPA70	19.6	47.0	1.6	1.3	–1.5	0.4	4.8	7.1	7.7	16.7	3.3	4.8
GDPNA70	–1.7	–5.0	0.1	0.1	0.3	0.1	–0.7	–1.1	–0.1	–0.5	–1.5	–3.8
AG HCons at P70	–4.1	–2.6	0.3	1.3	1.8	1.7	–3.6	–3.4	–1.4	–1.6	2.4	1.8
NAG HCons at P70	1.6	4.6	–0.7	–0.3	0.4	0.2	–0.4	–1.2	0.1	0.1	–1.1	–3.6
Trade deficit 70	–23.6	–20.6	–2.3	–1.5	–9.9	–0.4	–4.6	–4.5	–0.5	–1.7	–3.2	–3.0
AG trade deficit 70	77.8	122.2	4.3	1.4	24.6	–13.3	97.1	–896.6	10.8	27.4	–302.5	–314.0
Trade/GDP at WP	113.5	157.3	19.4	16.5	45.5	46.6	35.6	–21.6	30.5	56.8	78.8	102.9
GDPA at WP70	17.6	37.2	1.7	0.6	1.6	4.2	6.7	11.7	2.6	6.3	11.0	15.7
Investment	8.9	9.8	1.5	0.7	0.2	0.4	1.5	0.5	0.4	0.4	0.8	–1.6
Total capital	2.5	5.6	0.6	0.7	+0	0.3	0.7	0.5	0.1	0.1	0.5	–0.4
AG vol. index WP70	18.9	42.8	2.1	1.3	–1.2	1.1	7.4	12.0	5.4	13.9	9.9	15.0
Net calories produced	3.7	–29.6	4.8	–7.2	–13.6	–17.5	8.7	16.9	–10.5	–13.0	10.9	8.7
Agricultural capital	29.7	77.3	8.3	10.2	–0.9	1.5	22.3	33.4	8.6	20.0	5.0	11.2
Agricultural labor	17.1	48.9	1.3	3.6	–2.2	0.5	0.8	2.4	6.1	18.8	2.3	4.5
Total acreage	11.1	1.2	–0.4	+0	+0	–0	7.5	12.1	3.3	2.3	0.4	3.2
N fertilizer	59.3	137.8	38.1	19.1	–7.5	–3.7	6.1	10.6	1.3	28.2	18.8	30.6
P_A/P_N	55.5	47.6	17.5	8.5	–0.1	5.9	28.4	25.0	10.0	12.8	9.3	8.1
AG CSWP index Y70	13.8	7.2	12.9	7.6	14.2	10.9	4.9	1.1	14.0	11.1	6.4	2.8
Crop price index	37.7	41.1	–7.3	–10.3	–12.9	–11.8	17.5	15.2	7.4	7.5	20.9	19.3
Food price index	30.7	22.8	16.8	8.6	–2.1	–0.9	15.0	16.9	5.2	4.2	–3.1	–3.8
Terms of trade	19.3	19.4	13.4	14.6	37.8	66.7	4.6	3.3	21.7	29.2	–8.8	–9.6
Terms of trade R	13.2	6.7	9.8	7.1	15.4	14.0	–4.8	–8.3	11.2	11.6	–11.5	–16.0
AG SSR	18.8	33.2	0.4	–1.7	–2.0	0.2	7.1	12.0	–0.8	1.0	10.7	16.6
AG SCR	0.1	–0.7	–0.9	–0.2	–5.9	–6.7	3.6	5.3	2.2	4.4	–3.3	–2.7
Parity	58.2	44.9	17.6	5.8	0.5	5.6	33.9	31.0	11.5	10.6	9.6	8.1
Equivalent income	0.5	3.2	–0.6	–0.1	0.6	0.3	–0.8	–1.4	+0	–0	–0.1	–2.1
Calories/capita	–2.2	–1.5	0.4	0.7	0.5	0.5	–1.8	–2.0	–0.5	–0.8	0.3	–0.4
Protein/capita	–3.1	–2.3	0.3	0.7	0.5	0.5	–2.5	–2.1	–0.8	–1.4	1.2	0.6
Number hungry	47.5	31.0	–	–	–	–	21.7	49.8	–	–	–	–
Life expectancy	–1.0	–1.9	0.1	0.1	0.2	0.1	–0.5	–0.7	–0.2	–0.3	–0.3	–1.0

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2*.

Table 8.5. (Cont.)[a]

Indicator[b]	*India*		*Indonesia*		*Japan*		*Kenya*		*Mexico*		*New Zealand*		*Nigeria*	
GDP70	0.2	+0	0.4	1.1	0.2	0.3	1.7	3.2	-1.6	-4.1	1.3	1.3	0.4	-0.6
GDPA70	0.4	-0.1	2.7	6.1	-5.8	-5.6	5.5	10.0	0.9	1.4	9.8	10.8	2.6	-1.3
GDPNA70	0.1	+0	-0.5	-0.4	0.3	0.4	0.5	1.0	-1.8	-4.4	+0	-0	-0.3	-0.5
AG HCons at P70	0.1	0.1	-1.2	2.1	5.3	4.9	3.5	3.6	-0.1	0.2	3.6	3.9	1.2	1.6
NAG HCons at P70	0.2	0.2	-5.1	-4.2	0.8	1.0	-0.3	3.0	-2.0	-4.6	3.1	2.5	-1.9	-2.3
Trade deficit 70	-0.9	+0	-17.0	-8.8	4.4	1.8	-5.3	-2.1	-4.4	-8.8	-14.8	82.5	-0	2.1
AG trade deficit 70	74.6	553.8	-61.8	-53.5	40.5	52.9	-6.8	24.5	28.5	54.8	12.2	16.9	-8.3	5.6
Trade/GDP at WP	25.8	21.7	-49.5	-45.4	38.4	40.5	-5.5	11.3	-9.1	2.5	30.5	26.9	6.1	16.2
GDPA at WP70	0.1	-0	3.3	7.3	-2.6	-4.8	1.3	7.9	1.6	3.6	10.3	12.4	3.5	0.7
Investment	-0.4	0.1	8.2	5.5	-0.9	-0.4	8.4	8.5	-1.1	-4.4	6.2	3.5	0.9	-1.8
Total capital	NA[c]	NA[c]	2.3	4.4	-0.5	-0.6	3.2	6.1	-0.1	-2.0	2.5	3.6	0.7	-0.7
AG vol. index WP70	0.1	-0	3.1	7.1	1.1	0.5	1.1	7.6	0.6	2.2	7.4	9.9	2.9	0.1
Net calories produced	+0	-0	2.5	5.5	310.5	128.2	-2.5	6.0	19.6	29.7	10.9	21.0	2.9	-0.8
Agricultural capital	NA[c]	NA[c]	8.0	19.8	-13.5	-24.1	9.5	19.4	0.6	-0.9	16.0	23.9	2.2	-3.6
Agricultural labor	NA[c]	NA[c]	1.1	1.1	-3.8	-5.4	0	0	4.5	11.9	1.0	2.2	2.3	-1.1
Total acreage	+0	+0	-0	-0	-11.6	-6.0	NA[c]	NA[c]	-0	-2.0	NA[c]	NA[c]	0.5	-6.0
N fertilizer	0.6	0.5	5.9	16.8	-33.9	-47.2	-8.0	2.1	0.6	3.6	-8.3	-2.5	0.9	0.7
P_A/P_N	6.4	3.3	20.6	17.1	-39.4	-38.5	20.5	15.2	0.4	-4.7	19.3	8.4	-4.0	-8.6
AG CSWP index Y70	10.4	7.4	6.1	2.5	5.5	1.9	8.8	4.4	7.5	3.8	18.1	10.9	1.2	-1.7
Crop price index	NA[c]	NA[c]	24.3	19.5	-45.4	-46.0	8.6	5.3	1.8	-3.8	2.6	-0.1	4.4	2.5
Food price index	NA[c]	NA[c]	10.6	8.3	-19.6	-20.5	19.0	15.0	-1.4	-3.6	12.4	9.6	-5.4	-8.2
Terms of trade	4.0	12.2	-12.0	4.4	-5.4	-5.8	-1.2	-2.9	4.5	2.7	19.9	11.7	-10.1	-8.8
Terms of trade R	2.8	11.5	-13.4	-3.8	-5.3	-3.5	-6.9	-7.9	-4.0	-6.1	19.0	10.8	-9.0	-7.1
AG SSR	1.9	1.6	4.6	6.0	-8.3	-9.6	-1.6	4.6	1.6	3.3	5.4	7.1	2.5	-0.3
AG SCR	-0	0.1	4.3	5.0	-10.4	-13.1	-0.4	-0.9	3.7	4.7	-2.9	-1.0	1.6	-0.4
Parity	3.7	1.4	21.4	22.0	-40.7	-38.7	26.4	25.5	-4.0	-14.8	29.7	17.4	-5.2	-7.9
Equivalent income	-0.3	0.6	-2.5	-0.4	1.3	1.3	NA[c]	NA[c]	-1.8	-4.0	NA[c]	NA[c]	0.7	0.3
Calories/capita	-0.1	-0.4	-1.0	1.8	4.2	3.9	2.6	3.1	+0	0.2	0.7	0.8	1.1	1.1
Protein/capita	0.8	0.9	-1.6	2.1	3.6	3.8	3.2	3.3	-0.6	-0.5	0.7	0.8	1.2	2.2
Number hungry	0.4	2.2	17.3	0	–	–	-10.9	-14.2	-0.5	-2.8	–	–	-8.8	-56.9
Life expectancy	-0	-0.1	-0.5	0.3	0.9	0.8	0.7	0.9	-0.7	-1.5	0.1	0.1	-0.1	0.4

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.* [c]NA, not available.

Table 8.5. (Cont.)[a]

Indicator[b]	*Pakistan*		*Thailand*		*Turkey*		*USA*		*CMEA*		*EC*	
GDP70	1.8	3.1	0.1	0.1	0.6	1.2	0.1	0.1	–0	–0.3	0.1	0.2
GDPA70	–0.6	–0.9	2.5	5.7	–3.3	–8.9	1.4	1.4	–0	–0.5	–3.5	–7.5
GDPNA70	2.6	4.4	–0.3	–0.7	1.3	2.6	+0	0.1	–0	–0.3	0.3	0.4
AG HCons at P70	0.5	1.9	–2.3	–2.1	0.2	0.6	1.2	4.4	0.2	0.8	2.2	1.7
NAG HCons at P70	3.5	3.3	1.1	1.2	2.5	2.1	0.6	1.6	+0	0.2	0.2	0.2
Trade deficit 70	–0.5	2.1	–5.3	–2.5	1.1	1.1	0.7	–0.2	0	0	1.6	0.8
AG trade deficit 70	–61.0	–52.8	13.0	32.1	–20.7	–58.7	3.4	–0.6	2.6	26.1	46.0	49.6
Trade/GDP at WP	4.4	12.6	12.1	25.4	–18.4	–47.4	24.0	21.6	6.3	24.4	14.6	20.0
GDPA at WP70	1.9	3.2	2.8	7.1	–1.1	–6.9	1.7	2.4	–0.2	–2.2	–3.6	–7.8
Investment	1.7	2.9	4.8	3.1	–1.6	0.3	NA[c]	NA[c]	–0.2	–1.0	–0.3	–0.1
Total capital	0.4	1.4	1.4	2.5	–1.0	–0.7	NA[c]	NA[c]	–0	–0.3	–0.1	–0.2
AG vol. index WP70	2.6	3.0	2.3	6.3	–2.8	–8.4	1.6	1.5	+0	–0.3	–4.8	–8.6
Net calories produced	4.8	7.3	10.8	15.3	6.9	6.6	6.7	12.4	–0.2	–2.6	–13.8	–7.8
Agricultural capital	–2.8	–2.8	8.2	17.8	–7.0	–13.8	NA[c]	NA[c]	–0	0.1	–2.1	–5.5
Agricultural labor	–0.3	–3.2	0	0	–3.1	–7.9	NA[c]	NA[c]	0	0	–6.0	–12.1
Total acreage	–0.6	–1.2	NA[c]	NA[c]	–0.4	–1.0	2.9	2.5	NA[c]	NA[c]	–1.8	–2.2
N fertilizer	22.7	11.1	2.2	6.6	0.1	–6.2	NA[c]	NA[c]	1.9	6.2	–15.3	–15.5
P_A/P_N	–0.5	–1.3	25.4	19.8	–15.0	–10.3	1.4	–4.6	0	0	–12.7	–11.9
AG CSWP index Y70	12.6	9.4	7.3	3.2	4.9	2.2	13.5	9.0	10.7	7.8	13.0	9.3
Crop price index	6.0	8.9	23.5	19.2	–8.6	–6.8	0	0	NA[c]	NA[c]	–16.5	–18.7
Food price index	–1.0	–1.0	10.9	8.1	–6.3	–3.0	0.4	–3.8	NA[c]	NA[c]	–5.3	–5.4
Terms of trade	9.8	8.2	3.3	0.5	–6.4	–8.5	5.8	1.2	–3.4	1.2	–1.6	–1.0
Terms of trade R	13.5	13.5	0.8	–1.6	–2.2	–3.1	9.0	12.3	–3.4	1.5	2.7	4.1
AG SSR	2.6	1.8	3.7	7.4	–1.2	–6.3	0.8	–0.3	–0.1	–1.3	–6.4	–9.1
AG SCR	0.6	–2.3	–0	–0	0.6	1.4	–1.5	–2.8	–0.1	–1.3	–3.0	–5.8
Parity	–2.9	–0.5	28.9	27.4	–14.6	–10.4	1.4	–4.6	NA[c]	NA[c]	–10.2	–7.2
Equivalent income	2.0	2.7	NA[c]	NA[c]	1.7	1.7	NA[c]	NA[c]	NA[c]	NA[c]	0.4	0.4
Calories/capita	0.2	1.4	–0.2	–0.3	+0	0.2	NA[c]	NA[c]	+0	0.2	1.0	1.0
Protein/capita	0.4	1.6	–0.7	–0.7	0.1	0.2	NA[c]	NA[c]	0.1	0.4	1.2	0.9
Number hungry	–1.6	–16.9	1.6	3.3	–0.5	–5.7	–	–	–	–	–	–
Life expectancy	0.2	1.1	–0	–0.1	0.4	0.8	–0.2	–0.1	NA[c]	NA[c]	0.3	0.4

[a]The first figure for each country is for 1990, the second for 2000. [b]See footnote b to *Table 5.2.* [c]NA, not available.

Table 8.6. Percentage changes in global production levels in trade liberalization scenarios relative to the reference scenario.[a]

Commodity	*F-ALLME 1990*	*F-ALLME 2000*	*F-OECD 2000*	*F-LDC 2000*
Wheat	1.4	1.1	0.5	1.5
Rice	1.3	1.6	1.2	0.7
Coarse grains	0.7	1.7	1.7	-0[a]
Bovine and ovine meat	2.2	5.3	3.3	1.6
Dairy products	1.2	2.4	1.9	0.4
Other animal products	0.7	1.0	.8	-0[a]
Protein feed	2.7	2.3	2.0	0.3
Other food	0.2	+0[b]	0.2	-0.3
Nonfood agriculture	-0.1	-1.1	-1.5	-0.3
Total agriculture	0.8	1.1	0.8	0.2
Nonagriculture	+0[b]	-0[a]	-0[a]	-0[a]

[a]-0 means a small negative number. [b]+0 means a small positive number.

the pattern of production for different groups of countries, shown in *Table 8.7*, indicate that the changes are, in general, in directions that could be predicted from the changes in F-OECD and F-LDC scenarios, though, as might be expected, the magnitude of changes is often not additive. Thus, the developed market economies increase their wheat production by only 1.2% when all market economies liberalize, whereas under F-OECD and F-LDC the production changes were -2.6% and +6.3%, respectively.

The developing countries increase their production of all agricultural commodities except coarse grains. The most significant increases are in rice, bovine and ovine meat, protein feed, other food, and nonfood agriculture. Though the increases in the last two commodities seem small in percentage terms, these commodities constitute nearly 60% of the value of agricultural output in developing countries.

The developed market economies reduce their production of rice, protein feed, other food, and nonfood agriculture.

The CMEA countries, which do not participate in agricultural trade liberalization in any of the scenarios, nonetheless are affected by the changes in world prices. The production pattern in the model of the CMEA countries changes in response to world price changes as constrained by prescribed minimum self-sufficiency levels. They increase their production of bovine and ovine meat, dairy products, and coarse grains.

The changes in production patterns at national levels are driven by the changes in relative producer prices of various commodities and total factor availabilities. The production allocation behavior of countries follows the pattern described in Chapters 5 and 7. The country-wise changes in producer prices and production are further discussed in Appendix A3, so a repetition is avoided here.

Table 8.7. Percentage changes in agricultural production in country groups in 2000 under various trade liberalization scenarios relative to the reference scenario.

	Industrial market economies			*CMEA*			*Developing countries*		
Commodity	*F-ALLME*	*F-OECD*	*F-LDC*	*F-ALLME*	*F-OECD*	*F-LDC*	*F-ALLME*	*F-OECD*	*F-LDC*
Wheat	1.2	–2.6	6.3	–0.2	–0.2	0.6	2.1	4.4	–3.1
Rice	–19.0	–18.4	0.3	0.4	0.4	0.1	3.1	2.6	0.7
Coarse grains	3.7	1.6	1.4	2.9	2.9	0.9	–2.2	1.2	–3.0
Bovine and ovine meat	0.3	1.6	–0.7	5.9	5.9	1.5	1.2	4.2	4.0
Dairy products	1.3	0.2	1.1	5.9	5.9	1.5	.7	0.9	–1.5
Other animal products	2.3	2.4	–0.5	–1.7	–1.9	–0.2	0.5	–0.1	0.3
Protein feed	–2.7	1.9	–4.3	–2.8	–3.6	–0.4	9.5	3.0	6.2
Other food	–6.5	–3.7	–2.9	–3.7	–3.9	–0.6	2.1	1.8	0.3
Nonfood agriculture	–4.7	–2.6	–1.6	–6.1	–5.0	–2.5	2.5	0.6	1.2
Nonagriculture	0.18	0.15	0.02	–0.27	–0.36	–0.11	–0.49	–0.22	–0.17

8.3.2. Global trade volume increases substantially

These changes in production patterns, which are even more significant when looked upon at the level of individual countries, translate into substantial increases in volumes of trade, as was seen in *Table 8.1*. The changes in trade patterns over groups of countries are shown in *Table 8.8*.

The developed market economies significantly increase their imports of bovine and ovine meat and other food. For rice, the group changes from being a net exporter to a net importer.

The CMEA countries increase their imports of grains and other food. The several-fold increase in protein feed imports does not amount to much as the reference run level of imports was very low.

The developing countries increase their exports of protein feed and other foods. They, as a group, turn from being net importers of rice and bovine and ovine meat into net exporters. Their agricultural balance of trade increases by more than 200% (i.e., more than triples) and, as a consequence, their imports of nonagriculture increase by 18%. In 1970 prices, the additional earnings from agricultural exports amount to around US$7 billion.

The changes in trade patterns at the country levels are even more dramatic. As seen in *Tables 8.9* and *8.10*, many countries change the direction of trade for some commodity or other. For all commodities, the percentage changes are large. The absolute changes shown in *Table 8.10* indicate the contribution of various countries to changes in global net exports.

8.4. Main Factors behind the Changes of the World Market Prices

8.4.1. Price of dairy products

The fact that the EC and the USA, with shares of global milk production in the reference scenario of 18% and 12%, respectively, strongly protect their dairy sectors is one reason for the dairy price climb on the world market in the F-ALLME scenario. However, the tariff equivalent for dairy products alone does not fully explain the situation. The price rise is also influenced by changes in the size of the labor force (dairy production is the most labor-intensive enterprise), investment in agriculture, and, of course, by the development of feed costs. Labor and investment in agriculture depend largely on the overall profitability of agriculture, and their response to changes varies from country to country. For example, the agricultural labor force in Japan shrinks by about 4% in 1990 and about 5% in 2000, which leads, together with the relative improvement of net revenue, to an increase in milk production. Also, Canada would not expand dairy production so strongly were it not for the increase in the total labor force in agriculture. A similar argument can be put forward for the EC.

Table 8.8. Changes in trade patterns (net exports in 2000): Volumes for reference run and percentage changes relative to the reference run for other scenarios.

Country group and commodity	*Volumes in R0*[a]	*% change over R0*		
		F-ALLME	*F-OECD*	*F-LDC*
Industrial market economies:				
Wheat	109.4	2	–6	12
Rice	3.3	–291	–280	7
Coarse grains	82.3	19	2	12
Bovine and ovine meat	–0.5	605	372	74
Dairy products	25.2	–7	–25	28
Other animal products	0.9	–2	1	–2
Protein feed	2.3	–80	–21	–59
Other food	–4.5	118	71	47
Nonfood agriculture	–2.8	16	6	8
Nonagriculture	15.0	32	35	–6
Agricultural balance of trade	10.3	–57	–46	–4
CMEA:				
Wheat	–19.2	20	20	2
Rice	–0.4	1	1	+0
Coarse grains	–12.0	8	7	1
Bovine and ovine meat	0	0	0	0
Dairy products	0.8	7	6	2
Other animal products	0	0	0	0
Protein feed	–0	–[b]	–[b]	–[b]
Other food	–1.5	80	84	14
Nonfood agriculture	–2.1	–6	–5	–2
Nonagriculture	4.2	25	34	–3
Agricultural balance of trade	–3.7	26	27	4
Developing countries:				
Wheat	76.6	–3	–15	15
Rice	–4.5	–210	–199	6
Coarse grains	–63.8	19	2	16
Bovine and ovine meat	–0.1	–1856	–1109	–224
Dairy products	–23.5	–4	–22	30
Other animal products	–0.2	–2	10	–10
Protein feed	4.6	44	15	30
Other food	15.9	39	25	14
Nonfood agriculture	2.8	12	3	6
Nonagriculture	–33.1	18	21	–4
Agricultural balance of trade	3.2	213	174	18

[a]Units = 10^6 t for all commodities except other food, nonfood agriculture, nonagricultural, and agricultural balance of trade, which are 10^9 US\$ 1970.

[b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table 8.9. Percentage changes in net exports in 2000 under trade liberalization by all market economies relative to the reference scenario.[a]

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine and ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood*
USA	23	6	20	159	–158	+[b]	–5	–24	–[b]
Canada	6	–3	–82	88	+[b]	36	–77	–64	20
Australia	12	–9	–45	56	154	–115	36	–24	9
New Zealand	–47	1	156	16	26	–78	45	29	10
Austria	–22	–1	–172	–80	252	148	–6	62	22
EC	–95	106	–71	93	–31	–372	–12	32	18
Japan	1	1203	7	47	70	44	56	76	7
CMEA	20	1	8	0	+[b]	0	–[b]	80	–6
Argentina	–45	204	–105	235	1615	428	–24	339	98
Brazil	15	–86	–16	–52	–62	–79	30	173	–15
Mexico	–58	10	–79	–259	+[b]	–25	–33	–20	221
Egypt	17	+[b]	45	12	–9	–115	1253	286	63
Kenya	1	+[b]	7	322	+[b]	132	40	22	51
India	–22	11	13	191	+[b]	117	0	+[b]	–87
Indonesia	6	–141	185	6	–7	51	8	–85	–39
Pakistan	194	–67	–417	156	53	–51	184	–44	–59
Thailand	1	260	21	122	0	127	–32	1	2
Turkey	–67	–185	–66	–124	–82	–136	+[b]	–52	–33

[a]The percentage change figures for trade should be interpreted with care. A negative percentage change implies reduction in net exports or imports. A negative percentage change that exceeds 100 shows a reversal of trade direction. A positive percentage change shows an increase in traded quantity.

[b]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus is used to indicate an increase in net exports (increased export or decreased import), and a minus is used to indicate a decrease in net exports.

Table 8.10. Changes in trade structure (percentages and volumes) worldwide and in selected countries in 2000 under trade liberalization by all the market economies relative to the reference scenario.

Commodity	*World-wide*	*EC*	*Austra-lia*	*Argen-tina*	*Japan*	*Canada*	*USA*	*Brazil*	*India*
Wheat[a]									
% in trade	3.06	-94.58	12.49	-44.82	0.82	5.85	23.44	15.48	-21.73
Volume: export	4.27	-16.68	1.98	-2.96	–	1.49	15.18	–	-1.33
Volume: import	–	–	–	–	0.08	–	–	1.02	–
Rice[a]									
% in trade	35.51	105.97	-8.68	204.11	1202.90	-2.57	5.89	-86.02	10.51
Volume: export	5.70	–	-0.02	0.08	–	–	0.36	–	0.41
Volume: import	–	0.21	–	–	9.37	-0	–	-0.89	–
Coarse grains[a]									
% in trade	-2.72	-70.76	-44.71	–	7.34	-82.17	20.25	-15.76	12.98
Volume: export	-4.68	–	-5.57	-12.86	–	-12.14	25.99	–	–
Volume: import	–	-13.88	–	0.63	2.79	–	–	-1.35	1.32
Bovine and ovine meat[a]									
% in trade	69.40	93.22	56.44	235.06	47.16	88.45	158.93	-51.76	191.227
Volume: export	4.15	–	0.28	–	0.31	–	–	–	–
Volume: import	–	0.96	–	–	0.16	–	2.13	-0.51	0.12
Dairy products[b]									
% in trade	23.62	-30.96	154.48	1614.82	69.80	–[f]	–	-61.68	–[f]
Volume: export	6.85	-2.69	2.84	3.07	–	9.43	-9.07	–	–
Volume: import	–	–	–	–	0.28	-0.04	5.30	-1.06	-0.30

Table 8.10. (Cont.)

Other animal products[c]									
% in trade	14.43	–	–	428.27	44.29	35.76	–[f]	–78.75	117.07
Volume: export	0.20	–0.08	–0.02	0.13	0.17	0.09	0.10	–	–
Volume: import	–	0.22	–	–	–	–	–	–0.17	0.04
Protein feed[c]									
% in trade	3.74	–12.09	36.08	–23.95	55.76	–77.18	–5.10	29.73	0.14
Volume: export	0.89	–	0.06	–0.06	–	–	–0.82	1.41	–
Volume: import	–	–0.77	–	–	2.08	–0.24	–	–	–
Other food[d]									
% in trade	10.16	32.23	–23.92	338.65	76.04	–63.73	–24.06	172.75	–[f]
Volume: export	2.48	–	–0.15	1.95	–	–	–0.71	1.58	1.15
Volume: import	–	2.31	–	–	1.36	–0.24	–	–	–0.52
Nonfood agriculture[c]									
% in trade	5.61	17.95	8.63	97.75	6.71	20.08	–[f]	–14.85	–86.59
Volume: export	0.39	–	0.07	0.44	–	0.04	–0	–0.04	–0.18
Volume: import	–	0.37	–	–	0.09	–	0.01	–	–
Nonagriculture[c]									
% in trade	13.25	27.09	18.10	174.01	29.33	6.53	–	18.38	–[e]
Volume: export	7.94	3.84	–	–	2.81	–	–	–2.32	–
Volume: import	–	–	0.50	4.78	–	1.80	0.52	0.31	0.97

[a]Volume in 10^6 t.
[b]Volume in 10^6 t of milk equivalent.
[c]Volume in 10^6 t of protein equivalent.
[d]Volume in 10^9 US$ 1970.
[e]In the case where a country switches its trade position, changes in percent are not given.
[f]No percentage change is given when the volume traded in the reference scenario does not exceed 2% of domestic disappearance.

The changes of the dairy price at the retail level are smaller than those for producers, which is one reason why human consumption does not react strongly to world market price changes.

8.4.2. Price of bovine and ovine meat

As for the dairy products, two major producing countries, the USA and the EC, protect their producers of bovine and ovine meat. Farmers in these countries face a price decline. The EC cuts back its production, but even then US farmers increase their output marginally. At the same time, demand increases significantly in the USA and Japan, where consumer prices fall. Argentina, which has a strong comparative advantage in bovine and ovine meat production, responds to the rise in world market prices with a substantial production increase.

8.4.3. Price of wheat

Many countries indicate a positive tariff equivalent for wheat (see *Table 4.12*). Among them are countries with a sizable production share such as Australia, Canada, India, and the EC, all of which are exporters too in the reference scenario. Hence, quite a price incentive from the world market is needed to offset the domestic price decline and to recover the production loss (the EC and India) or even increase production (Canada and Australia). Largely the USA and, to some extent, Australia and Pakistan step up their wheat exports.

Total demand for wheat does not respond to the price changes: neither human consumption nor feed use show much of a change.

8.4.4. Price of coarse grains

What was said for wheat demand holds also for coarse grains demand. To recover the loss in output occurring in some countries with a sizable share in coarse grains production (Australia and Canada), the world market price must go up because of a rather low price response in the USA. The shift of the EC into coarse grains production certainly has a dampening effect on the price increase.

8.4.5. Price of rice

It is mainly Japan that causes the rice price to rise. After removing its protection, it buys a substantial amount of rice on the international market. The two main rice-producing countries (China and India) respond to the price rise either not at all (China, by assumption) or only marginally. A substantial price incentive is needed for the producers with a relatively small share in production to meet the additional import requirements of Japan. It may be added that the treatment of quality differences in the BLS implies that there would be no problem for the world market to supply the variety of rice preferred by Japanese consumers though it may involve some quality premium. In fact, this applies to quality differences in all commodities for all countries.

8.4.6. Price of protein feed

Two major producers of protein feed, the USA and Brazil, both together having an export share of more than 50% in 2000 in the reference scenario, do not protect this commodity. Since the grains (especially coarse grains for the USA) are the major competing crops, the protein feed price must increase, otherwise the acreage would be allocated to grains and production would decline. The price incentive is too small for the USA to expand protein feed production. Only Brazil meets the additional import needs, which come mainly from Japan. The latter uses it as feed in the production of pork, poultry, and eggs.

8.4.7. Price of other animal products

Other animal products have a rather high price elasticity of supply so that only a little price incentive is needed to compensate lost production in one country by others. But these products are also relatively little protected.

8.4.8. Price of other food

Many developing countries tax the export of these products in order to raise government revenue. The developing countries together have a production share of more than 70% in the year 2000 in the reference scenario. Removal of export taxes gives farmers enough incentive to step up output to make up for the reductions occurring in output in the developed market economies. The latter impose a small positive protection in the reference run that is as large in nominal terms as in real terms, since the price of other food declines and therefore reduces the domestic price of this aggregate relative to the other agricultural products in many of these countries.

8.4.9. Price of nonfood agriculture

An argument similar to that used for other food can be put forward for nonfood agriculture. Again, most developing countries tax the export of this commodity. Under liberalization, these taxes are removed and the countries expand production. The developed market economies reduce their production. As was mentioned earlier, the treatment of tobacco and fibers in the US model does not lead to full liberalization of these commodities by the USA, so the USA reduces its demand as well and, thus, the world price falls.

8.5. Nominal versus Real Tariff Equivalents

The discussion on changes in domestic producer prices showed that they adjust to a level that sometimes could not be expected from looking at the nominal tariff equivalents of *Table 4.12.* The reason, of course, is that, when a large country or a number of small countries liberalize their agricultural trade, the world market prices also change and thereby dampen or reinforce the effect of the removal of the tariff equivalent. The countries with positive protection have to adjust less, and those with negative protection more, when the corresponding world market price increases.

The tariff equivalents that one obtains by comparing domestic prices with the world market prices that would prevail under global trade liberalization may be called real protection rates, as a part of the protection provided by nominal tariff equivalent is neutralized by the protection introduced by other countries. They indicate how strong the price adjustment would be if all countries move to liberalized trade in agriculture. As an example, the nominal and real tariff equivalents for the EC in the year 2000 are given in *Table 8.11.*

Table 8.11. Nominal,[a] real,[b] and realized[c] tariff equivalents of the EC in 2000.

Commodity	*Nominal, R0*	*Real, F-ALLME*	*EC policy adjusted*
Wheat	112	32	51
Rice	61	41	59
Coarse grains	37	26	35
Bovine and ovine meat	12	3	7
Dairy products	34	–3	7
Other animal products	24	16	11
Protein feed	36	22	35
Other food	12	18	12
Nonfood agriculture	28	54	26

[a]Computed using reference run domestic prices and reference run border prices (see *Table 4.13*).
[b]Computed using reference run domestic prices and border prices under F-ALLME.
[c]Computed using reference run domestic prices and border prices under F-EC.

On the other hand, one may argue that each country may take the protection level of other countries as *given*; then the protection realized by a country through its own tariff is the difference between the domestic price in the reference run and the border price when that country alone liberalizes. Thus, one may define realized protection as the own-policy-adjusted protection rates. These are also shown for the EC in *Table 8.11.*

From *Table 8.11* one can observe that, given all the assumptions made with regard to protection in the reference run, by 2000 the EC has a less than zero real tariff rate for ruminants. For all other crops, the real tariff rate is around

20–30% with the exception of rice (41%) and nonfood agriculture (54%). It is the high nominal protection for dairy products that many *other* countries exercise which pushes the real protection rate of this commodity in the EC to just below zero.

It is also worth noting that, for a large entity such as the EC, the real protection levels are much smaller compared to the nominal protection rates for commodities in which the EC is a significant trader – namely, wheat, bovine and ovine meat, dairy, and other animal products.

8.6. Welfare Gains and their Distribution from Agricultural Trade Liberalization by All Market Economies

8.6.1. Global GDP increases, but still by a small amount

At the global level, as more countries remove distortions, more gains in production efficiency should result. This does indeed seem to happen, and the increase in global GDP at 1970 world prices, though still small at 0.28% in the year 2000, is larger for this liberalization scenario than for the others (see *Table 8.12*). At the global level, the gain in GDP due to trade liberalization by the OECD countries is more than four times that due to liberalization by developing countries, and the gains seem to add up. The much larger gains due to liberalization by the OECD countries are understandable since these countries protect their agriculture more than the developing countries do, and in many commodities (all except rice, other food, and nonfood agriculture) the OECD countries' production is more than that of the developing countries.

Table 8.12. Impact on GDP (at 1970 world prices) of various agricultural trade liberalization scenarios: Percentage change in 2000 relative to the reference scenario.

Scenario	*World*	*OECD*	*CMEA*	*Developing*
F–ALLME	0.28	0.63	–0.30	–0.22
F–OECD	0.22	0.48	–0.40	–0.02
F–LDC	0.05	0.15	–0.11	–0.10

The distribution of global gains, however, across groups of countries is uneven. Whereas OECD countries increase their GDP in all scenarios, both CMEA countries and developing countries lose in all the scenarios. The CMEA countries lose most under F-OECD as they suffer the worst terms-of-trade loss in that scenario. On the other hand, the developing countries' GDP falls most under F-ALLME.

The prices of wheat and coarse grains, which are imported by many developing countries, rise most under this scenario. Moreover, the removal of what may be an optimal tax on the exports of nonfood agriculture by the developing countries results in their exporting 10% more of it, but, owing to a 17% fall in price, earning less from it. This does not happen in F-LDC, as the OECD countries continue to protect in that scenario; this restricts exports by the developing countries, which therefore do not expand exports to the same extent.

8.6.2. Hunger increases marginally

The number of persons who are hungry increases marginally in this scenario (see *Table 8.13*). Food becomes more expensive for consumers in developing countries in this scenario compared to the F-LDC scenario. The adverse impact of higher food prices does get offset by gains in income for some developing countries. Still, in the aggregate, the impact on hunger is marginally adverse.

Table 8.13. Impact on hunger of various agricultural trade liberalization scenarios: Percentage change in persons hungry relative to the reference scenario.

Scenario	*1990*	*2000*
F-ALLME	+0.8	+1.4
F-OECD	+3.3	+3.6
F-LDC	–4.7	–4.6

The fact that the distorting agricultural trade policies of the developing countries that are removed in this scenario do not make much of an impact on hunger implies that such distortions cannot be considered to be important causes of hunger, and removal of such distortions is not a solution to the problem of chronic hunger in the world.

8.6.3. Welfare effects on individual countries

The impact on different countries is once again summarized in terms of the set of indicators used to reflect producer, consumer, and social welfare.

Table 8.14 shows that all the developed market economies of the OECD gain from agricultural trade liberalization in terms of GDP at 1970 world prices and consumption cost comparisons, except for Canada, which loses in GDP at 1970 prices but does show a gain in production value comparison (see *Table 8.3*) and an insignificant loss (less than 0.05%) in consumption costs.

Whereas Austria, the EC, and Japan show gains in equivalent income as well, Canada and Australia show small (less than 0.1%; see *Table 8.5*) losses. As

Table 8.14. Gains and losses on some macroeconomic and welfare indicators under agricultural trade liberalization by all market economies relative to the reference scenario.[a]

Country	*GDP70*	*Parity*	*Equiv. income*	*Consumption cost*	*People hungry*	*Life expect.*
USA	G	L	–	G	–	NS
Canada	L	G	NS	ID	–	L
Australia	NS	G	L	G	–	G
New Zealand	G	G	–	G	–	G
Austria	NS	G	G	G	–	G
EC	G	L	G	G	–	G
Japan	G	L	G	G	–	G
CMEA	L	–	–	G	–	–
China	–	–	–	ID	–	–
Argentina	G	G	G	G	L	L
Brazil	L	G	L	L	L	L
Mexico	L	L	L	L	G	L
Egypt	L	G	L	L	–	L
Kenya	G	G	–	G	G	G
Nigeria	L	L	G	G	G	G
India	NS	G	G	G	L	NS
Indonesia	G	G	L	ID	–	G
Pakistan	G	L	G	G	G	G
Thailand	G	G	–	G	L	NS
Turkey	G	L	G	G	G	G

[a]G, country gains; L, country loses; ID, indeterminate; NS, not significant; –, not calculated. For a description of the indicators, see Section 3.3.5.

explained earlier, equivalent income and consumption cost comparisons should be consistent. However, small discrepancies are possible in the BLS models, where the consumer expenditure systems are *approximated* by a linear expenditure system every year around an expected consumption point. Thus, a small loss of equivalent income for Australia, while it shows somewhat larger gains in terms of consumption cost comparison, can be interpreted to show a gain for Australian consumers.

Thus, except for the very small loss for consumers in Canada, all OECD countries gain from agricultural trade liberalization by all market economies.

8.6.4. CMEA consumers gain too

The CMEA countries do not liberalize their agricultural trade in this scenario. However, they do respond to a limited extent to changes in world market prices. This results in gains for consumers in terms of consumption cost comparisons even though the production value comparison shows a loss.

8.6.5. A mixed picture for the developing countries

The developing countries show a mixed picture. Some clearly lose, some are clear gainers, and others show losses on some indicator or other.

Brazil and Egypt lose on all indicators and thus are clear losers. Mexico loses on all indicators except number of hungry people. In spite of a 4% loss in production value, lower food prices in Mexico reduce hunger. In general, however, Mexico should be considered a loser.

Production value and consumption costs both show improvement for Thailand, but higher food prices increase hunger in that country.

India shows an increase in hunger and a loss in production value but gains in average equivalent income and consumption costs. Thus, both Thailand and India gain on the average, but the poor in these countries lose. Conversely, Indonesia shows a gain for the poor but a loss on the average for consumers.

Kenya, Pakistan, and Turkey show clear gains on all indicators.

Argentina shows substantial gains in production value, equivalent income, and consumption cost, but an increase in hunger because of a large increase in the food price index. Yet, the number of hungry in Argentina is very low, and the average level of calorie intake is more than 3500 kcal per day. In principle, from the large gains in production value in Argentina, the few poor losers can be easily compensated. Since lump-sum transfers are not considered in this scenario, Argentina may be considered a country with mixed outcome.

Nigeria, which shows improvement on all indicators other than production value, which is not really a welfare indicator, should be considered a gainer.

In summary, among the explicitly modeled developing countries are three losers and four gainers, and the picture is mixed for the remaining four.

8.6.6. "Getting prices right" can play only a limited role in further promoting economic growth in developing countries

In a sense, the prices in the F-ALLME scenario are the least distorted of the prices in all the free trade scenarios reported here. To that extent, the agricultural prices in this scenario may be considered as the "right prices". The impacts on production value comparisons and on the incidence of hunger are mixed. Moreover, even for those countries where production values increase, the gain after 15 years of trade liberalization is small. Though one should not scoff at such gains, this does indicate the limited role that further improvement in agricultural prices can play.

This is, of course, not to say that a country may have such a bad pricing policy that correcting it could not produce dramatic improvements. However, the prices of the explicitly modeled developing countries, when made "right", do not always help; and, when they do help, they do little. One should, however, qualify this conclusion by noting that the present analysis does not account for all gains from trade liberalization, such as those from elimination of rent-seeking activities. Some of these gains are difficult to quantify. But, if such gains are large, the conclusion here should be modified.

8.6.7. For the developing countries, it matters who else liberalizes

Comparison of whether countries gain or lose under alternative scenarios of agricultural trade liberalization shows the importance of the interaction of policies of different countries.

Table 8.15. Gainers and losers under alternative scenarios of trade liberalization.[a]

Country	*F-ALLME*	*F-OECD*	*F-LDC*
USA	G	G	G
Canada	?	?	?
Australia	G	G	L
New Zealand	G	G	L
Austria	G	G	G
EC	G	G	G
Japan	G	G	G
Argentina	G	G	G
Brazil	L	L	L
Mexico	L	L	L
Egypt	L	L	G
Kenya	G	G	G
Nigeria	G	G	?
India	?	L	G
Indonesia	?	L	G
Pakistan	G	?	G
Thailand	G	?	L
Turkey	?	L	G

[a]G, country gains; L, country loses; ?, outcome unclear.

Table 8.15 shows that, for the developing countries, their status as gainers, losers, or mixed-outcome countries changes for quite a few countries between F-LDC, when only they themselves liberalize, and F-ALLME, when all market economies liberalize. Only for Brazil, Mexico, Kenya, and Pakistan does the status remain the same. Other developing countries change their status. Though between the scenarios the changes are in both directions, more developing countries are adversely affected when the developed market economies also liberalize. Thus, whereas one could have said, as in Chapter 7, that agricultural trade liberalization is in general beneficial to developing countries, it can no longer be said when the developed market economies also liberalize their agricultural trade.

Table 8.16. Percentage changes in agricultural labor and income parity for selected countries[a] in 2000 under alternative trade liberalization scenarios relative to the reference scenario.

	Labor in agriculture			*Income parity*		
Country	*F-ALLME*	*F-OECD*	*F-LDC*	*F-ALLME*	*F-OECD*	*F-LDC*
USA[b]	NA	NA	NA	–3	–0	+0
EC	–12	–12	–2	–7	–4	1
Japan	–5	–5	–1	–39	–35	–1
Mexico	12	6	5	–15	–3	–13
Nigeria	–1	5	–5	–8	–1	–7
Pakistan	–3	2	–11	–1	1	–7
Turkey	–8	3	–11	–10	4	–15

[a]Countries where income parity is adversely affected.
[b]In the US model, agricultural labor is not explicitly accounted for and parity figures are calculated assuming no change in sectoral labor share.

On the other hand, developed market economies that gain when they themselves liberalize (in F-OECD) continue to remain gainers when the developing countries also liberalize in F-ALLME. In fact, their gains are larger. However, in terms of income parity (see *Table 8.16*), the farmers in the USA, the EC, and Japan are marginally worse off in F-ALLME than in F-OECD, suggesting somewhat larger adjustment problems. However, larger economic gains in F-ALLME should make it easier to deal with them. Thus, the developed market economies find it in their interest that not only they themselves but also the developing countries liberalize agricultural trade.

CHAPTER 9

Findings and Policy Conclusions

After the analyses of the impact of agricultural trade liberalization presented in the preceding chapters of this book, the questions naturally arise: What are the major findings and what do they mean for policy? To what extent do the results reflect reality and to what extent can they be ascribed to the characteristics of the analytical tool used? What are the methodological or analytical lessons to be learned from the study? These questions are addressed in this chapter. Before addressing them, however, it would be useful to reiterate the scope of the study.

The study was concerned with assessing the impact of agricultural trade liberalization by various groups of countries. Agricultural trade liberalization was partial in the sense that trade distortions reflected in the differences between domestic relative price and border relative price (FOB for exports or CIF for imports) were removed from agricultural commodities. Thus, distortions introduced as a result of border measures such as tariffs and quotas were removed. The distorting effects of other measures, such as input subsidy or taxes, may have also been removed to the extent that they are reflected in the relative price differences, which depend on the measures used to restrict trade.

It should also be emphasized that distortions on the nonagricultural economy, which was represented by one aggregated sector, were not removed. Thus, agricultural trade liberalization, as defined here, removed relative distortions, as defined above, from all agricultural commodities in the country, but not all of the distortion between the agriculture sector and the nonagriculture sector.

Finally, in none of the scenarios is agricultural trade liberalization accompanied by any compensating nondistorting income transfers between countries.

The scenario results presented in this book consist of agricultural trade liberalization by OECD countries, by the EC, by the USA, by the developing countries excluding China, and by all market economies. The CMEA countries and China do not liberalize their agricultural trade in any of the scenarios, but they do adjust their trade volumes in response to changing world prices.

9.1. Small Global Impact of Agricultural Trade Liberalization

Agricultural trade liberalization leads to a global efficiency gain, as reflected in global GDP measured at constant world prices. The gain, however, is small. The largest gains occur when all market economies liberalize. Even then, the annual gain is only 0.28% in the year 2000 over the GDP in the reference scenario.

It is true that in the present study only partial liberalization of agriculture is carried out and the distortion between agriculture and nonagriculture is not fully removed. One may think that, were these distortions to be fully removed, the global efficiency gains would be larger. Scenarios were generated to analyze the impact of removing, in addition to agricultural protection measures, those in nonagriculture. For the latter, some very crudely estimated and some assumed protection factors were used. The results did not show a significant increase in global efficiency gains. Of course, with only one aggregate nonagriculture sector the BLS cannot capture fully the efficiency gains that could be realized by removing distortions among various subsectors of nonagriculture.

Other studies of trade liberalization that follow the general equilibrium approach also report such gains to be small and of similar magnitude. Thus, Whalley (1985) reports an annual gain of around 0.65% (measured as equivalent variation) of global GDP from a simultaneous abolition of tariffs from all the seven regions of the world. Similarly, Deardorff and Stern (1986) also report welfare gains comparable to that reported by Whalley. These studies involve liberalization of all trade, whereas the present study has involved only agricultural trade liberalization.

The small size of the gain in percentage terms is understandable, as agriculture is a small part of the global economy and only agricultural trade is being liberalized. The annual gain expressed as a percentage of agricultural GDP of the countries liberalizing amounts to 4% when all market economies liberalize. In the case of agricultural trade liberalization by the OECD countries, the global gain in GDP evaluated at 1970 world prices is 0.22%, which amounts to 20% of the agricultural GDP of OECD countries.

Viewed this way, the present study shows somewhat larger gains from trade liberalization than other studies do.

These trade liberalization studies, including the present one, which show gains at the global level to be small, assume that production in an economy takes place on the production possibility frontier before and after liberalization. The gains are to be obtained by a change in the production structure along this efficiency frontier due to changes in relative prices. These studies also assume that producers do not enjoy any monopoly powers. The monopoly power that producers in a sheltered economy enjoy may be severely curtailed and disappear when the country liberalizes. The efficiency gains from such a situation could be substantial. Thus, Harris (1984), in his study of trade liberalization for Canada, shows annual gains of nearly 5% of GDP for Canada for a 50% reduction in tariff, using a model that accounts for the monopoly power of producers.

Similarly, it has been argued that rent-seeking activities that arise as a result of distortions waste real resources and that production in such an economy takes place *inside* the production possibility frontier. The gains from liberalization to be realized by a movement from inside the efficiency frontier to the frontier can be much larger than gains from movement along the frontier. Thus, Grais *et al.* (1984) show with a general equilibrium model of Turkey, and assuming a production function for rent-seeking activities, large gains in GDP from the removal of quotas on intermediate and consumer imports.

Since agriculture is characterized by many "small" producers, they do not enjoy monopoly power. Thus, agricultural trade liberalization is not likely to produce gains from curtailment of such power.

To what extent rent-seeking activities induced by distortions in agriculture absorb productive resources has not been empirically estimated. It is therefore not possible to say how important gains from abolition of such directly unproductive activities can be. Until such quantification is made, the extent of such gains cannot be estimated.

Moreover, it is worth noting that Bhagwati and Srinivasan (1982) have shown that, in a second-best world, such rent-seeking activities can be welfare improving. This implies that, in an economy with other distortions, the gains from elimination of such rent-seeking activities may not be as great as may appear from the resources used up in such activities.

Summarizing, one may note that gains from agricultural trade liberalization could be larger than what has been estimated in this study. Though the estimated gains are small, they are not negligible, and the gains accruing to the OECD countries are comparable to the level of aid that they give at present to developing countries.

9.2. Should OECD Countries Liberalize Agricultural Trade?

Among the OECD countries, separate models of Austria, Australia, Canada, the EC, Japan, New Zealand, and the USA are available in the BLS. Thus, policy implications for these countries are drawn.

Austria, the EC, Japan, New Zealand, and the USA gain from agricultural trade liberalization whenever these countries liberalize. The measures of consumer welfare – equivalent income and consumption cost comparisons – show annual gains exceeding 1% for Japan and the USA, 0.1–0.3% for Austria, 0.4% for the EC, and more than 3% for New Zealand. Considering that agriculture is a small part of these economies (less than 4% of GDP originated in agriculture in 1980 in the OECD countries), the gains are substantial. These countries would thus find it in their interest to liberalize agricultural trade.

For Canada and Australia, the outcome is somewhat mixed, and an unambiguous policy recommendation cannot be made.

Even when consumer welfare increases, agricultural incomes go down in the EC, Japan, and, marginally, the USA. Nonetheless, the overall consumer welfare gains show that agricultural producers can, in principle, be compensated from the gains of agricultural trade liberalization.

Unilateral agricultural trade liberalization by the EC and the USA shows that most of the consumer welfare gains are realized by the country that liberalizes even when the other OECD countries do not do so. This would indicate that the EC and the USA could unilaterally liberalize agricultural trade. Of course, when other OECD countries also liberalize their agricultural trade, the losses in agricultural incomes are smaller, so that adjustment problems would be smaller.

Since the gains from agricultural trade liberalization are so small as a percentage of GDP, the following question arises: Why change the *status quo* and liberalize? For one thing, the policies that provide protection to agriculture are themselves not easy to continue because of the growing costs of such support. Secondly, even when one accepts the goal of farm income support, it could be provided at a smaller cost than at present through nondistorting alternatives.

In fact, for a large economy such as that of the EC, measures of agricultural protection have become self-defeating to a considerable extent. The price increases realized for EC farmers for their products through the protective policies of the EC over its border prices are much smaller than the nominal protection provided. Protection by the EC depresses world prices in most agricultural commodities below what they would be in the absence of such protection. Thus, when the nominal tariff level in excess of 100% percent for wheat is removed, the world market price increases and the domestic producer price of wheat is only 34% lower. Similar effects are observed for most other agricultural commodities. What this suggests is that the outlays on nondistorting alternatives to preserve farm income would be much smaller than the costs of current policy. This is also reflected in the fact that the fall in agricultural incomes in the EC is only 7% when the OECD countries liberalize their agricultural trade, whereas the agricultural protection removed has an aggregate rate of nearly 40% in the EC.

9.3. Do the Current Protective Agricultural Policies of the Rich Countries Help or Hinder the Poor?

The present protective agricultural policies of the OECD countries can affect the developing countries in a number of ways. They reduce opportunities for developing countries to export agricultural products to developed country markets. By stimulating agricultural production in the OECD countries, they depress world prices of agricultural products, which in turn may depress the domestic prices and production incentives for agricultural producers in the developing countries.

The lower food prices in the developing countries in the short run may reduce the level of hunger in them, but the reduction in hunger may be reversed in the long run if the loss of agricultural production incentive adversely affects the incomes of the poor.

When the OECD countries liberalize agricultural trade in the F-OECD scenario, the number of hungry persons in the world increases marginally. Even when countries gain in average equivalent income, the number of hungry in them increases. These results imply that the present protective agricultural policies of the OECD countries result in world market food prices that are lower than those that would have been obtained in the absence of such policies. The food-importing developing countries are able to import more food.

The beneficial effect of lower food prices on the number of hungry persons in the world is not fully offset by the adverse effect on agricultural production and the reduced opportunities for other countries to export agricultural products to OECD countries. Though beneficial, the net effect on the number of hungry is, however, very small.

A particular case of protective agricultural policies is the CAP of the EC. When the EC's agricultural trade is liberalized (in the F-EC scenario), the results obtained are similar to those when all OECD countries so liberalize. Thus the EC's CAP, on balance, helps to reduce, howsoever marginally, hunger in the world.

This does not mean, however, that the policies of the EC and other OECD countries to protect domestic agriculture should be continued. If the intention is to protect farm incomes and also incidentally to help the poor in some developing countries, then one should examine whether the CAP and similar policies are the best ways of realizing these objectives.

As was seen earlier, protecting farmers' incomes by nondistorting ways ought to be much cheaper. Similarly, provision of direct aid to poor countries may be much more cost-effective. Moreover, such aid can be targeted to specific countries, unlike the effect of protective policies that benefit all food-importing countries, rich and poor.

It should be emphasized that this result – that the protective policies of the OECD countries, on balance, help the poor – relates to only agricultural protection. The protection policies in the nonagricultural sector, through which OECD countries restrict industrial imports from developing countries, may have a significant adverse impact on the developing countries. This issue has not been examined in the present study.

9.4. Should the Developing Countries Liberalize their Agricultural Trade?

Many, though not all, developing countries find agricultural trade liberalization beneficial. When only the developing countries liberalize in F-LDC, the number of persons in hunger is reduced and consumer welfare also goes up.

Increases in consumer welfare, either equivalent income or consumption cost comparisons, in the year 2000 amount annually to 2–3% for Pakistan and Turkey; 1–2% for Egypt, Kenya, and India; and around 0.5% for Argentina and Indonesia.

For some of these developing countries these gains are reduced, and some of them even suffer a loss in consumer welfare, when the OECD economies also liberalize their agricultural trade. However, most of these developing countries are worse off when they do not liberalize their agricultural trade along with the OECD countries than when they do. Thus, once again for Argentina, Egypt, India, Indonesia, Kenya, Pakistan, and Turkey, agricultural trade liberalization is a preferred policy irrespective of whether OECD countries liberalize their agricultural trade or not.

Brazil, Mexico, Nigeria, and Thailand suffer a loss in consumer welfare when, as considered here, they liberalize their agricultural trade in all commodities. It is thus not a policy that can be recommended for these countries.

The impact of agricultural trade liberalization on economic development is somewhat muted in these models. In the models, domestic and imported savings and capital goods are perfect substitutes. To the extent that, for many developing countries, restricted availability of imported capital goods that cannot be substituted by domestically produced capital goods constrains economic growth, the larger imports that become possible when agricultural trade is liberalized should stimulate economic growth. Such effects are not accounted for in these models, and gains in production value result from increases in allocative efficiency and increased investments resulting from removal of price distortions. Even then, the gains in production value or constant-price GDP become as high as 3–5% for some developing countries. For most countries, however, these gains or losses are much smaller. Removal of agricultural price distortions or getting agricultural prices right is thus shown to be useful for some countries, but in general the scope of these reforms in stimulating economic development is limited for many developing countries.

This conclusion, however, relates only to agricultural prices. The potential gains from removal of distortions from the various subsectors of nonagriculture, the elimination of wasteful rent-seeking activities, and the stimulating effect of larger availability of nonsubstitutable imported capital goods may translate into a much larger effect on growth. This, however, has not been explored in this study.

9.5. Development of the Global Agricultural System

The reference scenario with more or less continuing present policies provides a perspective on global agricultural development. It shows that the global system continues to provide growing quantities of food to a larger and richer population with very modest increase – less than 0.5% per year – in overall agricultural prices, but with a decline in basic staples prices.

Production of crops in particular shows that technical progress and supply possibilities are significant, so that crop prices decline modestly over the years in the reference scenario.

The main increases in prices occur for ruminant products, namely, bovine and ovine meat and dairy products. These commodities also show much larger price changes in the various agricultural trade liberalization scenarios. The relatively limited possibilities of technical progress and higher income elasticities of demand for these products result in much larger price changes for them than for other commodities.

Agricultural output in these scenarios shows significant price responses at the aggregate level over the long run in most countries. A higher relative price of agriculture increases investment, capital, labor, and input use in agriculture. Over the years, these factor allocations to agriculture build up and result in greater production in agriculture. The long-term supply elasticity of agricultural GDP exceeds 1 in some cases (Argentina, Canada, and New Zealand), is between 0.5 and 1.0 for quite a few countries (Egypt, Kenya, Nigeria, Pakistan, and the EC), and is less than 0.5 for other countries. Thus, agricultural output can be stimulated by increasing agricultural prices. However, this is not to say that it is always good to stimulate agricultural output. As is seen in this study, changes in agricultural GDP may be large in a country, but changes in the total GDP may be small. Larger agricultural output is achieved at the cost of drawing away productive resources from the nonagricultural sector. This shows the need to consider agriculture as a part of the economy and not as an isolated sector.

9.6. Need for the Analytical Approach

At the end of such a study, from an analytical point of view, one may raise the questions: Could one have arrived at the results and policy conclusions with the same degree of confidence through a much simpler approach? How useful has the BLS been as an analytical tool?

The results presented in this study have demonstrated the importance of accounting for the following in the analysis of the impact of agricultural trade liberalization:

(1) The substitution possibilities in production and consumption of commodities.
(2) The interactions of simultaneous changes in policies of different countries.
(3) The behavioral responses of economic agents as producers and consumers.

Though the broad patterns of reactions at the global level to agricultural trade liberalization have been fairly predictable, the specific details are not so. The changes in prices of different commodities, and often even the direction of these changes, are not easily predictable by single means. This is highlighted by the fact that some other studies indicate price changes with signs different from those shown here.

Similarly, the national-level changes are often large, and the quantitative impacts at the level of individual commodities show many surprising changes that are nonetheless understandable on *ex post* analysis of the results of the scenario. As has been pointed out at a number of places in the text, some important changes with respect to a number of commodities are such that they would not have been observed if the model did not distinguish a number of commodities.

The changes in commodity prices at the international level and the production and trade patterns at national levels provide information necessary for the formulation of national policies.

In summary, the multicommodity, multinational general equilibrium approach of the BLS has been shown to be necessary for analyzing the impact of agricultural trade liberalization. The BLS has proved to be a useful analytical tool.

The question now is what further uses of the BLS can be made to help formulate better agricultural trade policies in different countries.

9.7. Global Interdependence, Trade Policy Negotiations, and the Usefulness of the BLS

It is almost a cliché that the countries of the world are becoming more interdependent as time marches on. Yet, for some, this growing interdependence is simply a reflection of a growing dependence of some on others and, indeed, of the weak and powerless on the strong and powerful. One important contribution a study such as this can make is to evaluate interdependence in, it is hoped, a scientific way.

At one extreme is autarkic development of the countries of the world with interactions between countries kept to an unavoidable minimum; and at the other is free and unfettered exchange of goods, services, people, and ideas. The real world lies in between the two extremes, with severe restrictions (if not outright prohibitions) on some forms of interactions (e.g., movement of people, particularly workers, across national boundaries) and almost no restrictions on others (e.g., most countries have no restrictions on imports of lifesaving drugs). It is difficult to quantify the joint impact on a country of its *own* myriad policy interventions (which may have accumulated over some period of time) in its foreign trade, and virtually impossible to assess the impact on it of the policy interventions of all other trading nations. A system such as the BLS can provide each country with such impact assessments.

An equally, if not in fact a more, important use of the assessment of the distribution of gains and losses from policy interventions through a system such as the BLS is that it can help negotiations toward removal of trade barriers. This it does in several ways. First, it is almost certain that multilateral liberalization scenarios will produce positive global net gains for *the group*, showing that the game of trade negotiations is likely to have a positive sum. Second, it can help each country to formulate better its proposals for liberalization. As Whalley (1985) showed in the Tokyo Round, the formulae for tariff cutting that the USA, Japan, Canada, etc., each proposed did not often lead to the maximum gains for the country that proposed them. Third, it may bring home to a country negotiator, as has been shown to be the case for the EC, that the removal of his country's nominal protection as part of a multilateral or global bargain need not cost his country as much as the pre-removal tariff levels would suggest. Fourth, by assessing the distribution of the impacts of unilateral and multilateral, as well as global, liberalization, a more informed judgment of the costs and benefits of interdependence is made available to policy-makers. Fifth, agricultural trade policy negotiations are likely to involve suggestions on partial or selective trade liberalization. A common understanding of the consequences of such liberalization proposals can contribute to the success of negotiations. The BLS constitutes a powerful tool for such analysis and could be of much value in this context.

Apart from this, many national policies in the real world involve moving from one second-best situation to another. Quantitative exploration of the consequences of policy changes with the help of empirically relevant analytical tools becomes valuable in formulating economic policy in such situations. The national models of the BLS provide analysts of national agricultural policies with such a tool.

Many improvements are possible in the models. Some of them can even be made with marginal effort. Yet, even without them, the analysis reported in this book shows the power and usefulness of the BLS.

APPENDIX A1

Economic Theory of Trade Liberalization: Some Selected Results

In most of the literature, free trade is urged for the efficiency in the allocation of resources that it leads to, resulting in greater possibilities for improvement in the welfare of the citizens of a country. Moreover, it is also argued that free trade would improve the efficiency of global resources allocation and the welfare of mankind. In this appendix, we examine aspects of efficiency, welfare, and distribution under free trade.

Some of the propositions of trade theory are elaborated in this appendix using the geometrical arguments traditional in trade theory. It can be shown that, under suitable assumptions, equilibrium with income transfers can be represented through the use of (Samuelson) social utility functions and the associated indifference map as if there were only one consumer in the economy who receives all the income and spends it so as to maximize social utility. In what follows we use this construct.

A1.1. Some Trade is Better than No Trade – and Free Trade is Optimal for a Small Economy

The first thing to note is that, for any country, trading with others provides an opportunity to transform one set of goods into another that is in *addition* to that available through domestic production and exchange. For this reason some trade is better, or at least no worse than, no trade since it is possible to exploit trade opportunities in such a way that the country can have no less of any good than it had without trade. With the improved availability of goods, trade thus provides an *opportunity* to improve the welfare of the country's citizens.

While some trade is better than no trade in the above sense, there is the further question of whether or not unrestricted trade is the best in some sense. This question has attracted the attention of economists since Adam Smith. The basic proposition of this literature is that, for a small open competitive economy, free trade is the "optimal" policy. By a "small economy" is meant an economy that has negligible market power – i.e., it cannot influence the equilibrium prices in world markets by its trade policy. Such an economy could be large in other dimensions: geographical area, population, etc. This is seen as follows: producer's profits will be maximum under free trade only if the marginal transformation ratio in production between any two domestic products (i.e., how much production of one commodity can be increased by reducing the output of the other by one unit – which equals the domestic price ratio between the two under competition) is equal to the foreign rate of transformation (i.e., how much of one commodity may be obtained by exchanging one unit of the other on the world market – which is the price relation between the two on the world market). If this condition is not satisfied for all pairs of commodities, someone can make profits by arbitraging between domestic and world markets. This condition also means that the value of national income measured in international prices is maximized, thus ensuring *efficiency* of resource allocation in production. This in turn means that the value, at international prices of output under no trade or autarky equilibrium is less than the national income in the free trade equilibrium. However, by definition, autarky output is the sum of the consumption of all individuals in the economy in that equilibrium. Hence, with free trade national product, one can certainly maintain the autarky level of welfare of each person by providing enough income to that individual to enable that person to consume the bundle of commodities (s)he consumed under autarky *and* still have some product leftover. With the leftover income, the welfare of one or more individuals can be raised above autarky levels. Thus, the free trade equilibrium *can be made Pareto-superior* to autarky in that, under free trade, no individual is worse off and some are better off compared to autarky. This in general will involve income transfers between individuals since the income an individual earns from participating in the market in the free trade equilibrium may not equal the value of his consumption bundle in the Pareto-superior free trade equilibrium. Indeed, this argument can be seen, on reflection, to show that a Pareto-superior free trade equilibrium can be found relative to any restricted trade equilibrium. Thus free trade is optimal for a small open economy.

This can be seen in *Figure A1.1(a)*. AB is the domestic production possibility curve. The country can have any combination of outputs on AB. Suppose that, under autarky, production takes place at S with the price ratio p^A. If the world price ratio p^* is different from p^A, then *continuing* to produce at S but trading at prices p^* in the direction ST will improve welfare over the level achieved at S.

That trade also improves social utility can be seen in *Figure A1.1(b)*. Under autarky, production and consumption will be at S, giving a utility of U'. With trade, on the other hand, production can be at F and trade along CD can provide consumption at Q with a utility level U'' higher than U'.

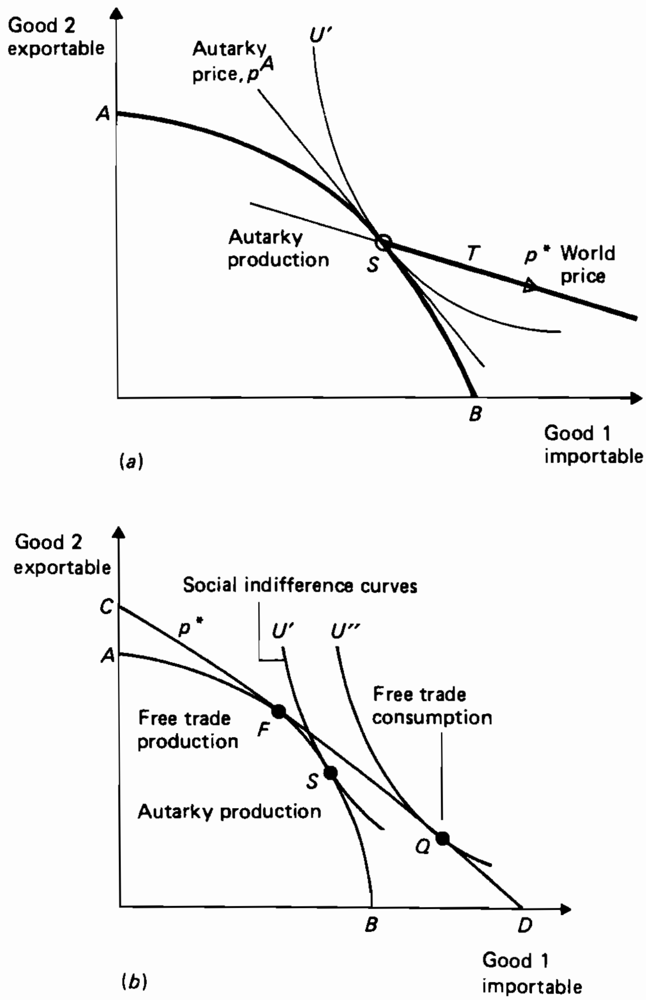

Figure A1.1. (*a*) Some trade is better than no trade. (*b*) Liberalization is welfare improving for a small country.

When trade is permitted but distortions are introduced through tariffs, etc., the domestic production will take place at a point other than at F, and trade at international prices will result in a utility level lower than U''.

Note that the allocation of resources in autarky is such that production at S is on the production possibility frontier AB. The gain in efficiency in free trade over autarky here arises from the reallocation of resources to produce at F rather than at S, and from exploitation of the opportunity to trade.

When a country intervenes in agricultural trade, through tariffs, subsidies, or trade quotas, or other barriers, the domestic prices are no longer the same as the world market prices. Thus, domestic production decisions will be such that the domestic rate of transformation will not be equal to the foreign rate of transformation. The economy will not maximize the value of domestic product at world market prices and, hence, social utility will not be maximized.

It has been argued by Anam (1982), Bhagwati (1982a), Bhagwati and Srinivasan (1982), Findlay and Wellisz (1982), Krueger (1974), Tullock (1967), and Young and Magee (1983) that, in the absence of free trade, production in a country may take place at an inefficient point and not on the production possibility efficiency frontier, and that, under free trade, production will shift to the frontier. A number of reasons are given why production in a distorted economy may not be on the production possibility frontier. Protection may create sheltered markets and monopolies with little incentive for producers to be efficient. Entrepreneurs may find that rent-seeking activities that are not directly productive give them much more personal income compared to productive activities. Thus, scarce entrepreneurial resources get squandered. The bureaucracy administering the distortions may obstruct entrepreneurs in order to earn part of the rent from them. All these wastes disappear in free trade, and even domestic monopolies have incentives to become efficient under the threat of foreign competition. In such a case the gains from free trade could be substantial.

A1.2. Global Free Trade Could be Pareto-Superior

Turning now to the *world* economy, under fairly general conditions Grandmont and McFadden (1972) have established the possibility of Pareto-superior equilibrium under free trade compared to autarky in a world of many nations, each with many consumers and with competitive domestic markets, as follows:

Proposition A: Given a world competitive trade equilibrium allocation, any alternative allocation that is feasible under autarky and makes some consumers in a nation better off must make some other consumers in that nation worse off.

Under somewhat restrictive assumptions, the following is also established:

Proposition B: Given an allocation achieved under autarky, one can find a system of world trade prices and domestic lump-sum transfers for which there will exist a competitive equilibrium allocation that will be at least as satisfactory as autarky for every consumer.

Proposition B, though it is established under a set of restrictive conditions (such as convexity of consumer preferences and technology of production), does show that gains from free trade are sufficiently large to finance the needed lump-sum transfers to fully compensate everyone who may lose under free trade.

A1.3. Without Compensating Transfers, Free Trade May not Be Socially Preferable

What can one say about a free trade *competitive* equilibrium if we rule out transfers? Being a competitive equilibrium, it is still Pareto optimal. In other words, under free trade for each country the domestic rate of transformation equals the domestic rate of substitution, and these are also equalized (adjusted approximately to account for transport costs) globally. Thus, the first-order condition for Pareto optimality is satisfied. Yet this does not imply that everyone is better off under free trade, but only that free trade leads to a Pareto-optimal outcome for global welfare. Corresponding to each different distribution of resource endowments among countries, a different Pareto-optimal solution will be attained under free trade. Thus, an infinity of such alternative solutions is possible. Under a given distribution of resource endowments, some countries may lose under free trade relative to autarky; and, even in the countries that gain, some people may lose. In a country that gains, if the rich gain and the poor lose and compensating transfers are not possible, free trade may not be considered socially desirable for that country if the society places larger weight on the welfare of the poor.

A1.4. Terms-of-Trade Loss Can Make a Country Worse Off under Free Trade

In *Figure A1.2* the utility possibility curves are shown for two individuals in an economy under protection and under free trade. If individual 1 is poor and individual 2 is rich and compensating transfers are not possible, protected equilibrium at S may be considered socially preferable to free trade equilibrium at F. Of course, with lump-sum transfers, any point on $S'S''$ will give under free trade a Pareto-superior equilibrium to the equilibrium under protection of S.

Though free trade is an optimal policy for a small competitive economy, it is not so for an economy that is large in the sense of having significant market power. A large country affects world prices by its own trade. Thus, it may find that, by restricting trade, it can improve its terms of trade so that it gains. If the world demand for its exports is inelastic, a major exporting country can raise its export earnings relative to free trade by restricting imports. If individual private exporters do not perceive this market power of the country, then a tax on its exports may ensure that only an optimal volume of exports, and no more, occurs. Similarly, if the world market supply is inelastic, a major importer may restrict imports to an optimal level, and no more, through a tariff on imports.

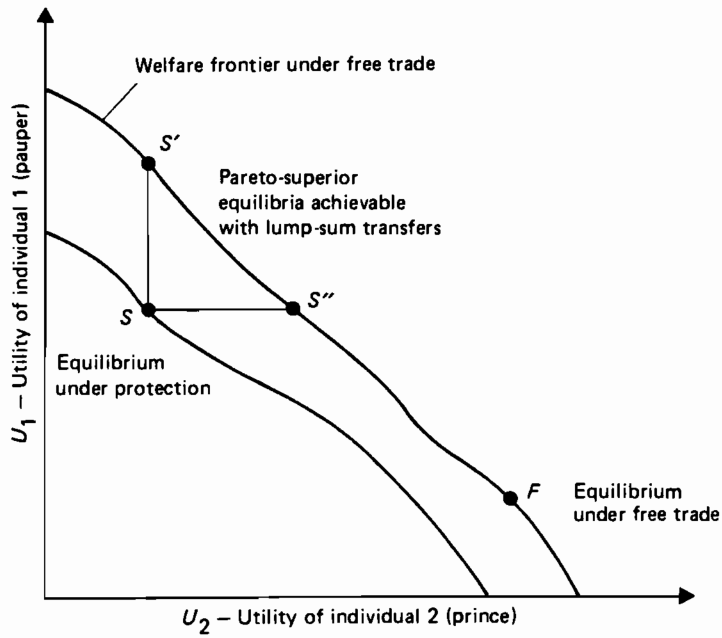

Figure A1.2. Utility possibilities under protection and under free trade.

Abolition of such an optimal tariff in a shift to free trade could make such a country worse off.

Figure A1.3 illustrates how, when a country moves to free trade, terms-of-trade loss can make it worse off under free trade. The country initially produces at T under tariff and a domestic price ratio p^d, given by the slope of the production possibility frontier AB at T, and trades along TQ at the world price given by the slope of line TQ. Under free trade, the export tax on goods is removed and production takes place at F and the country trades along FR, the new world market price line, which provides the country with consumption at R with a utility level less than that of Q.

A1.5. A Change in World Prices Can Be Welfare Worsening even when the Country Trades Freely and Uses Domestic Lump-Sum Transfers

Just as a large country can suffer a terms-of-trade loss by its own action (for example, by abolition of its optimal tariff) and be worse off under free trade, a small country can also be worse off when world prices change and it suffers a

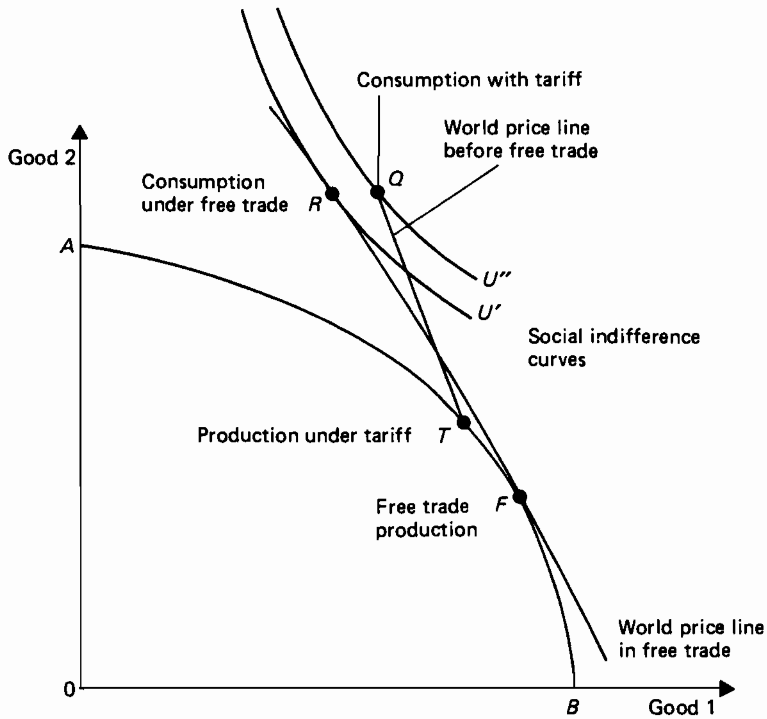

Figure A1.3. Terms-of-trade loss can hurt under free trade.

terms-of-trade loss even though it is following free trade policies and using lump-sum transfers.

How this can happen is shown in *Figure A1.4*. A small country following free trade is producing at F_o and consumption after trade is at Q_o. When world prices change, still pursuing free trade the country produces at F_1 and consumption at Q_1 is welfare worsening compared to that at Q_o. Of course, if this small country does not follow free trade policies, its welfare would be still less than that at Q_1. The important point is that policies of other countries can lead to price changes that make it worse off. However, given that the country has no influence over world prices and that the world price change would occur anyway and has occurred, protection does not help to reduce the welfare loss. Indeed, $U'-U''$ is an *unavoidable welfare loss* due to change in world prices, and protection simply adds *avoidable* welfare losses over and above this. Such a terms-of-trade loss can occur for a small country – for example, when other countries changes their policies and world prices change. This underlines the importance of accounting for the interdependence of policies.

A corollary to this is that protection may improve the welfare of a country or a group of countries, though it lowers global welfare.

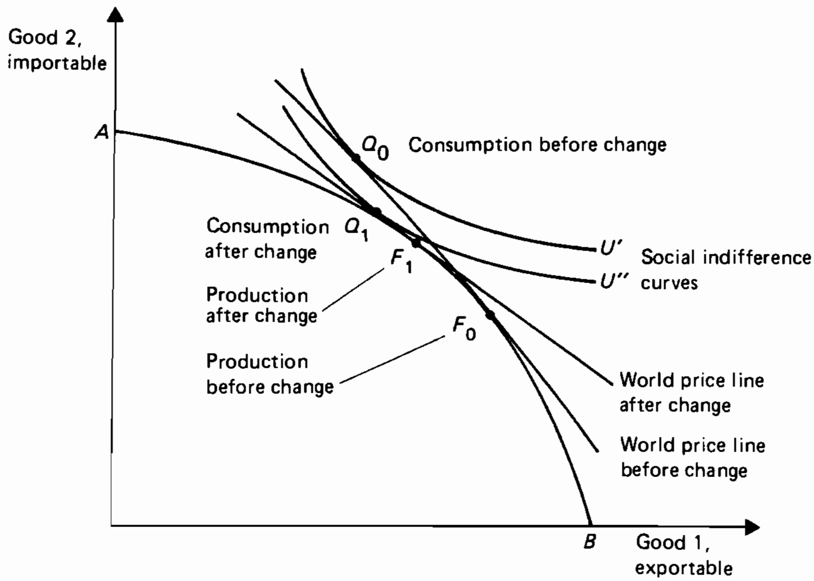

Figure A1.4. Change in world price can be welfare worsening.

The outcome of simultaneous abolition of tariffs by two trading partners is not predictable using quantitative theoretical considerations alone; empirical analysis is required to solve ambiguities.

A1.6. Simultaneous Abolition of Tariffs by Two Trading Partners Can Raise, Lower, or Leave Unchanged the World Market Prices

The traditional geometric tool of international trade theory – namely, the offer curve representing each country's export supply in exchange for its import demand – is used in the analysis. A point on the offer curve shows the amounts of goods the country would like to trade when the world market price ratio of these goods is given by the slope of the line connecting this point to the origin. In each subfigure (see *Figure A1.5*), the solid curve represents free trade offers and the broken curve represents offers when each country is levying an import tariff (or, equivalently, an export tax). Alternative world market prices or terms of trade can be read as slopes of rays from the origin. The curves are drawn under the assumption that, at each terms-of-trade position, the point on the tariff-ridden offer curve represents a lower offer of exports (and demand for imports under balanced trade).

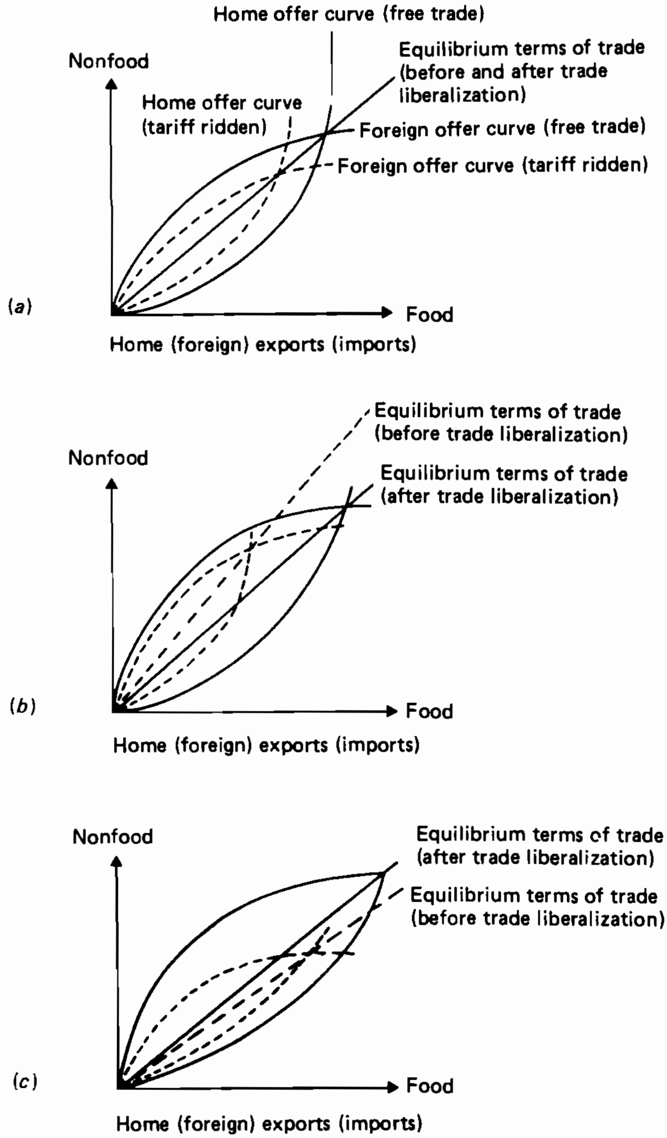

Figure A1.5. Possible changes in terms of trade under simultaneous liberalization by two countries.

In *Figure A1.5*(*a*), trade liberalization by both countries leads to *no change* in terms of trade, but only to an increase in trade volumes. In *Figure A1.5*(*b*), the home country's terms of trade deteriorate (i.e., the equilibrium world relative price of its imports in terms of its exports *rises* and it has to export more food now to get same amount of nonfood) after trade liberalization. In *Figure A1.5(c)*, the equilibrium world relative price of the home country's imports in terms of its exports *falls* (i.e., the home country's terms of trade improve).

A1.7. Dynamic Effects: Gains from Free Trade May Be Lost over Time

The discussion on gains from free trade so far has been mainly in the context of a static situation with and without free trade. It is conceivable that a large country that gains immediately by moving to free trade can, over years, become poorer. This can happen, for example, when it puts more resources into an exportable commodity of which it becomes a major exporter and does not impose an optimal tariff. Thus, the price of the exportable commodity becomes lower, adversely affecting the country's terms of trade.

A1.8. Removal of One Distortion while Others Remain May Be Welfare Worsening for an Economy

A possibility that should be recognized in analyzing the impact of a trade liberalization is that removing some trade distortions while leaving others in place might exacerbate the distorting effects of the latter.

The literature on distortions shows that the removal of one distortion while others remain may be welfare worsening. In the free trade scenarios presented here, only trade distortions are eliminated, leaving in place other distortions that are not related to trade. It is not inconsistent with neoclassical theory that in such a context a move to free trade can be welfare worsening even for a small country. Loosely speaking, the gain from trade is more than offset by accentuation of the effects of other distortions. One nontrade distortion is of particular significance in the dynamic context. If the *intertemporal resource allocation* mechanisms (loosely speaking, the savings–investment–allocation nexus and labor movement between sectors) are not optimal, then a move to free trade may lead to a dynamic path that is welfare inferior relative to the path associated with protection. Again crudely speaking, the effect of the nonoptimal allocation of resources over time gets accentuated enough under free trade to offset the intertemporal gains from trade that would have otherwise accrued. It is to be noted, however, that the crucial feature in either case is that a move to free trade *accentuates* the welfare loss due to the other distortions. This can be shown as outlined below.

Consider the following simple model. The economy produces two goods using capital and two fixed factors of production, one being specific to each good.

Let one of the goods be investment goods. Let the world price of investment goods in terms of consumption goods be unity. Let there be an *ad valorem* tariff at the rate t on the investment good. Let the economy operate just for two periods. Let the world prices and tariffs remain unchanged between periods. Let the initial capital stock be K and let there be no depreciation. It is fairly easy to see that the value of the profit-maximizing output of the two goods evaluated at world prices can be written as a function $\Phi\ (t, K)$ of the tariff rate and the capital stock. Φ attains its maximum for any K at $t = 0$: i.e., free trade maximizes the value of output at world prices. Let the economy invest I in the first period so that the capital stock available in the second period is $K + I$. The value of a second-period output at world prices is $\Phi\ (t, K + I)$. Suppose the welfare of the consumers of the economy can be represented by $W = U(C_1) + \rho U(C_2)$ where C_i is consumption in period i ($i = 1, 2$) and ρ is the discount factor. We can set investment in period 2 at zero, since the economy operates only for two periods.

How liberalizing trade may lead to loss in welfare is illustrated in *Figure A1.6.* In the top part of the diagram the availability line in period 1 at world prices is shown. Under free trade, the available capital K enables the economy to achieve any combination on $F_1F'_1$ between consumption and investment in the period. In other words, OF_1 equals $\Phi(0, K)$ and $F_1F'_1$ has slope 1 since the world price of investment is 1. If the economy imposes a tariff on investment goods, the availability shifts inward to T_1T_1' parallel to F_1F_1'. Clearly, OT_1 equals $\Phi(t, K)$.

Starting from OF_1 (OT_1) by giving up current consumption and investing, consumption can be increased. By spending the entire value of output at world prices on consumption and not investing anything, the second-period consumption will equal the first-period consumption. This choice is shown in the bottom part of the diagram as $G_2(H_2)$ whose distance from the horizontal axis is OF_1 (OT_1): i.e., $OF_2 = OF_1$ and $OT_2 = OT_1$. By making positive investment I, and using the production possibilities, the consumption that can be obtained in period 2 is $\Phi(0, K + I)$ under free trade and $\Phi(t, K + I)$ under a tariff. By plotting this against the corresponding first-period consumption, i.e., $\Phi(0, K) - I$ under free trade and $\Phi(t,K) - I$ under the tariff, we obtain the curves G_2G_2' and H_2H_2'. Given that F_1F_1' lies to the right of T_1T_1', the curve G_2G_2' will lie below and to the right of the curve H_2H_2'.

If investment is optimally set both under free trade and tariff, the corresponding intertemporal choices can be shown as P^* and Q^*. Clearly, free trade dominates. If nonoptimal choice of investment leads to an intertemporal choice of P under free trade and of Q under a tariff, the tariff equilibrium can lead to higher welfare than the free trade equilibrium. As the diagram shows, loosely speaking, the loss in welfare due to nonoptimal investment is "small" (i.e., Q is close to Q^* in welfare terms under a tariff) but it becomes accentuated under free trade (i.e., P is further from P^* in welfare terms).

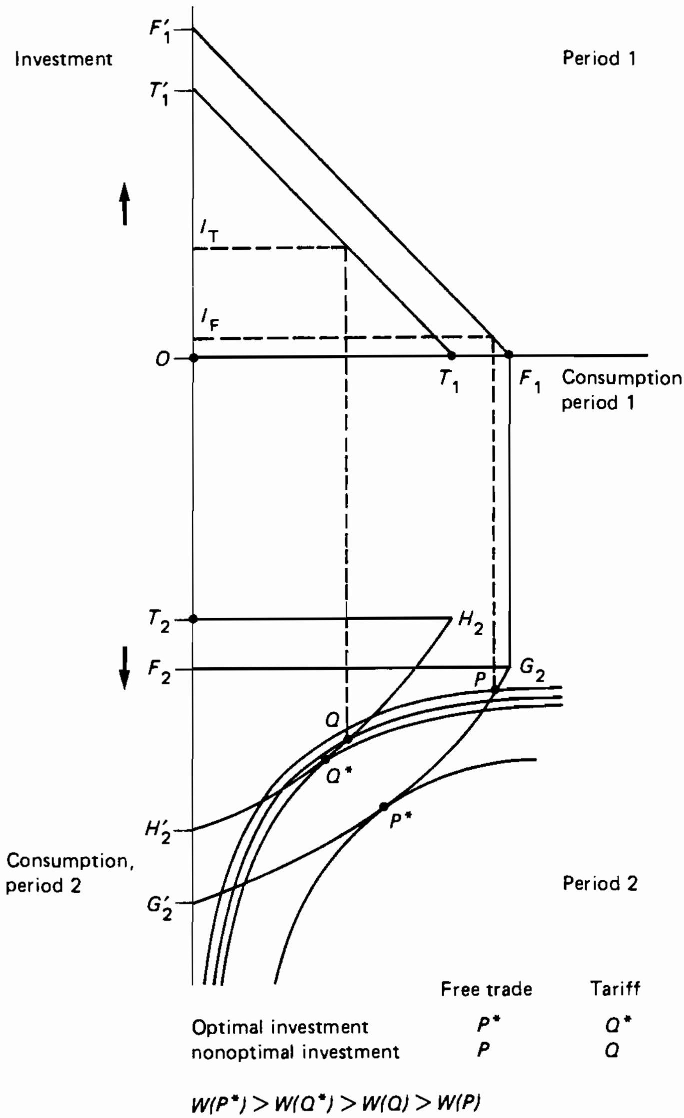

Figure A1.6. **Welfare effect of removal of one distortion when another persists.**

A1.9. Concluding Summary

From this brief look at the gains from free trade, it should be clear that, although a free trade equilibrium is Pareto optimal, it is not immediately clear to whom the gains from trade will accrue. Their distribution between countries, as well as within countries, depends on several factors. Within the countries the distribution of the gain will depend on the adjustment path. For a country that gains in free trade if production factors move easily or the transition period to free trade is well adapted to the speed at which factors can move between sectors, gains will accrue to both producers and consumers. Not only the policies of the country itself matter; the policies of other countries also affect the outcome of who gains under a move to free trade.

Thus, a small economy for which free trade is the optimal policy may lose under free trade (compared to its position before the movement to free trade) when the movement to free trade is part of a global movement toward free trade. However, if the small economy does not move to free trade when others do, it will be worse off than if it were also to move to free trade.

Similarly, as we have seen, it may be optimal for a large country to impose a tax on its exports or a tariff on imports to affect world market prices to its advantage. In free trade, where such taxes and tariffs are removed, the country would lose its advantage. However, the lowering (raising) of world prices of its exports (imports) may benefit (hurt) the consumers in countries importing those commodities, whereas producers of those commodities in other countries may lose (gain). Also, in the presence of other distortions in the economy, such as nonoptimal investment decisions, nonoptimal allocations of capital, rigidities in movement of labor, etc., free trade could be welfare worsening for a country.

In summary, one can conclude that, provided nondistortionary redistribution arrangements are available, there are gains from a move to free trade. In the absence of such arrangements, the issue is one of second best, and no general statements can be made. In such a situation, the distribution of gains and losses between countries and within countries needs to be evaluated and assessed before one can reach a conclusion on the desirability or otherwise of free trade. Moreover, such an assessment cannot be made from purely qualitative considerations: an empirical analysis is essential.

APPENDIX A2

Modes, Means, and Estimates of Protection

A2.1. Modes of Distortion – A Multiplicity of Measures

Protection can take many forms. In fact, the ways in which governments intervene in markets are so numerous that there is no easy way to measure fully the combined effect of all of them. They vary from sheltering domestic from world markets through tariffs and quotas to purchaser taxes or subsidies that influence domestic demand, producer taxes or subsidies that affect production, market regulations, government purchases, sales and stock accumulation, and so on. Though many of the measures are obviously distorting, others are less easy to describe as such. For example, an import quota is an obvious protection measure. However, if the same restriction of imports is realized through imposing hygienic quality standards, it is discriminating only if the same hygienic standards are not applied and enforced on domestic production. Even then, "imposition" of such standards in itself could be distorting unless one argues that the level of hygiene that would prevail in the absence of the imposition is below the socially desirable level. And it would fall below such a level only if there is some market failure. Nondiscrimination is not necessarily nondistortion.

Similarly, subsidies given or taxes imposed on inputs such as fertilizer, chemicals, electricity, and fuel are rarely nondistorting and easy to quantify. However, the value to farmers of subsidized agricultural research, or subsidies given to develop infrastructure such as transport and power, may not be distorting if these subsidies address a market failure arising from an externality; and, even if they are distorting, their value is often difficult to quantify.

Even when trade is unrestricted, a government-operated domestic buffer stock can be distorting if it is large enough to affect world market prices and if the level of stocks is beyond what would be "optimal" from a global perspective – i.e., if its stocking or destocking ability is large enough. If world prices are not affected, it could still be distorting unless government stocking ensures social optimality of stocks compared to private stock activity.

Usually, at least in developed countries, border protection measures (i.e., measures that drive wedges between domestic and world market prices for agricultural products through tariff and nontariff barriers) dominate. In some countries these are supplemented, and in some replaced, by production subsidies, which increase the profits of producers over and above the margin they would otherwise obtain from the price paid by consumers.

We can classify (after OECD, 1983), without claiming to be exhaustive, the various intervention measures according to the group of individuals they *primarily* affect, though obviously many measures affect more than one group of individuals. These are given in Sections A2.1.1–A2.1.3.

A 2.1.1. Measures primarily affecting producers

(1) *Price-support payments or output subsidies.* These are specific payments per unit of output, paid regardless of the level of market price.

(2) *Diversion payments.* These are payments made to farmers for the purpose of limiting output.

(3) *Input subsidies.* Both "fixed" inputs (e.g., land, building, and machinery) and variable inputs (e.g., fertilizer) may be subsidized. Subsidies reduce the farmer's cost of production and increase his profits. They also lead to misallocation of these inputs and hence to a loss in efficiency of the economy.

(4) *Production/marketing quotas.* Usually such quotas, which set quantitative floors or ceilings on how much can be produced or marketed, are linked to a specific pricing arrangement and they affect prices and incomes of producers.

(5) *Storage subsidies.* Subsidies for on-farm storage of domestic products reduce a farmer's costs and hence increase profits.

(6) *Deficiency payments.* These are payments made to cover part or all of the difference between market prices and a specified target or guaranteed price; they are intended to help to stabilize farmers' incomes and assure them a minimum income from production.

(7) *Price/income stabilization funds.* These may be direct transfers of funds or interest rate subsidies.

(8) *Producer levies or taxes.* These apply when producers are required to sell a specified part of their output to the government at prices below the ruling open market prices.

A2.1.2. Measures primarily affecting consumers

(1) *Consumer subsidies/taxes.*
(2) *Domestic donations.* Programs directed at specific segments of the population (e.g., children, the elderly, or the poor) may involve the free distribution of foodstuffs or various degrees of price reduction for selected groups.

A2.1.3. Measures affecting both producers and consumers

(1) *Tariffs.* A tariff raises the price that domestic producers can command for their production and the price that consumers have to pay.
(2) *Two-price schemes.* Such schemes involve differential pricing by commodity or type of market: e.g., the markets for fluid versus processed milk, or subsidized prices in urban ration shops selling limited amounts to consumers versus the free market price when any amount can be purchased.
(3) *Variable levies.* A variable levy is a tariff that is adjusted in response to changes in cost, insurance, freight (CIF) import prices, so as to maintain the domestic price of imported goods at a predetermined level.
(4) *Import or export quotas.* These affect domestic availability and prices.
(5) *Transportation subsidies.* These are often provided to equalize prices to all consumers in a large country. Normally such subsidies benefit producers located far away from main markets and also consumers far away from the producing areas. However, they may impose additional costs on nearby consumers, while producers nearer the market lose their locational advantage.
(6) *Export credits/subsidies.* Export subsidies and preferential credits increase the returns to domestic producers and, by making export markets more attractive, increase the price of the product to domestic consumers.

A2.2. Measuring Protection – Nominal, Relative, Real, and Effective Protection

A number of alternative concepts and methods for measuring protection have been suggested in the economic literature: see Balassa (1971) and Strak (1982). The different concepts are useful for different purposes of analysis.

Nominal rate of protection is defined by Balassa (1971) as "the percentage excess of the domestic price over the world market price, resulting from the application of protective measures." Thus, the nominal rate of protection for the ith commodity, t_i^n, can be expressed as

$$t_i^n = (p_i^d - p_i^w)/p_i^w$$

where p_i^d is the domestic price of the ith commodity and p_i^w is the world market price of the ith commodity at the country's border.

In this definition the domestic price may be defined, for either the producer or the consumer, to measure the nominal protection rates for the producer and the consumer, respectively.

Since the difference between p_i^d and p_i^w has often been interpreted as tariff, the nominal rate of protection can be looked upon as measuring the tariff equivalent of various protection measures; however, equivalence, in the sense that if the various other protection measures were eliminated and a tariff at this rate imposed the same equilibrium would result, will not hold in general. There is an extensive literature on the equivalence and nonequivalence of tariffs, quotas and other protective measures (see, for example, Bhagwati, 1983; Dasgupta and Stiglitz, 1977; Rodriguez, 1974; Takacs, 1978). Be that as it may, tariff equivalents are arrived at by computing the percentage by which the actual producer price lies above the price the producers would receive, if the world market price also operated on the domestic market (in the absence of border measures and subsidies). In practice, the would-be producer price is calculated as the world market price in exporting at the harbor minus the distribution and processing margin necessary to bring the commodity from the farm gate to the wholesale market. For lack of data, or if the margin is insignificant, comparison is made between the export and domestic wholesale prices.

The tariff equivalent includes the net effect of all measures affecting the producer prices, be they tariffs, import levies, quotas, or subsidies. However, subsidies to inputs (fertilizers, below-market interest rates for investment loans, etc.) affect the difference between domestic and world prices differently depending on the protection measure used. The domestic price at which a given quota is absorbed in equilibrium is different, depending on whether or not there is an input subsidy. A negative tariff equivalent can appear for export products that are being taxed. The tariff equivalent for consumers might be lower than that for producers with price subsidies, or higher if the producers have to incur a loss when the export price is lower than the domestic one.

The size of the tariff equivalent is, of course, dependent on the level of world market prices. If a country stabilizes its domestic price through, say, stock operations and quotas while the world price fluctuates, tariff equivalents will fluctuate from year to year and will seem to indicate a changing government policy, whereas the policy to stabilize domestic prices may have continued unchanged. A measurement problem arises in the case of a large country, which may depress the world market price by its protection. For such a country two measures are conceivable, one based on current world market prices and the other on what the world market price would have been in the absence of protection by this country (see below). For a large country, the tariff equivalent could be negative when calculated using the latter method, if the Metzler paradox applies – i.e., the country lowers its domestic price or domestic production by protecting the commodity. In this case the domestic price *falls* after the tariff has been introduced, but the world price also falls. The post-tariff equilibrium tariff is *positive* measured in the first way, but *negative* measured in the second. Incidentally, if one defines *protection* as a measure to raise domestic output from what it would have otherwise been, what the Metzler paradox suggests is that a tariff need not protect.

The implied tariff corresponding to a given trade quota can be calculated *ex post*, but it is not always easy to determine in advance what level of tariff will be equivalent to a particular quota value. One difference between quotas and tariffs is that tariff revenue accrues to the government, whereas the premium on quotas accrues to the quota holder unless the government allots quotas through auction. But a tariff equivalent *could* be the same either way if income effects are absent in a competitive set-up. This would be the case, for example, when the consumption pattern of those who receive premiums on quotas or income from tariff receipts, including the government, are the same. This, in general, is not likely to be the case. And, of course, in the general equilibrium framework, how the government disposes of its tariff revenue also affects the outcome regarding which quota level would be equivalent to a particular tariff level.

In spite of such difficulties, tariff equivalence provides a simple way to capture the effects of a large range of border distortion measures, particularly for estimating distortion over historical periods.

If one is interested in evaluating the distortions introduced in the domestic structure of production or consumption, *relative rates of protection* between different commodities are more relevant. If two commodities have the same nominal rate of protection and neither one is used as an input for the other, their relative price is not affected by this protection. This means that one commodity is not economically favored in terms of nominal protection in comparison with the other. Thus, if we select the nominal protection rate on the nonagricultural sector, t_n^n, as the numeraire, then the relative protection rate for commodity i, t_i^r, can be defined as

$$t_i^r = \left[\frac{1 + t_i^n}{1 + t_n^n}\right] - 1$$

Once again, the relative protection rate may be defined for consumers and producers.

In estimating the nominal protection rate as defined above one needs the world market price at the country's border. However, the question arises as to which world market price to use – the present one, which may itself be affected by the distortion the country has imposed when it is a large country, or the world market price that would have prevailed had the country not introduced the distortion? In addition, the distortion introduced by a country may be in retaliation for the distortion introduced by other countries. In this case, should one not take the world market price that would have prevailed had all countries removed their distortions? In a sense the nominal protection rates calculated using such global free trade world prices are the ***real protection rates***, and that is how we define them. As mentioned already, protection imposed by a single large country depresses world market prices. The corollary is that the introduction of free trade by that country alone would lead to higher world market prices. However, the effect of simultaneous removal of protection by all countries is not predictable (see Chapter 3).

Similar to real protection rates (i.e., protection rates calculated with world prices that would prevail under global free trade), one can define *adjusted protection rates* as those calculated with world market prices that would prevail under free trade by a limited number of countries. Of particular interest are *EC-adjusted, USA-adjusted* and *OECD-adjusted protection rates*, which are defined as rates calculated with world prices that would prevail, respectively, under trade liberalization by the EC alone, the USA alone, and all the OECD countries together.

As pointed out above, there are a number of protection measures, such as input subsidy, taxes, stock operations, etc., which affect the difference between domestic and trade prices only under some measures of protection, but which nonetheless affect the effective price received by the farmers or paid by the consumers. Such protection measures may distort the nominal, real, adjusted, or relative rates of protection.

To account for the effect of input subsidies, the notion of *effective protection rate* is introduced. This can be described as the protection of the value added of a commodity, as opposed to the nominal protection, which applies to the gross output value of the commodity. It is arrived at by subtracting the protection of the intermediate inputs from the nominal protection of the end product. If the former protection is lower than the latter, the effective protection is higher than the nominal one. This can apply to agriculture, for example, if the protection of feed is lower than that for the animal product produced by the feed. Thus, the effective rate of protection, t_i^e, is defined as

$$t_i^e = \frac{v_i^d - v_i^w}{v_i^w}$$

where v_i^d and v_i^w are value added in production of the commodity, valued at domestic and world prices, respectively.

The difference between effective and nominal protection rates is important in understanding the adjustments of production structure when a country moves toward freer trade.

An alternative approach – due to Josling and followed in the FAO (1975) study – used to measure protection calculates producer subsidy equivalents

(PSEs) and consumer subsidy equivalents (CSEs) of all measures of intervention. In essence, this is similar to the measurement of effective protection rates but includes the impact of all other measures of intervention, which may not be reflected in changes in the domestic prices of inputs and outputs compared to their international prices. The advantages of this method are that it looks at the various specific measures of intervention and tries to quantify their impact on producers and consumers. Thus it helps in focusing negotiations between countries and groups on specific measures of protection. The disadvantage of the method is that it follows a partial equilibrium approach, and thus the impacts of substantial changes in policies or of simultaneous changes in protection in a number of commodities or by a number of countries cannot be assessed using this approach.

In marginal analysis based on a partial equilibrium approach, effective protection rates may be preferable. However, such partial analysis can be misleading. In fact, it has been shown (Ramaswami and Srinivasan, 1971; Jones, 1971; Bhagwati and Srinivasan, 1973) that, except under restrictive assumptions, the relative values of effective rates of protection indices of two sectors cannot be relied upon to indicate even the directions in which factor reallocation, and hence supply changes, will take place when rates of protection are changed.

For our analysis we use the nominal rates of protection, as the major agricultural inputs constitute separate sectors in our system. Removal of nominal tariffs from both output and input sectors thus amounts to removing effective tariffs. The supply behavior in our models thus integrates the nominal protection rates into effective protection and responds as such.

A2.3. Estimation of Protection Rates – Nominal Tariff Equivalents

A2.3.1. Broad outline of the approach

For estimating the nominal tariff equivalent of all border measures (tariffs, quotas, other barriers), the difference between domestic price and world market price may be used. However, the difference between a country's trade price and its domestic price may be due to a number of factors. These are:

(1) Tariffs (positive or negative) and trade quotas.
(2) Composition differences.
(3) Quality differences.
(4) International trade margins – which depend on whether the country is an exporter or an importer.

For estimating nominal tariff equivalents, factors (2), (3), and (4) are estimated first, and tariff is obtained as a residual.

A2.3.2. Definition of domestic prices under free trade

In this section the treatment of the three major causes of possible deviations of the domestic prices in free trade from world market prices as annually generated in the BLS is described. Two of these aspects deal with individual commodity mixes and quality differences; the third adjustment then takes into account a country's trading position.

World Price Aggregation Factors (WPAF) for a Country

The general idea of calculating this first correction factor, WPAF, is to account for country-specific compositions of the commodities that are aggregated to the nine agricultural commodities used in the BLS.

The FAO Supply Utilization Accounts (SUA), the primary data source on agricultural commodities used in the BLS, are originally composed of over 1000 commodities related to agriculture, 600 of which are used as input for the aggregation down to nine commodities (see Fischer and Sichra, 1983). The following list gives an overview of the aggregation steps:

Name	*Number of commodities*
Original SUA	600 (260 main + 340 derived)
Main commodities	260
Large FAP commodity list	19 (including nonagriculture)
Small FAP commodity list	10 (including nonagriculture)

Over the historical period 1961–1981, world market prices of each commodity in the original SUA list have been calculated reflecting the lowest export unit values among producers exceeding a minimal prespecified export share in the world trade of that particular commodity (see Sichra, 1984). In the aggregation process these prices are weighted with the corresponding world export levels to arrive at world market prices in terms of the FAP 19- and 10-commodity lists. Hence, aggregate world prices reflect the commodity mix as traded on the world market. The aggregation weights most appropriate in the case of a particular country's "free trade" price for consumers, however, are the corresponding demand levels (instead of world trade) and for producers, the corresponding production levels. We therefore proceed as follows: Given a set of world market prices pw_i, total world export weights w_{io} and country-specific commodity weights w_{ij}, where the commodity index i refers to the original SUA list, and j refers to individual countries. Let K be the set of SUA commodities i that are aggregated to FAP commodity k; then the country-specific commodity aggregation world price factors, WPAF_{kj} – aggregation correction factors for brevity – can be calculated from

$$\mathrm{WPAF}_{kj} = \frac{\sum\limits_{i \in K} w_{ij} pw_i}{\sum\limits_{i \in K} w_{io} pw_i}$$

In other words, in the numerator we weight the world market prices computed at the most detailed commodity level available to us by country-specific commodity weights, whereas world trade data are used in the denominator.

A2.3.3. Country-specific quality world price factors (WPQF)

So far, only structural differences of commodities in different countries have been taken into account. A further criterion to be considered, however, is quality differences. Unfortunately, there is no simple and straightforward way to tell quality differences from the information contained in the FAO SUA data base. Accordingly, the quality adjustment multipliers used in the BLS price functions were supplied using one of the following three methods:

(1) Data were processed in terms of the original SUA commodity list. Whenever a country exported a minimal prespecified fraction of domestic production, the deviation of the implied export unit value from the corresponding world market price series has been interpreted as an indication of possible quality differences (see Section 3.2).
(2) Whenever commodity-specific tariff levels were known from other sources, this information was used to estimate quality differences, since the total difference between world market price and domestic price can be attributed to tariff quality differences and aggregation differences and the latter are known.
(3) Whenever (1) and (2) could not be applied, the quality factor reflects "best guesses" from agricultural experts.

Aggregation correction factors (WPAF) and quality multipliers (WPQF) together yield a country-specific world price factor CSWPF_{kj}:

$$\mathrm{CSWPF}_{kj} = \mathrm{WPAF}_{kj} \times \mathrm{WPQF}_{kj}$$

We use this to define a country-specific world market price CSWP_{kj} taking into account the quality and mix of commodities relevant to a particular country j:

$$\mathrm{CSWP}_{kj} = \mathrm{CSWPF}_{kj} \times \mathrm{PW}_k$$

where PW_k represents the aggregate world price of commodity k in the FAP commodity list.

The country-specific world price factors for the nonagricultural commodity, $CSWP_{nj}$, were taken to be 1.0.

A2.3.4. Country-specific trade position world price factor (WPTF)

In determining raw material producer prices under liberal trade scenarios we consider yet another aspect that relates to a country's net export situation for a particular commodity. In practice, countries importing agricultural goods are faced with costs higher than those implied by the world market price (export unit value) owing to transport costs. Similarly, exporters are required to provide special processing and transport up to the border to make a product exportable. Hence, we assume a price band around the appropriate country-specific world price as indicated in *Figure A2.1*.

The graph in *Figure A2.1* shows that, for countries at 100% self-sufficiency (no export or import of that particular commodity), $WPTF_{kj}$ is set to 1.0, implying a raw material price under free trade equal to the country-specific world market price $CSWP_{kj}$. The transition from minimum to maximum price has been stretched out between self-sufficiency levels labeled b and a in *Figure A2.1*. One of the justifications that may be offered for this particular function specification accounts for the fact that most BLS commodities represent aggregates, so that the net export concept hides the possible (and likely) coexistence of subcommodity exports and imports. The interval $(a, 1)$ may therefore be interpreted as the range of aggregate self-sufficiency levels where imports dominate but some exports still take place, and *vice versa* for the interval $(1, b)$. A second argument is the increased numerical stability achieved by stretching the interval (a, b) as far as justifiable, since zigzagging of target prices cannot occur easily from one year to another. When self-sufficiency falls, prices will deviate upward up to a commodity-specific maximum, which is reached at a self-sufficiency level indicated by a in *Figure A2.1*. Conversely, $WPTF_{kj}$ decreases until it reaches a minimal level at a self-sufficiency ratio b and stays constant thereafter. In the BLS, the values of a and b are commodity-specific but not country-specific. The value of b is set to 1.10 except for meats (FAP commodity 4 and 6) and "Non-food agriculture" (FAP commodity 9) where b is set to 1.05. Similarly, a is set to 0.90 for "Dairy products" (FAP commodity 5) and "Other food" (FAP commodity 8), and to 0.95 otherwise (see *Table 3.2*). Country-specific data on transport costs by commodity were not available to us. Therefore, average international transport costs have been estimated as the difference between average world import and world export unit values. Estimates on domestic transport (for export) and export processing requirements have been provided by experts. Percentages defining maximum upward and downward deviations of WPTF from 1.0 are shown in *Table A2.1*.

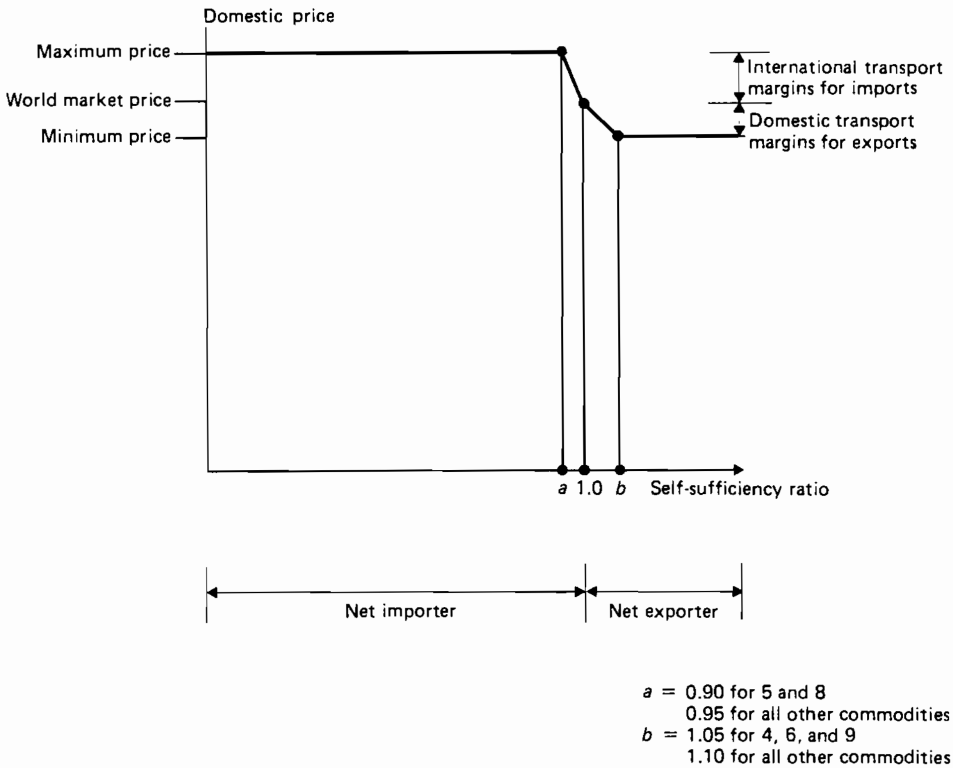

Figure A2.1. Domestic raw material price under trade liberalization.

The relatively high margin for dairy products as set for developing countries reflects the belief that infrastructure and dairy processing industries are generally inadequate to allow for substantial trade in milk powder, which needs reconstitution to give whole milk.

A 2.3.5. Price of nonagriculture in the BLS

The quantification of prices and physical supply and demand volumes for the highly aggregated nonagriculture commodity poses serious practical problems that require simplifying assumptions that are important for understanding the notion of protection rates used in this study.

In the BLS, the nonagricultural sector output is measured in millions of 1970 US dollars. Accordingly, the world price of the nonagriculture commodity

Table A2.1. Average international transport cost, and domestic transport plus export processing requirements, as percentage of world market price for various commodities and countries.

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*
International	12	11	12	9	6	8	10	11	2
Argentina	15	20	15	5	50	5	20	15	3
Australia	15	20	15	5	10	5	20	15	5
Austria	10	20	10	5	10	5	20	15	3
Brazil	20	20	20	5	50	5	20	15	3
Canada	15	20	15	5	10	5	5	15	3
Egypt	10	20	10	5	10	5	20	20	3
Indonesia	10	20	10	5	50	5	20	20	3
Japan	10	20	10	5	10	5	20	15	3
Mexico	10	20	10	5	50	5	20	15	3
Nigeria	10	20	10	5	50	5	20	15	3
Pakistan	10	20	10	5	50	5	20	15	3
Turkey	10	20	10	5	50	5	20	10	3
EC	20	20	20	5	10	5	20	15	3

in 1970 has been set to 1.0. Time series data for GDP of the nonagricultural sector used in this study [from United Nations (UN) National Accounts Statistics] were available in terms of current and constant 1970 national prices.

Given time series estimates for country j on tariff equivalent of protection on nonagriculture $t_{\mathrm{n},j,t}$, exchange rates $\mathrm{EXCH}_{j,t}$, value added of nonagriculture $V_{j,t}$ at current domestic prices and $V^c_{j,t}$ at constant domestic prices of 1970, and country-specific aggregation and quality multipliers $\mathrm{CSWPF}_{\mathrm{n},j,t}$ (following the concepts outlined in the previous sections), consistent series on "true" nonagriculture prices $\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t}$ and production volumes $Q^{\mathrm{true}}_{\mathrm{n},j,t}$ can be constructed as follows:

$$\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t} = (1 + t_{\mathrm{n},j,t}) \times \mathrm{CSWPF}_{\mathrm{n},j,t} \times \mathrm{PW}_{\mathrm{n},t}$$

and

$$Q^{\mathrm{true}}_{\mathrm{n},j,t} = (V_{j,t}/\mathrm{EXCH}_{j,t})/\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t} = (V^c_{j,t}/\mathrm{EXCH}_{j,70})/\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,70}$$

It should be emphasized that estimates of tariff equivalents $t_{\mathrm{n},j,t}$ and aggregation/quality multipliers $\mathrm{CSWPF}_{\mathrm{n},j,t}$ were not available. An attempt to estimate the required coefficients $t_{\mathrm{n},j,t}$ would involve estimating the tariff equivalent of the border protection of tradeable goods as well as its impact on the value added of the nontradable output of the nonagriculture sector. Given the unavailability of data and the highly aggregated treatment of nonagriculture in the study, the effort needed to collect the necessary data was considered not justifiable within the resource constraints of the study. Instead, time series $\mathrm{PRAW}_{\mathrm{n},j,t}$ and $Q_{\mathrm{n},j,t}$ were constructed in the following way:

$$\mathrm{PRAW}_{\mathrm{n},j,t} = (V_{j,t}/\mathrm{EXCH}_{j,t})/(V^{c}_{j,t}/\mathrm{EXCH}_{j,70})$$

$$Q_{\mathrm{n},j,t} = (V_{j,t}/\mathrm{EXCH}_{j,t})/\mathrm{PRAW}_{\mathrm{n},j,t} = V^{c}_{j,t}/\mathrm{EXCH}_{j,70}$$

which implies

$$\mathrm{PRAW}_{\mathrm{n},j,t} = \mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t}/[\mathrm{CSWPF}_{\mathrm{n},j,70} \times (1 + t_{\mathrm{n},j,70})]$$

and

$$Q_{\mathrm{n},j,t} = Q^{\mathrm{true}}_{\mathrm{n},j,t} \times [\mathrm{CSWPF}_{\mathrm{n},j,70} \times (1 + t_{\mathrm{n},j,70})]$$

We have to emphasize the fact that only $\mathrm{PRAW}_{\mathrm{n},j,t}$, and not the "true" price $\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t}$, is used in this study; this has also an important bearing on the estimations of agriculture protection factors. In the rest of this Appendix it is $\mathrm{PRAW}_{\mathrm{n},j,t}$ that is meant whenever the price of nonagriculture is referred to, and *not* $\mathrm{PRAW}^{\mathrm{true}}_{\mathrm{n},j,t}$.

A2.3.6. Country-specific raw material prices under free trade

Given all the adjustment factors as outlined above, we define country-specific raw material prices PRAWF_{kj} under free trade conditions in the following way:

$$\frac{\mathrm{PRAWF}_{kj}}{PRAWF_{\mathrm{n},j}} = \mathrm{WPTF}_{kj} \times \frac{\mathrm{CSWP}_{kj}}{\mathrm{CSWP}_{\mathrm{n},j}} = \mathrm{WPTF}_{kj} \times \frac{\mathrm{CSWPF}_{kj} \times \mathrm{PW}_{k}}{\mathrm{CSWPF}_{\mathrm{n},j} \times \mathrm{PW}_{\mathrm{n}}}$$

$$k = 1, \ldots, 9$$

where k refers to agricultural commodities, n stands for the nonagriculture sector, and j refers to BLS countries shown in *Table A2.1*. For BLS scenarios where agricultural prices PRAW_{kj} are set according to endogenized policy functions, the above definition of country-specific raw material prices under free trade implies the calculation of agricultural protection levels PRTC_{kj},

$$\mathrm{PRTC}_{kj} = \left[\frac{\mathrm{PRAW}_{kj}}{\mathrm{PRAW}_{n,j}}\right] / \left[\frac{\mathrm{PRAWF}_{kj}}{\mathrm{PRAWF}_{n,j}}\right] \qquad k = 1, \ldots, 9$$

It should be noted that these implied protection levels are not to be confused with tariff levels, but rather indicate average deviations of country raw material prices from what might prevail under liberalization of agricultural policies and trade. Thus they represent nominal tariff equivalents.

A2.3.7. Use of protection factors to define prices under free trade

So far we have only covered the set of countries in the BLS that use policy transmission functions annually to set domestic prices. The rest of the countries (except the CMEA and China) use a somewhat simpler approach in that domestic prices are calculated by applying a fixed margin PRCFCT_{kj} on top of the world market price. This margin is assumed to capture all of the above individual aspects – commodity mix, quality aspects, and protection – pertaining to a deviation of domestic prices from world market prices as generated in the BLS:

$$\mathrm{PRAW}_{kj} = \mathrm{PRCFCT}_{kj} \times \mathrm{PW}_k$$

In addition, we have specified relative protection factors, PRTC_{kj}, for each of these countries and country groups; these factors are used to modify the price-setting mechanism under free trade assumptions. Free trade prices are therefore specified by adjusting the above price-setting mechanism accordingly:

$$\mathrm{PRAWF}_{kj} = \frac{1}{\mathrm{PRCT}_{kj}} \times \mathrm{PRAW}_{kj} = \frac{\mathrm{PRCFCT}_{kj}}{\mathrm{PRCT}_{kj}} \times \mathrm{PW}_k$$

It should be noted that, in these price functions, self-sufficiency considerations are not explicitly included.

A2.4. Data Analysis in the Quantification of Protection Levels

In the previous section we have presented the general definition used to arrive at country-specific prices under free trade as well as implied protection levels for the BLS reference scenario. Even though the general concept may sound trivial, the appropriate classification of the observable differences between domestic agricultural prices and the respective set of world market prices used in the BLS poses many practical problems, so that "expert judgment" had to be applied generously. In the following, we describe the relevant data analysis carried out to quantify the required adjustment multipliers or to assist experts in their judgment.

A2.4.1. Country-specific commodity aggregation world price factors

This adjustment multiplier, which corrects for differences in domestic versus world trade commodity mixes, is the least problematic in terms of quantification. All the required data to carry out the calculations indicated in Section A2.3.3 are available in the FAO SUA data base, so that even time series indicating a possible change in commodity mixes could be generated. The results obtained for 1961–1976 turned out to be fairly stable over time, justifying a constant value of the WPAF multipliers to be used in the BLS simulation runs. *Tables A2.2* and *A2.3* show average values (usually for 1961–1976) obtained for each of the nine agricultural commodities using country-specific production and demand weights, respectively. In the case of the BLS wheat and rice commodities, the corresponding factors have to be strictly unity, since the FAO SUA does not distinguish different qualities of these two commodities. However, the value differences are accounted for.

It should be noted that the WPAF multipliers are especially relevant to the highly aggregated BLS commodities 6–9, i.e., "Other animal products", "Protein feed", "Other food", and "Nonfood agriculture".

A2.4.2. Separating quality aspects from protection effects on prices

A first serious problem in data analysis arises from the fact that FAO time series on average annual producer prices are given in national currencies whereas trade is reported in US dollars. To make price series comparable, one therefore has to apply exchange rates, which, however, may be distorted because of lag effects, balance of payments considerations, or other deliberate national policy targets. To avoid exchange rate problems, we looked at relative prices, i.e., agricultural prices divided by the price of the nonagricultural commodity. It should be noted that this procedure is fully compatible with the BLS methodology requiring model results to be independent of absolute price levels [homogeneity of degree zero in world market prices: see Keyzer (1981)]. Hence, all results reported in the following will refer to this notion of relative agricultural prices. To extract as much relevant information as possible from the SUA data base, time series for

Table A2.2. Country-specific commodity world price aggregation factors weighted by domestic production.

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*
Argentina	1.00	1.00	0.99	1.04	1.00	1.26	1.16	0.86	0.96
Australia	1.00	1.00	0.94	1.01	1.00	1.28	0.51	0.93	1.26
Austria	1.00		1.01	1.10	1.00	1.61	0.65	0.92	0.75
Brazil	1.00	1.00	1.04	1.05	1.00	1.35	1.06	0.54	0.94
Canada	1.00		1.02	1.07	1.00	1.24	0.77	0.93	0.58
China	1.00	1.00	0.98	0.95	1.12	1.66	0.88	0.69	0.87
Egypt	1.00	1.00	1.00	0.67	0.82	1.48	1.07	0.77	1.39
India	1.00	1.00	0.92	1.26	0.85	1.34	1.36	0.89	0.91
Indonesia		1.00	1.04	1.01	1.00	1.16	1.33	0.46	0.55
Japan	1.00	1.00	1.00	0.88	1.00	0.70	0.87	0.71	0.45
Kenya	1.00	1.00	1.01	1.13	1.05	1.63	1.31	0.56	1.24
Mexico	1.00	1.00	1.00	1.03	1.03	1.28	0.97	0.91	1.21
New Zeal.	1.00	1.00	0.98	0.99	1.00	1.57	0.46	0.78	1.21
Nigeria	1.00	1.00	0.89	1.39	1.00	1.44	2.09	0.60	0.80
Pakistan	1.00	1.00	0.96	0.96	0.82	1.18	0.89	1.04	1.05
Sweden	1.00		0.99	1.08	1.00	1.10	0.62	1.07	0.78
Thailand		1.00	1.03	0.70	0.81	1.05	1.15	0.49	0.78
Turkey	1.00	1.00	1.02	1.18	1.40	0.90	1.12	0.78	0.90
USA	1.00	1.00	1.00	1.08	1.00	1.45	0.85	0.89	0.92
Bulgaria	1.00	1.00	1.01	0.99	1.32	1.39	1.49	0.77	0.63
Czech.	1.00		0.97	1.03	1.08	1.59	0.64	0.83	0.78
GDR[a]	1.00		1.01	1.03	1.01	1.38	0.59	0.89	0.81
Hungary	1.00	1.00	1.03	1.02	1.05	1.58	1.21	0.83	0.70
Poland	1.00		0.98	1.05	1.00	1.47	0.68	0.84	0.59
Rumania	1.00	1.00	1.04	1.01	1.15	1.50	1.38	0.84	0.74
USSR	1.00	1.00	0.97	1.05	1.00	1.22	1.21	0.92	1.08
EC	1.00	1.00	1.01	1.03	1.02	1.34	0.70	0.90	0.78
Bel-Lux[b]	1.00		0.97	1.05	1.00	1.47	0.66	0.94	0.71
Denmark	1.00		1.00	1.06	1.00	1.42	0.84	1.07	0.75
France	1.00	1.00	1.01	0.99	1.04	1.31	0.62	0.88	0.82
FRG[a]	1.00		1.03	1.07	1.00	1.46	0.61	0.99	0.85
Ireland	1.00		0.90	1.03	1.00	1.26	0.59	0.93	1.03
Italy	1.00	1.00	1.02	1.01	1.08	1.25	0.69	0.89	0.63
Netherlands	1.00		0.95	1.05	1.00	1.38	0.74	0.90	0.72
UK	1.00		0.97	1.05	1.00	1.22	1.21	0.92	1.08

[a]GDR, German Democratic Republic (East Germany); FRG, Federal Republic of Germany (West Germany).

[b]Belgium and Luxemburg combined.

Table A2.3. Country-specific commodity world price aggregation factors weighted by domestic consumption.

Country[a]	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*
Argentina	1.00	1.00	0.98	1.04	1.00	1.29	0.98	0.79	1.01
Australia	1.00	1.00	0.93	1.01	1.00	1.22	0.58	0.89	1.07
Austria	1.00	1.00	1.01	1.08	1.00	1.48	0.88	0.92	0.96
Brazil	1.00	1.00	1.04	1.05	1.00	1.32	1.12	0.49	0.89
Canada	1.00	1.00	1.03	1.07	1.00	1.43	0.77	0.85	0.83
China	1.00	1.00	0.98	0.95	1.12	1.67	0.88	0.69	0.92
Egypt	1.00	1.00	1.00	0.68	0.83	1.41	1.03	0.76	1.14
India	1.00	1.00	0.91	1.26	0.90	1.35	1.14	0.89	0.97
Indonesia	1.00	1.00	1.04	1.01	1.00	1.17	1.15	0.42	0.62
Japan	1.00	1.00	0.99	0.88	1.00	0.72	0.84	0.78	0.94
Kenya	1.00	1.00	1.01	1.13	1.06	1.64	1.39	0.57	1.19
Mexico	1.00	1.00	1.00	1.03	1.03	1.29	0.94	0.93	1.08
New Zeal.	1.00	1.00	0.97	1.03	1.00	1.60	0.52	0.88	0.95
Nigeria	1.00	1.00	0.89	1.39	1.00	1.34	1.61	0.51	0.74
Pakistan	1.00	1.00	0.96	0.96	0.83	1.29	0.96	1.03	0.99
Sweden	1.00	1.00	1.00	1.07	1.00	1.19	0.91	0.96	0.83
Thailand	1.00	1.00	1.02	0.70	0.98	1.05	1.11	0.65	0.75
Turkey	1.00	1.00	1.02	1.18	1.40	0.90	1.09	0.78	0.94
USA	1.00	1.00	1.00	1.08	1.00	1.42	0.87	0.84	0.90
Bulgaria	1.00	1.00	1.01	0.99	1.28	1.38	1.31	0.83	0.99
Czech.	1.00	1.00	0.97	1.03	1.08	1.51	1.08	0.81	0.98
GDR	1.00	1.00	1.01	1.01	1.01	1.32	0.89	0.85	0.89
Hungary	1.00	1.00	1.03	1.02	1.05	1.60	1.14	0.83	0.91
Poland	1.00	1.00	0.99	1.05	1.00	1.47	0.93	0.83	0.86
Rumania	1.00	1.00	1.04	1.00	1.17	1.48	1.27	0.85	0.87
USSR	1.00	1.00	0.97	1.05	1.00	1.23	1.21	0.90	1.00
EC	1.00	1.00	1.01	1.02	1.02	1.32	0.94	0.89	0.96
Bel–Lux	1.00	1.00	0.96	1.04	1.00	1.37	0.91	0.84	1.00
Denmark	1.00	1.00	1.00	1.04	1.00	1.09	0.94	0.99	0.79
France	1.00	1.00	1.02	0.99	1.05	1.30	1.00	0.83	1.00
FRG	1.00	1.00	1.02	1.07	1.00	1.41	0.92	0.91	0.94
Ireland	1.00	1.00	0.95	1.00	1.00	1.40	0.93	0.87	0.97
Italy	1.00	1.00	1.02	1.02	1.07	1.18	0.86	0.93	0.91
Netherlands	1.00	1.00	1.01	1.04	1.00	1.39	0.91	0.87	0.88
UK	1.00	1.00	0.99	1.02	1.00	1.30	1.02	0.89	1.00

[a]See footnotes to *Table A2.2.*

Table A2.4. Producer price of wheat relative to world market price, 1966–1980.

Country	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*
Argentina	0.58	0.60	0.69	0.71	0.68	0.66	0.58
Australia	1.18	1.12	0.97	0.94	1.05	1.12	1.05
Austria	1.82	1.62	1.63	1.54	1.71	1.75	1.62
Brazil	2.19	1.87	1.85	1.83	1.94	2.03	1.86
Canada	1.18	0.98	0.81	0.73	0.91	0.90	1.17
Egypt	1.35	1.38	1.22	1.21	1.63	1.59	1.52
India	2.05	2.44	1.81	1.89	2.11	2.06	2.01
Japan	2.82	2.60	2.74	2.70	3.06	3.41	3.36
Kenya	1.35	1.29	1.31	1.24	1.15	1.35	1.25
Mexico	1.33	1.15	1.19	1.13	1.23	1.31	1.22
New Zealand	1.07	0.91	0.92	0.94	1.05	1.08	1.11
Nigeria	2.46	1.92	1.92	2.38	2.66	3.74	3.34
Pakistan	1.70	1.88	1.74	1.55	1.82	1.95	1.93
Sweden	2.05	1.82	1.76	1.65	1.78	1.81	1.67
Turkey	1.68	1.46	1.50	1.50	1.60	1.54	1.37
USA	1.18	0.90	0.80	0.77	0.89	0.93	1.16
EC:							
Belgium/Luxemburg	1.82	1.65	1.66	1.57	1.83	1.85	1.76
Denmark	1.48	1.26	1.17	1.20	1.33	1.37	1.42
France	1.51	1.42	1.42	1.32	1.54	1.66	1.57
FRG	2.22	1.82	1.89	1.84	1.93	1.93	1.84
Italy	2.22	1.94	1.91	1.84	2.06	2.13	1.97
Netherlands	1.96	1.72	1.71	1.64	1.89	1.84	1.74
UK	1.22	1.12	1.18	1.18	1.36	1.40	1.42

the years 1966–1980 of five different indicators have been calculated in terms of the original SUA commodity list. It may be noted that, since these calculations are done at the levels of the detailed commodity list, there is no composition difference between countries. The five indicators calculated are:

(1) Domestic producer price over world market price, which is defined as the minimum unit value of exports above a certain threshold value in share of world exports. This indicates the total difference in the prices that needs to be separated into that due to quality differences and that due to protection.

(2) Domestic producer price over average world export unit value. This ratio shows the value of the domestic producer price relative to the unit value of the average traded quality.

(3) Domestic producer price over each country's export/import unit value. This shows the combined effect of protection and any quality difference between the average quality of production and the average quality of product traded by the country.

Table A2.4. (Cont.)

1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1966–1980*
0.81	0.57	0.43	0.47	1.04	1.12			0.60
1.84	1.06	0.83	0.64	1.02	1.19	1.11	0.90	1.07
1.49	1.01	0.94	1.00	1.45	1.41	1.25	1.07	1.42
1.96	1.59	2.14	1.49	2.40	2.17	1.55		1.92
2.64	1.48	0.90	0.86	1.19	1.53	1.50		1.20
1.60	1.25	1.25	1.02	1.41	1.40			1.37
1.97	1.78	1.49	1.27	1.89	1.67	1.44		1.73
3.40	2.50	2.61	2.95	5.88	5.87	5.03	4.60	3.57
1.33	1.13	1.24	1.36	1.94	1.89	1.47		1.38
1.14	0.94	1.01	0.88	1.25	1.32	1.09	0.88	1.14
1.43	0.81	0.85	0.75	1.07	1.06	0.81	0.68	0.97
3.01	1.65	1.58	1.30	1.91				1.86
1.64	1.05	1.30	1.43	2.03	2.13			1.70
1.50	1.11	1.08	1.09	1.57	1.51	1.29	1.11	1.52
1.37	1.29	1.24	1.11	1.48	1.21	0.91		1.37
2.49	1.60	1.30	0.97	1.18	1.42	1.42	1.19	1.21
1.76	1.09	1.09	1.15	1.64	1.60	1.30	1.12	1.53
1.61	1.06	0.97	0.97	1.55	1.45	1.27	1.11	1.28
1.55	1.06	0.99	1.08	1.57	1.54	1.24	1.04	1.37
1.83	1.22	1.16	1.31	1.82	1.76	1.46	1.26	1.69
2.33	1.78	1.53	1.57	2.35	2.30	1.84		1.98
1.71	1.07	0.98	1.04	1.45	1.40	1.16	1.00	1.49
2.24	1.30	0.96	1.14	1.76	1.65	1.37	1.05	1.36

(4) Export/import unit value of each country relative to world market price. This shows the difference between the quality of a country's traded goods and that of the cheapest major exporter.

(5) Domestic producer price relative to producer price of a selected country. Usually a country is selected that is an important producer of the commodity and known not to protect that commodity. This ratio gives information on the relative protection provided by different countries for that commodity.

This information is used to arrive at judgments on the quality factors for each commodity and each country. Naturally, more emphasis was put on major countries and important commodities.

To illustrate the kind of results obtained from these calculations and the process of analysis, *Tables A2.4–A2.7* present time series of the five indicators in the case of wheat.

In *Table A2.6* two series are given per country. The first line shows the ratio of domestic producer price to relevant trade price (i.e., export unit value or import unit value), which may be interpreted as an indication of commodity

Table A2.5. Producer price of wheat relative to average world export unit value, 1966–1980.

Country	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*
Argentina	0.51	0.54	0.63	0.66	0.62	0.53	0.50
Australia	1.04	1.00	0.89	0.87	0.95	0.89	0.90
Austria	1.60	1.45	1.48	1.43	1.55	1.40	1.39
Brazil	1.93	1.67	1.68	1.69	1.77	1.62	1.59
Canada	1.04	0.87	0.74	0.68	0.83	0.72	1.01
Egypt	1.19	1.23	1.11	1.12	1.48	1.27	1.30
India	1.80	2.18	1.65	1.74	1.92	1.65	1.72
Japan	2.48	2.32	2.49	2.50	2.78	2.72	2.88
Kenya	1.19	1.16	1.19	1.15	1.05	1.08	1.07
Mexico	1.17	1.03	1.09	1.04	1.12	1.04	1.04
New Zealand	0.94	0.81	0.84	0.87	0.95	0.87	0.95
Nigeria	2.16	1.72	1.75	2.20	2.42	2.99	2.86
Pakistan	1.50	1.68	1.58	1.43	1.65	1.55	1.66
Sweden	1.80	1.62	1.61	1.52	1.62	1.45	1.43
Turkey	1.48	1.30	1.36	1.38	1.46	1.23	1.17
USA	1.03	0.80	0.73	0.71	0.81	0.74	1.00
EC:							
Belgium–Luxemburg	1.60	1.48	1.52	1.45	1.67	1.48	1.51
Denmark	1.30	1.13	1.06	1.11	1.20	1.09	1.22
France	1.33	1.27	1.29	1.22	1.40	1.32	1.35
FRG	1.95	1.62	1.72	1.70	1.76	1.54	1.58
Italy	1.95	1.73	1.74	1.70	1.87	1.70	1.69
Netherlands	1.72	1.53	1.56	1.51	1.72	1.47	1.49
UK	1.07	1.00	1.08	1.09	1.23	1.12	1.22

protection; the second time series refers to the relationship of trade price to world market price. The latter will often indicate quality differences, but should be interpreted with care, as in the case of wheat for EC countries shown in *Table A2.6.* The values presented there indicate that border prices in EC countries have been 40–60% above world market prices (as defined in the BLS). This high margin clearly cannot be explained by quality differences, but is rather an outcome of border protection in the Community and trade between EC member countries at this protected price, which is reflected in their trade statistics.

To give an example of the kind of considerations involved in the sometimes difficult task of separating out price differences due to quality aspects on the one hand and price-policy-induced deviations on the other hand, let us look at the figures for the USA in *Tables A2.4–A2.7*:

(1) From *Table A2.4*, we learn that US producer prices of wheat have been (on the average for 1966–1980) around 20% above the respective world market price as defined in the BLS approach.

Table A2.5. (Cont.)

1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1966–1980*
0.51	0.40	0.37	0.42	0.81	0.90			0.49
1.15	0.75	0.72	0.58	0.80	0.96	0.92	0.82	0.88
0.94	0.72	0.82	0.90	1.13	1.14	1.03	0.97	1.20
1.23	1.13	1.85	1.34	1.87	1.75	1.27		1.60
1.65	1.04	0.78	0.77	0.93	1.23	1.23		0.97
1.00	0.88	1.08	0.92	1.10	1.13			1.14
1.23	1.26	1.29	1.15	1.48	1.35	1.19		1.44
2.13	1.77	2.26	2.66	4.60	4.74	4.14	4.17	2.98
0.83	0.80	1.07	1.22	1.52	1.53	1.21		1.15
0.71	0.66	0.87	0.79	0.97	1.07	0.90	0.80	0.95
0.90	0.57	0.74	0.68	0.84	0.85	0.67	0.61	0.80
1.88	1.17	1.37	1.17	1.49				1.55
1.03	0.74	1.12	1.28	1.59	1.71			1.42
0.94	0.79	0.93	0.98	1.23	1.22	1.06	1.00	1.28
0.86	0.91	1.07	1.00	1.16	0.97	0.75		1.15
1.56	1.13	1.13	0.87	0.92	1.14	1.17	1.08	0.99
1.10	0.77	0.94	1.04	1.29	1.29	1.07	1.02	1.28
1.01	0.75	0.84	0.88	1.21	1.17	1.04	1.01	1.07
0.97	0.75	0.85	0.97	1.22	1.24	1.02	0.94	1.14
1.15	0.86	1.00	1.18	1.42	1.42	1.20	1.14	1.42
1.46	1.26	1.32	1.42	1.84	1.85	1.51		1.65
1.07	0.75	0.84	0.94	1.13	1.13	0.95	0.90	1.25
1.40	0.92	0.83	1.03	1.38	1.33	1.13	0.95	1.12

(2) *Table A2.5*, however, shows that the US wheat producers received about as much per metric ton of wheat as the average export unit value on the world market.

(3) Finally, *Table A2.6* indicates that US export prices, on the average, matched US producer prices of wheat fairly well.

(4) We therefore conclude that there has not been any substantial protection of US producer prices for wheat over the period 1966–1980. (Note that set-aside policies, loan rate mechanisms, and other US agricultural policies aimed at protecting farmers are separately treated in free trade scenarios.) The above analysis further suggests that the quality of US wheat is about 20% above the quality of wheat exports of the cheapest major exporter in the historical period (see Sichra, 1984).

All this information has been compiled to come up with country-specific world price factors $CSWPF_{kj}$ (k referring to commodities, j indicating the country). *Table A2.8* shows the final choice of factors as used in the BLS simulation runs.

Table A2.6. Producer price[a] of wheat relative to export or import price and ratio of export or import price[b] to world market price, 1966–1980.

Country	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*
Argentina	0.58	0.60	0.69	0.71	0.68	0.59	0.51
	1.00	1.00	1.00	1.00	1.00	1.12	1.15
Australia	1.14	1.07	0.95	0.94	1.04	1.12	1.05
	1.04	1.05	1.03	1.00	1.00	1.00	1.00
Austria (export)		1.53			1.38		
		1.06			1.23		
Austria (import)	1.37	1.03	1.09	1.02	1.14	1.18	1.06
	1.33	1.58	1.49	1.51	1.50	1.48	1.53
Brazil	1.71	1.50	1.52	1.57	1.63	1.49	1.37
	1.28	1.25	1.21	1.16	1.19	1.36	1.35
Canada	0.97	0.80	0.68	0.61	0.82	0.75	1.02
	1.22	1.22	1.20	1.20	1.12	1.20	1.15
Egypt	1.09	1.15	1.11	1.17	1.60	1.21	1.27
	1.25	1.20	1.10	1.04	1.02	1.31	1.19
India	1.45	1.98	1.34	1.28	1.56	1.34	1.46
	1.41	1.23	1.35	1.48	1.36	1.54	1.37
Japan	2.20	2.07	2.21	2.32	2.46	2.56	2.78
	1.29	1.26	1.24	1.16	1.24	1.33	1.21
Kenya	0.88	0.86	0.90	0.79	0.73	0.84	0.86
	1.53	1.50	1.46	1.57	1.59	1.60	1.46
Nigeria	1.50	1.08	1.19	1.50	1.75	2.43	1.72
	1.64	1.78	1.61	1.59	1.52	1.54	1.94
Pakistan	1.37	1.54	1.24		2.15	2.25	1.54
	1.24	1.22	1.40		0.84	0.87	1.26
Sweden	2.03	1.85	1.89	1.74	1.70	1.58	1.72
	1.01	0.98	0.93	0.95	1.05	1.14	0.97
USA	1.05	0.83	0.75	0.76	0.84	0.70	1.05
	1.12	1.08	1.07	1.02	1.06	1.32	1.11
EC:							
Bel–Lux (export)	1.54	1.19	1.07	1.04	1.08	0.95	0.90
	1.19	1.39	1.55	1.50	1.70	1.94	1.95
Bel–Lux (import)	1.18	1.14	1.10	1.07	1.08	1.04	0.99
	1.55	1.45	1.51	1.47	1.70	1.79	1.79
Denmark	1.30			1.15	1.06	1.25	1.44
	1.14			1.04	1.25	1.09	0.98
France	1.26	1.12	1.25	1.07	1.11	0.97	1.02
	1.20	1.27	1.13	1.24	1.39	1.71	1.54
FRG (export)	1.90	1.66	1.57	2.09	1.56	1.18	1.22
	1.17	1.09	1.21	0.88	1.24	1.63	1.51
FRG (import)	1.54	1.32	1.30	1.20	1.31	1.14	1.15
	1.44	1.37	1.46	1.53	1.47	1.69	1.61
Italy	1.48	1.31	1.34	1.37	1.46	1.39	1.28
	1.49	1.48	1.42	1.34	1.41	1.53	1.54
Netherlands	1.55	1.32	1.20	1.12	1.19	1.19	1.09
	1.26	1.30	1.43	1.46	1.59	1.55	1.60
UK	0.91	0.88	0.99	1.04	1.07	1.02	1.12
	1.34	1.27	1.20	1.14	1.27	1.37	1.27

[a]First line for each country. [b]Second line for each country.

Table A2.6. (Cont.)

1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1966–1980*[c]
0.58	0.40	0.37	0.47	1.04	1.07			E 0.64
1.40	1.43	1.17	1.00	1.00	1.04	1.07	1.00	E 1.09
1.84	0.89	0.68	0.57	0.78	1.19	1.11	0.90	E 1.02
1.00	1.20	1.23	1.12	1.30	1.00	1.00	1.00	E 1.07
			0.94		1.03	1.09	0.83	E 1.13
			1.06		1.37	1.15	1.29	E 1.19
0.81			0.65					M 1.04
1.84			1.55					M 1.53
1.01	0.91	1.84	1.27	2.05	1.63	1.19		M 1.48
1.94	1.76	1.17	1.17	1.17	1.33	1.30	1.42	M 1.34
1.75	0.89	0.74	0.72	0.96	1.37	1.25		E 0.95
1.50	1.66	1.22	1.20	1.24	1.12	1.20	1.11	E 1.24
1.13	0.74	0.92	0.88	0.74	0.80			M 1.06
1.41	1.70	1.36	1.16	1.91	1.75	0.76	1.08	M 1.28
0.98	1.38	1.11	0.93	0.94				M 1.31
2.01	1.29	1.34	1.37	2.00				M 1.48
1.83	1.38	1.93	2.23	4.29	4.06	3.62	3.46	M 2.63
1.86	1.81	1.35	1.32	1.37	1.44	1.39	1.33	M 1.37
1.08	0.66		1.06					E 0.87
1.23	1.71		1.28					E 1.49
1.38	0.81	1.05	0.84	1.51				M 1.40
2.18	2.03	1.50	1.56	1.26	1.32	1.26	1.10	M 1.59
1.39	1.03	1.02	1.28	1.45	1.72			M 1.50
1.18	1.03	1.27	1.11	1.39	1.23	1.20	1.07	M 1.16
1.22	0.79	1.03	1.08	1.55	1.36	1.19	1.01	E 1.45
1.23	1.41	1.04	1.01	1.02	1.12	1.08	1.10	E 1.07
1.52	1.12	1.14	0.91	1.00	1.16	1.19	1.09	E 1.01
1.64	1.42	1.14	1.07	1.18	1.22	1.19	1.09	E 1.18
1.01	0.79	0.89	0.99	0.84	0.96	1.07	1.15	E 1.03
1.75	1.39	1.23	1.17	1.96	1.67	1.21	0.98	E 1.51
0.86	0.86	0.85	0.87	0.80	0.77	0.72	0.79	M 0.94
2.04	1.27	1.28	1.32	2.05	2.09	1.80	1.43	M 1.64
0.82	0.89	0.88	0.78	0.93	0.78	0.88	0.94	E 1.01
1.96	1.20	1.11	1.24	1.67	1.86	1.44	1.18	E 1.32
0.80	0.88	0.97	0.96	0.85	0.79	0.80	0.80	E 0.98
1.94	1.21	1.02	1.13	1.85	1.95	1.54	1.31	E 1.43
0.97	0.85	0.96	1.03	1.02	0.83	0.83	0.86	E 1.23
1.89	1.44	1.21	1.28	1.78	2.12	1.77	1.46	E 1.44
0.94	0.86	0.86	0.95	0.97	0.90	0.81	0.81	M 1.07
1.96	1.41	1.35	1.37	1.88	1.95	1.81	1.56	M 1.59
1.10	1.05	1.01	1.28	1.36	1.28	1.16		M 1.28
2.12	1.69	1.51	1.23	1.73	1.80	1.59	1.51	M 1.56
0.92	0.78	0.76	0.84	0.83	0.77	0.71	0.68	M 1.00
1.87	1.37	1.28	1.24	1.74	1.82	1.63	1.46	M 1.51
1.34	0.80	0.77	1.00	1.11	0.95	0.87	0.84	M 0.98
1.67	1.63	1.25	1.14	1.59	1.73	1.58	1.26	M 1.38

[c]E, export; M, import.

Table A2.7. Producer price of wheat relative to US producer price, 1966–1980.

Country	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*
Argentina	0.49	0.67	0.86	0.93	0.76	0.71	0.50
Australia	1.00	1.25	1.21	1.23	1.17	1.20	0.90
Austria	1.55	1.81	2.02	2.01	1.91	1.89	1.40
Brazil	1.86	2.08	2.30	2.38	2.18	2.18	1.60
Canada	1.01	1.08	1.01	0.96	1.02	0.97	1.01
Egypt	1.15	1.53	1.52	1.58	1.82	1.71	1.31
India	1.74	2.72	2.25	2.46	2.37	2.22	1.73
Japan	2.40	2.89	3.41	3.52	3.42	3.67	2.89
Kenya	1.15	1.44	1.63	1.62	1.29	1.45	1.08
Mexico	1.13	1.28	1.49	1.47	1.38	1.41	1.05
New Zealand	0.91	1.01	1.14	1.22	1.18	1.17	0.95
Nigeria	2.09	2.13	2.39	3.10	2.98	4.03	2.87
Pakistan	1.45	2.09	2.16	2.01	2.03	2.10	1.66
Sweden	1.74	2.02	2.19	2.15	1.99	1.95	1.44
Turkey	1.43	1.62	1.86	1.95	1.79	1.66	1.18
USA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EC:							
Belgium–Luxemburg	1.55	1.84	2.07	2.04	2.05	1.99	1.52
Denmark	1.26	1.40	1.45	1.57	1.48	1.47	1.22
France	1.29	1.58	1.77	1.72	1.73	1.78	1.35
FRG	1.88	2.02	2.35	2.39	2.16	2.08	1.59
Italy	1.88	2.15	2.38	2.40	2.30	2.30	1.69
Netherlands	1.66	1.91	2.13	2.13	2.12	1.98	1.50
UK	1.04	1.24	1.47	1.54	1.52	1.50	1.22

Note that not all of the BLS countries are listed in this table because only this group of BLS countries is modeled in this particular way. It should also be noted that in some cases the CSWPF multiplier has been used as a calibration device for the policy price transmission function. One prominent example for this *ex post* modification is the low value of the corresponding multiplier for protein feed in Brazil, where the boost in soybean production in the 1970s led to a significant composition change in the aggregate commodity.

The high multiplier values shown for dairy products in Egypt, India, and Pakistan are explained by their high shares of buffalo milk – with a much higher fat content than cow milk – in the composition of the aggregate commodity.

A2.5. Agricultural Protection Levels in the BLS

It has been indicated in Section A2.1 that each country can be assigned a country-specific world market price that takes into account quality and commodity mix considerations.

Table A2.7. (Cont.)

1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1966–1980*
0.32	0.36	0.33	0.48	0.88	0.79			0.62
0.74	0.67	0.64	0.66	0.86	0.84	0.78	0.75	0.93
0.60	0.63	0.72	1.04	1.23	0.99	0.88	0.90	1.30
0.79	1.00	1.65	1.53	2.03	1.53	1.09		1.73
1.06	0.92	0.69	0.89	1.01	1.08	1.05		0.98
0.64	0.78	0.96	1.05	1.19	0.99			1.25
0.79	1.11	1.15	1.32	1.60	1.18	1.01		1.69
1.36	1.56	2.00	3.05	4.99	4.15	3.53	3.86	3.11
0.53	0.70	0.95	1.40	1.64	1.34	1.03		1.23
0.46	0.59	0.77	0.91	1.06	0.93	0.77	0.74	1.03
0.57	0.50	0.66	0.77	0.91	0.75	0.57	0.57	0.86
1.21	1.03	1.22	1.34	1.62				2.17
0.66	0.66	0.99	1.47	1.72	1.50			1.58
0.60	0.70	0.83	1.13	1.34	1.07	0.90	0.93	1.40
0.55	0.81	0.95	1.14	1.26	0.85	0.64		1.26
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.71	0.68	0.83	1.19	1.39	1.13	0.91	0.94	1.39
0.65	0.67	0.74	1.00	1.31	1.02	0.89	0.93	1.14
0.62	0.66	0.76	1.11	1.33	1.09	0.87	0.87	1.24
0.74	0.76	0.89	1.35	1.54	1.25	1.03	1.06	1.54
0.93	1.11	1.17	1.62	1.99	1.62	1.29		1.78
0.69	0.67	0.75	1.07	1.23	0.99	0.81	0.83	1.37
0.90	0.81	0.74	1.18	1.50	1.16	0.97	0.88	1.18

Since consistent data for domestic prices were not available for many countries in the BLS for 1978–1980, these were generated from simulation runs of the national models, with observed world market prices for these years. We assume a continuation of past political trends in setting agricultural price levels. Therefore, domestic prices will generally deviate from the corresponding world prices appropriately adjusted for quality and product mix.

As far as the transmission of changes in world prices to domestic price levels is concerned, we can distinguish two types of model in the BLS. One group of countries uses price transmission functions, parameters of which were estimated econometrically. Here the domestic price level, apart from world market prices, usually also depends on past domestic price levels as well as each country's self-sufficiency situation. Hence, the ratio of domestic to world prices may well change over time, and also for different simulation runs. These countries will be treated in the next subsection. The second type of model uses fixed protection factors to keep a constant relationship between domestic and world price levels. Country models following this approach are discussed in the next-but-one subsection. No protection rates were estimated for CMEA and China, as these do not liberalize agricultural trade in any of the scenarios.

Table A2.8. Country-specific world price factors, CSWPF.

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*
Argentina	1.00	1.00	1.08	1.40	1.00	1.60	1.24	1.08	1.03
Australia	1.05	0.80	1.00	1.10	1.00	1.40	1.24	0.88	1.40
Austria	1.00	1.70	1.05	1.20	1.00	1.70	1.12	1.05	1.00
Brazil	1.00	0.90	1.00	1.00	0.98	1.45	0.26	0.70	0.96
Canada	1.07	1.90	0.95	1.45	1.00	1.75	1.09	1.70	1.12
Egypt	1.05	1.15	1.30	1.25	1.50	1.80	1.75	0.83	3.10
India	1.10	1.00	1.20	1.00	1.60	2.10	0.88	1.00	2.10
Indonesia	1.00	0.75	1.09	1.00	1.00	1.32	8.24	0.69	1.15
Japan	1.00	1.00	1.10	1.00	1.00	1.15	0.45	0.88	1.25
Mexico	1.05	1.25	1.50	1.40	1.00	1.90	1.60	1.03	2.60
Nigeria	1.05	1.00	1.00	1.20	1.00	0.86	4.50	1.35	1.35
Pakistan	1.05	1.40	1.60	1.45	1.75	1.00	2.85	1.53	1.75
Turkey	1.05	1.00	1.10	1.75	1.10	1.00	2.60	0.90	1.50
EC	1.05	1.00	1.10	1.50	1.02	1.52	0.94	1.25	1.30

A2.5.1. Protection levels in country models using price transmission functions

Table A2.9 shows a comparison of agricultural prices relative to country-specific world prices for 1978–1980 as generated by the national models. Note that the last two columns in *Table A2.9* show average aggregate deviations of domestic raw material prices from world market prices weighted by domestic production and demand items, respectively.

When we talk about protection levels in agriculture, we include one additional multiplier that reflects a country's trading position as explained in Section A2.3.4. According to our definition, the implied agricultural protection levels would amount to values as shown in *Table A2.9* if the corresponding commodity self-sufficiency ratios were exactly 100%. Lower self-sufficiency – i.e., net imports – will increase the price level deemed appropriate under free trade conditions and hence decrease implied protection levels; higher self-sufficiency will act in the opposite direction. It should therefore be understood that in our definition the agricultural protection level implied by given sets of domestic and world market prices may change with different production and consumption levels.

In *Table A2.10*, commodity-wise as well as average agricultural protection rates are listed for BLS countries where the concept described so far is applicable. Data refer to the national model scenarios for the years 1978–1980. Note that the protection rates in *Table A2.10* depend also on the trade position of the country in that commodity. A large positive protection rate for an exported commodity can change to a small positive protection rate when the commodity is imported without there being any substantial change in the domestic price. This

Table A2.9. Percentage deviations of relative domestic raw material prices from country-specific world market prices: BLS reference scenario, 1978–1980.[a]

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*	*Production*	*Consumption*
Argentina	−37.5	−10.7	−35.8	−30.0	−16.4	−13.6	−20.5	−34.3	−6.9	−27.5	−28.0
Australia	−7.2	−2.7	3.5	−10.4	−16.7	39.6	−8.6	0.3	−8.2	−1.6	−0.9
Austria	27.8	7.3	67.5	65.4	23.2	23.1	35.0	23.7	46.6	35.7	36.0
Brazil	30.8	−16.9	−12.5	−17.0	50.1	−30.0	−14.9	−25.4	−20.6	−14.8	−13.4
Canada	−4.9	−3.0	−10.0	22.4	53.6	−3.6	−8.0	−3.6	14.5	4.3	5.4
Egypt	41.7	−28.5	47.2	88.3	77.2	76.0	−13.6	−33.4	−29.8	18.4	26.7
India	31.5	8.6	31.3	14.9	40.2	−1.8	19.9	−20.4	−8.0	4.3	19.2
Indonesia	9.8	−8.0	−4.1	17.1	70.5	11.6	−23.7	−19.8	−35.7	−8.4	−8.3
Japan	50.9	256.8	73.3	62.5	141.2	39.7	164.6	58.2	100.9	101.0	98.7
Mexico	1.3	14.1	−0.1	22.9	19.4	19.1	0.5	−2.0	−32.9	5.0	5.1
Nigeria	56.6	80.9	37.7	47.9	122.5	122.0	−33.7	−8.6	−16.8	5.4	13.0
Pakistan	10.4	20.0	57.7	45.5	95.5	27.4	−8.5	−6.5	−15.2	33.9	35.6
Turkey	41.6	52.0	25.4	62.6	170.7	56.6	27.0	−2.7	−5.8	37.7	40.1
EC	41.8	76.0	74.9	62.7	56.6	26.6	50.7	19.9	27.9	41.5	40.6

[a]Domestic prices generated as described in the text.

Table A2.10. Protection of agricultural commodities (in percent) for countries, using price transmission functions, 1978–1980.[a]

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*	*Produc-tion*	*Consump-tion*
Argentina	-25.6	2.3	-17.0	-26.6	-15.4	-19.9	2.1	-29.8	-4.6	-22.7	-24.0
Australia	10.4	18.5	33.7	-6.0	-7.9	46.9	17.3	16.4	-4.3	11.2	13.0
Austria	40.1	-2.3	97.1	71.7	36.1	14.1	21.6	12.3	44.2	38.4	36.2
Brazil	16.0	-2.2	-20.8	-14.0	22.4	-35.1	-9.9	-13.4	-18.6	-11.6	-11.4
Canada	13.2	-11.7	16.2	28.4	53.6	1.4	-17.2	-12.5	17.4	9.3	7.6
Egypt	25.8	-12.8	24.8	73.7	15.6	85.1	6.9	-21.2	-28.0	14.4	20.3
India	75.5	-1.4	9.8	8.6	48.8	0.2	7.9	-27.2	-9.2	3.7	38.4
Indonesia	-2.5	-16.2	-18.7	8.0	11.2	17.4	-2.1	-14.4	-34.6	-7.5	-7.8
Japan	33.9	237.6	46.9	49.9	109.3	45.0	138.3	43.7	97.7	93.3	89.2
Mexico	-10.1	3.9	11.0	15.3	-0.1	25.3	-9.5	13.7	-31.2	9.2	8.5
Nigeria	39.0	64.7	16.7	36.4	45.1	105.8	-14.9	-10.9	-18.2	0.5	7.0
Pakistan	23.4	46.2	58.1	37.7	27.5	34.0	9.8	-15.1	-16.6	17.7	17.7
Turkey	25.6	38.4	6.3	63.6	224.6	64.8	63.0	7.1	-3.4	46.5	48.9
EC	79.8	60.3	48.3	59.1	73.1	27.7	35.7	8.9	25.8	41.2	37.7

[a]Based on domestic prices generated as described in the text.

Table A2.11. Range of protection of agricultural commodities (in percent) as implied by respective maximum and minimum self-sufficiency ratios: BLS reference scenario, 1978–1980.

Country		*Wheat*	*Rice*	*Coarse grains*	*Bovine & ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agric.*	*Produc-tion*	*Consump-tion*
Argentina	max	–25.6	8.8	–17.0	–26.6	59.5	–9.1	2.1	–23.8	–4.6	–16.3	–16.3
	min	–44.5	–18.7	–45.6	–35.4	–45.5	–19.9	–28.4	–40.4	–8.4	–34.8	–35.2
Australia	max	10.4	18.5	33.7	–6.0	–7.9	46.9	17.3	16.4	–4.3	11.2	12.5
	min	–17.7	–11.4	–12.3	–17.4	–27.7	29.4	–17.7	–8.9	–9.7	–9.9	–9.1
Austria	max	42.9	30.8	97.1	73.5	36.1	29.5	73.3	43.5	50.3	50.8	54.9
	min	13.4	–2.3	42.0	52.5	6.9	14.1	21.6	12.3	44.2	21.7	23.4
Brazil	max	65.8	1.2	25.0	–12.9	186.5	–26.4	–9.9	–13.4	–18.6	8.2	11.8
	min	16.0	–24.3	–25.8	–23.5	–2.1	–35.1	–23.3	–32.2	–21.9	–25.8	–25.0
Canada	max	13.2	18.2	16.2	28.4	69.7	1.4	18.0	18.1	17.4	18.7	21.4
	min	–15.6	–11.7	–23.7	12.9	33.3	–10.6	–17.2	–12.5	12.7	–5.8	–4.7
Egypt	max	58.5	–12.8	73.1	97.6	238.3	85.1	10.9	–18.4	–28.0	45.2	56.7
	min	25.8	–34.9	24.8	73.7	15.6	63.2	–22.2	–39.5	–30.9	3.6	10.5
India	max	75.5	33.5	94.9	18.7	51.2	2.9	54.2	–8.9	–6.2	23.0	55.2
	min	14.3	–1.4	9.8	8.6	25.6	–8.4	7.9	–27.2	–9.2	–5.5	7.1
Indonesia	max	22.8	12.1	12.8	22.9	225.3	17.4	–2.1	–7.0	–34.1	4.9	5.9
	min	–2.5	–16.2	–18.7	8.0	11.2	3.4	–31.3	–27.2	–36.8	–16.4	–16.3
Japan	max	68.7	334.7	103.9	70.5	166.5	47.0	239.6	83.6	106.0	129.4	126.3
	min	33.9	224.8	46.9	49.9	109.3	29.5	138.3	43.7	97.7	84.0	82.0
Mexico	max	13.3	39.1	17.5	29.0	127.8	25.3	29.0	13.7	–31.2	24.3	26.0
	min	–10.1	3.9	–15.3	13.4	–22.2	10.4	–9.5	–11.0	–34.0	–6.7	–6.7
Nigeria	max	75.1	120.4	61.9	55.2	324.7	133.6	–14.9	6.0	–14.7	21.1	30.0
	min	39.0	64.7	16.7	36.4	45.1	105.8	–40.3	–17.0	–18.2	–4.6	2.1
Pakistan	max	23.4	46.2	85.4	52.7	273.2	34.0	17.5	8.4	–13.1	95.1	101.4
	min	–2.1	9.3	33.6	34.2	27.5	18.1	–17.6	–15.1	–16.6	7.6	7.9
Turkey	max	58.3	85.3	47.5	70.6	416.7	64.8	63.0	7.2	–3.4	75.9	79.7
	min	25.6	38.4	6.3	50.0	76.6	45.2	14.4	–11.6	–7.3	17.5	19.4
EC	max	79.8	114.5	149.7	70.7	73.1	33.1	93.5	39.1	31.1	61.9	62.2
	min	25.8	60.3	48.3	50.0	35.9	17.3	35.7	8.9	25.8	27.4	27.1

can be seen in *Table A2.11*, which shows the possible range of protection levels implied by the extreme values of the country-specific trade position world price factor (WPTF). Rows labeled "max" give protection levels in relation to minimum prices (as would be applicable for exporters), while rows labeled "min" refer to maximum prices, i.e., world market price plus international transport margin.

As with the data presented in *Table A2.9*, values in the last two columns represent average agricultural protection rates weighted by production and consumption items, respectively.

A2.5.2. Protection levels in country models that do not use price transmission functions

It was mentioned that the BLS consists of different types of models, some of which use a less sophisticated approach in determining domestic price targets. In these cases, commodity-wise relative protection rates have been collected to describe the relationship between domestic and world market prices. When the model is run under free trade assumptions, the individual relative prices are reduced by the corresponding rates regardless of the country's trading position. It should be mentioned, however, that the tariff rates used in the BLS simulation runs were calculated on the basis of the SUA data analysis, though "expert judgment" had to be used to fill gaps in the data base and to resolve quality versus protection conflicts.

A summary of protection rates for these countries and country groups where applicable in the BLS is given in *Table A2.12*.

No protection rates could be provided for the "Far East Medium-High Calorie Importer" (FEA MH CALIM) group of countries, which includes Kampuchea, Korea DPR, Laos, and Vietnam owing to lack of appropriate data.

A2.5.3. The price of nonagriculture, measurement of protection factors, and relative prices under trade liberalization

It was explained that the price of nonagriculture $\mathrm{PRAW}_{n,j}$ as used in this study is a construct subject to various kinds of distortions. Therefore, protection factors as measured above need to be carefully interpreted.

The procedure in this study measures agricultural protection factors for commodity k in country j,

$$\mathrm{PRTC}_{kj} = \left[\frac{\mathrm{PRAW}_{kj}}{\mathrm{PRAW}_{n,j}}\right] \Big/ \left[\frac{\mathrm{CSWP}_{kj}}{\mathrm{PW}_{n,j}}\right]$$

Table A2.12. Protection of agricultural commodities (%) for countries and country groups, not using price transmission functions, 1978–1980.

Country	*Wheat*	*Rice*	*Coarse grains*	*Bovine and ovine*	*Dairy*	*Other animal products*	*Protein feed*	*Other food*	*Nonfood agriculture*
Kenya	1.10	1.00	1.00	0.75	1.25	1.05	0.95	0.90	0.90
New Zealand	1.00	1.00	1.00	1.00	1.00	1.20	1.00	1.00	1.00
Thailand	1.00	0.80	0.90	0.75	1.30	0.90	0.90	0.95	0.75
USA	1.00	1.00	1.00	1.25	1.80	0.95	1.00	1.05	1.25
Regional groups[a]									
AFR OIL EXP	1.50	0.80	0.90	3.90	1.70	1.25	0.75	0.85	0.85
AFR M CALEX	1.40	1.00	1.45	1.15	1.50	1.20	0.80	1.00	0.90
AFR M CALIM	1.50	1.60	1.25	2.20	2.10	1.40	0.80	0.90	1.10
AFR L CALEX	1.30	1.00	0.95	1.20	1.50	1.20	0.50	0.80	0.85
AFR L CALIM	1.15	0.80	1.10	0.95	1.40	1.10	0.55	0.85	0.85
LAM H CALEX	1.00	1.40	1.35	0.85	1.40	1.10	0.75	0.85	0.85
LAM H CALIM	1.15	1.20	1.40	1.80	1.80	1.10	0.85	0.90	1.00
LAM ML	1.40	1.10	1.25	0.95	1.50	1.10	0.70	0.90	0.65
FEA MH CALEX	1.15	1.30	1.15	1.05	1.75	1.00	0.80	0.95	0.70
FEA MH CALIM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FEA LOW	1.15	1.10	1.50	1.30	1.80	0.95	1.30	0.95	0.75
NEA OIL EXP	1.50	3.40	1.50	2.80	2.40	1.35	1.05	1.00	1.10
NEAR EAST ML	1.50	1.20	1.90	1.80	2.70	1.40	1.50	1.25	1.05
ROW RESIDUAL	1.60	1.70	1.70	1.70	1.60	1.25	1.50	1.10	1.30

[a]For an explanation of the regional groups, see Appendix A4.

instead of "true" protection factors,

$$\mathrm{PRTC}_{kj}^{\mathrm{true}} = \left[\frac{\mathrm{PRAW}_{kj}}{\mathrm{PRAW}_{\mathrm{n},j}^{\mathrm{true}}} \right] / \left[\frac{\mathrm{CSWP}_{kj}}{\mathrm{CSWP}_{\mathrm{n},j}} \right]$$

which implies a distortion

$$\frac{\mathrm{PRTC}_{kj}}{\mathrm{PRTC}_{kj}^{\mathrm{true}}} = 1 + t_{\mathrm{n},j,70}$$

where $t_{\mathrm{n},j,70}$ is the tariff equivalent of the base-year 1970 protection on nonagriculture in country j.

In trade liberalization scenarios, domestic prices for the agricultural commodities are adjusted by the measured protection factors PRTC_{kj} instead of the unobserved $\mathrm{PRTC}_{kj}^{\mathrm{true}}$, resulting in partial liberalization in which relative distortions among agricultural commodities are removed but distortions between agriculture and nonagriculture may not be fully eliminated. Comparing "true" protection rates across countries j and l, this implies

$$\frac{\mathrm{PRTC}_{kj}^{\mathrm{true}}}{\mathrm{PRTC}_{kl}^{\mathrm{true}}} = \frac{\mathrm{PRTC}_{kj}}{\mathrm{PRTC}_{kl}} \times \frac{1 + t_{\mathrm{n},l,70}}{1 + t_{\mathrm{n},j,70}}$$

In other words, "true" relative prices in trade liberalization scenarios will only be equal across countries with comparable levels of protection for the nonagriculture sector. The implications of this for the analysis of agricultural trade liberalizations are discussed in Section 3.3.3.

APPENDIX A3

The Impact of Trade Liberalization from the Country Perspective

The main text in the book is structured around global trade policy issues and options. The discussion focuses on a particular scenario, describes regional trends, and looks at individual country results from the sole viewpoint of obtaining an understanding of what determines the major outcome of that scenario. A deeper analysis of the specific features and characteristics of the individual countries, which obviously play a role in determining their reactions to alternative policy options, would take too much space. The present chapter is an attempt to balance the presentation by taking a country view and discussing the responses to all five trade liberalization scenarios presented in this volume. Emphasis is placed on those effects that show the largest responses. In most cases these are effects of scenarios in which the country itself participates in the liberalization. In this chapter we only discuss results for those countries that are included in the BLS with a detailed model. There are 18 such "countries" including the EC.

Each country model generates information for a large number of variables. Together for all trade liberalization scenarios and the reference scenario this adds up to a rather voluminous amount of data. Not all of this can be presented in the tables in this chapter. Only those data that are indicative of the main effects of alternative trade policies are tabulated for the years 1990 and 2000. To facilitate comparison, the corresponding values of the reference scenario are given in the tables as well.

For better readability of the text, *Tables A3.1-A3.18* have been put at the end of this Appendix.

A 3.1. Argentina

With a per capita income of about US$1400 (at 1970 prices) in 1980, Argentina belongs to the upper part of the middle-income group of developing countries. Agricultural commodities account for about 20% of the country's exports, and these constitute about 8% of the total agricultural exports of all developing countries together. Still, the agricultural sector accounts for only 10% of the total value added, with about 13% of the labor force and 12% of the capital stock employed therein (*Table A3.1.*)

Natural conditions are favorable for agricultural production, and the ratio of cultivated land to population is quite high (0.75 ha per person in 1980). Crop yields are relatively high given the low use of yield-increasing inputs (6 kg nitrogen per ha). This gives Argentina's agriculture a comparative advantage and favors exports of both livestock and crops even when the government has effectively taxed agricultural exports.

It can therefore be expected that, in all trade liberalization scenarios, agriculture will expand whenever world market prices move favorably for Argentina. The increase varies from 6% when the EC removes protection to 47% in the case of liberalization by all market economies (*Table A3.1*). The changes in domestic prices across the scenarios are similar in magnitude to the changes in agricultural GDP. This implies an elasticity of agricultural GDP with regard to domestic prices of around unity.

Based on equivalent income, Argentina gains under trade liberalization. This holds irrespective of whether Argentina joins the countries liberalizing trade or not. A small deterioration occurs only in the initial period when the LDCs liberalize. The gains are in general quite sizable, especially when all developed countries liberalize too.

Several factors contribute to these gains in welfare. There are substantial terms-of-trade improvements for Argentina, reaching almost 20% when all market economies or all OECD countries liberalize. The improvements in the country's terms of trade when other countries liberalize and the transmission of those changes from the world market prices to the domestic market are sufficient for Argentina to enjoy welfare gains. But an alignment of the domestic prices with the much higher world market prices leads to additional welfare gains. The increase in equivalent income is smaller when all developed countries liberalize than when all market economies do so, because Argentina enjoys a far smaller increase in the terms of trade in this scenario.

In all the liberalization scenarios, agricultural exports increase substantially, especially exports of livestock products. As a consequence, imports of nonagriculture can be increased, responding to higher demand and replacing some domestic production. The trade surplus is slightly reduced, but the volume traded is much larger as compared to GDP.

This rather positive picture in overall terms includes some drastic shifts in domestic distribution of income in favor of the agricultural population and a decline in calorie consumption. A look at the food price index reveals why the latter happens. This index goes up in all runs, but more in those in which Argentina also liberalizes its agricultural trade. As a consequence of these higher food prices, most food products are consumed in smaller quantities. Persons at the low end of the urban income strata may be seriously affected by the increase in the food price index. Argentina's government must pay attention to this development when agricultural trade is liberalized.

Substantial changes occur also on the production side. The most noticeable difference from the reference scenario is Argentina's sharp reduction in the production of wheat and coarse grains and the expansion of all other agricultural commodities. As a consequence, much more land is used for roughage production. When all market economies liberalize simultaneously, the number of dairy cattle goes up by 50% in 2000 and the number of beef cattle and sheep by 70%. The total roughage area needed in addition to that used in the reference run is therefore considerable. In the national models only that roughage area is accounted for which is required in addition to that used already in 1970. This adjustment works also when the herd sizes of ruminants shrink. Then it is assumed that the land not used any more for roughage production can be planted with other crops. If one considers only the changes in the roughage acreage in addition to that of 1970, then one finds an increase of almost 170% in the scenario where all market economies liberalize, its share rising from 15% in R0 to almost 40% in F-ALLME.

The reduction in wheat and coarse grains production is caused by the high opportunity cost of land, which becomes a scarce resource under all scenarios, but especially when Argentina also liberalizes. These high opportunity costs reduce the relative profitability of wheat and coarse grains. In addition to lower production, more of the two grains is fed to animals, and exports therefore decrease substantially. Coarse grains are even imported in small amounts when all market economies liberalize by 2000. On the other hand, exports of all other agricultural commodities strongly increase, except those of protein feed.

A3.2. Australia

Australia is one of the countries with the lowest agricultural protection. Compared directly with world market prices, producer prices hardly reveal any difference. However, when the domestic costs related to the trading activities are taken into account, even the grains show a protection of approximately 25%. Dairy products and bovine and ovine meat are taxed when they are shipped abroad. The average protection rate (weighted with value of production) amounts to less than 10%. Australia accounts for about 5% of agricultural exports from developed market economies but, at the same time, these exports account for some 45% of its merchandise exports.

The welfare indicators show some ambiguous results of the trade scenarios (see *Table A3.2*). Equivalent income points toward welfare losses except in the EC trade liberalization scenario.

When Australia participates in trade liberalization by OECD countries or by all market economies, both sectors of the economy expand. Since relative agricultural prices increase, the agricultural sector expands much more than the nonagricultural sector. Investment is shifted into the agricultural sector, but also more labor is employed as a result of the parity ratio increase. The improvements in the terms-of-trade are quite sizable. As in the case of Argentina, this allows Australia to import more nonagricultural products because the value of agricultural exports increases (by 16% when all market economies liberalize).

The changes in world market conditions with trade liberalization are as favorable for Australia as they are for Argentina, if one compares the improvements in the terms of trade for both countries. However, the welfare implications are different for the two countries. This may be explained by several factors. First, agricultural GDP appears to be much more price-responsive in Argentina than in Australia. Also, compared to Argentina, the price distortions in the reference scenario are not as severe in Australia, leading to smaller gains after the domestic prices are aligned with those of the world market. Investment increases by only 1–2% in Australia while it goes up 6–10% in Argentina. The stronger increase in value added in Australia does not mean more savings and investment compared to Argentina. Finally, differences in the preference systems of the two countries, together with the changes in food prices, also contribute to the opposite behavior of the welfare indicators. Whereas in Argentina total consumer expenditure increases significantly, it does so only marginally in Australia. As a result, in spite of higher food prices, in Argentina human consumption of nonagriculture increases, whereas it declines marginally in Australia. This explains why equivalent income increases in Argentina but declines in Australia.

When OECD countries or all market economies liberalize, production of wheat is expanded in Australia and production of coarse grains is reduced because of a widening gap between their prices. Herd sizes of ruminants are expanded while less of pork, poultry, and eggs are produced. Again, this is mainly a result of international price changes, which are fully transmitted to the domestic market.

The adjustments of both production and demand lead to a sizable increase in exports of dairy products, but also to a switch in trade of other animal products from net exports to net imports, although the quantities are small.

Australia's income distribution changes favorably for farmers and landowners when agricultural trade is liberalized. Not only does the parity ratio go up, but also the shadow price of land rises by more than 10%.

A3.3. Austria

Agriculture is generally less protected in Austria than it is in the neighboring EC countries. Some commodities are substantially protected, particularly nonfood agriculture, wheat, coarse grains, and bovine and ovine meat. Exports of dairy products are taxed and imports of rice subsidized.

The country's agriculture is characterized by widely different natural conditions between plain and mountain areas. Particularly in the less suitable regions, a relatively large share of the labor force remains engaged in agriculture. This results in relatively low agricultural income. Among the developed market economies, Austria has one of the lowest parity ratios in the reference scenario (only Japan has a lower one). Eleven percent of the labor force generated 5% of GDP in 1980 (see *Table 4.16*). More than 60% of the farms are run on a part-time basis, with the low farm income being compensated by off-agricultural employment.

Austria benefits from trade liberalization in agriculture, although an alignment of domestic with world market prices does not substantially increase total value added (see *Table A3.3*). Austria benefits from the very strong improvements in the terms of trade when either the OECD countries or all market economies liberalize. No other country in the system shows similar improvement.

The adjustments in production are rather substantial under trade liberalization. Most noticeable are the declines in output of coarse grains and other animals and the increase in dairy production. Export of the latter commodity is stepped up by 250%. It is the dairy export that largely contributes to the improvements in the terms of trade. It dominates the calculation of the unit value of exports in trade liberalization.

Austria's self-sufficiency in agriculture increases slightly when trade is liberalized. Also, the dependence of agriculture on the international market increases when one considers its foreign trade ratio – i.e., the value of exports plus imports relative to the agricultural GDP. However, this goes up by a slightly lower percentage than does the foreign trade ratio of the whole economy.

Owing to the price increases, agriculture employs more capital and labor when all market economies and all OECD countries liberalize (see *Table A3.3*). However, less fertilizer is applied since the crop price index falls relative to the fertilizer price. (The fertilizer price is assumed to change proportionally with the nonagricultural price). Farmers gain in income relative to those employed in nonagriculture.

A3.4. Brazil

Brazil is one of the largest agricultural producers among the developing countries, its agricultural value added being exceeded only by China and India. Agriculture in Brazil is also characterized by a large diversity of natural conditions, covering areas from the tropical up to the temperate zone. Agriculture plays a major role in employment, absorbing about 40% of the total labor force. Since this 40% accounts for only about 6% of GDP, there is a wide income disparity between agriculture and nonagriculture.

Exports of agricultural products earn about half of the country's foreign exchange from trade. In the more recent past, however, processed and semiprocessed commodities have become increasingly important in exports. At the same time, Brazil is one of the largest importer of cereals among the developing countries: in particular, the wheat self-sufficiency rate is low.

As *Table A3.4* shows, Brazil's total value added is always lower when agricultural trade is liberalized than in the reference scenario, regardless of whether the country itself participates in trade liberalization or not. Why this happens has been explained in Chapter 7 for the scenario in which developing countries liberalize. The same reasoning can be applied in all other scenarios.

The decline in total GDP and the increase in food prices work in the same direction in Brazil – toward a lowering of equivalent income. The percentage loss in equivalent income always exceeds that of total GDP.

Table A3.4 reveals that human consumption is lower under free trade than in the reference run for all commodities but wheat and protein feed. Wheat is consumed more because its retail price falls when Brazil liberalizes. Wheat is the only agricultural commodity that has a positive tariff equivalent. The rather steep increase in food prices makes it necessary for Brazilians to allocate more money for food. However, the increase in food expenditure does not match the food price rise, resulting in reduced consumption of food.

Brazil does not benefit much from terms-of-trade improvement. The world market prices of its major export commodities, protein feed and other food, do not increase relative to the prices of those commodities that it mainly imports.

While most countries show an increasing ratio of the value of trade to GDP when they liberalize trade, Brazil indicates the opposite. This ratio falls by 20% when all market economies or all developing countries liberalize. Demand for agricultural products goes down while production increases for most products. This happens for almost all agricultural products, leading to less imports in value terms. Since the trade deficit for the whole economy changes only marginally, nonagricultural exports are also cut back.

Given the rigidities in the mobility of labor, as found in the model, one might argue that agricultural prices lower than the world market prices are preferable for Brazil because they could prevent welfare losses. As an alternative, policies to improve factor mobility in conjunction with trade liberalization could lead to positive results.

A3.5. Canada

Canada's agriculture is very export oriented. This is indicated by the high share of agricultural exports in total exports (25%) and by one of the highest self-sufficiency ratios among all nations (*Table 4.11*), even though this number is not an indication of the high level of bilateral agricultural trade with the USA. Agricultural exports are equivalent to about 40% of farm cash receipts. Protection from world market conditions is low, or even negative, for almost all agricultural products with the exception of dairy products and bovine and ovine meat. For the former commodity, production quotas are issued aimed at balancing supply and demand. Given the low protective policies, Canada's farmers depend to a large extent on the level of world market prices for their income.

As with most countries, Canada's adjustments occur mainly in those scenarios in which it also liberalizes trade. Accordingly, the welfare implications of those scenarios in which Canada does not liberalize are very small or negligible (see *Table A3.5*). However, the two scenarios in which it participates in trade liberalization show only small changes that indicate losses.

These welfare losses occur in spite of sizable improvements in the terms of trade, which are the second largest among all countries. In 2000 these increases reach almost 30%. As Canada is a net exporter of agricultural products, this helps to improve the agricultural trade balance (at current prices), which goes up by 65% in the case when all market economies liberalize. Out of this, 27% is a volume effect leading to higher imports of nonagricultural goods.

The domestic terms of trade change in favor of agriculture, leading to more resource use in this sector. Approximately 20% more of both investment and labor are used in agriculture when Canada participates in trade liberalization. In addition, fertilizer application goes up by a similar amount and more acreage is cultivated. This pushes agricultural GDP up by 17%, implying a GDP elasticity with regard to price changes of about unity. The additional labor use in agriculture comes entirely from the nonagricultural sector, and almost all of the agricultural capital stock is built up by shifting investment away from nonagriculture. The GDP elasticity of labor is six times higher in nonagriculture than in agriculture (see *Table A3.1*). In spite of a 50% higher GDP elasticity in agriculture than in nonagriculture with respect to capital, the increase in agricultural GDP cannot completely compensate the loss in nonagricultural GDP and, as a consequence, total GDP falls marginally in Canada under trade liberalization. This decline in value added is not offset by terms-of-trade improvements. Under free trade, Canadians buy fewer agricultural goods but slightly more of the nonagricultural aggregate, leading, in conjunction with an increase in food prices, to a decline of equivalent income.

Adjustments in agricultural production are very substantial in Canada. They are dominated by a shift into milk production when Canada participates in trade liberalization. Milk output is doubled by the year 2000 compared to the reference scenario, mainly as a result of the removal of the production quota.

The imputed shadow price of this quota is about 50% of the milk price in the reference run. (This proportion is almost constant over the period 1980–2000; it might somewhat overestimate the real value of the quota). A removal of the quota is equal in its impact to a milk price increase of the same proportion. This explains why dairy output increases so much, although its price change does not suggest such a response.

The other changes in production are, of course, also affected by the expansion of dairy output. The doubling of the dairy herd size implies that more roughage is produced on land that was used for other crops in the reference run. The decline in wheat and coarse grains acreage (2 and 10%, respectively) equals this increase in roughage land. The acreage expansion of the other crops is matched by more land brought under cultivation.

The additional animal production – bovine and ovine meat and other animal products are also produced in larger quantities – leads to strong increases in feed use, especially of coarse grains because its price goes up less than that of wheat. The trade effects are strong: wheat exports are increased by 6% when market economies liberalize, while coarse grains are shipped abroad only in very small quantities in 2000. Canada becomes the largest exporter of dairy products by 2000, when all market economies or OECD countries liberalize, reaching a quarter of the global net exports of these products. Total demand for this commodity hardly increases, with more than 90% of the additional production sold on the world market.

A 3.6. Egypt

At the end of the last decade, Egypt's agriculture contributed approximately 20% to total GDP with a labor share of 50%. Rapid growth of population, scarcity of agricultural land, and changes in the water regime due to the Aswan High Dam together resulted in a sharply increased dependence of the country on the world market for staple food imports. Exports of high-value crops like citrus fruits and cotton have been maintained, through direct government control, to overcome the negative nominal protection of these products. Wheat imports, covering more than 50% of domestic disappearance, as well as imports of bovine and ovine meat and of other animal products are heavily taxed. This mix of domestic price policies leads to relatively low agricultural incomes as compared to nonagricultural earnings.

Egypt has all-year-round agricultural production, which is made possible by the warm climate and fully irrigated land. Rain-fed production is insignificant. The cropping intensity is one of the highest in the world and reached 190 at the end of the last decade. Expansion of cultivated land is mainly possible only through a further increase in the cropping intensity.

Egypt benefits from trade liberalization only when this policy is confined to LDCs, as indicated by the equivalent income measure in *Table A3.6*. This cannot be explained by changes in terms of trade because they fall in all scenarios, but especially strongly when Egypt also liberalizes together with all other market economies or all other developing countries. The reason can be found in the sectoral allocation of resources. Investment and labor are shifted into nonagriculture only in the scenario with liberalization by developing countries. This, together with a relatively strong increase in total investment, leads to a higher nonagricultural capital stock so that GDP of nonagriculture goes up by almost 3%, offsetting the loss in agricultural value added. It should also be noted that the elasticity of capital is twice as high in nonagriculture as it is in agriculture, while the reverse holds for labor but at a much lower level (see *Table A3.1*). Also of interest in this scenario is the substitution between acreage and fertilizer: more fertilizer is used on less land.

From the change in value added, it becomes clear why Egypt gains in terms of equivalent income when developing countries liberalize but loses when all market economies do so. The loss of income in the latter scenario leads to a strong decline in consumption of nonagriculture, while in the former both agricultural and nonagricultural commodities are consumed at higher levels (see *Table A3.6*). Changes in relative prices at the retail level and in terms of trade do not have very much influence on this result.

Egypt's rice production is strongly affected by trade liberalization, especially when all market economies liberalize. The rice price increases in this scenario by 25% and production by 50%. Land allocation is shifted from coarse grains (mainly maize in Egypt) into rice. It is implicitly assumed in the model that these shifts can be accommodated within the available irrigation capacity. The land not needed any more for production of coarse grains is not fully used up by rice. The acreage share of rice does not increase so drastically because total acreage also goes up in this scenario; the acreage share of rice reaches 17% of the total. Rice consumption goes down in this scenario with the result that Egypt becomes an exporter of rice and reaches a market share in global trade of 6% by 2000.

The 25% price increase of rice is to be compared with the change in all crop prices. The crop price index goes up by 19%, which is also the result of the rise in the price of nonfood agriculture, which is negatively protected in the reference scenario. Production of the latter commodity also increases substantially with trade liberalization.

The agricultural balance of trade turns from a deficit into a surplus when all market economies liberalize, mainly because of the large exports of rice. Egypt remains in deficit in agricultural trade when only the developing countries liberalize and obtains a balanced foreign account for agriculture when the OECD countries liberalize since mainly imports of agricultural commodities are reduced. In general, Egypt becomes more open under trade liberalization, as is indicated by the ratio of trade to total GDP.

A3.7. India

Over the past 15 years, India has moved from being a net importer of agricultural products to being a net exporter. Extension of water control and irrigation, combined with the introduction of new technologies for major food crops, has resulted in a better balance of domestic effective demand and food supplies, with comfortable stock margins in most years. Still, in terms of food adequacy for all people, further improvements are still required as, around 1980, close to one-third of the population could be considered to be chronically hungry.

Protection levels in agriculture are low for most products, except for exported products in the other food and nonfood categories, which have negative nominal rates, and for wheat and dairy products, which are increasingly protected to move toward self-sufficiency. Given these developments over past years and the changes that came about in the level and composition of agricultural trade, India is found in a position where its terms of trade improve with every liberalization scenario (see *Table A3.7*). The improvement is particularly marked when the OECD countries liberalize, or when all market economies do so, whereas the scenario with liberalization by only developing countries leads to an initial deterioration but subsequent improvement of a smaller magnitude than in the other two scenarios.

The improvement of the terms of trade when only the developing countries liberalize is different in nature from the improvements in the F-OECD or F-ALLME scenarios. In the first case, the effect of improving terms of trade on domestic prices of agricultural products is a relative decline except for other food. As a consequence, agricultural prices lag behind those for the nonagricultural product, and parity for agricultural incomes shows a slight deterioration. In the two other liberalization scenarios, import prices rise also by less than export prices, but domestic prices do rise for almost all agricultural products when the OECD countries liberalize and, at the aggregate, are at similar magnitude when all market economies liberalize. Parity improvement comes about mainly because agricultural product prices increase more than nonagricultural prices, aided to some extent by higher agricultural production volumes.

Obviously, the income distribution effects are equally contrasting. Agricultural producers – notably those producing a marketable surplus – are worse off when developing countries liberalize but the larger number of market-dependent consumers benefits. In terms of equivalent income, there is a gain, and the same is noted for calorie consumption per capita. The number of hungry is reduced. With liberalization by OECD countries or by all market economies together, all of these indicators are reversed, as the benefits appear to belong to a smaller group of farmers who market part of their output and are more than offset by the negative effects on consumers.

When developing countries liberalize, India's trade balance (at constant 1970 prices) initially contracts and then widens, but these changes are rather marginal. Lower production of, and more domestic demand for, most products reduces exports of wheat, rice, and nonfood agricultural products; imports of coarse grains increase substantially. However, these changes in trade are largely offset by export increases for protein feed, other animal products, and other food. In the two other scenarios, when the OECD countries also liberalize, the trade deficit in agricultural products widens considerably.

A3.8. Indonesia

In spite of a rapid population growth, Indonesia was able to move gradually toward self-sufficiency in its main staple food, rice, over the last two decades. Policies to promote agricultural growth have generally been nonprotective and have concentrated on reliably providing input supplies for rice-growing farmers and on enabling farmers to buy new technologies at relatively low costs. The achievement of the strong output growth of rice has led to increased attention on diversifying food production, both in traditional farming regions and in parts of the country that are gradually being opened up for agricultural production.

Agriculture is still the dominant sector of Indonesia's economy. In 1980, agriculture employed 60% of the labor force and 35% of the total capital stock to generate roughly one-third of the country's value added (*Table 4.15*). This indicates a rather low (average) labor productivity in agriculture as compared to nonagriculture. Eighty percent of the land is cultivated by small-scale farming, with the rest being held by large estates. Given the unequal distribution of rainfall over the year and its variability, it is often necessary to provide supplementary irrigation in some years and to have a well-functioning drainage system in other years.

Indonesia does not reach self-sufficiency for any of the agricultural aggregates in the reference run by 2000 (see *Table A3.8*). Staple food imports are subsidized by the government at decreasing cost as both international prices and volumes imported decline.

Under trade liberalization the government no longer subsidizes imports and hence reduces the tax level. Consumption expenditures go up in spite of the fact that the increase in value added in the liberalization scenarios is completely used for additional capital formation. But, of course, food prices also increase. The fact that consumption of agricultural commodities is higher when all market economies liberalize than for the scenario in which only the developing countries do so, although food prices are lower in the latter case, can be explained by the difference in consumption expenditure. Consumers have less to spend in the latter scenario, and the income effect dominates the price effect.

Equivalent income goes down when all market economies liberalize, signifying a welfare loss in this scenario. It increases slightly when only developing countries liberalize, but the other scenarios also indicate welfare losses, especially when liberalization takes place only in OECD countries. As holds for the other countries, changes in equivalent income are dominated by changes in the consumption of nonagriculture in Indonesia, although the share of expenditure spent on food is one of the highest among all countries in the BLS.

When Indonesia participates in liberalizing agricultural trade, agricultural prices increase and attract more resources, especially capital, into the agricultural sector. When all market economies liberalize, 20% more capital is employed in this sector by 2000; when only developing countries do so 13% more capital is employed. The increase is so large that the capital stock goes down in the nonagricultural sector in spite of greater total investment. However, this decline is only marginal, and the nonagricultural GDP shrinks by a marginal amount. GDP of agriculture increases, but proportionally less than its decrease in the nonagricultural sector because capital, especially, has a much smaller elasticity in agriculture than in nonagriculture (see *Table A3.1*).

In agricultural production, Indonesia switches into rice and away from coarse grains when it liberalizes trade. The expansion of rice production is strong enough to make Indonesia a small exporter when all market economies liberalize. In all other scenarios rice is imported. The strongest price and production increases concern nonfood agriculture. This is mainly due to an expansion of acreage, while yield of this commodity increases by about 3%. So much more acreage is allocated to this commodity because it has the largest improvement in net revenue per hectare among all crops.

Net revenue from animals increases only modestly when developing countries liberalize, but somewhat more when all market economies liberalize, although relatively less than the average for all crops. This is partly a result of increasing feed costs. Therefore, animal production does not vary strongly, with the exception of milk production. This responds with output increases exceeding 10%.

The value of agricultural production increases more than that of consumption. Under trade liberalization, Indonesia improves its agricultural balance of trade: i.e., it reduces its deficit. This shows up as lower net export of the nonagricultural aggregate.

A3.9. Japan

Japan is a net importer of all agricultural products except other animal products. The country still employs about 13% of its labor force in agriculture, with a considerable number of part-time farmers. Even then, labor in agriculture is relatively high for a country with this level of development. Agriculture contributes only 4% to total value added. Japan's farm structure is characterized by small farms, and average income in agriculture is one-third of that in nonagriculture. This situation prevails in spite of the fact that Japan has the highest average protection of agriculture among all countries included in the BLS. It is therefore not surprising that this sector declines drastically when Japan participates in trade liberalization. Relatively small changes are observed in the three scenarios for which Japan is assumed not to liberalize (see *Table A3.9*).

Trade liberalization leads to welfare gains in Japan as evidenced by the increase in equivalent income. The distribution of these welfare gains is likely to be biased in favor of those employed in nonagriculture since the parity ratio falls exceptionally strongly. Terms of trade also worsen under trade liberalization. Their negative impact on the whole economy is offset by a reallocation of resources to more efficient uses: investment, especially, is shifted to the nonagricultural sector. The capital stock in agriculture is reduced by more than 20% in 2000 in the scenarios with Japan participating in liberalization. It is obvious that Japan's agricultural self-sufficiency declines under trade liberalization. However, the decline is less than 10%.

Production of all agricultural commodities except dairy products and other animal products declines under trade liberalization (see *Table A3.9*). The latter increases by more than 10%. Considering only pork, poultry, and eggs (i.e., excluding fish), this increase is about 40%. (The aggregate other animal products contains approximately 65% fish in the year 2000 in the reference run, the rest being pork, poultry, and eggs; in the scenario where almost all countries liberalize the latter reach a share of approximately 45%.) The reason for this strong increase in the output of pork, poultry, and eggs is the decline in feed costs, which leads to an increase in net revenue per animal and gives this aggregate a strong comparative advantage. The situation is somewhat similar, but less pronounced, for dairy products. In 1990, when labor migration out of agriculture is not as pronounced as in subsequent years, production of milk increases. The reason for this is the relative improvement in net revenue per dairy cow. By 2000, more labor has left agriculture, and this affects milk production especially strongly since it coincides with a fall in the milk price. Therefore, milk output does not change significantly by the end of the period.

Japan increasingly exports other animal products when its trade in agriculture is liberalized. It is able to capture a world market share of about 35% by 2000, an increase of 7 percentage points from the reference scenario. In contrast, more dairy products have to be imported because of higher demand.

The most drastic change in trade position concerns rice. A sizable cut in production coincides with an equally large increase in the quantity demanded. The fall in the rice price is the strongest among all agricultural prices.

Imports of protein feed are also increased substantially under free trade. Feed use of this commodity goes up by 50%. Since protein feed becomes substantially cheaper compared to grains, it substitutes for the latter in the feed rations of pork, poultry, and eggs. (Feed intake of protein feed per animal unit increases in the range between 15 and 20% for the three animal types in the scenario where almost all market economies liberalize compared to the reference run, while those of wheat and coarse grains decline in similar proportions). In 2000, 80% of the total feed use of protein feed is needed for the production of pork, poultry, and eggs in the reference run. Their production increase of 40% in the F-ALLME scenario pushes this share up to 86%. This aggregate alone increases the feed use of protein feed by 75%. In absolute value, this equals the total increase in feed consumption, which has to be entirely imported because production also goes down slightly. Protein feed consumption by ruminants does not increase since their number of heads declines.

As can be seen from *Table A3.9*, Japan's trade balance changes only modestly with trade liberalization (4.1% when OECD countries liberalize). To balance increasing imports of agricultural products, exports of the nonagricultural aggregate drastically increase (by 30%).

One of the interesting observations with regard to Japan is that it matters little whether all countries join in trade liberalization or only the OECD countries liberalize. The results are very similar because of the high protection that is removed in both scenarios. Relatively speaking, the differences in world market prices are small in both scenarios compared to the impact that the removal of protection has on domestic prices.

A3.10. Kenya

Throughout the 1960s and 1970s Kenya's economy showed one of the higher growth rates among African nations, with agriculture having a slightly lower growth rate than other sectors of the economy. With its high growth rate of population, Kenya remains one of the countries with serious food problems. Its production is very vulnerable to weather shocks, as recent years have shown. With about 80% of the country's labor force employed in agriculture, generating 25% of GDP, and approximately one-half of the country's foreign exchange earnings obtained from agricultural exports, this vulnerability extends to virtually the entire population and economy.

Protection of agriculture has traditionally been modest, and is largely restricted to wheat and dairy products. Exports such as bovine and ovine meat, other food, and nonfood agriculture are taxed at the border. Given these trade policies it is to be expected that the welfare indicators show positive impacts from all trade liberalization scenarios for Kenya. The cost of consumption comparison is positive, the number of people hungry declines, and life expectancy improves. Agricultural prices increase in all scenarios and agricultural GDP is pushed up quite substantially owing to a higher capital stock (see *Table A3.10*). Labor does not adjust in these scenarios. Since total investment also increases, the nonagricultural sector expands as well, so that total value added increases considerably in Kenya. This can even be observed for the scenario when OECD countries liberalize.

Higher income leads to more consumption of all commodities in all scenarios, except when the EC liberalizes. Consumption of wheat declines marginally by 2000 in this scenario. The increase in the consumption of animal products is particularly noticeable.

On the production side, Kenya expands ruminant production (both meat and dairy) and cuts back output of other animal products. This adjustment is caused by relative price changes and, of course, the expansion of capital. Both favor ruminant production. Dairy output increases substantially so that Kenya becomes an exporter of this commodity. Bovine and ovine meat are also exported at higher levels by the year 2000. Of the commodities from which Kenya earns most of its surplus in agricultural trade in the reference run – other food and nonfood agriculture – only other food is exported in larger quantities when Kenya liberalizes trade. The surplus in agricultural trade (at current prices) increases in all scenarios by 2000 and higher imports of nonagriculture are possible. The foreign trade ratios both of the total economy and of the agricultural sector increase and make Kenya a more open economy.

A3.11. Mexico

As for Brazil, which has about the same level of economic development as Mexico, the overall growth performance of Mexico over the 1960s and 1970s has still left more than one-third of the labor force occupied in agriculture, producing only 8% of total GDP (see *Table 4.15*). The rapid growth of the nonagricultural sector has been achieved by large investments, including a substantial component for the oil industry. This capital-intensive growth of the nonagricultural sector restricted the absorption of labor employed in low-income agriculture. To offset the negative equity effects of this nonagricultural-growth-oriented policy, Mexico followed an "asset-redistribution" policy, the land reform. In spite of the massive distribution of expropriated cultivated land and virgin land (approximately 84 million hectares over the time span from 1916 to 1976), a large-scale farming system also developed that is very export oriented (see, for example, Fischer *et al.*, 1982).

Mexico's trade policies with regard to agriculture are a mix of modest protection for rice, coarse grains, bovine and ovine meat, other animals, and other food, and mostly negative tariffs for most other agricultural products. The labor market situation, aggravated by rapid population growth, can to some extent explain why Mexico does not gain from trade liberalization in agriculture, either when it participates or when only other countries liberalize. This shows up not only in indicators like equivalent income and life expectancy but also in total value added (see *Table A3.11*). With regard to hunger, the situation improves in those scenarios in which Mexico participates in trade liberalization and deteriorates in all others. The reason for this is that, in addition to income, the food price index moves unfavorably when Mexico does not liberalize; income distribution between the two sectors is also heavily affected in these scenarios. Although agricultural GDP (at constant prices) shrinks only when all developing countries liberalize, taking migration and price changes into account farmers face parity losses in all but the EC liberalization. These income losses are very heavy when Mexico itself also liberalizes because the agricultural labor force strongly increases in these scenarios.

That more people work in agriculture in the scenarios when Mexico participates in liberalization is mainly a result of the increase in the ratio of marginal value product of labor in agriculture to that of nonagriculture. This increase is spurred by two factors. First, there is a price increase in animal products relative to crops, shifting resources away from crops into animal production. As a result of this change the shadow price of acreage declines strongly. This, in turn, increases the relative scarcity of the two other constrained inputs, labor and capital. The shadow price of labor rises proportionally much more than that of capital, which explains why more labor is attracted by agriculture in these scenarios. The proportionally higher increase of the labor shadow price is a result of the changes in relative prices within agriculture. The most labor-intensive commodity, dairy products, enjoys one of the highest price increases and, at the same time, a relative decline of feed cost, resulting in a large increase in net revenue per animal. Similar arguments can be advanced to explain the increase in labor in the other scenarios as well.

Total investment goes down in all scenarios (see *Table A3.11*). This leads to a smaller capital stock in nonagriculture in all scenarios, even in those in which agricultural capital declines. Together with a reduced labor force in nonagriculture, GDP declines. Agricultural GDP does not go up enough in any of the scenarios to offset the decrease of nonagricultural GDP, resulting in a contraction of the whole economy.

There is a second reason why Mexico's economy shrinks. The strongest contribution to the increase in agricultural GDP comes from the increased labor input. However, since average labor productivity is considerably higher in nonagriculture, total GDP declines as labor is shifted to agriculture.

The tax imposed on exports of dairy products in the reference scenario by 2000 and the relatively large increase in world dairy prices in all the scenarios discussed here lead to a strong increase in export of this commodity. Although this increase is from a relatively small base value, dairy products are almost the only agricultural commodity group for which Mexico becomes increasingly an exporter. The exceptions to this general pattern are nonfood agriculture, of which higher quantities are also sold on the world market in all scenarios except when the US liberalizes, and other food, when OECD countries liberalize. Mexico is self-sufficient in agricultural production in the reference scenario. It increases this self-sufficiency in all but the LDC liberalization scenario.

A3.12. New Zealand

New Zealand is a net exporter of all agricultural products except rice. Agriculture contributes 15% to total GDP, the highest percentage among the developed market economies included in the BLS with a detailed model. Approximately

9% of the labor force is still employed in agriculture, and 15% of the capital stock is also in agriculture.

Farm incomes are considerably higher on average than nonfarm incomes. These circumstances explain why New Zealand does not protect its agriculture, except for other animal products. Seventy-four percent of all exports originate in agriculture.

New Zealand derives quite sizable welfare gains when it liberalizes agricultural trade together with other countries. Trade liberalization by the developing countries alone brings a small welfare loss when one considers the cost of consumption. In the remaining scenarios, the cost of consumption comparison shows a small welfare gain. Value added in nonagriculture indicates only marginal changes in this sector, while the agricultural GDP shows that agriculture must adjust substantially (see *Table A3.12*). These adjustments are in general positive: i.e., more capital and a larger labor force are employed. However, fertilizer application is reduced. In nonagriculture, capital is substituted for labor with no volume effects. The parity ratio increases, giving the farming community an even more substantial income advantage over workers in nonagriculture.

When only developing countries liberalize agricultural trade, the entire economy is negatively affected and almost all adjustments are of opposite sign, though at lower levels, compared to the scenarios when New Zealand participates in liberalization. Agricultural prices fall, GDP of agriculture goes down, total value added declines, and with it investments are reduced. Labor does not migrate at all, and both sectors of the economy operate with a smaller capital stock.

Table A3.12 also reveals which agricultural commodities cause this rather different outcome in F-LDC compared to the other scenarios. Ruminant prices go up much less than in the other scenarios. The ruminant products taken together reach a value share of nearly 70% of the total value of agricultural production in the reference run by 2000. This indicates how much the outcome of the agricultural sector is tied to the performance of the ruminant sector in New Zealand. The aggregate "other animal products" is the only commodity that obtains a relatively strong price advantage compared to the scenario in which all market economies liberalize. However, production does not respond very much to this increase because feed becomes more expensive.

In all other scenarios, ruminant products more or less receive the strongest price boosts. Since grains are not used as feed supplements in New Zealand, ruminants do not obtain an advantage from the relative decline in the prices of feed grains. Nevertheless, ruminants show the largest production increase in almost all other scenarios. Since demand for these products expands only marginally, a strong increase in exports can be observed. However, New Zealand loses some of its world market share of bovine and ovine meat in most scenarios because of the large increase in international trade in this product. Only when the EC liberalizes is New Zealand able to capture a higher share. In dairy products, the situation is just the opposite. Because global trade in most cases does not expand as strongly as that of bovine and ovine meat, New Zealand increases its share in world net exports in 2000.

A3.13. Nigeria

Nigeria placed emphasis on developing its oil industry during the 1960s and 1970s, neglecting somewhat its agricultural sector output, which appears to have declined over this period. Although there is some uncertainty about the reliability of the data, corroborating evidence can be obtained from trade statistics.

The importance of oil for Nigeria's economy affected incomes, prices, and the exchange rate in ways detrimental to agriculture and in favor of food imports at low prices. Nominal protection for most grains and animal products appears high but is to a large extent compensated by equally high protection of the nonagricultural sector and by an overvalued exchange rate. Export taxes on protein feed, other food, and nonfood agriculture seem to be small but are, for the same reason, prohibitive.

The most favorable scenario for Nigeria is when the OECD countries liberalize their agricultural trade, since this scenario gives the highest gain in equivalent income (see *Table A3.13*). This is obtained because of a large increase in total value added and in spite of a worsening of the terms of trade and increases in food prices. It is very important for Nigeria which other countries join in the trade liberalization. When all market economies liberalize, the country gains in welfare; when the developing countries liberalize, it loses. Negative changes occur in both these scenarios with regard to the terms of trade, food price index, and value added. The latter only increases when Nigeria itself does not liberalize but other countries do. This is easily explained because these scenarios are the only ones in which Nigeria increases resource use in agriculture, especially the use of capital as the country invests more. Cultivated area and fertilizer use increase as well. The agricultural sector expands considerably in these scenarios, although prices improve only moderately. According to the results shown in *Table A3.13*, however, agricultural GDP responds differentially. A positive price change leads to a strong response whereas even a strong price decline is followed by only a slight decline in agricultural GDP. This reflects the lack of opportunities in the nonagricultural sector in Nigeria. Resources respond strongly to a price increase by moving into agriculture, and very sluggishly to a price decline by not moving out proportionally.

Production of all agricultural goods is negatively affected under trade liberalization, with the exception of other food (which has a high share of coffee in Nigeria) and protein feed – the two commodities with a domestic price below the world market price in the reference run. Feed concentrates are used only as supplements in Nigeria. The price decline of grains, therefore, does not improve net revenue from animals. Herd sizes are not cut back as much as the crop land for wheat and coarse grains. Among crops, wheat, which is of small importance in Nigeria, shows the largest response.

The demand changes resemble somewhat those in Indonesia. All agricultural commodities are consumed at higher levels except other food, which is consumed slightly less. It is worth noting that milk and rice are bought at considerably higher levels in the scenarios where Nigeria participates in liberalization. Nonagricultural consumption goes down in both these scenarios, but much more so in F-LDC.

A3.14. Pakistan

Compared to India, Pakistan has enjoyed the advantage of a much larger share of cultivated land being irrigated. Significant improvements have been made in water control systems, and their capacity has been increased over the years, providing an excellent opportunity to introduce new crop varieties and technologies and increasing production. Thus, agricultural production in Pakistan grew at an average rate of 5% per year during the 1960s and at 2.5% per year during the 1970s. The excellent performance in the early period resulted from the introduction of high-yielding varieties of wheat along with increased use of fertilizer, expansion of irrigation, and extension of acreage. In the second period, a worsening of the domestic terms of trade for agriculture, combined with the fact that scope for expansion of acreage and irrigation was reduced, led to a slowdown in agricultural growth. The high growth of agriculture during the 1960s has not yielded a favorable food situation for all. The country is still poor (it ranks in the lower third with regard to income per capita - see *Table 4.16*), and approximately 10% of the population is counted as being hungry.

The agricultural sector employs 50% of the country's labor force but contributes only 28% to total GDP. Pakistan's protection is similar to that of Egypt. Grains and animal products receive protection, but exports of other food and nonfood agriculture are taxed.

Equivalent income increases in all scenarios in Pakistan, but welfare improves most when the country itself also liberalizes agricultural trade (see *Table A3.14*). In terms of equivalent income, no other country shows percentage gains from trade liberalization as large as those for Pakistan. What makes it gain so much? The gains are due mainly to increases in total value added and, to a much lesser extent, in trade deficit. Comparison of the results of the different scenarios shows that changes in the terms of trade do not seem to have a strong impact on these welfare gains.

When the country participates in trade liberalization, the agricultural price index falls compared to nonagriculture. Labor and capital are reallocated to the nonagriculture sector. Total GDP increases owing to an increase in nonagricultural GDP, which more than offsets the decline in agricultural GDP. Increase in total investment is not the only explanation for the rise in GDP because it increases much less when developing countries liberalize than when all market economies do so. The increase in total GDP is even slightly higher in F-LDC than in F-ALLME because more labor and investment are shifted to nonagriculture. Both inputs have a somewhat higher GDP elasticity in nonagriculture than in agriculture (see *Table A3.1*).

Compared to its per capita income, Pakistan is engaged in a large trade with other countries. When only developing countries liberalize, this ratio of trade to GDP decreases, whereas it increases under liberalization by all market economies. This follows the changes in the terms of trade, which improve in the latter scenario and worsen in the former. The foreign trade ratio of agriculture increases in both scenarios, but the increase is not always due to the same commodities. When all market economies liberalize, more wheat and less bovine and ovine meat are exported and fewer dairy products are imported than in the more restrictive scenario when only LDCs liberalize. In general, the agricultural trade pattern changes significantly between these two scenarios. But nonagriculture also shows such changes. Again, a higher import of nonagriculture is made possible – in spite of a lower overall trade deficit – when all market economies liberalize than when only developing countries do so, because the agricultural trade deficit (at current prices) increases much less.

Behind these changes in trade are, of course, alterations in production and/or demand. On the production side, the difference in wheat output is especially noticeable. Owing to the strong price and net revenue increase when all market economies liberalize, more wheat is produced in this scenario. It is mainly the price responsiveness of its yield that changes Pakistan's comparative advantage in wheat so drastically. A higher price leads to a relatively large increase in yield and also in net revenue. Therefore, more acreage is allocated to this commodity.

All animal production is reduced in both scenarios, and dairy production especially so when the developing countries liberalize. Since, at the same time, demand for dairy products increases strongly in this scenario, Pakistan's imports increase by 70%. Rather substantially increased human consumption is also found for rice, for other animal products, and for nonagriculture.

A3.15. Thailand

Thailand's performance in agricultural production over the last 20 years has been remarkable. Agricultural output has increased annually by about 5% over this period. In the early years of the period, additional land was brought under cultivation. Later, the country had to shift to more intensive land use. A labor share of nearly 80% was absorbed by agriculture in the early 1980s, but only

20% of total value added came from this sector. More than half of export earnings originate from agriculture. The country has been able to respond well to changes in international market conditions by adjusting its exports and the structure of production.

Agricultural incomes are unequally distributed between the richer Central Plains and the hilly regions, particularly the densely populated Northeast. About 15% of the population is still counted as hungry. Agricultural commodities are taxed at the border when they are exported. The two exceptions to this rule are wheat and dairy products, of which Thailand is a net importer and of which the latter is taxed.

The aggregate "other food" plays an important role in Thailand for future earnings of foreign exchange. In the year 2000 in the reference scenario, 76% of total export earnings is obtained from exporting this commodity. About 40% of production is exported in that year (see *Table A3.15*). It is therefore important for Thailand how the relative world market price of this commodity changes. In the scenarios in which Thailand participates in liberalization, this price drops by 3%–6%. The impact on the terms of trade amounts to a modest gain when all market economies liberalize and a nearly 5% fall when only developing countries follow a policy of trade liberalization.

These scenarios also indicate different impacts on domestic prices and, with that, on resource allocation, total investment, and fertilizer use. These differential changes show up in the form of varying responses of sectoral value added, although total value added is almost of the same magnitude in both scenarios. However, based on welfare considerations, Thailand is better off when all market economies liberalize rather than when only the developing countries do so. The cost-of-consumption comparison shows a rather positive impact for F-ALLME but a small loss for F-LDC. The number of people hungry also reveals that liberalization by all market economies yields results that are preferable for Thailand compared to a liberalization by only developing countries. This occurs in spite of the relatively larger increase in the food price index when all market economies liberalize.

Table A3.15 offers some additional insight into why such differences in welfare changes show up. The demand for the nonagricultural commodity declines substantially in F-LDC compared to F-ALLME. Movements of the food price index, which goes up less with LDC-liberalization, would suggest the opposite result, but the worsening of the terms of trade actually reduces the income when international prices are used for this comparison.

In all other scenarios – i.e., in those in which Thailand is not pursuing trade liberalization – it gains in small amounts. The income distribution is also affected in some of the scenarios, especially when Thailand liberalizes. In these cases, the farming community obtains much higher incomes, which exceed the rise of agricultural prices.

A3.16. Turkey

Turkey belongs to the lower part of the middle-income country group (see *Table 4.16*). Agriculture makes up 20% of the total economy in terms of GDP but employs more than 50% of the labor force. The income parity ratio is rather low, indicating that an agricultural employee earns less than one-third of what a nonagricultural worker earns. Turkey trades relatively less with the outside world, but agricultural exports are important for foreign exchange earnings. This rather autarkic economy has been designed by policy and is not a result of lack of opportunities since large markets are within reach, both in Europe and the Middle East.

This characteristic is also to be found when one considers the protective system, which consists of a relatively high import barrier for grains, high protection for the dairy industry, and almost no barriers for other food and nonfood agriculture.

The country gains when it liberalizes agricultural trade but, as can be expected from the low trade levels, does not benefit from freer trade pursued only by other countries. The gains occur in spite of a worsening of the terms of trade in those scenarios in which the country participates in liberalization. However, total value added increases in both these scenarios because of a reallocation of labor and capital in favor of the nonagricultural sector (see *Table A3.16*). Both capital and labor have a higher GDP elasticity in the nonagricultural sector than in agriculture (see *Table 3.1*). Although the total capital stock goes down slightly, given the higher elasticities in nonagriculture, the resource shift is sufficient to increase total GDP. The decline in agricultural prices that causes this reallocation also leads to lower fertilizer application and to less land being cultivated.

In addition, the decline of agricultural prices causes the food price index to go down. This stimulates consumption of agricultural commodities. Almost all of these commodities are consumed at higher levels in both scenarios in which Turkey participates in liberalization, with the exception of wheat and coarse grains, when only developing countries liberalize. Demand for nonagriculture also goes up as a result of the increase in income.

The changes in Turkey's agricultural production are similar in both these scenarios. Wheat and coarse grains production remain almost unchanged, while outputs of the other crops are reduced. This cannot be explained by a change in relative prices (see *Table A3.16*). However, the opportunity costs of land fall drastically (more than 50% by 2000 when all market economies liberalize), raising the comparative advantages of wheat and coarse grains. The reduction in the agricultural labor force also gives advantage to these products since they have the lowest labor intensity.

Animal production is reduced by approximately 14–23%. The decline in grain prices does not help much to improve their profitability because only small amounts of feed concentrates are used in Turkey. The relative increase in the scarcity of labor and capital affects animal production in general more than it does grain production, especially production of bovine and ovine meat, which declines in spite of a relatively small price decline. However, this reduction is also affected by the smaller herd size of dairy cattle under trade liberalization since a rather high share of beef production in Turkey comes from culling dairy cows. This affects beef output as well.

The agricultural trade balance worsens in both the scenarios in which Turkey participates in liberalization. The surplus Turkey has in the reference run is lost to the extent of 57% when all market economies liberalize and 81% when all developing countries pursue this policy. Therefore, Turkey's imports of nonagricultural commodities have to be cut. The increase in the total trade deficit offsets only a small part of the worsening of the agricultural trade surplus.

A3.17. USA

The USA is a major supplier of agricultural products to the world market. This strong export performance is possible because of vast natural resources available for agricultural production. Incomes in agriculture are comparable with those in other sectors of the economy since only a small part of the total labor force is occupied in agriculture. The share of agricultural labor in total labor is less than the share of agriculture in total GDP.

For most agricultural products no protection is given. Meat, dairy products, and some commodities of the aggregates other food and nonfood agriculture (e.g., sugar) are protected, but not at high rates with the exception of dairy products.

The USA benefits from trade liberalization as a comparison of consumption costs reveals. These gains occur not only when the USA liberalizes agricultural trade but also when other countries pursue these policies. Under EC trade liberalization, however, the picture is not as clear because only negligibly small improvements are indicated.

In general, the trade liberalization scenarios discussed here lead to lower average agricultural prices, EC liberalization being the only exception (see *Table A3.17*). This, in turn, lowers food prices in all scenarios except those when only other countries liberalize. Human consumption of both agricultural and nonagricultural goods increases simultaneously in most scenarios. Only in the F-EC or F-USA scenarios are the changes in human consumption of opposite sign. Comparing the changes in aggregate human consumption with aggregate supply, one finds that human consumption is more affected by trade liberalization than is supply.

In spite of the lower prices in agriculture, value added in this sector increases in all scenarios except when the USA itself liberalizes. There is a shift in production when either all market economies or all OECD countries liberalize. Production increases occur for wheat and coarse grains and for bovine and ovine meat. The most noticeable change occurs in milk production because of a relatively strong price decline leading to a cut in production of more than 10%. The USA becomes an importer of this commodity. On the other hand, exports of wheat and coarse grains increase. The USA dominates the coarse grain trade in this scenario even more than in the reference scenario. Its world market share increases from 75% in the reference scenario to above 90% in the year 2000 when all market economies liberalize.

When the USA is the only country to liberalize trade, there is no strong increase in grain production. All other commodities are also produced in about the same quantities as in the reference scenario with the exception of dairy products and nonfood agricultural products, which are produced less by 12% and 8%, respectively. Under trade liberalization by the developing countries and the EC, dairy production goes up.

Changes in human consumption of agricultural commodities are also quite pronounced when the USA liberalizes. The lower prices of bovine and ovine meat lead to 16% more consumption, while dairy products are consumed in 9% larger quantities.

A3.18. The EC

The CAP of the EC replaced in 1964 the market regulations of its then six member countries by a joint price and intervention system. At that time the EC was a net importer of agricultural products, with dairy products the main exception. The CAP's objectives of stable prices and regular supplies for consumers and fair incomes for farmers compared to those prevailing in the nonagricultural sector are pursued through price settings, intervention purchases, and border levies. With this system the internal markets of the major agricultural products are regulated in a community that now includes twelve member nations.

The relatively high agricultural prices in the EC together with the introduction of new technologies have stimulated rapid growth of its agriculture and increasing self-sufficiency. The more recent past is characterized by large expenditures for intervention buying, storage, and subsidized sales both to internal and outside markets. New policy designs are being discussed to curb production growth and to achieve a better internal balance in physical as well as financial terms.

The EC shows gains from trade liberalization in all scenarios. Equivalent income increases by less than 0.5%, and all the other welfare indicators show positive signs (see *Table A3.18*). Yet, not everyone is likely to benefit from these welfare gains. Those who make their living from agriculture may lose in all scenarios, including the EC liberalization, because their income goes down. A redistributive income policy could offset or at least dampen this effect.

Under trade liberalization, the EC uses less land and its capital stock is lower. Total labor remains constant across all scenarios. However, total GDP increases in all scenarios, except when the USA alone liberalizes. This indicates that average productivity goes up. The improvement is caused by a shift of labor from agriculture into nonagriculture where it has a substantially higher GDP elasticity (see *Table 3.1*).

Total investment declines in the EC when trade is liberalized because savings do not increase enough to compensate for the relative increase in the nonagricultural price. The reduction of factor inputs in agriculture is caused by the shift of the domestic terms of trade in favor of nonagriculture.

Table A3.18 summarizes the major adjustments that take place in the agricultural sector. Production of milk is reduced by only about 11% when the EC liberalizes trade because its real protection rate is relatively low. Since wheat prices fall in most scenarios more than the prices of coarse grains, output of wheat is reduced and coarse grains output increased. As a result, the EC virtually ceases to export wheat and buys increasingly less coarse grain on the world market. Coarse grains is the only product for which the EC expands production under trade liberalization.

The value of agricultural imports increases by 45% when all market economies liberalize in the year 2000. This is the result of fewer exports of temperate-zone food products and more imports of commodities from LDCs, both other food and nonfood agriculture.

Note

The abbreviations used in *Tables A3.1–A3.18* refer to the following:

GDP70, GDP at 1970 prices (10^6 US\$); GDPA70, GDP of agriculture sector at 1970 prices (10^6 US\$); GDPNA70, GDP of nonagriculture sector at 1970 prices (10^6 US\$); AG vol. index WP70, volume index of agricultural production weighted with 1970 world market prices (1970 = 1); Trade deficit 70, trade deficit at 1970 prices (10^6 US\$); AG trade deficit 70, deficit in agricultural trade at 1970 prices (10^6 US\$); Investment, investment at 1970 prices (10^6 US\$); Total capital, capital stock at 1970 prices (10^6 US\$); Agricultural capital, capital stock in agriculture (10^6 US\$); Agricultural labor, labor force in agriculture (thousand people); P_A/P_N, agricultural price index relative to nonagriculture price index; Food price index, index of food retail prices (1970 = 1); Terms of trade, index of unit value of exports over index of unit value of imports (1970 = 1); Parity, agricultural GDP per person engaged in agriculture divided by nonagricultural GDP per person engaged in nonagriculture; Equivalent income, income required to buy a consumption bundle at domestic prices of 1970 that would provide the same utility as provided by current consumption (1970 US\$ per capita); Calories/capita, energy intake from average diet (kcal per capita per day).

Commodity units of measurement are 10^6 t for wheat, rice, coarse grains, bovine and ovine meat, and dairy products, 10^6 t protein equivalent for other animal products and protein feed, and 10^9 US\$ 1970 for all other commodities.

Commodity prices are in 10^9 US\$ per unit of commodity.

Table A3.1. Argentina: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	36018	1.33	1.63	0.3	–0.2	0.1	+0	0.2	0.1	+0	+0	+0	–0
GDPA70	3852	1.17	1.42	19.6	47.0	8.1	13.9	12.6	28.5	2.7	6.4	4.3	9.3
GDPNA70	32166	1.35	1.65	–1.7	–5.0	–0.7	–1.4	–1.1	–2.9	–0.2	–0.6	–0.4	–1.0
AG vol. index WP70	1.169	1.19	1.46	18.9	42.8	8.1	12.5	12.6	24.9	2.9	5.9	4.1	8.0
Trade deficit 70	–809.0	0.36	0.16	–23.6	–20.6	–4.6	–3.2	–16.9	–13.7	–0.6	–0.7	–5.1	–2.5
AG trade deficit 70	–303.1	1.36	2.12	77.8	122.2	32.9	35.0	53.7	72.6	12.0	16.5	17.6	22.9
Investment	7121	1.46	1.88	8.9	9.8	2.7	2.0	5.1	5.9	1.1	0.8	1.3	1.3
Total capital	94132	1.69	2.55	2.5	5.6	1.0	1.5	1.4	3.2	0.3	0.6	0.5	0.9
Agricultural capital	11533	1.53	2.25	29.7	77.3	10.4	20.4	16.5	43.0	3.6	8.3	5.6	12.2
Agricultural labor	1379	0.94	0.96	17.1	48.9	7.8	14.7	11.2	28.1	2.8	6.8	4.5	10.0
P_A/P_N	1.044	1.14	1.25	55.5	47.6	17.3	12.1	33.3	31.4	7.9	5.4	9.2	8.2
Food price index	0.989	1.13	1.26	30.7	22.8	13.5	7.7	21.8	16.2	5.5	3.3	8.4	6.4
Terms of trade	1.006	1.11	1.18	19.3	19.4	19.4	19.8	2.5	6.8	8.8	9.1	8.2	12.6
Parity	0.808	1.22	1.43	58.2	44.9	17.4	11.0	34.8	31.4	7.8	4.9	8.9	7.3
Equivalent income	1108	1.17	1.30	0.5	3.2	0.7	2.1	–1.3	0.5	0.2	0.9	0.1	1.1
Calories/capita	3653	1.00	1.00	–2.2	–1.5	–0.9	–0.3	–1.7	–1.2	–0.4	–0.2	–0.4	–0.2
Wheat:													
Price	0.034	1.08	0.95	49.6	60.9	16.1	22.5	27.9	32.4	10.1	11.8	–1.1	2.4
Production	8.378	1.19	1.42	3.5	–21.0	9.3	–2.8	6.7	–6.9	5.4	–0.1	2.0	–5.5
Human consumption	2.615	1.10	1.19	0.6	–0.2	0.5	–0.1	0.1	–0	0.3	0.1	–0.2	–0.2
Net exports	4.257	1.24	1.55	2.5	–44.8	14.3	–6.1	9.4	–16.2	8.8	–0.8	3.1	–10.9
Rice:													
Price	0.114	1.01	0.97	4.9	8.1	–0.6	–4.6	–6.2	–8.8	–0	–2.7	–0.2	–3.2
Production	0.220	1.15	1.42	7.3	37.7	3.4	11.4	2.2	15.7	0.9	5.6	2.4	7.9
Human consumption	0.163	1.15	1.29	–0.7	0.5	–0.5	1.0	0.9	2.3	–0.6	–0	0.7	1.0
Net exports	0.016	1.04	2.48	57.6	204.1	10.2	58.3	–7.5	65.1	13.1	32.3	16.4	40.5
Coarse grains:													
Price	0.031	0.98	0.90	49.5	78.0	11.2	8.3	26.9	21.2	6.2	2.8	–1.7	1.2
Production	16.84	1.22	1.49	2.4	–32.6	7.0	–12.7	6.4	–23.8	3.3	–4.7	2.2	–5.8
Human consumption	0.244	1.18	1.38	–8.7	–10.2	–2.6	–1.1	–4.7	–3.4	–1.7	–0.7	1.2	0.3
Net exports	9.305	1.18	1.38	–10.0	–104.9	5.8	–41.0	3.6	–72.7	3.5	–16.7	0.2	–21.8

Table A9.1. (Cont.)

Bovine & ovine meat:													
Price	0.440	1.28	1.53	75.5	55.8	27.7	17.2	43.1	35.8	11.1	6.9	18.8	14.3
Production	3.870	1.15	1.37	27.1	65.0	10.9	20.4	15.3	37.0	3.6	8.9	6.8	13.6
Human consumption	3.320	1.07	1.13	−6.3	−4.2	−3.5	−2.0	−5.3	−3.4	−1.1	−0.4	−3.2	−2.2
Net exports	0.535	1.63	2.86	163.1	235.1	69.5	75.4	99.3	136.1	22.8	31.9	47.7	52.2
Dairy products:													
Price	0.051	1.12	1.17	26.9	34.5	13.0	6.5	11.1	4.5	8.0	3.5	11.1	11.2
Production	5.062	1.11	1.27	15.1	49.8	8.0	15.6	8.6	24.4	3.0	7.3	6.0	12.7
Human consumption	4.899	1.12	1.23	−0.4	−0.3	−0.3	−0	−0.1	0.1	−0.2	−0.1	−0	−0
Net exports	0.028	−1.79	6.87	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]
Other animal products:													
Price	4.758	1.01	1.01	23.7	20.1	0.6	−0	21.0	22.3	0.8	0.8	−0.5	−0.4
Production	0.107	1.33	1.82	20.7	66.2	3.9	19.0	12.9	42.3	0.8	9.2	2.8	12.2
Human consumption	0.118	1.21	1.40	−5.6	−3.5	0.6	1.1	−4.9	−5.1	0.1	0.1	1.2	0.8
Net exports	−0.009	−0.20	−3.30	+[c]	428.3	+[c]	112.0	+[c]	288.5	+[c]	56.5	+[c]	70.6
Protein feed:													
Price	0.124	1.00	0.95	18.2	20.2	10.4	13.4	6.2	4.7	3.6	0.9	0.5	1.0
Production	0.382	1.22	1.57	20.4	57.1	7.4	15.1	13.8	33.9	2.3	6.0	3.1	8.3
Human consumption	0.175	1.35	1.84	44.5	115.6	4.9	17.0	29.9	62.6	3.0	11.4	1.7	12.8
Net exports	0.179	1.08	1.34	−13.0	−23.9	6.2	10.0	−5.7	−4.7	−0.3	−3.6	5.9	−0.2
Other food:													
Price	0.510	0.99	1.02	36.7	35.2	4.4	3.5	30.7	30.7	2.2	1.7	0.1	0.7
Production	2.067	1.19	1.51	24.7	67.5	6.2	18.3	16.6	41.1	1.7	8.5	2.6	11.0
Human consumption	1.719	1.15	1.27	−1.8	−1.2	0.1	0.3	−1.5	−1.5	+0	+0	0.4	0.3
Net exports	0.119	1.68	4.86	294.3	338.6	68.2	89.8	203.1	210.5	19.5	42.2	25.8	53.5
Nonfood agriculture:													
Price	0.633	1.16	1.18	−2.6	−8.0	4.6	−4.2	−7.4	−5.0	4.6	+0	−1.9	−6.1
Production	0.594	1.19	1.46	17.1	52.3	8.3	16.6	9.0	29.8	3.1	7.8	4.1	10.1
Human consumption	0.305	1.16	1.34	−0.6	2.8	−1.9	1.7	1.7	1.4	−1.8	−0.3	1.5	2.5
Net exports.	0.281	1.23	1.59	35.0	97.7	18.6	30.3	16.5	55.9	7.9	15.3	6.6	17.2
Nonagriculture:													
Production	33.40	1.35	1.66	+0	−1.9	0.4	−0.1	−0.5	−1.4	0.2	−0.1	0.2	−0.1
Demand	33.77	1.38	1.72	4.3	6.4	2.6	2.9	1.8	2.9	1.0	1.2	1.2	1.8
Net exports	−0.370	3.92	7.43	137.5	174.0	70.5	64.6	71.5	88.6	26.0	28.3	33.4	40.2

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.2. Australia: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	53700	1.33	1.67	0.2	0.1	0.3	0.3	+0	–0.1	0.2	0.2	+0	0.1
GDPA70	3958	1.21	1.45	1.6	1.3	1.7	2.5	0.4	–1.2	2.9	5.2	–0.1	1.1
GDPNA70	49742	1.34	1.69	0.1	0.1	0.2	0.1	–0	–0	–0	–0.1	+0	–0
AG vol. index WP70	1.206	1.23	1.49	2.1	1.3	2.0	1.7	0.4	–0.8	3.1	5.0	–0	2.1
Trade deficit 70	11.24	–17.32	–18.62	–2.3	–1.5	–1.0	0.1	–0.8	–0.4	0.6	1.0	–0.8	0.1
AG trade deficit 70	–1844	1.29	1.67	4.3	1.4	4.2	3.1	–0	–3.1	6.8	11.0	0.8	4.8
Investment	10318	1.33	1.67	1.5	0.7	1.8	1.2	–0.1	–0.5	0.7	0.6	0.4	0.4
Total capital	109066	1.41	1.88	0.6	0.7	0.6	0.9	–0	–0.2	0.2	0.4	0.1	0.3
Agricultural capital	8469	1.35	1.79	8.3	10.2	9.4	13.7	–0.4	–3.3	3.5	7.9	2.1	4.3
Agricultural labor	355.8	0.98	0.99	1.3	3.6	1.4	4.3	–0	–0.5	0.3	1.4	0.4	1.4
P_A/P_N	0.842	1.12	1.24	17.5	8.5	22.6	14.5	–2.9	–5.9	7.8	5.4	5.8	5.8
Food price index	0.928	1.10	1.22	16.8	8.6	18.1	12.1	0.6	–2.0	4.9	3.9	6.2	6.1
Terms of trade	1.047	1.08	1.05	13.4	14.6	16.8	19.7	–2.4	–3.0	6.4	5.5	4.3	4.4
Parity	1.120	1.26	1.55	17.6	5.8	22.6	12.2	–2.5	–6.5	10.7	9.5	5.3	5.5
Equivalent income	2965	1.12	1.20	–0.6	–0.1	–0.5	–0.1	–0.2	–0.2	0.1	0.2	–0.2	–0.2
Calories/capita	3832	1.01	1.02	0.4	0.7	0.3	0.5	+0	0.1	–0.1	–0.2	–0.2	–0.2
Wheat:													
Price	0.056	1.04	0.93	0.6	5.5	–4.8	0.5	3.6	5.9	9.8	9.9	–1.0	1.8
Production	12.38	1.41	1.66	13.7	11.2	8.2	5.0	9.2	8.2	16.0	13.6	–3.2	1.1
Human consumption	1.238	1.18	1.38	0.4	–0.2	0.7	0.2	–0.1	–0.3	0.3	0.2	+0	–0
Net exports	8.484	1.53	1.87	14.4	12.5	6.2	5.5	9.6	7.7	17.3	14.6	–3.1	0.4
Rice:													
Price	0.097	0.99	1.02	–5.8	–8.6	0.4	–4.2	2.6	0.7	3.9	1.0	–0.4	–0.1
Production	0.350	1.03	1.08	–11.0	–5.9	–2.5	–1.6	3.0	0.9	–1.5	0.3	–0.7	0.4
Human consumption	0.042	1.25	1.50	0.9	3.7	–2.5	1.5	–0.8	0.2	–2.4	–0.9	0.1	0.1
Net exports	0.240	0.99	0.96	–13.9	–8.7	–1.5	–1.7	4.6	1.9	–0.5	0.3	–1.3	0.4
Coarse grains:													
Price	0.047	0.97	0.86	–8.4	–15.2	–11.3	–16.8	2.4	3.9	8.5	3.6	–2.4	1.5
Production	5.464	1.98	3.21	–13.0	–31.6	–17.2	–37.9	3.3	5.6	7.1	2.4	–7.0	0.4
Human consumption	0.350	1.19	1.40	0.2	0.6	0.3	0.7	–0.1	–0.1	–0.5	–0.2	0.1	–0.1
Net exports	1.916	3.47	6.50	–19.7	–44.7	–26.5	–53.4	5.8	8.1	12.4	2.0	–11.4	–0.2

Table A3.2. (Cont.)

Bovine & ovine meat:													
Price	0.461	1.17	1.42	42.1	25.1	44.4	31.7	4.1	-0.7	8.7	7.5	16.4	15.0
Production	2.709	1.10	1.24	4.2	7.3	5.4	9.8	-0.2	-1.2	-0.2	2.1	2.3	3.2
Human consumption	1.938	1.18	1.38	-2.2	-1.3	-2.3	-1.7	-0.2	0.1	-0.6	-0.5	-0.9	-0.9
Net exports	0.651	0.80	0.76	33.3	56.4	40.6	74.7	-0.4	-8.9	1.7	16.7	17.0	26.5
Dairy products:													
Price	0.049	1.21	1.44	61.0	46.9	57.1	42.8	0.1	-0.3	6.7	-3.2	-0.5	-3.8
Production	7.875	1.14	1.31	23.7	29.3	22.2	28.7	-0.1	-0.5	-0.4	0.1	1.0	0.2
Human consumption	5.285	1.19	1.39	2.3	1.4	2.3	1.4	-0	-0.1	0.6	-0	-0.1	-0.2
Net exports	1.622	1.04	1.14	114.7	154.5	106.9	150.3	-0.7	-2.1	-3.5	0.2	5.0	1.4
Other animals products:													
Price	6.821	0.91	0.93	-9.8	-16.4	-9.8	-16.4	0.2	-0.2	2.3	3.1	0.5	-0.4
Production	0.115	1.08	1.32	-14.0	-8.1	-13.7	-7.3	-0.8	-0.8	-5.2	1.5	0.6	0.6
Human consumption	0.084	1.28	1.54	3.4	5.8	3.5	6.1	-0.2	-0.1	-0.5	-0.7	-0.1	0.2
Net exports	0.027	0.45	0.62	-168.9	-115.0	-166.3	-110.3	-6.5	-6.1	-46.9	19.2	6.2	4.2
Protein feed:													
Price	2.932	1.00	0.97	0.8	1.1	-1.7	0.7	1.6	1.2	1.8	0.2	0.5	0.1
Production	0.354	1.14	1.34	2.3	5.4	3.4	8.1	-0.6	-2.1	+0	3.5	1.8	3.1
Feed	0.289	0.99	1.05	-14.6	-11.4	-15.1	-11.9	-0.1	0.4	0.6	5.8	-0.9	1.6
Net exports	0.061	1.89	2.71	43.7	36.1	48.5	44.6	-2.0	-6.8	-1.3	-0.6	8.1	5.8
Other food:													
Price	0.625	1.05	1.16	-16.4	-23.1	-9.2	-15.4	-12.7	-19.0	4.0	7.3	1.2	2.3
Production	1.150	1.24	1.57	-10.4	-7.6	-5.7	-0.5	-7.6	-12.6	0.3	8.2	1.3	4.1
Human consumption	0.751	1.19	1.40	0.8	1.3	0.4	0.7	0.5	0.8	-0.2	-0.3	-0	0.1
Net exports	0.319	1.37	2.03	-36.1	-23.9	-19.8	-3.2	-26.0	-36.5	1.3	23.1	4.6	11.6
Nonfood agriculture:													
Price	0.844	1.19	1.27	-3.4	-13.3	17.1	2.9	-12.3	-14.5	5.5	2.3	-0.7	-5.0
Production	0.951	1.11	1.28	3.4	6.5	5.2	9.6	-0.7	-2.0	0.2	2.7	1.9	2.9
Human consumption	0.308	1.17	1.36	1.0	2.2	-1.9	-0.3	2.1	2.4	-0.4	-0	0.1	0.9
Net exports	0.638	1.09	1.24	4.4	8.6	8.5	14.8	-2.1	-4.2	0.3	4.3	2.6	4.0
Nonagriculture:													
Production	50.12	1.34	1.68	+0	-0.1	0.1	-0	-0	-0	0.1	-0	+0	0
Demand	51.86	1.34	1.68	0.7	0.5	0.9	0.8	-0.1	-0.2	0.5	0.5	0.2	0.3
Net exports	-1.740	1.24	1.58	20.8	18.1	24.5	25.9	-2.5	-6.6	15.1	18.7	5.8	10.4

[a] 1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b] See note on page 307.

Table A3.3. Austria: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	17989	1.48	2.16	0.2	0.1	0.2	–0	0.1	0.2	–0	–0.1	–0	–0
GDPA70	894.2	1.12	1.24	–1.5	0.4	–1.1	1.5	–0.6	–2.1	0.5	1.7	0.3	0.4
GDPNA70	17095	1.50	2.21	0.3	0.1	0.2	–0.1	0.1	0.3	–0	–0.2	–0	–0.1
AG vol. index WP70	1.087	1.11	1.23	–1.2	1.1	–0.9	1.8	–0.5	–1.8	0.4	1.3	0.2	0.5
Trade deficit 70	322.2	0.05	–0.18	–9.9	–0.4	–7.4	1.3	–1.5	–0.2	3.4	0.8	–1.5	0.8
AG trade deficit 70	3.553	0.82	0.51	24.6	–13.3	19.2	–31.7	10.8	40.4	–2.4	–21.0	–3.4	–8.9
Investment	4994	1.49	2.20	0.2	0.4	0.3	0.3	–0	0.1	–0	–0.1	+0	–0
Total capital	43784	1.47	2.15	+0	0.3	+0	0.3	–0	–0	–0	–0	+0	–0
Agricultural capital	7248	1.19	1.42	–0.9	1.5	–0.8	2.0	–0.4	–1.7	0.2	1.1	0.3	0.5
Agricultural labor	379.3	0.83	0.68	–2.2	0.5	–1.7	2.1	–1.1	–3.4	0.5	2.0	0.5	0.7
P_A/P_N	1.001	0.98	0.96	–0.1	5.9	1.1	7.5	–2.0	–2.7	1.5	0.7	0.3	0.3
Food price index	1.039	1.04	1.08	–2.1	–0.9	–1.2	0.6	–0.8	–0.9	0.7	0.5	0.1	0.3
Terms of trade	0.965	0.99	1.02	37.8	66.7	23.6	52.9	9.0	6.3	3.9	6.3	15.1	20.4
Parity	0.413	0.99	0.98	0.5	5.6	1.6	6.8	–1.5	–1.3	1.5	0.4	0.1	+0
Equivalent income	1792	1.38	1.94	0.6	0.3	0.4	0.2	0.2	0.3	+0	–0.1	+0	0.1
Calories/capita	3448	1.00	1.00	0.5	0.5	0.3	0.3	0.2	0.1	0.1	0.1	+0	+0
Wheat:													
Price	0.078	0.89	0.78	–15.1	–5.5	–17.5	–5.7	0.4	–1.0	1.2	2.3	–0.4	0.5
Production	1.001	1.15	1.25	–0.8	–0.7	–1.2	–1.5	0.9	0.2	0.5	1.0	–0.2	–0.2
Human consumption	0.470	0.99	0.98	–0.1	–0.1	–0	–0.1	–0	–0	0.1	0.1	+0	+0
Net exports	0.021	3.96	4.51	–29.4	–22.1	–48.2	–37.8	11.9	7.0	–9.3	0.2	–2.4	–9.1
Rice:													
Price	0.222	0.94	0.98	21.0	17.7	26.3	22.1	1.9	1.2	3.7	1.1	–0.7	0.2
Human consumption	0.026	1.06	1.08	–2.0	–1.2	–2.8	–1.7	–0.1	0.1	–0.7	–0.3	0.1	0.1
Net exports	–0.028	1.08	1.14	–1.8	–1.0	–2.6	–1.5	–0.1	0.1	–0.7	–0.3	0.1	0.1
Coarse grains:													
Price	0.078	0.88	0.79	–16.8	–13.7	–19.2	–14.7	0.4	–0.6	2.4	1.9	–0.6	0.6
Production	2.960	1.13	1.30	–9.7	–11.5	–9.9	–12.5	0.3	0.2	1.6	0.7	–0.6	0.2
Human consumption	0.392	0.91	0.83	–1.6	–1.2	–1.7	–1.5	–0	–0.1	0.5	0.2	–0	0.2
Net exports	0.349	0.92	1.17	–142.9	–171.8	–160.2	–199.2	13.4	19.5	12.1	–4.4	–9.2	–6.4

Table A3.3. (Cont.)

Bovine & ovine meat:													
Price	0.938	1.02	1.04	–8.8	–6.1	–7.7	–2.6	0.3	–0.2	0.8	0.5	1.3	1.0
Production	0.219	1.16	1.33	–7.3	–6.0	–7.0	–3.5	–0.3	–2.6	0.4	1.4	1.0	0.8
Human consumption	0.213	1.11	1.24	1.3	1.9	0.8	0.7	0.1	0.3	–0.7	–0.4	–0.1	–0.2
Net exports	0.007	2.70	4.22	–121.2	–79.6	–109.2	–43.3	–5.3	–29.6	14.7	18.2	16.0	9.4
Dairy products:													
Price	0.078	0.93	0.86	32.8	56.0	29.5	51.6	–0.4	0.1	1.1	0.4	0.5	0.4
Production	3.384	1.10	1.19	21.6	36.3	19.1	34.0	0.2	–0.6	–0	0.8	0.8	0.8
Human consumption	2.339	1.04	1.07	–0.7	–0.8	–0.7	–0.8	+0	+0	–0.1	–0	+0	+0
Net exports	0.389	1.40	1.81	189.1	251.6	170.9	235.4	2.1	–0	–0.8	1.9	5.7	3.9
Other animal products:													
Price	7.221	0.99	0.98	–5.6	–6.6	–5.5	–6.2	+0	0.4	0.6	0.2	–0.2	–0.2
Production	0.049	1.15	1.30	–8.4	–11.6	–7.8	–10.5	+0	–1.1	–0.3	0.9	–0.1	0.2
Human consumption	0.056	1.12	1.22	1.7	1.6	1.9	1.8	–0	–0.2	0.2	0.3	0.1	0.1
Net exports	–0.008	0.93	0.75	81.7	147.6	78.2	137.3	–0.6	8.9	4.5	–7.3	1.6	–1.5
Protein feed:													
Price	2.606	1.00	0.97	–10.8	–9.2	–12.5	–9.3	1.3	0.8	2.5	0.6	0.4	0.6
Production	0.001	0.94	0.87	–5.5	–4.8	–3.6	–1.7	–2.0	–4.4	1.0	2.5	0.4	1.1
Feed	0.125	1.14	1.29	–4.8	–5.7	–4.6	–4.8	+0	–1.2	–0.2	1.0	0.1	0.3
Net exports	–0.124	1.14	1.29	–4.8	–5.7	–4.6	–4.8	+0	–1.2	–0.2	0.9	0.1	0.3
Other food:													
Price	0.920	1.02	1.05	–10.1	–11.7	–4.0	–4.7	–5.0	–6.3	2.1	2.1	0.2	0.7
Production	0.463	1.07	1.14	–6.4	–6.4	–4.2	–3.2	–2.1	–4.2	0.6	2.1	0.3	0.8
Human consumption	0.407	1.04	1.04	2.3	1.8	1.7	1.1	0.7	0.7	0.5	0.2	0.1	–0
Net exports	–0.071	1.05	0.93	53.1	61.9	30.6	28.0	20.8	38.9	–1.9	–15.2	–2.5	–7.3
Nonfood agriculture:													
Price	0.958	1.32	1.58	–42.8	–54.0	–31.2	–45.7	–17.6	–25.2	8.3	5.6	–0.6	–7.6
Production	0.013	1.15	1.30	–9.0	–8.4	–8.1	–5.8	–0.8	–3.2	0.6	1.6	0.9	0.6
Human consumption	0.066	0.90	0.82	13.1	12.6	10.9	11.2	2.9	3.5	1.1	0.5	+0	1.0
Net exports	–0.054	0.84	0.70	20.5	21.8	17.3	18.6	4.1	6.3	1.4	–0.1	–0.1	1.2
Nonagriculture:													
Production	17.63	1.49	2.19	0.2	–0.1	0.2	–0.1	0.1	0.2	+0	–0.1	–0	–0.1
Demand	17.88	1.47	2.15	0.3	0.2	0.2	0.1	0.1	0.2	+0	–0.1	+0	+0
Net exports	–0.250	–0.26	–0.43	–[c]	–[c]	–[c]	–[c]	–[c]	+[c]	–[c]	–[c]	–[c]	–[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.4. Brazil: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	96931	1.83	3.36	–0.4	–0.8	–0.2	–0.3	–0.3	–0.6	–0	–0.1	–0.1	–0.1
GDPA70	5839	1.40	1.76	4.8	7.1	1.0	0.8	3.6	6.3	0.2	0.3	0.3	0.1
GDPNA70	91092	1.86	3.46	–0.7	–1.1	–0.2	–0.3	–0.5	–0.8	–0.1	–0.1	–0.1	–0.1
AG vol. index WP70	1.240	1.27	1.52	7.4	12.0	2.2	3.7	4.9	8.8	0.6	1.7	0.4	0.9
Trade deficit 70	1968	–0.25	–1.02	–4.6	–4.5	–7.6	0.5	0.7	–3.9	–3.8	0.8	–0.1	0.5
AG trade deficit 70	–331.3	0.84	–0.17	97.1	–896.6	33.5	–281.8	64.0	–655.0	13.2	–136.8	4.5	–67.9
Investment	25455	1.78	3.30	1.5	0.5	0.6	+0	0.9	0.4	0.3	+0	0.1	+0
Total capital	212511	2.05	3.94	0.7	0.5	0.3	0.1	0.4	0.4	0.1	0.1	0.1	0.1
Agricultural capital	20233	1.61	2.19	22.3	33.4	7.3	9.8	14.1	24.2	2.1	4.4	2.4	3.1
Agricultural labor	14329	1.06	1.12	0.8	2.4	0.3	0.8	0.5	1.7	0.1	0.3	0.1	0.3
P_A/P_N	1.302	1.07	1.15	28.4	25.0	11.3	7.8	18.7	18.2	5.2	3.8	2.8	2.8
Food price index	1.162	1.09	1.17	15.0	16.9	7.0	5.8	10.5	12.5	3.4	2.5	2.4	2.4
Terms of trade	1.055	0.97	0.85	4.6	3.3	7.2	–1.6	–1.5	0.8	1.7	–3.7	1.8	–2.8
Parity	0.135	1.06	0.96	33.9	31.0	12.1	7.7	22.5	23.6	5.2	3.8	3.1	2.6
Equivalent income	593.9	1.43	2.14	–0.8	–1.4	–0.9	–0.9	–0.4	–0.9	–0.4	–0.3	–0.3	–0.3
Calories/capita	2860	1.07	1.15	–1.8	–2.0	–0.9	–0.5	–1.2	–1.4	–0.6	–0.4	+0	–0.1
Wheat:													
Price	0.079	0.97	0.97	–6.1	–9.7	–1.2	0.5	–16.1	–21.7	–0.8	–0.4	0.4	–0.3
Production	2.746	1.24	1.40	2.6	5.1	0.6	3.0	–2.0	–0.3	–0	1.4	0.1	0.8
Human consumption	4.208	1.39	1.91	–0.8	0.7	–1.5	–0.3	1.0	1.9	–1.0	–0.5	–0.1	–0
Net exports	–2.996	1.48	2.21	12.9	15.5	2.5	0.7	20.1	22.2	1.3	+0	–0.7	–0
Rice:													
Price	0.094	0.99	1.03	26.9	36.3	20.4	20.6	14.3	27.3	3.6	1.7	–0.1	–0.2
Production	6.306	1.17	1.30	7.4	14.0	4.5	7.0	4.2	10.2	0.4	1.4	+0	0.4
Human consumption	4.330	1.28	1.61	–0.6	–0.7	–0.7	–0.6	–0.2	–0.5	–0.3	–0.2	–0	+0
Net exports	0.386	–0.32	–2.67	+[c]	–86.0	+[c]	–57.7	+[c]	–61.0	+[c]	–9.5	+[c]	–2.5
Coarse grains:													
Price	0.038	1.02	0.90	46.0	50.1	14.2	11.5	35.5	41.3	7.9	4.0	–1.8	1.3
Production	18.00	1.19	1.32	6.7	10.8	2.8	3.2	5.4	8.7	1.8	1.1	–1.4	0.7
Human consumption	2.961	1.31	1.71	–2.5	–2.6	–1.5	–0.9	–1.7	–2.0	–1.0	–0.5	0.1	–0.2
Net exports	–0.048	48.55	177.54	–39.2	–15.8	–44.4	–8.1	–40.2	–17.2	–30.8	0.5	22.9	–2.7

Table A3.4. (Cont.)

Bovine & ovine meat:													
Price	0.372	1.31	1.59	43.2	36.1	28.7	17.6	22.0	19.8	10.8	6.5	18.8	13.8
Production	2.911	1.22	1.41	8.3	10.6	5.9	5.4	3.7	6.1	2.0	2.0	4.9	3.8
Human consumption	2.586	1.29	1.65	–2.8	–2.1	–2.5	–1.4	–1.4	–1.2	–1.2	–0.7	–1.2	–1.0
Net exports	0.076	–3.12	–12.96	–158.9	–51.8	–123.8	–28.4	–71.4	–29.1	–45.9	–11.0	–90.8	–20.4
Dairy products:													
Price	0.089	1.07	1.13	19.8	20.7	4.9	3.0	9.9	12.8	2.9	1.7	3.2	3.9
Production	9.805	1.31	1.66	2.5	6.7	0.5	2.1	–0.1	3.7	+0	0.9	2.3	2.7
Human consumption	9.490	1.32	1.71	–1.2	–0.8	–0.9	–0.3	–0.4	–0.3	–0.6	–0.3	–0.1	–0.2
Net exports	–0.575	1.52	2.98	–43.8	–61.7	–22.1	–22.2	6.0	–28.7	–9.0	–10.1	–35.4	–27.3
Other animal products:													
Price	3.552	1.04	1.06	56.5	50.5	3.8	–0.2	53.4	53.0	4.9	4.9	–3.3	–2.3
Production	0.275	1.42	2.00	14.7	17.6	–0.9	–0	14.8	17.8	0.2	1.8	–1.1	–1.0
Human consumption	0.361	1.45	2.09	–11.9	–10.0	–1.4	0.3	–11.0	–10.3	–1.5	–1.1	0.8	0.6
Net exports	–0.092	1.54	2.37	–84.0	–78.7	–2.7	1.1	–80.9	–80.1	–6.2	–8.4	5.9	4.5
Protein feed:													
Price	0.147	0.99	0.94	23.7	26.8	10.2	13.6	12.8	12.5	3.4	0.8	0.8	1.0
Production	3.436	1.44	1.74	19.4	29.6	6.2	9.2	12.1	20.9	1.6	4.0	1.4	2.5
Feed	0.348	1.53	2.19	24.6	27.7	0.4	–2.2	26.1	32.8	2.3	3.2	–2.6	–1.4
Net exports	2.807	1.43	1.69	18.3	29.7	6.4	10.7	10.3	19.0	1.3	3.9	2.1	2.8
Other food:													
Price	0.377	0.97	1.01	14.4	11.2	5.7	3.9	8.9	7.3	2.7	1.8	–0.1	0.5
Production	12.70	1.26	1.50	6.3	11.0	1.6	3.6	4.0	7.7	0.3	1.6	+0	0.8
Human consumption	7.465	1.31	1.69	–0.8	–1.5	–0.5	–0.5	–0.5	–0.9	–0.3	–0.2	+0	–0.1
Net exports	1.633	1.02	0.56	38.1	172.8	11.1	65.2	23.0	113.5	2.4	30.0	–1.2	14.0
Nonfood agriculture:													
Price	0.499	1.20	1.26	11.1	2.3	8.4	–1.5	5.7	5.6	6.6	1.9	–1.5	–5.8
Production	1.204	1.20	1.33	–2.4	–2.8	0.7	–1.5	–2.3	–0.9	1.2	0.2	–1.7	–3.5
Human consumption	0.831	1.25	1.54	–0.8	–0.2	–0.4	0.5	–0.6	–0.7	–0.4	0.1	0.2	0.8
Net exports	0.345	1.11	0.84	–7.1	–14.8	3.1	–10.6	–6.9	–1.7	5.4	0.9	–7.2	–22.3
Nonagriculture:													
Production	88.79	1.88	3.51	–0.3	–0.9	–0.4	–0.5	0.1	–0.5	–0.1	–0.2	–0.1	–0.2
Demand	92.20	1.82	3.36	0.5	–0	–0.1	–0.3	0.5	0.1	+0	–0.1	–0	–0.1
Net exports	–3.410	0.26	–0.68	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A9.5. Canada: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

Indicator[b]	Reference scenario[a]			Agricultural trade liberalization by: All MEs		All OECD		All LDCs		EC		USA	
	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	124687	1.43	1.95	0.1	–0.1	0.1	–0.1	–0	–0	–0	–0.1	–0	–0.1
GDPA70	3597	1.23	1.48	7.7	16.7	7.2	16.6	0.8	0.8	3.6	4.9	0.8	1.2
GDPNA70	121090	1.44	1.96	–0.1	–0.5	–0.1	–0.5	–0	–0	–0.1	–0.2	–0.1	–0.1
AG vol. index WP70	1.199	1.25	1.55	5.4	13.9	4.8	12.6	0.3	2.4	2.9	6.2	–0.5	1.6
Trade deficit 70	115.7	–5.82	–7.88	–0.5	–1.7	1.5	0.5	–1.2	–1.1	0.9	1.0	–0.1	0.7
AG trade deficit 70	–1127	1.56	2.34	10.8	27.4	7.7	24.3	–0.4	5.1	4.9	13.3	–0.2	3.6
Investment	28236	1.45	1.99	0.4	0.4	0.5	0.4	+0	–0	0.2	+0	+0	–0
Total capital	280374	1.58	2.32	0.1	0.1	0.1	0.1	–0	–0	+0	–0	+0	–0
Agricultural capital	10732	1.35	1.76	8.6	20.0	8.6	21.2	0.7	0.4	4.3	5.7	2.4	2.5
Agricultural labor	464.4	0.96	1.02	6.1	18.8	6.2	19.8	0.4	0.4	3.2	6.0	2.2	3.0
P_A/P_N	1.166	1.04	1.03	10.0	12.8	11.3	15.5	+0	–0.4	4.8	2.1	1.6	2.3
Food price index	1.073	1.06	1.11	5.2	4.2	6.5	6.5	–0.1	–1.0	2.1	0.3	1.7	1.3
Terms of trade	0.997	1.02	0.98	21.7	29.2	18.9	29.8	2.3	2.4	7.1	7.9	1.2	2.8
Parity	0.728	1.11	1.09	11.5	10.6	12.1	12.2	0.5	0.1	5.2	1.0	0.2	0.5
Equivalent income	4108	1.25	1.49	+0	–0	–0	–0.1	–0	+0	+0	0.1	–0.1	–0.1
Calories/capita	3566	1.01	1.01	–0.5	–0.8	–0.4	–0.8	–0.1	–0	+0	0.2	–0.4	–0.3
Wheat:													
Price	0.055	1.02	0.92	5.7	10.1	0.1	4.9	2.3	4.7	6.8	8.7	–0.4	1.6
Production	17.73	1.42	1.79	0.4	10.2	–4.5	–2.6	5.2	11.6	8.1	18.2	–1.8	0.4
Human consumption	1.621	1.13	1.27	–0.2	–0.1	–0.2	–0.1	–0	–0	–0.2	–0.1	+0	+0
Net exports	12.59	1.52	2.03	–6.7	5.8	–14.2	–8.5	3.9	10.3	6.1	18.9	–1.0	–0.7
Rice:													
Price	0.231	0.99	1.02	22.6	20.2	28.0	24.7	2.0	0.5	3.0	0.7	–0.3	–0
Human consumption	0.089	1.24	1.49	–4.2	–2.6	–5.5	–3.7	–0.2	0.2	–1.3	–0.5	0.1	0.1
Net exports	–0.092	1.24	1.49	–4.1	–2.6	–5.5	–3.6	–0.2	0.2	–1.3	–0.5	0.1	0.1
Coarse grains:													
Price	0.036	1.01	0.90	7.4	2.1	4.6	0.5	2.8	4.2	7.4	3.7	–1.5	0.8
Production	22.54	1.32	1.71	–9.0	–12.1	–8.8	–10.9	–3.4	2.4	–2.7	0.1	–6.4	2.5
Human consumption	0.804	1.15	1.32	–0.6	–0.2	–0.6	–0.1	–0.1	–0.2	–0.7	–0.3	0.2	–0.2
Net exports	4.770	1.84	3.10	–63.8	–82.2	–65.0	–79.1	–10.9	7.1	–17.6	–8.3	–24.8	1.4

Table A3.5. (Cont.)

Bovine & ovine meat:													
Price	0.805	1.15	1.28	10.0	5.9	11.8	11.5	1.1	–1.7	5.6	2.6	9.3	6.8
Production	1.237	1.25	1.58	3.7	13.7	3.8	15.8	1.6	–0.4	5.5	6.5	6.4	5.3
Human consumption	1.233	1.15	1.29	–4.2	–2.7	–4.1	–4.5	–1.0	0.5	–1.6	–0.1	–4.5	–3.1
Net exports	0.003	43.95	111.00	83.5	88.5	84.2	108.1	28.0	–4.3	77.6	36.8	117.9	43.7
Dairy products:													
Price	0.096	1.04	1.06	–3.9	2.8	–6.2	–0.1	1.5	1.7	2.6	2.0	3.2	4.8
Production	7.819	1.09	1.19	76.2	104.0	71.9	107.8	–0.3	–1.0	2.4	1.6	–0.5	–0.8
Human consumption	6.927	1.09	1.18	2.9	–0.7	4.8	1.4	–0.6	–1.2	2.3	1.3	–0.4	–0.8
Net exports	0.035	0.15	–1.02	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]
Other animal products:													
Price	5.861	0.99	0.94	12.3	14.2	12.4	14.7	0.3	0.1	1.3	–2.0	–2.4	–2.6
Production	0.382	1.23	1.51	0.5	13.5	0.7	13.5	0.6	0.2	2.5	3.7	1.0	0.6
Human consumption	0.234	1.19	1.40	–2.1	–2.6	–2.1	–2.5	–0.1	–0.1	+0	0.6	0.5	0.5
Net exports	0.141	1.29	1.69	4.4	35.8	4.8	35.6	1.6	0.6	6.3	8.0	1.8	0.7
Protein feed:													
Price	0.850	1.00	0.95	31.0	34.7	28.5	29.9	1.8	1.1	3.7	1.0	0.4	1.0
Production	0.874	1.12	1.34	9.1	18.8	12.1	21.5	–2.5	–3.0	0.5	2.5	1.4	1.6
Feed	1.048	1.19	1.33	–10.4	–2.5	–11.4	–1.5	1.5	2.0	5.9	6.1	0.2	0.4
Net exports	–0.241	1.45	1.29	–58.2	–77.2	–69.7	–82.4	12.3	20.5	22.3	22.5	–4.4	–0.3
Other food:													
Price	1.226	1.00	1.03	7.3	5.3	14.8	12.4	–3.6	–4.9	2.4	–0.3	–0.7	–0.4
Production	1.205	1.14	1.38	4.5	15.6	7.5	18.5	–1.8	–2.4	2.5	4.3	1.6	2.1
Human consumption	1.291	1.17	1.35	–0.6	–0.3	–1.1	–0.9	0.3	0.4	–0.2	+0	0.1	+0
Net exports	–0.271	1.36	1.41	–17.2	–63.7	–31.4	–79.0	8.2	11.8	–9.8	–17.6	–5.5	–8.8
Nonfood agriculture:													
Price	0.846	1.03	0.99	–10.8	–10.7	8.1	5.9	–8.2	–8.1	2.3	–1.8	–1.9	–4.7
Production	0.269	1.21	1.46	–2.5	9.3	2.6	14.7	–1.3	–1.6	4.9	5.9	2.1	1.9
Human consumption	0.180	1.07	1.16	1.5	–0.2	2.5	0.7	–0.3	–0.6	1.7	0.8	–0	–0.1
Net exports	0.089	1.51	2.06	–8.5	20.1	2.1	30.4	–2.8	–2.6	9.3	11.7	4.8	4.1
Nonagriculture:													
Production	122.7	1.44	1.96	–0.1	–0.4	–0	–0.4	–0	–0	+0	–0.1	–0	–0.1
Demand	124.0	1.44	1.95	0.3	0.4	0.3	0.3	+0	+0	0.2	0.2	–0	+0
Net exports	–1.294	1.03	1.50	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]	–[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.6. Egypt: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	10738	1.61	2.50	–0.7	–2.6	–0.4	–1.1	0.4	1.8	–0	–0.8	–0.2	–0.2
GDPA70	2253	1.31	1.65	3.3	4.8	1.5	2.1	–1.3	–4.4	0.3	1.9	0.4	0.2
GDPNA70	8485	1.69	2.73	–1.5	–3.8	–0.8	–1.6	0.8	2.8	–0.1	–1.3	–0.3	–0.3
AG vol. index WP70	1.270	1.35	1.76	9.9	15.0	3.0	5.4	5.4	2.6	0.6	3.3	0.4	0.5
Trade deficit 70	1191	0.65	0.88	–3.2	–3.0	–3.0	–1.2	0.5	2.2	–1.2	–0.5	–0.2	0.2
AG trade deficit 70	215.0	1.13	2.22	–302.5	–314.0	–86.1	–115.6	–153.8	–42.1	–18.5	–67.5	–16.8	–17.3
Investment	2290	1.44	2.14	0.8	–1.6	1.0	–0.5	0.1	1.4	0.7	–0.4	–0.2	–0.2
Total capital	25627	1.60	2.43	0.5	–0.4	0.4	0.1	–0	0.5	0.2	0.1	+0	–0.1
Agricultural capital	8618	1.45	1.94	5.0	11.2	3.3	6.2	–0.2	–2.2	1.3	3.9	0.5	0.4
Agricultural labor	5867	1.17	1.36	2.3	4.5	1.4	1.8	–2.2	–5.3	0.3	2.3	0.6	0.3
P_A/P_N	1.284	1.07	1.17	9.3	8.1	8.5	5.4	–0.9	1.3	5.2	4.1	–0.3	0.1
Food price index	1.172	1.05	1.10	–3.1	–3.8	4.9	3.0	–8.5	–7.5	2.9	1.7	0.2	0.6
Terms of trade	1.117	1.00	1.03	–8.8	–9.6	–2.7	–5.6	–9.0	–11.1	–0.4	–1.2	–5.1	–7.9
Parity	0.316	0.93	0.86	9.6	8.1	8.0	5.7	1.4	4.2	4.9	2.9	–0.7	–0.1
Equivalent income	245.3	1.24	1.57	–0.1	–2.1	–0.3	–1.2	0.9	1.7	–0.1	–0.7	–0.3	–0.6
Calories/capita	2799	1.06	1.12	0.3	–0.4	–0.2	–0.5	0.7	0.6	–0.1	–0.1	–0.1	–0.3
Wheat:													
Price	0.088	1.02	0.91	–16.7	–10.1	18.5	20.0	–25.6	–22.1	12.4	11.0	–1.2	1.7
Production	1.690	1.39	1.42	–22.3	–38.8	9.1	14.8	–34.3	–36.5	10.2	15.0	–1.7	3.2
Human consumption	3.629	1.28	1.63	0.6	–0.1	–0.4	–0.6	0.9	0.8	–0.3	–0.3	–0.1	–0.2
Net exports	–2.732	1.24	1.82	15.4	17.2	–6.6	–8.2	23.0	16.4	–7.6	–7.6	0.9	–1.7
Rice:													
Price	0.104	1.01	1.08	32.4	25.3	12.6	8.5	8.6	6.3	4.3	1.7	+0	–0.1
Production	1.691	1.21	1.41	57.9	54.4	–2.3	3.7	18.3	16.4	–5.3	0.8	0.8	0.1
Human consumption	1.072	1.28	1.61	–0.7	–1.0	–0.2	–0.3	–0.1	0.1	–0.1	–0.1	–0.1	–0.1
Net exports	0.206	0.56	–0.21	1032.5	+[c]	–52.5	+[c]	388.9	+[c]	–95.7	+[c]	15.2	+[c]
Coarse grains:													
Price	0.087	0.94	0.82	–10.2	–10.5	16.5	11.9	–19.6	–16.0	9.0	3.6	–2.8	1.2
Production	4.253	1.08	1.06	–9.1	–27.0	0.4	–0.8	–17.4	–19.5	0.7	1.3	–1.9	1.7
Human consumption	2.956	1.19	1.40	1.6	1.1	–0.1	–0.4	1.6	0.7	0.1	0.4	0.4	–0.1
Net exports	–0.033	28.02	77.72	38.0	45.3	–1.4	2.7	68.6	18.9	–2.5	1.9	14.4	–2.3

Table A3.6. (Cont.)

Bovine & ovine meat:													
Price	1.099	1.08	1.17	−21.0	−22.2	9.0	4.6	−34.6	−31.5	4.0	1.8	5.5	4.3
Production	0.315	1.41	1.93	−9.8	−5.3	2.5	3.2	−15.9	−17.6	0.2	1.8	3.3	1.8
Human consumption	0.495	1.38	1.89	1.8	0.7	−0.7	−0.9	3.3	3.5	−0.4	−0.3	−0.7	−0.8
Net exports	−0.180	1.34	1.83	23.0	11.7	−6.4	−8.4	38.7	42.4	−1.3	−4.2	−8.2	−5.5
Dairy products:													
Price	0.168	1.06	1.15	5.0	3.7	4.7	1.5	−11.6	−10.9	3.0	0.7	−0	0.8
Production	1.740	1.30	1.66	−6.9	−1.2	−1.9	0.2	−13.2	−15.4	−1.8	0.6	2.5	1.3
Human consumption	1.977	1.38	1.88	−0.3	−1.5	−0.1	−0.5	1.4	1.8	−0.1	−0.1	−0.3	−0.5
Net exports	−0.542	1.75	2.88	6.5	−8.8	5.2	−0.8	26.6	23.4	4.6	+0	−7.1	−4.2
Other animal products:													
Price	11.07	1.04	1.06	−38.3	−40.9	4.2	−0.3	−39.6	−39.9	5.3	5.2	−3.5	−2.6
Production	0.039	1.57	2.43	−23.4	−20.6	2.7	2.2	−21.9	−25.0	1.9	3.8	−1.0	−1.6
Human consumption	0.032	1.40	1.92	26.1	25.4	1.2	1.0	24.3	25.4	−0.2	−0.7	1.0	0.7
Net exports	0.006	2.54	5.36	−180.1	−115.0	7.5	4.7	−168.0	−128.7	8.5	13.1	−7.4	−6.1
Protein feed:													
Price	0.600	0.99	0.99	15.3	12.3	2.5	2.0	4.2	−1.5	1.4	0.5	−0.2	−0.1
Production	0.125	1.42	1.93	7.5	13.3	2.2	4.5	3.9	0.5	0.5	2.9	0.5	0.4
Feed	0.093	1.46	2.02	−31.9	−26.8	13.0	10.2	−34.4	−32.1	7.1	6.0	−0.9	0.1
Net exports	0.008	0.87	0.81	794.8	1252.8	−236.8	−161.9	773.7	956.4	−141.7	−96.3	34.8	−4.5
Other food:													
Price	0.399	1.00	1.04	20.3	18.3	5.7	4.5	14.3	14.0	2.7	2.2	0.1	0.8
Production	2.500	1.36	1.79	14.5	23.4	4.0	6.9	14.1	10.3	0.7	3.5	0.4	0.6
Human consumption	2.041	1.34	1.75	−0.7	−1.4	+0	−0.4	−0.5	−0.2	+0	−0.1	−0.2	−0.3
Net exports	0.166	1.60	2.10	174.8	285.6	45.7	84.0	168.2	120.9	8.7	42.0	7.2	10.5
Nonfood agriculture:													
Price	1.431	1.06	1.06	44.0	38.4	3.4	−1.2	37.1	42.8	2.8	0.4	−0.8	−2.6
Production	0.277	1.50	2.16	10.4	15.5	1.3	2.0	6.0	5.3	0.6	2.4	0.5	−0.4
Human consumption	0.242	1.34	1.76	−3.2	−3.6	−0.1	−0.1	−2.8	−2.8	−0.2	−0.1	−0.1	−0
Net exports	0.034	2.70	5.02	57.6	63.4	5.8	7.3	36.9	25.9	3.0	8.6	2.3	−1.2
Nonagriculture:													
Production	9.065	1.68	2.66	−1.8	−4.8	−0.3	−1.9	−0.3	1.5	0.2	−1.3	−0.2	−0.4
Demand	9.940	1.57	2.48	−0.1	−2.3	−0	−1.2	0.5	1.5	0.2	−0.7	−0.3	−0.6
Net exports	−0.875	0.51	0.59	55.8	114.3	8.5	34.3	28.6	5.3	−1.8	24.6	−4.9	−8.5

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.7. India: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

				Agricultural trade liberalization by									
	Reference scenario[a]			*All MEs*		*All OECD*		*All LDCs*		*EC*		*USA*	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	68271	1.56	2.72	0.2	+0	0.2	0.1	+0	–0.2	0.1	+0	+0	+0
GDPA70	28856	1.25	1.60	0.4	–0.1	0.1	0.1	+0	–0.5	0.1	0.1	0.1	+0
GDPNA70	39415	1.78	3.54	0.1	+0	0.2	0.1	–0	–0.1	0.1	+0	–0	+0
AG vol. index WP70	1.262	1.33	1.80	0.1	–0	–0.1	0.1	0.1	–0.3	+0	0.1	0.1	0.1
Trade deficit 70	1917	1.55	2.66	–0.9	+0	–1.1	0.4	–0.2	0.2	–0.3	0.7	–0	0.4
AG trade deficit 70	–105.8	1.07	0.17	74.6	553.8	18.7	211.9	10.0	–4.7	8.4	83.5	1.6	50.8
Investment	107392	2.00	4.45	–0.4	0.1	–0.5	0.3	–0.2	–0	–0.1	0.4	+0	0.3
P_A/P_N	0.957	1.02	1.10	6.4	3.3	4.6	3.0	–1.9	–2.1	2.4	1.5	0.3	0.8
Terms of trade	1.108	0.99	0.92	4.0	12.2	11.1	14.6	–2.6	3.4	4.8	2.8	0.6	1.0
Parity	0.540	1.00	1.04	3.7	1.4	2.5	1.3	–0.8	–0.9	1.4	0.7	0.2	0.4
Equivalent income	71.84	1.07	1.22	–0.3	0.6	–0.5	–0.2	0.7	0.9	–0.3	–0.2	+0	–0
Calories/capita	2141	1.08	1.18	–0.1	–0.4	–0.7	–0.9	1.9	1.5	–0.2	–0.2	0.1	–0
Wheat:													
Price	0.094	0.76	0.67	–4.0	–2.0	3.8	5.2	–12.9	–12.2	1.7	2.6	0.1	0.5
Production	30.77	1.59	2.44	–0.3	–0.2	0.6	0.8	–0.9	–2.0	0.9	0.6	–0.1	0.2
Human consumption	28.82	1.51	2.25	3.5	1.8	–0	–1.2	5.9	5.4	0.3	–0.4	0.1	–0
Net exports	0.124	20.81	49.52	–65.1	–21.7	10.9	22.5	–115.0	–80.4	11.4	11.0	–3.1	2.5
Rice:													
Price	0.136	0.94	0.92	5.9	4.4	5.0	3.2	–6.5	–5.0	2.0	0.7	–0.1	0.3
Production	45.49	1.38	1.90	0.1	+0	–0.1	0.1	0.2	–0.6	–0.2	0.1	0.1	–0
Human consumption	45.16	1.34	1.80	0.1	–0.5	–0.4	–0.4	2.9	1.8	0.2	0.3	0.2	0.1
Net exports	–0.353	–4.22	–11.21	3.0	10.5	9.7	10.0	–109.2	–51.0	–15.1	–4.0	–4.8	–3.8
Coarse grains:													
Price	0.072	0.95	0.87	2.1	–2.0	10.1	8.3	–8.4	–7.9	5.6	2.9	–1.2	0.8
Production	25.77	1.13	1.19	0.2	0.1	0.8	4.2	–1.8	–4.7	0.6	1.7	–0.5	1.2
Human consumption	27.94	1.19	1.39	2.5	3.4	–2.6	–2.4	3.5	3.1	–1.6	–0.9	0.7	0.2
Net exports	–3.824	1.51	2.65	13.4	13.0	–18.6	–21.0	28.3	25.1	–11.8	–8.1	6.3	–2.8

Table A3.7. (Cont.)

Bovine & ovine meat:													
Price	0.538	1.24	1.76	6.2	–14.8	2.8	1.4	–6.0	–24.9	1.4	0.8	1.1	0.9
Production	0.787	1.24	1.63	2.4	–3.6	0.8	0.4	–1.2	–7.1	0.3	0.2	0.3	0.2
Human consumption	0.784	1.29	1.72	–1.4	5.8	–0.4	–0.3	3.1	10.7	–0	–0	–0.4	–0.3
Net exports	0.004	–9.23	–16.50	–105.3	191.2	–32.0	–13.5	117.0	363.0	–10.0	–4.2	–18.6	–10.0
Dairy products:													
Price	0.142	1.07	1.25	6.3	3.6	6.1	4.5	–2.1	–2.4	3.3	2.2	2.3	3.6
Production	31.34	1.35	1.85	0.1	–0.2	–0.2	–0.3	0.5	–0.2	–0.1	–0.1	0.5	0.4
Human consumption	31.42	1.36	1.88	–1.8	–0.7	–2.6	–1.9	2.0	2.2	–1.4	–0.9	–1.3	–1.9
Net exports	–0.106	4.46	8.70	+[c]	+[c]	+[c]	+[c]	–[c]	–[c]	+[c]	+[c]	+[c]	+[c]
Other animal products:													
Price	6.889	1.28	1.46	–8.8	–16.6	3.0	1.2	–10.5	–15.3	2.5	1.9	–0.6	–0
Production	0.311	1.42	1.96	–1.3	–2.1	–1.1	–1.3	–0.5	–1.1	–0.7	–0.6	–0.2	–0.7
Human consumption	0.311	1.38	2.06	2.2	3.6	–0.2	–0.3	3.1	3.7	–0.1	–0.1	0.1	–0.1
Net exports	0.002	5.36	–14.46	–137.4	117.1	–37.0	19.8	–137.1	100.5	–25.6	8.4	–12.4	12.2
Protein feed:													
Price	0.239	0.76	0.60	–20.1	–6.9	0.6	0.9	–28.0	–19.2	0.2	+0	0.1	+0
Production	2.159	1.15	1.31	0.3	0.1	–0.5	–0.4	0.8	0.9	–0.3	–0.1	0.2	+0
Feed	1.511	1.15	1.31	0.3	0.1	–0.5	–0.4	0.8	0.9	–0.3	–0.1	0.2	+0
Net exports	0.646	1.15	1.31	0.3	0.1	–0.5	–0.4	0.8	0.9	–0.3	–0.1	0.2	+0
Other food:													
Price	0.549	1.07	1.16	11.5	11.7	1.7	1.3	7.5	8.8	1.0	0.6	0.1	0.3
Production	20.18	1.30	1.77	0.2	0.4	–0.1	–0	0.4	0.5	+0	+0	+0	+0
Human consumption	16.88	1.35	1.93	–4.6	–4.8	–0.1	–0.2	–3.8	–4.1	–0.1	–0.1	+0	–0.1
Net exports	1.242	0.63	–0.42	141.0	+[c]	0.9	+[c]	124.8	+[c]	1.9	+[c]	0.8	+[c]
Nonfood agriculture:													
Price	1.236	1.12	1.23	4.8	–6.0	4.1	+0	–0.8	–4.2	3.0	1.0	–0.6	–1.9
Production	2.203	1.21	1.42	0.3	–0.8	–0.3	–0.3	0.2	–0.5	–0.2	–0.2	–0	–0.3
Human consumption	1.659	1.11	1.32	–2.5	7.2	–2.6	0.4	1.6	5.0	–1.9	–0.6	0.6	1.8
Net exports	0.068	3.11	3.04	25.5	–86.6	18.1	–9.2	–11.8	–59.8	13.8	3.0	–4.9	–21.8
Nonagriculture:													
Production	40.02	1.78	3.51	0.1	+0	0.2	0.1	–0	–0.1	0.1	+0	–0	+0
Demand	42.72	1.75	3.40	1.2	0.7	0.6	0.5	+0	–0.1	0.3	0.2	+0	0.1
Net exports	–2.796	1.40	1.89	20.1	18.4	8.0	9.2	0.6	–0.6	3.6	3.4	0.7	2.3

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.8. Indonesia: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	12488	1.66	2.77	0.4	1.1	-0.1	0.1	0.4	0.8	-0	+0	-0	-0
GDPA70	4477	1.31	1.76	2.7	6.1	0.3	0.4	1.8	4.4	0.1	0.2	0.1	0.1
GDPNA70	8011	1.85	3.33	-0.5	-0.4	-0.3	-0	-0.2	-0.3	-0.1	-0	-0.1	-0
AG vol. index WP70	1.199	1.32	1.77	3.1	7.1	0.2	0.3	2.3	5.3	+0	0.2	+0	-0
Trade deficit 70	-170.2	0.37	0.24	-17.0	-8.8	1.9	0.9	-12.5	-7.2	1.9	0.9	-0.3	0.7
AG trade deficit 70	-0.239	-6.64	-13.12	-61.8	-53.5	-1.7	-2.6	-41.7	-49.2	1.0	-2.9	-1.5	-0.2
Investment	2219	2.21	4.25	8.2	5.5	1.1	0.6	4.6	4.1	0.5	0.2	0.1	0.1
Total capital	40946	1.66	3.05	2.3	4.4	0.4	0.5	1.3	3.0	0.1	0.2	0.1	0.1
Agricultural capital	14489	1.37	1.97	8.0	19.8	1.2	2.0	4.5	13.0	0.4	0.9	0.3	0.4
Agricultural labor	31321	1.14	1.29	1.1	1.1	0.1	-0	0.9	1.0	0.1	+0	0.1	+0
P_A/P_N	1.009	1.05	1.08	20.6	17.1	3.2	2.3	12.3	13.0	1.7	1.1	0.3	0.6
Food price index	1.022	1.06	1.12	10.6	8.3	1.8	1.4	6.0	6.0	1.0	0.6	0.3	0.5
Terms of trade	1.060	0.89	0.83	-12.0	4.4	-16.5	-8.6	0.6	6.0	-5.5	-3.2	-0.8	-1.1
Parity	0.375	0.93	0.82	21.4	22.0	3.4	2.7	12.2	15.8	1.7	1.2	0.2	0.6
Equivalent income	61.54	1.22	1.57	-2.5	-0.4	-2.6	-1.5	-0.4	0.5	-0.6	-0.2	-0.1	-0.2
Calories/capita	1840	1.14	1.29	-1.0	1.8	-0.1	+0	+0	0.3	0.2	-0.1	-0	-0
Wheat:													
Price	0.068	0.92	0.84	13.4	20.4	11.6	15.8	1.3	4.4	8.3	9.7	-0.7	0.3
Human consumption	0.460	1.69	2.89	-3.2	6.4	-1.6	-1.6	-0.9	2.9	-0.4	-0.7	-0	-0.1
Net exports	-0.583	1.66	2.71	-0.1	5.6	-0.1	-2.3	1.4	3.8	0.1	-1.1	-0.3	0.3
Rice:													
Price	0.087	1.02	1.02	27.1	15.3	2.4	1.8	14.6	8.5	0.8	0.1	-0.2	0.1
Production	15.55	1.38	2.01	8.1	12.1	-0.1	0.3	3.9	6.9	-0.4	-0	0.1	-0.2
Human consumption	14.26	1.49	2.06	-2.2	1.4	0.2	0.2	-0.7	0.4	0.4	-0	-0	+0
Net exports	-0.833	3.33	2.67	-79.9	-141.4	5.5	0.3	-38.6	-87.1	7.7	1.7	-0.4	3.3
Coarse grains:													
Price	0.044	1.22	1.18	16.3	5.9	6.6	5.9	4.5	-0.5	2.9	2.6	0.2	0.3
Production	2.985	1.07	1.32	-41.8	-61.2	3.4	3.7	-23.6	-41.0	3.4	2.9	-1.5	2.0
Human consumption	2.779	1.29	1.63	-0.3	0.7	-0.3	+0	+0	0.3	-0.3	-0.2	-0	+0
Net exports	-0.308	3.25	4.31	132.9	185.5	-10.0	-9.4	74.8	122.9	-10.0	-7.9	4.0	-4.1

Table A3.8. (Cont.)

Bovine & ovine meat:													
Price	0.465	1.30	1.55	25.6	11.7	22.1	12.6	4.2	–1.6	8.6	4.3	14.6	10.4
Production	0.305	1.41	1.92	3.7	1.1	4.1	2.3	0.5	–0.9	1.6	0.8	2.8	1.8
Human consumption	0.358	1.36	1.80	–0.9	1.5	–0.8	–0.4	0.1	0.7	–0.1	–0	–0.5	–0.3
Net exports	–0.053	1.07	1.07	–35.9	5.9	–38.5	–28.0	–2.7	17.7	–13.7	–8.3	–25.3	–21.9
Dairy products:													
Price	0.109	1.01	1.11	23.1	19.0	17.3	25.9	5.2	3.5	9.5	13.2	12.0	29.1
Production	0.060	1.48	2.34	10.6	23.9	7.5	11.2	2.0	11.4	3.7	5.5	4.5	9.7
Human consumption	0.189	1.69	2.63	–4.4	0.6	–3.0	–7.9	–0.3	1.6	–0.7	–3.1	–4.2	–9.9
Net exports	–0.170	1.69	2.55	–7.8	–7.0	–5.0	–12.5	–0.9	–2.0	–1.6	–5.3	–5.7	–14.5
Other animal products:													
Price	5.090	1.01	1.02	–3.7	–0.3	1.1	–0	–5.5	1.4	1.5	1.6	–1.1	–0.7
Production	0.213	1.32	1.72	–1.0	–0.3	+0	–0	–0.9	–0.2	0.1	0.1	–0.1	–0.1
Human consumption	0.186	1.44	2.11	–0.8	4.7	–0.5	–0.3	–0.1	1.8	0.1	–0	+0	–0
Net exports	0.020	0.12	–1.95	–[c]	50.6	+[c]	–3.4	–[c]	19.0	–[c]	–1.0	–[c]	–0.2
Protein feed:													
Price	0.328	1.08	1.14	32.1	27.0	5.5	8.4	21.0	13.9	1.9	0.1	0.6	0.1
Production	0.296	1.16	1.35	0.4	3.6	–0.2	+0	1.7	3.9	–0.1	+0	+0	+0
Feed	0.005	1.30	1.57	–10.2	–9.3	–1.4	–3.1	–10.8	–6.0	0.2	1.7	–0.4	0.1
Net exports	0.065	0.29	–0.92	28.1	8.2	6.5	–2.8	37.9	–14.7	–0.2	0.4	2.5	0.6
Other food:													
Price	0.394	1.04	1.09	21.5	22.0	1.8	1.4	16.4	18.9	1.0	0.6	0.1	0.3
Production	5.334	1.30	1.68	2.4	7.6	0.2	0.4	2.7	6.7	0.1	0.3	–0	+0
Human consumption	4.045	1.35	1.74	–0.6	0.8	–0.1	0.2	–0.2	–0	–0.1	–0.2	–0	+0
Net exports	0.271	–0.68	–2.76	–115.1	–85.2	–9.0	–4.4	–115.1	–82.5	–9.8	–6.3	–2.6	–1.2
Nonfood agriculture:													
Price	0.486	1.06	1.09	56.2	51.7	3.4	–0.6	47.8	56.4	2.6	0.6	–0.5	–2.3
Production	0.185	1.25	1.58	10.0	17.1	–2.9	–8.5	13.3	24.2	–0.5	–1.5	–0.6	–3.8
Human consumption	0.176	1.47	2.26	–4.6	1.6	–0.6	–0.3	–3.5	–2.6	+0	0.1	–0	0.2
Net exports	0.007	–4.43	–16.67	–118.0	–38.9	18.7	21.3	–134.9	–73.2	4.6	4.3	5.1	10.4
Nonagriculture:													
Production	7.942	1.87	3.39	–1.5	–1.6	–1.4	–0.7	–0.4	–0.7	–0.2	–0.1	–0.1	–0.1
Demand	7.840	1.81	3.26	0.9	1.2	–2.2	–1.0	1.5	2.0	–0.5	–0.1	–0.1	–0.1
Net exports	0.102	6.86	13.30	–50.7	–53.0	16.4	6.3	–38.2	–50.2	6.4	0.3	–0.6	0.9

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.9. Japan: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

				Agricultural trade liberalization by									
	Reference scenario[a]			*All MEs*		*All OECD*		*All LDCs*		*EC*		*USA*	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	355447	1.79	2.85	0.2	0.3	0.2	0.3	+0	+0	–0	–0.1	–0	–0.1
GDPA70	13280	1.19	1.37	–5.8	–5.6	–5.7	–5.2	–0.2	–0.3	0.3	1.2	0.1	0.7
GDPNA70	342166	1.81	2.91	0.3	0.4	0.3	0.4	+0	+0	–0	–0.1	–0	–0.1
AG vol. index WP70	1.223	1.27	1.56	1.1	0.5	1.0	1.4	–0.4	–1.0	–0.3	–0.3	–0.1	–1.5
Trade deficit 70	–2341	1.33	2.28	4.4	1.8	6.6	4.1	–1.2	–1.0	1.7	1.0	0.2	0.8
AG trade deficit 70	9.440	1.14	1.18	40.5	52.9	38.8	48.9	1.1	0.6	–0.6	–3.3	–0	–1.5
Investment	125255	1.88	3.08	–0.9	–0.4	–0.9	–0.4	+0	+0	0.1	–0.1	–0	–0.1
Total capital	1093775	2.06	3.76	–0.5	–0.6	–0.4	–0.6	+0	+0	+0	+0	–0	–0
Agricultural capital	70832	1.81	2.79	–13.5	–24.1	–12.6	–21.9	–0.3	–0.4	0.4	1.9	0.3	1.1
Agricultural labor	7831	0.75	0.58	–3.8	–5.4	–3.8	–5.4	–0.2	–0.7	0.5	2.1	0.4	1.0
P_A/P_N	1.068	1.01	1.02	–39.4	–38.5	–36.1	–35.3	–0.2	–0.9	4.0	2.7	–0	0.5
Food price index	1.081	1.07	1.12	–19.6	–20.5	–18.8	–19.2	0.4	0.3	2.6	2.0	0.2	0.6
Terms of trade	0.963	0.96	1.00	–5.4	–5.8	–9.3	–9.7	3.3	2.8	–5.1	–2.3	–0.5	–0.6
Parity	0.277	1.03	1.09	–40.7	–38.7	–37.3	–35.2	–0.2	–0.5	3.8	1.8	–0.3	0.1
Equivalent income	1986	1.58	2.32	1.3	1.3	1.1	1.1	+0	0.1	–0.2	–0.2	–0.1	–0.1
Calories/capita	2749	1.05	1.10	4.2	3.9	4.2	3.8	–0	–0.1	–0	+0	+0	–0.1
Wheat:													
Price	0.082	1.03	0.93	–14.9	–8.7	–18.6	–11.8	2.5	5.0	7.1	9.0	–0.5	1.7
Production	0.855	0.89	0.66	–8.8	–8.1	–11.9	–11.3	1.3	3.3	3.9	3.5	–1.1	–0.8
Human consumption	3.984	1.12	1.21	0.2	0.1	0.2	0.1	–0	–0	–0.2	–0.1	+0	–0
Net exports	–5.917	1.27	1.59	0.7	0.8	1.7	1.9	–0.1	–1.1	–1.6	–3.2	–0.9	–3.3
Rice:													
Price	0.450	1.01	1.06	–66.2	–67.5	–64.8	–66.3	1.9	0.1	2.7	1.6	+0	–1.1
Production	10.11	1.06	1.09	–34.4	–39.4	–31.6	–38.8	0.6	0.3	0.4	1.9	–0	0.3
Human consumption	8.296	1.00	0.98	5.7	4.4	6.4	5.1	–0.3	–0.6	1.4	0.9	–0	+0
Net exports	–0.431	1.22	1.81	1450.3	1202.9	1375.4	1172.7	–14.1	–24.5	24.8	–32.0	–7.8	–31.2
Coarse grains:													
Price	0.086	0.92	0.82	–20.9	–22.0	–23.1	–22.9	2.2	3.3	7.6	3.0	–2.5	0.8
Production	1.170	0.94	0.78	–12.9	–12.8	–15.3	–15.2	–0.4	1.0	1.6	–4.8	–2.2	–3.2
Human consumption	2.056	1.25	1.53	4.0	5.6	4.1	5.7	–0.3	–0.6	–1.9	–0.9	0.5	–0.3
Net exports	–17.42	1.56	2.18	0.9	7.3	0.7	9.1	–0.9	–3.4	–2.8	–3.3	0.5	–6.2

Table A3.9. (Cont.)

Bovine & ovine meat:													
Price	0.714	1.32	1.59	−19.2	−29.1	−18.0	−25.6	3.7	−2.5	11.0	6.3	18.8	13.6
Production	0.510	1.25	1.48	−3.6	−12.3	−2.2	−10.3	−0.7	−1.1	0.9	2.8	2.2	2.6
Human consumption	0.820	1.17	1.32	3.3	6.2	2.9	5.3	−0.6	0.5	−2.0	−1.1	−2.3	−1.6
Net exports	−0.323	1.05	1.05	16.3	47.2	12.5	39.8	−0.2	4.3	−7.3	−9.6	−10.9	−10.8
Dairy products:													
Price	0.150	0.98	0.97	−27.4	−19.9	−27.3	−20.7	1.3	1.1	2.5	0.7	1.7	1.8
Production	6.520	1.43	1.80	7.1	1.5	3.8	−0.5	0.3	0.4	−1.2	1.2	2.9	3.1
Human consumption	7.245	1.31	1.60	4.8	3.7	4.5	3.6	−0.1	−0	−0.9	−0.3	−0.3	−0.3
Net exports	−1.065	0.62	0.38	−26.2	69.8	14.1	127.9	−5.4	−13.2	3.3	−44.1	−43.7	−98.8
Other animal products:													
Price	5.777	0.96	0.90	−23.6	−21.3	−23.6	−20.9	1.4	2.2	5.5	3.7	−2.4	0.4
Production	1.581	1.35	1.76	10.0	13.2	9.0	13.7	−0.3	−1.3	−1.0	−2.0	−0.5	−3.5
Human consumption	1.400	1.29	1.57	4.8	6.0	4.4	5.6	−0.1	−0.3	−1.3	−1.1	0.3	−0.1
Net exports	0.064	2.74	6.11	50.2	44.3	45.0	49.6	−2.7	−6.0	2.9	−5.2	−8.3	−20.0
Protein feed:													
Price	0.228	0.98	0.91	−48.7	−45.2	−49.6	−45.2	2.5	1.5	5.6	1.7	−0.1	1.4
Production	0.746	1.37	1.67	−7.3	−7.2	−8.8	−7.5	−0.2	0.3	1.3	−2.7	−1.2	−0.7
Feed	1.896	1.44	1.94	54.3	53.8	51.9	54.9	−0.9	−2.3	−1.7	−3.3	−1.9	−8.5
Net exports	−2.259	1.29	1.65	53.6	55.8	51.9	56.9	−0.8	−2.4	−1.9	−2.2	−1.4	−8.1
Other food:													
Price	1.000	1.01	1.02	−28.9	−28.3	−24.2	−22.8	−2.3	−3.4	2.5	0.9	0.2	−0.2
Production	4.857	1.21	1.40	−3.1	−12.5	−2.4	−10.4	−1.0	−1.1	0.6	2.2	−0	1.0
Human consumption	5.488	1.16	1.26	9.3	6.0	9.2	6.0	0.3	−0	1.7	1.3	−0	+0
Net exports	−1.590	1.10	1.13	49.7	76.0	46.2	67.7	4.4	3.6	4.1	−3.9	−0.4	−5.4
Nonfood agriculture:													
Price	1.669	1.07	1.09	−49.9	−52.3	−39.6	−43.7	−5.9	−5.7	2.5	0.8	−0.7	−2.3
Production	0.568	1.13	1.24	−7.0	−11.5	−4.0	−8.4	−1.3	−1.4	0.4	1.6	−0.1	−0.3
Human consumption	1.755	1.12	1.20	0.6	0.6	0.3	0.4	0.1	0.1	−0.2	−0.1	+0	+0
Net exports	−1.190	1.11	1.19	4.4	6.7	2.6	4.9	0.7	0.8	−0.4	−1.0	0.2	0.2
Nonagriculture:													
Production	342.6	1.81	2.91	0.4	0.5	0.4	0.4	+0	+0	−0	−0.1	−0	−0.1
Demand	336.7	1.82	2.93	+0	0.2	−0	0.1	+0	0.1	−0.1	−0.1	−0.1	−0.1
Net exports	5.915	1.25	1.62	+[c]	+[c]	+[c]	+[c]	−[c]	−[c]	+[c]	+[c]	+[c]	+[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.10. Kenya: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

				Agricultural trade liberalization by									
	Reference scenario[a]			All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	2521	1.58	2.37	1.7	3.2	0.9	1.8	0.6	1.3	0.3	0.7	0.4	0.9
GDPA70	629.4	1.52	2.34	5.5	10.0	2.8	5.3	2.1	4.3	0.7	2.1	1.1	2.6
GDPNA70	1892	1.60	2.38	0.5	1.0	0.4	0.6	0.2	0.4	0.1	0.3	0.1	0.3
AG vol. index WP70	1.458	1.49	2.28	1.1	7.6	0.1	4.4	1.0	3.2	–0.6	1.8	–1.1	0.6
Trade deficit 70	142.9	1.89	2.64	–5.3	–2.1	–4.4	–1.4	–2.0	–0.9	–2.3	–0.4	–1.4	–1.3
AG trade deficit 70	–23.43	1.37	2.63	–6.8	24.5	–8.6	13.8	0.1	10.2	–6.7	5.3	–8.4	–1.4
Investment	597.2	1.73	2.71	8.4	8.5	5.6	5.1	3.1	3.7	2.6	2.4	2.0	3.2
Total capital	6332	1.96	3.43	3.2	6.1	2.2	3.8	1.0	2.4	0.8	1.7	0.9	2.0
Agricultural capital	949.9	1.64	2.74	9.5	19.4	6.5	11.8	3.1	7.4	2.4	5.3	2.6	6.3
Agricultural labor	4576	1.28	1.66	0	0	0	0	0	0	0	0	0	0
P_A/P_N	1.063	1.12	1.20	20.5	15.2	14.8	10.6	7.9	7.1	8.1	5.8	6.5	8.0
Food price index	0.143	1.09	1.15	19.0	15.0	12.9	10.4	7.5	6.9	6.3	4.8	7.5	9.5
Terms of trade	1.145	1.07	1.12	–1.2	–2.9	8.2	4.3	–8.1	–7.1	5.1	2.5	2.0	2.9
Parity	0.096	1.23	1.49	26.4	25.5	17.6	15.7	10.0	11.3	8.7	7.8	7.5	10.5
Calories/capita	2495	1.08	1.12	2.6	3.1	1.9	1.8	1.0	1.3	0.9	1.0	0.6	1.4
Wheat:													
Price	0.064	0.98	0.89	5.8	11.9	10.9	18.4	–7.0	–4.8	6.8	8.7	–0.4	1.6
Production	0.154	1.30	1.47	–15.4	3.5	–0.2	15.7	–16.3	–9.5	2.6	11.5	–8.8	–5.7
Human consumption	0.184	1.56	2.38	4.3	3.6	1.4	–0	3.7	3.8	0.3	–0.1	1.2	1.9
Net exports	–0.065	2.17	4.51	29.9	1.4	3.0	–13.6	30.4	13.2	–2.6	–9.4	13.3	6.7
Rice:													
Price	0.107	1.01	1.06	21.9	16.4	27.7	21.0	3.2	1.3	5.9	1.5	–1.0	0.2
Production	0.030	1.53	2.38	–0.1	2.9	10.7	8.6	–2.9	–3.7	–2.0	–2.1	–4.3	–5.2
Human consumption	0.023	1.67	2.49	1.7	3.0	1.2	1.9	0.7	1.2	0.4	0.8	0.2	0.7
Net exports	0.001	–1.43	–0.68	–2.4	+[c]	–258.8	+[c]	59.0	–[c]	65.5	–[c]	96.0	–[c]
Coarse grains:													
Price	0.038	0.97	0.86	16.8	12.6	13.4	11.0	2.8	4.2	7.4	3.7	–1.5	0.8
Production	1.844	1.25	1.48	–5.9	0.8	–1.5	2.7	–5.8	–1.5	0.2	0.9	–7.9	–3.8
Human consumption	2.024	1.52	2.24	3.2	3.8	2.5	2.3	1.1	1.5	1.3	1.4	0.7	1.8
Net exports	–0.275	3.40	7.41	23.5	6.8	11.5	1.7	16.4	4.7	4.0	2.3	21.4	8.9

Table A3.10. (Cont.)

Bovine & ovine meat:													
Price	0.402	1.41	1.69	67.6	48.5	27.7	17.2	37.3	29.9	11.1	6.9	18.8	14.3
Production	0.212	1.83	2.99	32.7	28.8	14.0	11.0	18.9	17.3	5.3	3.6	11.5	9.9
Human consumption	0.260	1.54	2.25	7.8	5.4	4.5	2.6	3.8	3.0	1.7	0.7	1.3	1.4
Net exports	-0.048	0.28	-0.98	-696.8	321.6	-264.8	115.7	-423.6	196.6	-98.8	39.1	-288.3	116.2
Dairy products:													
Price	0.075	1.23	1.37	10.3	7.4	34.7	30.7	-11.0	-10.5	18.9	14.9	28.8	39.0
Production	0.806	1.74	2.76	14.5	15.2	15.7	15.1	2.4	3.6	7.6	6.5	13.6	17.6
Human consumption	0.928	1.63	2.41	3.8	3.3	5.4	4.7	0.6	0.6	2.4	2.3	1.7	4.5
Net exports	-0.132	0.95	0.31	-118.0	+[c]	-111.5	+[c]	-20.5	+[c]	-55.9	+[c]	-132.9	+[c]
Other animal products:													
Price	7.904	1.05	1.06	-1.5	-5.3	3.5	-0.1	-3.6	-3.6	4.8	5.2	-3.3	-2.2
Production	0.010	1.60	2.59	-9.8	-7.4	-2.9	-2.5	-7.1	-5.1	0.8	2.5	-4.4	-3.5
Human consumption	0.011	1.67	2.61	3.9	6.0	2.3	3.3	1.5	2.5	0.8	1.5	0.7	1.6
Net exports	-0.001	2.45	2.85	96.2	131.9	37.2	57.9	59.6	74.7	0.5	-8.4	35.3	49.7
Protein feed:													
Price	0.302	0.99	0.95	16.7	18.8	8.7	12.8	7.2	6.4	2.9	0.2	0.9	0.3
Production	0.003	1.60	2.63	1.4	7.4	0.1	4.9	0.8	2.3	-0.8	0.9	-1.3	0.1
Feed	0.003	1.65	2.41	-11.4	-9.9	1.5	-1.1	-12.1	-7.7	5.7	7.0	-6.0	-2.2
Net exports	-0.000	1.67	-1.36	-143.4	376.1	15.9	141.5	-144.7	208.0	74.2	-116.5	-49.7	43.1
Other food:													
Price	0.448	1.01	1.05	9.6	7.3	5.9	4.9	5.4	4.2	3.2	2.4	0.3	1.1
Production	0.818	1.42	2.24	-4.4	6.0	-4.7	3.4	-0.3	2.4	-3.5	1.1	-4.3	-1.9
Human consumption	0.582	1.46	2.09	0.9	1.4	0.4	0.8	0.3	0.6	+0	0.3	-0.1	0.2
Net exports	0.233	1.31	2.62	-19.0	15.1	-18.8	8.7	-2.1	6.0	-13.2	2.7	-16.1	-6.3
Nonfood agriculture:													
Price	0.632	1.23	1.27	-0.6	-7.7	7.9	-1.8	-5.3	-4.7	6.6	2.0	-1.9	-5.8
Production	0.143	1.58	2.22	-6.0	-7.7	1.1	-3.2	-6.0	-5.0	1.9	-0.1	-1.1	-4.3
Human consumption	0.029	1.54	2.25	6.4	6.9	3.0	3.8	4.0	3.5	1.0	1.4	2.1	3.5
Net exports	0.114	1.59	2.21	-9.1	-11.5	0.6	-5.1	-8.5	-7.2	2.2	-0.5	-1.9	-6.4
Nonagriculture:													
Production	1.893	1.60	2.38	0.5	1.0	0.4	0.6	0.2	0.4	0.1	0.3	0.1	0.3
Demand	2.237	1.61	2.47	-0.2	3.1	0.3	2.6	-0.6	0.5	-0	1.2	-0.3	0.7
Net exports	-0.344	1.68	2.93	-4.2	12.5	-0.1	11.7	-4.9	1.0	-0.8	5.3	-2.4	2.2

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.11. Mexico: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	53884	1.70	2.72	-1.6	-4.1	-1.0	-2.1	-0.2	-1.6	-0.5	-0.8	-0.2	-0.4
GDPA70	4347	1.46	2.11	0.9	1.4	1.9	3.6	-1.8	-3.2	0.7	1.8	0.3	0.5
GDPNA70	49537	1.73	2.77	-1.8	-4.4	-1.2	-2.4	-0.1	-1.4	-0.6	-1.0	-0.2	-0.4
AG vol. index WP70	1.363	1.46	2.11	0.6	2.2	2.4	4.2	-2.2	-2.7	1.1	1.9	0.3	0.8
Trade deficit 70	781.5	0.50	0.56	-4.4	-8.8	-3.5	-4.3	0.5	-2.6	-1.3	-1.4	-0.6	-0.4
AG trade deficit 70	-25.72	1.13	1.71	28.5	54.8	59.1	75.8	-28.4	-22.3	32.7	32.1	0.5	14.9
Investment	11714	1.78	2.95	-1.1	-4.4	-0.3	-2.1	-0.4	-1.9	+0	-0.8	-0.2	-0.3
Total capital	140639	1.82	3.20	-0.1	-2.0	+0	-1.0	-0.1	-0.8	+0	-0.5	-0	-0.1
Agricultural capital	15566	1.67	2.66	0.6	-0.9	2.4	3.4	-2.7	-5.6	1.1	2.0	0.4	0.6
Agricultural labor	10660	1.13	1.31	4.5	11.9	2.8	6.1	0.9	4.7	1.3	2.1	0.4	1.1
P_A/P_N	1.219	1.05	1.08	0.4	-4.7	4.6	-0.7	-5.0	-4.8	3.5	0.6	0.3	0.3
Food price index	1.132	1.05	1.08	-1.4	-3.6	2.1	-0.4	-4.0	-3.8	1.6	0.1	0.4	0.6
Terms of trade	1.099	1.04	1.07	4.5	2.7	5.1	1.4	-2.3	-0.9	3.8	3.9	-1.3	0.6
Parity	0.124	1.27	1.52	-4.0	-14.8	3.1	-3.4	-8.0	-12.6	2.7	0.3	0.1	-0.3
Equivalent income	654.8	1.21	1.39	-1.8	-4.0	-0.9	-1.9	-0.5	-1.7	-0.4	-0.5	-0.2	-0.4
Calories/capita	2487	1.02	1.04	+0	0.2	-0.8	-0.5	0.4	0.3	-0.5	-0.3	0.1	-0.1
Wheat:													
Price	0.064	1.01	0.91	16.4	24.6	17.2	18.5	3.9	7.9	11.6	10.2	-1.1	1.5
Production	2.799	1.41	1.91	9.4	14.4	7.6	11.3	3.0	4.2	4.9	5.4	-0.3	1.5
Human consumption	2.182	1.48	2.16	-3.5	-3.8	-3.9	-3.2	-0.8	-1.5	-2.4	-2.0	0.5	-0.2
Net exports	-0.423	2.43	5.34	-62.0	-57.7	-51.2	-40.9	-26.2	-24.0	-37.1	-22.1	4.4	-3.4
Rice:													
Price	0.176	1.09	1.22	-1.5	-11.1	8.2	0.6	-15.6	-21.8	2.4	-2.4	-0.6	-0.3
Production	0.368	1.52	2.22	-0.5	-1.9	4.4	4.0	-8.8	-13.3	-0.4	0.9	0.6	0.3
Human consumption	0.314	1.50	2.18	-2.0	0.1	-4.2	-2.1	2.7	3.9	-2.0	-0.9	0.6	-0
Net exports	-0.022	1.66	2.68	-21.3	10.2	-78.0	-74.2	153.4	198.1	-21.2	-17.5	3.4	-5.9
Coarse grains:													
Price	0.065	1.03	0.99	8.5	7.2	5.9	4.2	-1.2	3.9	3.3	1.8	-0.8	0.5
Production	16.38	1.30	1.83	11.0	13.1	7.3	8.5	6.7	7.6	6.1	1.5	-2.0	1.8
Human consumption	6.058	1.35	1.81	0.6	0.6	0.5	0.4	-0.1	0.1	0.3	0.2	-0.1	+0
Net exports	1.164	-2.02	-4.88	-116.0	-78.7	-56.1	-30.3	-86.7	-68.7	-54.9	1.2	23.7	-6.3

Table A3.11. (Cont.)

Bovine & ovine meat:													
Price	0.798	1.09	1.18	14.9	11.7	4.7	-3.6	-0.9	1.8	2.6	-1.1	3.8	2.4
Production	0.787	1.40	1.97	6.9	12.3	2.7	4.7	0.9	3.2	0.9	1.5	1.5	1.3
Human consumption	0.800	1.40	1.93	-0.9	-0.8	-0.7	-0.2	-0	-0.3	-0.4	-0.2	-0	-0.1
Net exports	-0.043	1.56	1.84	-129.7	-259.3	-56.6	-98.5	-16.3	-69.4	-21.4	-33.1	-25.6	-28.5
Dairy products:													
Price	0.076	0.94	0.91	15.7	17.6	4.7	-0.6	12.2	16.9	3.4	-0.9	4.4	7.9
Production	6.199	1.57	2.37	4.2	5.4	1.8	3.1	0.9	0.1	0.5	1.4	2.0	2.9
Human consumption	6.157	1.52	2.24	-4.1	-4.2	-3.1	-1.6	-2.0	-3.1	-1.9	-1.1	-0.2	-1.2
Net exports	-0.287	0.49	-0.35	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]	+[c]
Other animal products:													
Price	7.797	1.01	1.02	-10.3	-13.2	1.2	-0.1	-12.3	-11.6	1.4	1.4	-1.0	-0.7
Production	0.200	1.81	3.02	-8.3	-8.9	-1.6	0.4	-8.5	-10.7	-1.8	2.2	0.7	-0.3
Human consumption	0.161	1.50	2.19	0.5	1.4	-2.6	-1.5	2.6	1.9	-1.6	-1.4	0.6	0.1
Net exports	0.031	3.40	7.39	-28.8	-24.9	0.6	3.4	-34.2	-30.3	-2.2	7.8	0.9	-1.0
Protein feed:													
Price	1.887	0.99	0.95	17.1	21.1	10.9	13.4	8.3	9.3	3.8	1.1	0.2	1.1
Production	0.347	1.48	2.09	1.2	3.2	2.2	4.8	-1.5	-2.4	0.4	1.9	0.4	0.7
Feed	0.458	1.86	3.14	-13.5	-16.3	-4.0	-4.0	-14.3	-14.9	-1.7	3.5	0.3	-0.6
Net exports	-0.145	2.76	5.54	-31.0	-33.1	-11.2	-11.6	-29.9	-25.7	-4.0	5.0	0.1	-1.7
Other food:													
Price	0.743	1.05	1.10	-11.7	-17.5	3.6	-1.2	-12.8	-14.6	3.1	-0.3	0.3	0.4
Production	2.830	1.41	1.96	-3.1	-0.8	2.0	4.2	-5.3	-5.4	0.5	1.8	0.3	0.7
Human consumption	2.125	1.41	1.94	1.1	1.6	-0.5	-0.1	1.3	1.3	-0.3	-0	0.1	+0
Net exports	0.321	1.27	1.77	-37.8	-19.5	21.5	39.1	-57.9	-58.7	7.0	16.7	2.1	6.2
Nonfood agriculture:													
Price	1.128	1.22	1.34	32.4	17.0	7.5	-3.5	26.1	20.7	6.3	0.8	-1.8	-5.8
Production	0.429	1.25	1.54	11.3	16.1	3.8	5.2	7.2	8.9	1.9	2.4	0.2	-0.5
Human consumption	0.313	1.37	1.87	0.7	0.5	0.3	+0	0.4	0.3	0.2	0.1	-0.1	-0.1
Net exports	0.095	0.85	0.46	67.0	220.9	21.0	72.5	43.8	121.9	10.6	33.3	1.3	-4.8
Nonagriculture:													
Production	51.66	1.73	2.77	-1.8	-4.5	-1.0	-2.3	-0.4	-1.8	-0.4	-0.8	-0.2	-0.4
Demand	52.78	1.70	2.74	-1.7	-4.3	-0.7	-1.9	-0.6	-1.9	-0.2	-0.6	-0.2	-0.4
Net exports	-1.123	0.74	1.06	-[c]	-[c]	-[c]	-[c]	+[c]	+[c]	-[c]	-[c]	+[c]	-[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.12. New Zealand: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

				Agricultural trade liberalization by									
	Reference scenario[a]			*All MEs*		*All OECD*		*All LDCs*		*EC*		*USA*	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	9912	1.40	1.86	1.3	1.3	1.4	1.6	0.1	–0.2	0.4	0.6	0.9	1.0
GDPA70	1523	1.23	1.46	9.8	10.8	10.3	14.0	0.6	–1.7	2.9	4.7	6.7	8.5
GDPNA70	8389	1.43	1.94	+0	–0	+0	–0	+0	–0	+0	+0	+0	–0
AG vol. index WP70	1.170	1.20	1.40	7.4	9.9	7.9	12.5	0.4	–0.9	2.5	4.7	4.8	8.0
Trade deficit 70	289.1	0.30	–0.01	–14.8	82.5	–15.9	123.0	–1.3	–17.6	–5.3	–166.9	–9.9	1.5
AG trade deficit 70	–1038	1.17	1.31	12.2	16.9	14.3	23.2	–0.4	–3.2	4.3	8.4	7.9	13.4
Investment	2508	1.50	2.09	6.2	3.5	7.4	5.6	0.3	–1.0	3.0	2.2	4.4	4.3
Total capital	34039	1.63	2.49	2.5	3.6	2.7	4.5	0.2	–0.1	1.0	1.8	1.6	3.1
Agricultural capital	4924	1.60	2.47	16.0	23.9	17.1	29.9	1.4	–0.5	6.0	11.8	10.2	20.5
Agricultural labor	121.4	0.92	0.85	1.0	2.2	1.0	2.6	0.1	+0	0.4	1.1	0.7	1.8
P_A/P_N	0.984	1.34	1.56	19.3	8.4	25.2	15.8	+0	–3.1	13.1	8.4	16.3	15.2
Food price index	1.242	1.09	1.16	12.4	9.6	10.6	9.1	4.0	3.1	5.8	5.2	9.4	11.9
Terms of trade	1.042	1.23	1.38	19.9	11.7	24.2	16.6	0.8	–1.2	11.8	7.7	16.1	16.7
Parity	1.709	1.50	1.96	29.7	17.4	36.6	28.5	0.5	–4.7	15.8	12.2	23.2	22.6
Calories/capita	3519	1.02	1.05	0.7	0.8	0.4	0.5	0.3	0.3	0.1	0.2	0.3	0.5
Wheat:													
Price	0.065	0.98	0.89	16.4	23.1	10.9	18.4	2.3	4.7	6.8	8.7	–0.4	1.6
Production	0.423	0.86	0.74	–1.5	12.4	–5.5	5.1	1.5	8.1	–0.4	5.1	–12.1	–6.3
Human consumption	0.244	1.11	1.22	–0.1	–0.4	0.1	–0.3	+0	0.1	0.3	0.1	–0.3	–0.4
Net exports	0.064	–0.48	–1.98	–59.0	–46.9	–12.8	–30.0	–13.5	–17.1	0.1	–8.9	108.5	10.9
Rice:													
Price	0.246	1.01	1.06	21.9	16.4	27.7	21.0	3.2	1.3	5.9	1.5	–1.0	0.2
Human consumption	0.006	1.38	1.80	1.2	1.1	1.4	1.3	0.1	–0.2	0.3	0.5	0.8	0.8
Net exports	–0.006	1.38	1.80	1.2	1.1	1.4	1.3	0.1	–0.2	0.3	0.5	0.8	0.8
Coarse grains:													
Price	0.057	0.97	0.86	16.8	12.6	13.4	11.0	2.8	4.2	7.4	3.7	–1.5	0.8
Production	1.076	0.90	0.75	2.6	27.0	–3.7	15.5	–0	14.3	1.5	6.2	–25.2	–4.3
Human consumption	0.012	1.03	1.04	–0.4	–0.3	0.7	–0.2	–0.8	–0.2	1.0	0.4	–1.3	0.2
Net exports	0.567	0.75	0.34	29.8	155.7	16.1	111.5	–0.4	52.3	4.4	15.2	–46.6	–9.6

Table A3.12. (Cont.)

Bovine & ovine meat:													
Price	0.644	1.41	1.69	25.7	11.4	27.7	17.2	3.0	-2.6	11.1	6.9	18.8	14.3
Production	1.222	1.32	1.62	13.0	9.9	14.0	14.9	0.3	-4.4	3.3	3.9	9.5	7.0
Human consumption	0.304	1.18	1.37	1.3	1.6	0.5	0.8	0.7	0.8	0.1	0.2	0.6	1.0
Net exports	0.706	1.35	1.64	21.6	16.5	23.5	25.2	0.3	-7.8	5.6	6.6	15.9	11.7
Dairy products:													
Price	0.059	1.23	1.37	37.9	34.2	34.7	30.7	11.3	11.9	18.9	14.9	28.8	39.0
Production	6.135	1.21	1.38	10.7	17.6	10.9	18.5	2.1	3.3	4.8	8.1	7.1	16.4
Human consumption	1.453	1.19	1.39	0.4	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.2	0.4
Net exports	3.903	1.22	1.37	15.5	26.0	15.8	27.1	3.0	5.2	6.8	11.7	10.1	24.1
Other animal products:													
Price	8.417	1.05	1.06	-13.8	-17.1	-13.7	-16.8	1.2	1.2	4.8	5.2	-3.3	-2.2
Production	0.026	1.04	1.19	-23.0	-17.6	-24.3	-19.3	0.7	2.7	-2.7	2.4	-9.7	-5.5
Human consumption	0.017	1.16	1.35	1.3	1.4	1.2	1.2	0.2	0.2	-0	-0.1	0.5	0.6
Net exports	0.008	0.78	0.86	-97.2	-78.2	-102.1	-84.7	2.4	11.0	-10.7	10.2	-41.1	-25.1
Protein feed:													
Price	0.141	0.99	0.95	10.9	12.9	8.7	12.8	1.9	1.0	2.9	0.2	0.9	0.3
Production	0.075	1.25	1.47	10.9	13.0	11.4	15.9	1.2	-0.5	3.8	5.9	7.7	11.2
Feed	0.046	1.05	1.18	-21.6	-16.5	-22.8	-18.1	0.7	2.8	-1.9	3.3	-9.8	-4.5
Net exports	0.026	1.58	1.94	48.9	45.4	51.5	53.1	1.8	-3.9	10.6	9.0	28.3	28.8
Other food:													
Price	0.898	1.01	1.05	-1.3	-3.4	5.9	4.9	-5.1	-6.2	3.2	2.4	0.3	1.1
Production	0.300	0.98	1.05	-12.6	-6.0	-10.2	-3.7	-4.6	-2.5	-5.1	-1.3	-9.0	-5.5
Human consumption	0.255	1.21	1.45	0.9	1.1	0.5	0.7	0.4	0.4	0.1	0.2	0.5	0.7
Net exports	0.032	-1.04	-2.41	117.2	29.3	92.1	18.1	44.1	12.0	45.0	6.5	82.1	25.6
Nonfood agriculture:													
Price	0.916	1.23	1.27	-10.6	-16.9	7.9	-1.8	-14.8	-14.3	6.6	2.0	-1.9	-5.8
Production	0.417	1.26	1.48	11.6	13.6	12.2	16.5	1.2	-0.5	4.0	6.0	8.1	11.6
Human consumption	0.073	1.51	2.16	25.9	23.4	12.8	13.1	13.9	12.3	4.2	4.6	14.2	17.7
Net exports	0.345	1.20	1.34	7.8	10.3	12.1	17.7	-2.2	-4.9	4.0	6.4	6.5	9.5
Nonagriculture:													
Production	8.767	1.43	1.94	+0	-0	+0	-0	+0	-0	+0	+0	+0	-0
Demand	9.922	1.40	1.87	3.2	2.6	3.8	3.7	+0	-0.4	1.5	1.5	2.3	2.8
Net exports	-1.155	1.16	1.38	32.6	31.0	39.5	44.0	0.4	-4.2	15.8	17.2	24.0	33.3

[a] 1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b] See note on page 307.

Table A3.13. Nigeria: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

				Agricultural trade liberalization by									
	Reference scenario[a]			All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	15617	2.03	3.89	0.4	0.6	0.8	1.2	-0.5	-1.7	0.2	0.5	0.2	0.3
GDPA70	5219	1.44	1.93	2.6	-1.3	3.0	6.5	-0.7	-6.5	0.8	3.3	0.9	1.2
GDPNA70	10399	2.33	4.88	-0.3	-0.5	0.1	0.1	-0.4	-0.7	+0	-0.1	-0	0.1
AG vol. index WP70	1.270	1.48	2.08	2.9	0.1	2.6	6.1	-0.1	-4.6	0.5	2.8	0.8	1.3
Trade deficit 70	-349.2	0.34	0.36	0	2.1	-0.9	0.8	2.5	1.9	0.8	0.4	-0.9	0.7
AG trade deficit 70	879.6	2.43	4.69	8.3	5.6	-14.4	-20.8	7.8	23.0	-4.3	-10.3	-4.4	-4.7
Investment	3981	2.45	5.01	0.9	-1.8	2.7	2.2	-2.0	-3.6	0.8	1.1	0.6	0.5
Total capital	25904	2.80	6.50	0.7	-0.7	1.2	2.2	-0.6	-2.6	0.3	1.0	0.4	0.5
Agricultural capital	4012	2.01	3.44	2.2	-3.6	3.9	8.5	-2.3	-10.0	0.9	3.8	1.2	1.8
Agricultural labor	17435	1.07	1.09	2.3	-1.1	2.2	4.8	-0.2	-4.9	0.5	2.2	0.8	1.2
P_A/P_N	1.311	1.16	1.30	-4.0	-8.6	4.8	0.3	-7.9	-8.8	2.2	0.6	0.4	0.3
Food price index	1.229	1.13	1.23	-5.4	-8.2	3.0	0.9	-8.1	-9.3	1.5	0.9	0.2	0.2
Terms of trade	0.949	0.94	0.93	-10.1	-8.8	-10.0	-7.8	-1.5	-1.7	-6.2	-5.3	-2.1	-3.8
Parity	0.583	1.00	1.02	-5.2	-7.9	3.8	-0.9	-7.9	-7.2	2.1	0.4	-0.2	-0.5
Equivalent income	144.3	1.35	1.77	0.7	0.3	+0	1.5	0.6	-0.5	-0.3	0.3	+0	0.1
Calories/capita	2254	1.21	1.41	1.1	1.1	-0.5	0.4	1.5	1.3	-0.4	-0.1	+0	-0
Wheat:													
Price	0.096	1.02	0.92	-24.3	-18.6	16.5	18.8	-32.4	-29.5	10.9	10.1	-1.1	1.7
Production	0.021	1.12	1.12	-30.8	-32.8	11.5	14.6	-37.0	-40.0	7.5	7.9	-0.2	2.2
Human consumption	0.931	4.25	10.23	4.8	2.1	-4.9	-1.0	8.0	3.5	-3.7	-1.6	+0	-0.3
Net exports	-0.981	4.22	10.18	4.6	1.8	-5.0	-1.1	7.8	3.2	-3.8	-1.7	+0	-0.3
Rice:													
Price	0.226	1.21	1.38	-43.9	-50.2	-1.3	-2.4	-51.8	-56.1	-0.6	-1.1	-0.5	-0.7
Production	0.442	2.09	3.82	-13.8	-20.2	2.1	6.5	-20.3	-27.8	0.4	2.9	0.9	1.5
Human consumption	0.549	2.86	5.89	9.6	12.6	-0.9	1.9	12.8	13.8	-0.9	0.5	-0	0.1
Net exports	-0.183	4.57	10.56	33.6	39.5	-3.7	-1.9	47.3	48.1	-2.3	-1.4	-1.0	-1.0
Coarse grains:													
Price	0.060	1.04	1.06	-9.4	-19.6	9.4	-0.6	-16.8	-24.4	5.0	1.0	-1.4	-0.5
Production	7.616	1.24	1.46	-1.2	-9.0	4.5	4.4	-6.9	-15.3	2.0	2.4	0.1	1.1
Human consumption	6.082	1.17	1.45	-3.4	0.5	0.7	-2.2	0.5	0.8	0.5	0.2	0.1	+0
Net exports	-0.593	1.22	2.82	-54.4	21.7	-26.6	-23.7	32.9	60.0	-7.7	-4.2	-2.4	-2.8

Table A3.13. (Cont.)

Bovine & ovine meat:													
Price	0.760	1.53	2.09	–22.3	–39.7	12.4	2.7	–35.7	–47.0	5.2	0.5	8.2	4.9
Production	0.542	1.52	2.11	–7.6	–18.7	5.3	5.9	–15.1	–25.5	1.9	2.2	3.5	2.7
Human consumption	0.728	1.56	2.27	1.4	2.5	–0.8	0.4	1.9	3.0	–0.4	0.1	–0.5	–0.3
Net exports	–0.186	1.65	2.72	25.9	50.6	–17.3	–12.0	47.8	67.5	–6.7	–4.8	–11.2	–7.2
Dairy products:													
Price	0.131	1.62	2.17	–36.1	–49.2	–2.4	–2.1	–45.4	–55.8	–0.9	–1.1	–1.3	–1.2
Production	0.364	1.57	2.25	–7.0	–15.5	2.7	5.2	–12.6	–21.6	0.7	2.2	1.6	1.6
Human consumption	0.854	2.43	4.61	7.0	12.1	–0.5	2.2	9.2	13.8	–0.7	0.5	0.1	0.2
Net exports	–0.612	2.81	5.66	8.4	15.4	–1.2	1.7	12.8	18.8	–0.9	0.4	–0.4	–0.2
Other animal products:													
Price	6.696	1.08	1.10	–50.9	–53.2	3.3	–0.2	–51.9	–52.4	4.6	5.0	–3.3	–2.1
Production	0.085	1.51	2.20	–11.7	–14.7	1.1	2.3	–12.2	–15.2	0.8	1.8	–0.2	+0
Human consumption	0.157	1.98	3.21	7.0	5.9	–0.6	0.8	6.6	5.5	–0.8	–0.3	0.3	0.2
Net exports	–0.076	2.51	4.32	19.3	17.5	–1.7	–0	19.1	17.0	–1.8	–1.5	0.7	0.3
Protein feed:													
Price	0.339	1.00	0.96	55.9	59.3	12.0	14.5	42.5	41.7	4.4	2.1	–0	2.1
Production	0.125	1.24	1.52	7.0	5.3	3.1	7.0	3.3	–0.6	0.5	2.6	0.8	1.3
Feed	0.005	1.94	3.44	–58.1	–65.6	–0.4	–5.8	–58.5	–64.5	2.2	4.0	–1.1	–2.3
Net exports	0.049	0.67	0.11	39.6	338.9	12.0	194.8	28.3	194.2	2.3	53.1	4.0	33.4
Other food:													
Price	0.858	1.09	1.13	5.8	4.9	3.6	1.2	3.3	5.1	1.3	0.9	0.2	–0
Production	9.048	1.49	2.09	4.6	2.6	2.4	6.4	1.9	–2.1	0.4	2.9	0.8	1.3
Human consumption	6.850	1.49	2.10	–0.3	–0.6	–0	0.3	–0.5	–0.8	–0	0.1	–0	+0
Net exports	–0.226	1.72	3.26	–127.9	–66.1	–62.3	–116.1	–64.7	19.8	–11.2	–54.1	–20.7	–24.5
Nonfood agriculture:													
Price	0.731	1.31	1.73	1.0	–25.9	1.0	–0.4	–3.7	–23.6	0.7	0.6	–0.3	–1.8
Production	0.121	1.50	2.09	–2.4	–18.0	2.3	5.2	–8.0	–22.2	0.8	2.4	1.5	1.4
Human consumption	0.135	1.74	2.63	0.2	1.9	–0.5	0.7	–0	1.4	–0.4	+0	–0	0.1
Net exports	–0.026	2.80	5.13	6.7	39.5	–7.0	–7.9	19.6	45.8	–3.3	–4.6	–3.7	–2.2
Nonagriculture:													
Production	12.80	2.16	4.30	0.4	–0.2	1.3	1.4	–0.7	–1.3	0.4	0.5	0.2	0.3
Demand	11.70	2.20	4.40	0.2	–1.3	1.7	2.3	–1.3	–3.0	0.3	0.9	0.3	0.4
Net exports	1.107	1.70	3.19	2.6	15.0	–4.4	–12.8	8.6	23.7	2.0	–4.9	–2.2	–0.8

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307.

Table A8.14. Pakistan: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	14510	1.51	2.19	1.8	3.1	0.3	–0.1	1.5	3.3	0.2	+0	+0	–0.1
GDPA70	4108	1.41	1.93	–0.6	–0.9	2.0	3.2	–3.5	–8.9	1.0	1.6	0.4	1.0
GDPNA70	10403	1.55	2.30	2.6	4.4	–0.3	–1.2	3.4	7.4	–0	–0.5	–0.1	–0.5
AG vol. index WP70	1.210	1.44	2.01	2.6	3.0	3.3	4.1	–1.2	–8.0	2.0	2.2	0.2	1.2
Trade deficit 70	1182	1.74	2.40	–0.5	2.1	–2.4	–0.1	3.8	5.0	–1.0	0.7	–0.4	+0
AG trade deficit 70	40.72	0.96	0.99	–61.0	–52.8	–118.0	–147.2	81.5	337.7	–71.5	–83.4	–16.9	–55.5
Investment	2959	1.73	2.52	1.7	2.9	1.8	0.2	–1.5	0.7	1.0	0.1	0.3	0.2
Total capital	48856	1.61	2.51	0.4	1.4	0.5	0.5	–0.6	–0.4	0.2	0.3	0.1	0.2
Agricultural capital	13994	1.81	2.86	–2.8	–2.8	2.1	3.4	–4.4	–10.2	0.9	1.6	0.6	1.2
Agricultural labor	11789	1.20	1.48	–0.3	–3.2	1.1	2.4	–3.5	–10.5	0.4	1.1	0.6	1.6
P_A/P_N	1.305	1.02	1.05	–0.5	–1.3	4.9	0.6	–12.7	–9.9	2.6	+0	1.5	1.3
Food price index	1.224	1.02	1.05	–1.0	–1.0	3.0	0.6	–8.9	–7.3	1.6	0.1	1.0	0.7
Terms of trade	1.002	0.97	0.91	9.8	8.2	11.3	12.0	–1.2	–7.0	4.1	3.2	–3.1	–3.3
Parity	0.462	1.13	1.19	–2.9	–0.5	5.0	0.6	–12.8	–7.2	2.9	0.2	0.9	–0
Equivalent income	176.4	1.10	1.19	2.0	2.7	1.3	1.0	2.0	3.1	0.6	0.5	0.3	0.3
Calories/capita	2460	1.06	1.10	0.2	1.4	–1.9	–0.6	2.3	2.7	–1.2	–0.5	–0.4	–0.5
Wheat:													
Price	0.073	0.83	0.72	0.7	10.3	7.8	4.9	–12.9	–7.6	5.8	2.6	–1.0	1.3
Production	11.25	1.47	2.15	19.6	28.1	12.8	11.8	6.5	–5.1	9.3	7.0	0.1	2.9
Human consumption	8.774	1.44	2.01	+0	0.8	–2.0	–0.8	2.1	2.4	–1.3	–0.6	–0.2	–0.5
Net exports	0.928	1.76	3.46	183.4	193.7	133.7	85.9	42.8	–46.0	97.4	51.5	2.0	22.5
Rice:													
Price	0.213	0.97	0.94	–11.0	–7.3	0.1	–4.0	–20.2	–12.4	–0.4	–2.5	+0	–1.3
Production	3.211	1.54	2.19	–9.9	–7.8	–0.9	–0.3	–11.4	–13.3	–0.8	–0.4	–0.2	–0.3
Human consumption	2.302	1.47	2.10	2.1	3.9	–2.8	–0.2	5.7	5.4	–1.7	–0.5	–0.6	–0.5
Net exports	0.362	2.13	2.99	–74.6	–66.6	1.8	–3.8	–97.4	–101.5	1.0	–2.3	0.6	–0.9
Coarse grains:													
Price	0.112	0.97	0.83	–18.9	–17.3	12.0	7.9	–27.6	–22.6	7.4	2.6	–1.8	1.3
Production	2.016	1.49	2.03	–44.6	–75.8	11.4	6.5	–64.7	–82.0	6.1	1.9	–1.9	1.5
Human consumption	1.458	1.32	1.71	–0.6	–1.1	1.0	0.5	–1.7	–1.5	0.7	0.3	+0	0.2
Net exports	0.123	3.57	5.60	–280.1	–417.1	66.3	32.6	–406.3	–449.5	34.5	8.4	–12.3	6.7

Table A3.14. (Cont.)

Bovine & ovine meat:													
Price	1.009	0.95	1.02	9.7	11.3	2.1	-5.1	-7.1	-2.2	0.2	-3.7	1.9	-2.1
Production	0.676	1.46	2.05	-2.7	-3.4	0.7	1.8	-5.3	-10.7	0.1	0.7	0.9	1.0
Human consumption	0.702	1.45	2.02	-1.5	0.4	-2.5	0.1	2.7	3.3	-1.4	-0.1	-0.8	-0.3
Net exports	-0.026	1.28	1.30	32.6	156.3	-97.7	-69.1	242.4	577.6	-45.8	-32.8	-50.2	-54.6
Dairy products:													
Price	0.213	1.13	1.26	-11.2	-14.7	4.3	1.3	-25.7	-27.0	2.3	0.6	3.5	3.1
Production	9.407	1.33	1.73	-7.0	-9.9	0.6	2.6	-10.6	-17.3	0.1	1.3	1.1	2.2
Human consumption	8.698	1.41	1.93	2.6	5.0	-2.2	-0.8	6.7	8.2	-1.3	-0.6	-1.1	-1.2
Net exports	-1.542	1.86	3.05	40.5	52.9	-13.2	-11.8	76.6	89.9	-7.0	-6.5	-10.2	-12.4
Other animal products:													
Price	9.859	1.00	0.97	-16.5	-16.3	3.0	-1.9	-18.3	-14.8	3.1	1.1	-1.8	-1.6
Production	0.022	1.44	2.10	-8.6	-11.1	0.6	0.8	-5.3	-9.6	0.7	1.3	-0.7	-0.5
Human consumption	0.015	1.43	2.01	5.2	5.8	-1.0	0.4	5.7	5.1	-0.9	-0.3	0.1	-0.1
Net exports	0.005	1.48	2.35	-45.8	-50.8	4.4	1.8	-34.7	-44.1	4.8	5.1	-3.0	-1.4
Protein feed:													
Price	3.435	0.84	0.78	25.6	31.1	2.2	-1.2	14.4	16.1	1.7	-0.7	0.4	0.4
Production	0.180	1.47	2.04	10.5	10.8	0.7	2.8	12.7	6.3	-0.1	1.3	-0	0.6
Feed	0.138	1.43	1.88	-19.9	-22.3	1.6	3.2	-21.6	-25.6	0.4	1.7	0.6	1.3
Net exports	0.015	1.76	3.34	241.9	184.2	-4.9	3.0	274.1	169.1	-3.5	0.3	-4.6	-2.1
Other food:													
Price	1.011	1.00	1.02	13.2	13.2	4.4	2.9	9.4	12.8	1.7	1.3	0.1	0.3
Production	1.426	1.49	2.08	4.0	3.6	1.6	3.6	5.5	-0.6	0.3	1.7	0.1	0.9
Human consumption	1.440	1.41	1.94	-1.2	0.3	-1.9	-0.8	0.2	0.8	-1.1	-0.6	-0.3	-0.4
Net exports	-0.231	0.88	0.99	-54.3	-43.5	-36.7	-56.9	-57.7	12.2	-15.4	-30.4	-4.7	-17.8
Nonfood agriculture:													
Price	0.989	1.03	1.03	23.3	18.4	1.0	-0.2	17.6	22.1	0.9	0.2	-0.3	-0.8
Production	0.511	1.28	1.69	19.0	15.9	-0.1	-0.9	15.8	11.5	-0.5	-0.4	0.5	-0.7
Human consumption	0.604	1.35	1.78	-0	0.1	-0.1	-0	+0	0.1	-0	-0	-0	-0
Net exports	-0.105	1.66	2.22	-70.5	-58.8	0.7	3.2	-59.1	-42.7	1.7	1.2	-1.6	2.5
Nonagriculture:													
Production	12.20	1.55	2.28	2.8	3.4	2.2	0.8	1.6	4.3	1.1	0.4	0.8	0.8
Demand	13.23	1.57	2.30	2.8	3.2	2.9	1.7	0.6	1.6	1.5	0.9	0.7	0.8
Net exports	-1.027	1.82	2.51	3.0	1.5	10.1	11.2	-9.5	-28.5	5.6	6.1	-0.9	0.5

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307.

Table A3.15. Thailand: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	9754	1.68	2.82	0.1	0.1	0.1	0.1	+0	0.1	–0	0.1	–0	–0.1
GDPA70	1932	1.35	1.78	2.5	5.7	1.6	2.7	1.2	3.5	0.2	1.0	–0.3	–0.6
GDPNA70	7822	1.77	3.08	–0.3	–0.7	–0.2	–0.3	–0.2	–0.4	–0	–0.1	–0	+0
AG vol. index WP70	1.326	1.34	1.74	2.3	6.3	2.9	4.4	0.6	2.5	–0.1	0.6	+0	–0
Trade deficit 70	354.7	1.35	1.91	–5.3	–2.5	–3.2	–0.6	–2.9	–1.7	–1.4	0.2	0.1	0.4
AG trade deficit 70	–47.22	1.26	1.42	13.0	32.1	14.5	23.2	3.8	12.6	0.3	3.1	0.4	0.8
Investment	2409	1.67	2.79	4.8	3.1	2.6	1.2	2.7	2.1	1.1	0.6	–0.2	–0.1
Total capital	38102	1.60	2.61	1.4	2.5	0.7	1.0	0.8	1.5	0.2	0.4	–0	–0.1
Agricultural capital	9316	1.42	1.96	8.2	17.8	4.2	7.3	4.6	10.7	1.2	2.9	–0.1	–0.6
Agricultural labor	16199	1.20	1.40	0	0	0	0	0	0	0	0	0	0
P_A/P_N	1.066	1.05	1.09	25.4	19.8	12.1	7.7	15.0	14.0	6.0	4.4	–1.0	+0
Food price index	0.050	1.02	1.04	10.9	8.1	5.2	2.9	6.7	6.3	2.9	2.3	–0.8	–0.3
Terms of trade	1.114	1.01	1.05	3.3	0.5	8.7	6.7	–4.3	–4.9	3.7	2.3	0.1	0.9
Parity	0.068	0.81	0.64	28.9	27.4	14.1	10.8	16.6	18.4	6.3	5.6	–1.3	–0.6
Calories/capita	2856	1.06	1.13	–0.2	–0.3	0.2	–0.1	–0.1	–0.4	–0.1	–0.2	+0	–0
Wheat:													
Price	0.033	0.98	0.89	16.4	23.1	10.9	18.4	2.3	4.7	6.8	8.7	–0.4	1.6
Human consumption	0.073	1.95	3.88	4.0	1.5	1.6	–0.4	3.1	2.1	0.3	–0.3	–0.2	–0.4
Net exports	–0.073	1.96	3.90	4.0	1.5	1.6	–0.4	3.1	2.1	0.3	–0.3	–0.2	–0.4
Rice:													
Price	0.062	1.01	1.06	52.4	45.5	27.7	21.0	28.9	26.6	5.9	1.5	–1.0	0.2
Production	9.234	1.34	1.72	15.5	17.6	10.3	8.6	9.4	9.9	0.9	0.1	0.1	–0.1
Human consumption	6.417	1.26	1.52	0.2	0.2	0.6	0.1	0.1	–0	0.1	0.1	0.1	–0
Net exports	0.353	1.90	3.03	293.9	260.4	208.1	147.6	162.5	132.1	8.9	–11.7	7.5	5.1
Coarse grains:													
Price	0.040	0.97	0.86	29.8	25.1	13.4	11.0	14.2	15.8	7.4	3.7	–1.5	0.8
Production	2.382	1.19	1.25	10.8	18.4	7.6	11.6	1.3	7.4	4.5	3.3	–1.9	3.7
Human consumption	0.063	2.11	4.50	–0.1	0.2	0.2	0.4	–0.4	+0	0.2	0.3	–0.2	0.3
Net exports	2.204	1.14	1.07	11.1	21.3	8.1	14.4	0.3	7.6	5.3	4.3	–2.1	5.3

Table A3.15. (Cont.)

Bovine & ovine meat:													
Price	0.281	1.41	1.69	67.6	48.5	27.7	17.2	37.3	29.9	11.1	6.9	18.8	14.3
Production	0.181	1.60	2.21	26.6	20.6	10.2	6.9	15.6	12.7	3.6	1.4	12.0	8.2
Human consumption	0.212	1.27	1.56	+0	–0	–0	–0	+0	–0	–0	–0.1	–0	–0
Net exports	–0.032	–0.65	–2.15	374.1	121.6	144.4	40.7	219.2	75.0	51.5	8.8	169.9	48.2
Dairy products:													
Price	0.076	1.23	1.37	6.1	3.2	34.7	30.7	–14.4	–13.9	18.9	14.9	28.8	39.0
Production	0.009	1.42	1.80	–20.0	–17.1	11.5	16.6	–25.6	–24.2	8.5	8.9	14.2	29.4
Human consumption	0.313	1.24	1.49	–0.3	–0.5	–0.1	0.2	–0.2	–0.4	–0	+0	–0.2	0.5
Net exports	–0.304	1.23	1.48	0.3	0.1	–0.5	–0.4	0.6	0.4	–0.3	–0.3	–0.7	–0.6
Other animal products:													
Price	5.596	1.05	1.06	14.9	10.5	3.5	–0.1	12.4	12.5	4.8	5.2	–3.3	–2.2
Production	0.173	1.45	2.05	–1.4	2.5	–4.7	–3.3	2.3	6.1	0.9	2.6	–2.2	–2.6
Human consumption	0.155	1.42	2.05	–4.6	–3.8	–1.7	–1.0	–3.5	–3.4	–1.0	–1.4	0.3	–0
Net exports	0.008	2.01	1.96	40.1	127.3	–45.9	–49.6	79.3	194.8	27.1	83.0	–35.7	–52.9
Protein feed:													
Price	0.312	0.99	0.95	23.2	25.5	8.7	12.8	13.2	12.3	2.9	0.2	0.9	0.3
Production	0.133	1.33	1.73	–1.7	4.9	–3.2	0.2	0.1	4.8	0.3	2.4	–1.2	–1.5
Feed	0.071	1.58	2.42	15.1	13.3	8.8	0.5	13.4	15.4	2.5	2.0	–2.6	–3.8
Net exports	0.049	0.96	0.74	–42.3	–32.1	–32.8	–1.1	–31.2	–42.8	–4.8	5.4	1.6	8.3
Other food:													
Price	0.385	1.01	1.05	3.9	1.7	5.9	4.9	–0.2	–1.3	3.2	2.4	0.3	1.1
Production	2.516	1.30	1.67	–6.8	–0.5	0.6	5.3	–7.0	–5.1	–1.8	–0.1	0.2	0.6
Human consumption	1.254	1.42	1.99	–1.0	–1.1	–1.1	–0.4	–0.5	–1.0	–0.6	–0.5	–0.1	–0
Net exports	1.249	1.17	1.33	–14.0	0.5	2.7	13.9	–15.1	–11.4	–3.3	0.5	0.5	1.6
Nonfood agriculture:													
Price	0.504	1.23	1.27	19.2	10.8	7.9	–1.8	13.6	14.3	6.6	2.0	–1.9	–5.8
Production	0.258	1.31	1.51	2.0	–0	–0.2	–3.2	2.3	2.7	1.3	–0.5	0.5	–2.3
Human consumption	0.203	1.25	1.56	–0.3	–0.6	–0	–0.3	–0.3	–0.6	–0	–0.4	0.3	–0.3
Net exports	0.055	1.53	1.33	8.9	2.2	–0.7	–15.9	10.2	16.9	5.1	–1.1	0.9	–10.8
Nonagriculture:													
Production	7.856	1.77	3.08	–0.3	–0.7	–0.2	–0.3	–0.2	–0.4	–0	–0.1	–0	+0
Demand	9.312	1.69	2.85	1.1	1.4	2.0	1.7	–0.2	0.1	0.3	0.3	+0	0.1
Net exports	–1.456	1.29	1.60	12.0	22.9	17.8	22.3	–0.7	5.0	2.8	4.1	0.2	1.2

[a] 1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b] See note on page 307.

Table A3.16. Turkey: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	25271	1.89	3.20	0.6	1.2	–0.1	–0.3	0.7	1.6	0.1	–0.2	–0.1	–0.2
GDPA70	5542	1.31	1.75	–3.3	–8.9	3.1	5.7	–6.1	–14.2	1.7	3.6	0.7	1.8
GDPNA70	19729	2.06	3.61	1.3	2.6	–0.6	–1.2	2.0	3.7	–0.2	–0.7	–0.3	–0.5
AG vol. index WP70	1.378	1.30	1.71	–2.8	–8.4	2.1	4.2	–4.5	–12.1	1.2	2.6	0.2	1.4
Trade deficit 70	1227	0.60	0.71	1.1	1.1	–2.4	0.2	3.0	1.5	–1.0	0.7	–0.3	0.3
AG trade deficit 70	–37.36	1.25	2.51	–20.7	–58.7	13.6	29.0	–35.9	–80.9	10.3	18.3	–0.5	8.4
Investment	5722	1.98	3.45	–1.6	0.3	1.3	–0.1	–2.8	0.3	0.9	–0.1	0.1	–0.1
Total capital	46162	2.07	3.86	–1.0	–0.7	0.8	0.5	–1.7	–1.1	0.4	0.3	0.2	0.1
Agricultural capital	9391	1.32	1.68	–7.0	–13.8	4.7	6.6	–10.6	–19.9	2.3	3.8	1.6	2.8
Agricultural labor	9862	0.92	0.87	–3.1	–7.9	0.9	2.7	–4.4	–10.8	0.3	1.5	0.5	1.4
P_A/P_N	1.122	1.01	0.94	–15.0	–10.3	7.3	1.4	–22.4	–13.2	4.8	0.1	1.7	1.7
Food price index	1.139	1.06	1.10	–6.3	–3.0	3.2	1.3	–9.9	–4.9	1.9	0.4	0.9	0.9
Terms of trade	1.136	1.08	1.13	–6.4	–8.5	9.5	5.7	–10.5	–12.3	5.5	3.2	3.3	4.8
Parity	0.288	1.08	1.08	–14.6	–10.4	9.6	4.3	–23.0	–15.4	6.3	2.1	1.9	2.1
Equivalent income	471.0	1.42	1.94	1.7	1.7	0.1	–0.1	2.0	2.1	0.1	–0	0.1	–0
Calories/capita	3137	1.01	1.03	+0	0.2	–0.2	–0.1	0.2	0.1	–0.1	–0.1	+0	+0
Wheat:													
Price	0.081	1.07	0.98	–13.7	–8.7	10.7	14.9	–22.7	–20.7	5.3	6.8	0.9	3.1
Production	14.31	1.19	1.48	7.8	5.8	3.7	8.6	5.4	2.7	3.7	6.3	–2.2	–0.9
Human consumption	7.234	1.24	1.51	+0	+0	+0	+0	+0	–0.1	+0	+0	–0	+0
Net exports	–1.238	1.86	2.19	–56.0	–67.4	4.6	–43.0	–53.8	–61.5	–5.7	–31.1	15.1	13.9
Rice:													
Price	0.197	0.87	0.81	–9.7	–5.2	12.6	13.0	–22.5	–14.6	2.7	1.4	0.4	0.1
Production	0.211	1.23	1.66	–3.6	–8.2	4.5	10.3	–9.6	–15.8	–1.0	2.1	0.1	0.6
Human consumption	0.183	1.20	1.44	–0.4	0.3	–0.4	–0.3	–0.1	0.3	–0.2	–0.1	0.1	+0
Net exports	–0.016	1.10	–0.67	23.5	–184.5	–58.7	293.9	103.8	–395.0	14.2	56.5	4.3	7.1
Coarse grains:													
Price	0.064	1.22	1.07	–18.8	–18.7	24.4	13.0	–29.4	–30.2	11.4	6.9	1.6	4.6
Production	7.519	1.28	1.58	–6.4	–1.5	4.0	1.2	–7.5	–2.1	8.2	–0.6	0.6	4.4
Human consumption	0.731	1.15	1.34	–0.6	–0.2	0.4	0.2	–1.0	–0.5	0.2	0.1	0.1	0.1
Net exports	–0.418	1.61	4.00	–22.7	–66.5	–86.0	14.9	–53.4	–92.2	–124.4	21.0	8.9	–18.3

Table A3.16. (Cont.)

Bovine & ovine meat:													
Price	1.285	1.02	1.01	−2.4	5.5	8.1	−2.0	−18.1	−6.3	4.8	−2.9	3.6	0.1
Production	0.818	1.40	1.91	−6.9	−13.5	4.8	4.2	−13.9	−22.3	1.9	1.8	3.5	2.6
Human consumption	0.835	1.30	1.64	+0	0.1	−0.7	−0.1	1.1	0.4	−0.5	−0	−0.2	−0
Net exports	−0.028	−1.70	−6.08	−161.0	−123.5	133.1	39.3	−356.3	−206.4	56.8	17.0	87.8	23.8
Dairy products:													
Price	0.187	0.98	0.84	−34.0	−29.6	12.1	8.3	−39.8	−31.5	7.3	4.3	7.5	12.9
Production	5.511	1.40	1.92	−13.9	−18.0	4.2	5.7	−17.5	−22.8	1.7	3.1	3.4	5.3
Human consumption	4.437	1.24	1.51	0.1	0.1	−0.1	−0	0.1	+0	−0.1	−0	−0	−0
Net exports	0.057	13.72	33.09	−112.0	−82.2	35.7	27.6	−142.8	−104.2	14.8	14.6	29.4	26.2
Other animal products:													
Price	7.937	0.90	0.77	−25.0	−15.0	0.2	−4.4	−26.5	−13.6	2.3	−1.6	−2.1	−1.5
Production	0.090	1.41	1.96	−13.0	−16.2	0.6	0.8	−12.7	−18.5	0.8	1.2	−0.4	+0
Human consumption	0.077	1.39	1.85	2.4	2.1	−0.9	0.1	3.4	1.5	−0.8	−0.1	0.2	0.1
Net exports	0.007	1.66	3.26	−163.1	−136.2	14.8	5.2	−169.1	−149.7	16.3	10.0	−6.0	−0.4
Protein feed:													
Price	1.908	1.05	1.08	−22.9	−22.2	3.7	1.9	−29.9	−31.4	2.4	0.5	0.3	0.4
Production	0.168	1.14	1.34	−2.8	−9.7	1.1	3.7	−4.0	−13.4	0.1	2.2	0.2	1.4
Feed	0.102	1.51	1.96	−8.0	−12.2	14.4	8.4	−10.7	−16.8	8.1	4.6	1.4	3.5
Net exports	0.049	0.34	−0.04	44.2	+[c]	−123.6	−[c]	57.1	+[c]	−75.8	−[c]	−10.5	−[c]
Other food:													
Price	0.633	1.00	1.01	−5.9	−2.9	2.9	1.7	−9.7	−3.2	1.7	0.8	0.2	0.4
Production	5.930	1.30	1.73	−2.2	−9.1	1.4	4.2	−3.3	−12.8	0.2	2.4	0.1	1.5
Human consumption	3.914	1.27	1.59	−0.1	0.4	−0.4	−0.2	0.3	0.2	−0.3	−0.2	+0	−0
Net exports	0.483	1.21	2.53	−7.7	−52.4	−0.7	23.7	−12.3	−70.0	−4.8	15.2	−2.7	7.3
Nonfood agriculture:													
Price	0.933	1.20	1.28	−6.5	−15.4	7.2	−2.4	−11.0	−12.7	6.1	0.8	−1.7	−5.3
Production	0.771	1.26	1.60	−2.0	−9.9	0.7	1.1	−3.4	−12.3	0.5	1.3	0.1	−0.5
Human consumption	0.454	1.34	1.74	0.6	2.7	−1.5	−0	1.9	1.9	−1.1	−0.4	0.1	0.6
Net exports	0.314	1.14	1.40	−6.6	−32.7	4.2	3.1	−12.1	−37.6	3.3	4.6	−0	−2.4
Nonagriculture:													
Production	21.06	2.03	3.53	1.5	2.4	0.2	−0.6	1.5	3.0	0.2	−0.4	0.1	−0.3
Demand	22.85	1.93	3.36	0.9	1.1	0.5	0.1	0.7	1.3	0.4	0.1	0.1	−0
Net exports	−1.791	0.82	1.32	−14.3	−39.0	10.8	21.1	−21.6	−52.0	7.0	13.0	2.1	8.8

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.17. USA: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	1980	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
GDP70	1254804	1.34	1.71	0.1	0.1	+0	0.1	+0	+0	-0	-0	0.1	0.1
GDPA70	28285	1.18	1.30	1.4	1.4	1.4	1.8	0.1	0.3	1.1	2.4	-1.2	-0.4
GDPNA70	1226519	1.35	1.72	+0	0.1	+0	0.1	+0	+0	-0.1	-0	0.1	0.1
AG vol. index WP70	1.383	1.21	1.37	1.6	1.5	1.7	1.8	+0	0.1	0.9	1.5	-0.8	-0.6
Trade deficit 70	265.3	-20.64	-24.72	0.7	-0.2	2.9	2.3	-1.2	-1.1	1.7	1.3	0.3	1.3
AG trade deficit 70	-9603	1.33	1.64	3.4	-0.6	4.6	1.9	0.2	+0	6.4	4.5	-8.0	-9.0
Investment	506257	1.35	1.73	0	0	0	0	0	0	-0	-0	-0	-0
P_A/P_N	1.001	1.10	1.15	1.4	-4.6	2.8	-2.0	0.3	-0.1	6.6	3.8	-5.6	-6.4
Food price index	1.961	1.80	3.09	0.4	-3.8	0.3	-3.2	1.4	1.4	3.8	1.6	-4.3	-4.7
Terms of trade	0.977	1.00	0.93	5.8	1.2	3.5	1.7	1.7	3.7	7.3	7.2	-12.0	-15.1
Parity	0.023	0.96	0.87	2.8	-3.4	4.2	-0.4	0.4	0.2	7.9	6.3	-6.7	-6.9
Wheat:													
Price	0.068	1.04	0.94	17.3	23.7	11.9	18.7	2.7	5.3	7.5	9.2	-0.6	1.8
Production	59.53	1.44	1.74	16.7	14.3	14.1	11.4	2.8	2.5	8.5	4.8	+0	1.8
Human consumption	15.76	1.10	1.27	-6.3	-6.5	-4.1	-4.3	-1.5	-2.0	-3.0	-2.4	-0.1	-0.9
Net exports	40.08	1.27	1.62	29.2	23.4	24.0	18.6	3.4	2.6	14.6	5.4	1.5	2.8
Rice:													
Price	0.165	1.00	1.05	22.2	16.3	28.8	20.9	3.3	1.1	6.0	1.4	-0.9	0.1
Production	4.023	1.55	2.05	3.4	4.5	3.9	4.7	0.9	0.5	0.2	+0	0.6	0.6
Human consumption	0.821	1.15	1.31	-4.3	-3.5	-5.7	-4.1	-1.5	-0.6	-0.8	0.2	0.3	0.5
Net exports	2.719	1.67	2.28	4.8	5.9	5.4	6.3	1.3	0.7	0.4	+0	0.7	0.7
Coarse grains:													
Price	0.053	1.05	0.93	17.3	13.2	14.4	11.6	2.6	4.2	8.0	4.1	-1.8	1.5
Production	224.1	1.28	1.57	2.3	7.5	0.8	4.6	1.2	2.5	-1.4	-0	2.4	1.5
Human consumption	13.88	1.26	1.51	-0.4	-0.2	-0.7	-0.3	-0	+0	-1.3	-0.7	1.4	1.2
Net exports	61.82	1.34	2.08	3.6	20.3	-1.2	12.1	3.0	6.1	-9.4	-4.4	10.8	2.8

Table A3.17. (Cont.)

Bovine & ovine meat:													
Price	1.333	1.25	1.54	−1.5	−15.1	−0.2	−10.8	0.9	−1.2	7.8	1.3	−7.6	−13.1
Production	11.84	1.08	1.09	0.2	2.0	−1.7	2.7	1.4	0.7	1.6	5.2	−6.7	−0.1
Human consumption	12.41	1.09	1.10	4.3	17.5	4.0	13.6	−0.3	0.7	−3.6	2.4	8.9	16.0
Net exports	−1.161	1.15	1.16	41.7	158.9	55.8	113.8	−15.5	0.6	−51.1	−22.7	150.6	163.7
Dairy products:													
Price	0.122	1.21	1.36	−23.2	−25.5	−25.0	−27.5	11.5	12.1	18.8	14.6	−28.4	−22.8
Production	56.66	1.15	1.35	−4.5	−11.0	−5.1	−12.1	1.7	4.4	2.0	5.3	−5.8	−12.1
Human consumption	55.29	1.08	1.16	8.4	9.8	9.4	11.2	−4.0	−4.9	−5.3	−4.9	10.6	8.8
Net exports	−0.984	−2.35	−9.21	−340.2	−158.5	−381.8	−176.7	148.7	69.9	190.4	77.4	−430.5	−160.1
Other animal products:													
Price	8.825	1.07	1.09	9.5	4.5	9.7	4.9	1.4	1.1	5.1	4.6	1.9	2.7
Production	2.172	1.13	1.18	1.6	−0.1	1.4	−0.1	0.3	0.1	0.1	0.8	1.5	1.6
Human consumption	1.733	1.16	1.35	−4.8	−4.3	−4.6	−3.8	−0.6	−0.5	−1.5	−1.9	−1.9	−3.1
Net exports	0.252	0.99	0.04	53.0	+[c]	49.9	+[c]	7.9	+[c]	13.1	+[c]	28.9	+[c]
Protein feed:													
Price	0.331	1.03	0.99	10.9	12.9	8.7	12.8	1.9	1.0	2.9	0.2	0.9	0.3
Production	19.29	1.23	1.40	0.6	−3.5	4.0	1.8	−3.0	−4.9	0.8	−0.3	−1.5	−1.1
Feed	7.145	1.27	1.39	2.3	−0.8	1.9	−0.6	0.8	0.4	1.3	2.1	0.1	0.4
Net exports	11.39	1.22	1.42	−0.4	−5.1	5.4	3.2	−5.4	−8.1	0.5	−1.7	−2.5	−2.0
Other food:													
Price	1.548	1.03	1.07	−6.0	−8.2	0.8	−0.4	−5.2	−6.4	2.9	2.2	−4.7	−3.9
Production	12.16	1.21	1.30	−1.9	−3.7	1.6	0.7	−2.9	−4.2	0.2	0.2	−0.7	−0.9
Human consumption	8.225	1.14	1.29	1.3	1.5	−1.1	−1.1	2.0	2.4	−0.6	−0.6	1.1	0.6
Net exports	2.030	1.56	1.45	−11.7	−24.1	10.1	6.6	−17.8	−28.9	3.0	3.0	−6.4	−7.1
Nonfood agriculture:													
Price	1.387	1.22	1.28	−28.1	−33.4	−13.2	−21.4	−14.7	−14.4	6.7	1.8	−21.2	−24.7
Production	2.360	1.10	1.25	−6.4	−9.1	−5.2	−8.8	−0.9	−0.5	0.4	−0	−5.8	−8.3
Human consumption	1.620	1.08	1.18	2.4	4.3	1.0	2.2	1.1	1.8	−0.4	−0.3	1.6	2.9
Net exports	0.017	−0.04	0.44	−[c]	−[c]	−[c]	−[c]	−[c]	−[c]	+[c]	+[c]	−[c]	−[c]
Nonagriculture:													
Production	2502	1.35	1.72	+0	0.1	+0	0.1	+0	+0	−0.1	−0	0.1	0.1
Demand	2511	1.35	1.71	0.1	0.1	+0	0.1	+0	+0	−0	−0	+0	0.1
Net exports	−9.643	0.74	0.82	20.3	6.5	17.2	10.3	4.3	7.5	23.1	20.5	−28.8	−35.4

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

Table A3.18. The EC: Percentage changes (relative to the reference scenario) in main indicators in 1990 and 2000 for each of the agricultural trade liberalization scenarios.

	Reference scenario[a]			Agricultural trade liberalization by									
				All MEs		All OECD		All LDCs		EC		USA	
Indicator[b]	*1980*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
GDP70	824414	1.38	1.83	0.1	0.2	0.1	0.2	+0	0.1	0.1	0.2	–0	–0
GDPA70	40666	1.08	1.13	–3.5	–7.5	–3.0	–7.1	–0.3	–0.8	–3.1	–8.9	0.3	0.3
GDPNA70	783749	1.40	1.87	0.3	0.4	0.2	0.4	+0	0.1	0.2	0.5	–0	–0
AG vol. index WP70	1.141	1.09	1.16	–4.8	–8.6	–4.4	–8.4	–0.1	–0.4	–4.6	–10.0	0.2	0.4
Trade deficit 70	385.1	–11.64	–16.16	1.6	0.8	3.5	3.0	–1.1	–0.9	3.2	2.6	–0.1	0.9
AG trade deficit 70	4095	1.30	1.73	46.0	49.6	42.7	46.8	2.2	2.1	49.3	60.0	–2.3	–2.6
Investment	187022	1.38	1.84	–0.3	–0.1	–0.2	–0	+0	+0	–0.5	–0.1	–0	–0
Total capital	2874495	1.44	2.02	–0.1	–0.2	–0.1	–0.1	–0	+0	–0.2	–0.2	–0	–0
Agricultural capital	162839	1.33	1.60	–2.1	–5.5	–1.8	–5.4	–0.1	–0.6	–2.4	–7.2	0.4	0.6
Agricultural labor	9089	0.77	0.63	–6.0	–12.1	–5.8	–11.7	–0.8	–1.9	–6.2	–14.9	1.0	0.8
P_A/P_N	1.084	1.00	1.03	–12.7	–11.9	–10.5	–8.8	–0.4	–0.4	–16.5	–12.1	0.3	0.9
Food price index	1.079	1.03	1.09	–5.3	–5.4	–4.2	–3.7	–0.2	–0.2	–7.1	–5.3	0.1	0.4
Terms of trade	0.927	0.96	0.94	–1.6	–1.0	–9.1	–8.4	6.3	6.4	–6.8	–7.5	2.2	2.7
Parity	0.615	1.09	1.15	–10.2	–7.2	–7.7	–4.0	+0	0.7	–13.6	–5.7	–0.4	0.4
Equivalent income	2446	1.30	1.64	0.4	0.4	0.3	0.3	0.1	0.1	0.4	0.4	+0	+0
Calories/capita	3491	1.02	1.03	1.0	1.0	0.8	0.8	0.1	+0	1.2	1.0	+0	–0
Wheat:													
Price	0.091	0.99	0.90	–35.1	–24.5	–36.0	–25.6	3.5	5.1	–37.7	–33.7	–1.0	0.8
Production	51.42	1.25	1.26	–21.8	–27.1	–22.7	–28.0	5.6	10.4	–23.4	–25.1	0.5	2.2
Human consumption	20.68	1.00	1.00	–0.6	–0.4	–0.5	–0.4	0.1	0.1	–0.7	–0.6	+0	0.1
Net exports	11.18	1.81	1.58	–79.4	–94.6	–83.4	–97.6	17.3	37.1	–84.6	–93.5	2.7	7.3
Rice:													
Price	0.220	0.98	0.99	–28.7	–28.8	–25.7	–26.3	0.4	0.4	–37.2	–37.2	–0.2	0.1
Production	0.611	1.34	1.65	–24.5	–21.5	–15.1	–18.7	–0.5	–1.5	–39.5	–31.1	0.8	0.1
Human consumption	0.531	1.16	1.30	3.8	4.4	2.8	3.7	0.1	0.2	5.6	7.2	–0	+0
Net exports	–0.303	0.80	0.64	84.6	106.0	55.9	88.5	2.3	6.0	137.6	162.5	–2.3	–1.1
Coarse grains:													
Price	0.086	0.90	0.81	–20.0	–20.9	–22.7	–21.8	1.8	2.6	–25.0	–26.2	–2.1	–0.2
Production	69.24	1.12	1.28	4.5	9.0	4.8	8.5	–1.8	–3.9	2.9	4.1	–2.5	–2.4
Human consumption	7.536	1.08	1.15	1.0	1.1	1.0	1.2	–0.1	–0.1	1.3	1.5	0.1	–0
Net exports	–2.268	5.51	8.65	–43.0	–70.8	–33.3	–61.5	5.4	9.5	–12.5	–42.7	19.6	13.3

Table A3.18. (Cont.)

Bovine & ovine meat:														
Price	1.149	1.04	1.07	–6.1	–3.0	–4.7	1.9	0.4	–0.4	–16.5	–6.7	2.6	2.0
Production	9.274	1.09	1.11	–4.0	–8.9	–3.9	–7.6	–0.4	–1.5	–6.8	–12.1	1.4	1.0
Human consumption	9.494	1.09	1.16	3.0	0.4	3.7	0.3	–0.4	–0.6	7.2	2.9	–0.7	–0.6
Net exports	–0.377	1.36	2.72	139.5	93.2	151.1	78.6	–0.5	9.2	279.2	152.9	–41.7	–16.5
Dairy products:														
Price	0.103	1.01	1.04	–3.5	3.2	–4.8	1.6	1.1	1.6	–14.6	–6.9	1.8	2.7
Production	106.1	1.06	1.11	–2.2	–4.2	–3.7	–6.2	0.3	–0.2	–6.2	–11.2	1.4	1.9
Human consumption	76.38	1.05	1.09	0.5	–0.3	0.9	0.1	–0.1	–0.3	1.1	0.5	–0.1	–0.2
Net exports	10.03	0.94	0.87	–23.2	–31.0	–43.5	–60.4	3.7	–0.5	–78.1	–134.1	18.4	28.2
Other animal products:														
Price	7.028	0.97	0.97	–13.4	–13.6	–13.6	–13.3	0.7	1.7	–14.0	–9.7	–1.7	–0.5
Production	2.277	1.17	1.33	–3.6	–7.9	–3.7	–8.2	+0	–0.3	–1.1	–6.1	–0.5	–0.4
Human consumption	2.159	1.16	1.31	1.2	2.2	0.7	1.6	0.1	0.1	1.2	1.0	0.2	0.1
Net exports	0.049	1.61	1.66	–162.6	–372.2	–149.8	–363.1	–2.0	–13.1	–76.7	–263.9	–23.3	–18.0
Protein feed:														
Price	1.141	1.01	0.98	–18.9	–17.8	–20.4	–17.9	1.3	0.7	–24.1	–26.1	0.7	0.2
Production	0.980	1.17	1.31	–2.3	–6.2	–1.6	–5.4	–0.5	–0.9	–1.0	–6.1	0.1	0.2
Feed	5.907	1.14	1.29	–5.4	–11.2	–4.9	–10.8	–0.3	+0	–0.8	–6.1	–1.8	–0.6
Net exports	–4.982	1.13	1.28	–6.0	–12.1	–5.5	–11.8	–0.3	0.2	–0.8	–6.1	–2.2	–0.8
Other food:														
Price	1.089	1.00	1.09	–9.0	–15.4	–2.8	–8.6	–3.1	–3.7	–5.1	–10.6	–0.3	+0
Production	15.91	1.01	1.02	–4.8	–12.3	–2.6	–10.2	–1.6	–2.3	–1.5	–11.9	0.2	0.3
Human consumption	16.43	1.08	1.12	2.9	2.6	2.6	2.2	0.4	0.2	2.2	2.7	0.1	–0
Net exports	–4.173	1.43	1.72	19.6	32.2	11.5	25.6	6.2	6.0	7.4	30.4	–0.8	–1.3
Nonfood agriculture:														
Price	1.083	1.21	1.28	–28.7	–35.1	–14.2	–23.4	–13.6	–14.5	–15.2	–20.5	–1.0	–5.4
Production	0.969	1.08	1.07	–8.1	–14.1	–5.0	–11.2	–2.7	–3.8	–5.4	–13.1	0.6	–0.3
Human consumption	3.043	1.00	1.01	7.2	7.2	4.7	5.1	2.3	2.2	4.1	4.6	0.1	0.9
Net exports	–2.083	0.96	0.98	15.3	17.9	10.0	13.4	4.9	5.1	9.2	13.4	–0	1.5
Nonagriculture:														
Production	796.4	1.39	1.86	0.3	0.4	0.3	0.4	+0	+0	0.3	0.5	–0	–0
Demand	792.4	1.39	1.85	0.1	0.1	+0	0.1	0.1	0.1	–0	0.1	+0	+0
Net exports	4.054	2.55	3.50	+[c]	+[c]	+[c]	+[c]	–[c]	–[c]	+[c]	+[c]	–[c]	–[c]

[a]1980, absolute values; 1990 and 2000, index numbers (1980 = 1.0). [b]See note on page 307. [c]No percentage change is given when the traded volume in the reference scenario does not exceed 2% of domestic disappearance. In these cases a plus sign is used to indicate an increase in net exports (increased export or decreased import), and a minus sign is used to indicate a decrease in net exports.

APPENDIX A4

Countries and Groupings

(1) Countries represented by a model with common structure:

(a) Developed market economies: Australia, Austria, Canada, Japan, New Zealand, the EC (as the countries of the EC have integrated economies, they are modeled as one country).
(b) Developing countries: Argentina, Brazil, Egypt, Indonesia, Kenya, Mexico, Nigeria, Pakistan, Thailand, Turkey.

(2) Countries represented by a model with specific structure: China, the CMEA, India, the USA (as the countries of the CMEA have integrated economies, they are modeled as one country).

(3) Simplified country grouping models:

(a) Africa:

Oil exporters: Algeria, Angola, Congo, Gabon.
Medium income/calorie exporters: Ghana, Ivory Coast, Senegal, Cameroon, Mauritius, Zimbabwe.
Medium income/calorie importers: Morocco, Tunisia, Liberia, Mauritania, Zambia.
Low income/calorie exporters: Benin, Gambia, Togo, Ethiopia, Malawi, Mozambique, Uganda, Sudan.
Low income/calorie importers: Guinea, Mali, Niger, Sierra Leone, Upper Volta, Central African Republic, Chad, Zaire, Burundi, Madagascar, Rwanda, Somalia, Tanzania.

(b) Latin America:

High income/calorie exporters: Costa Rica, Panama, Cuba, Dominican Republic, Ecuador, Surinam, Uruguay.
High income/calorie importers: Jamaica, Trinidad and Tobago, Chile, Peru, Venezuela.
Medium-low income: El Salvador, Guatemala, Honduras, Nicaragua, Colombia, Guyana, Paraguay, Haiti, Bolivia.

(c) Far East Asia:

High-medium income/calorie exporters: Malaysia, Philippines.
High-medium income/calorie importers: Republic of Korea, Laos, Vietnam, Korea DPR, Kampuchea.
Low income: Nepal, Burma, Sri Lanka, Bangladesh.

(d) Near East Asia:

Oil exporters/high income: Libya, Iran, Iraq, Saudi Arabia, Cyprus, Lebanon, Syria.
Medium-low income: Jordan, Yemen Arab Republic, People's Democratic Republic of Yemen, Afghanistan.

(e) Rest of the world:

Developed countries:

Albania, Finland, Greece, Iceland, Norway, Portugal, Spain, Sweden, Switzerland, Yugoslavia, South Africa, Greenland, Hong Kong, Israel, Singapore, Liechtenstein, Malta, Monaco, San Marino.

Developing countries:

Africa: Botswana, British Indian Territory, Cape Verde, Comoros, Equatorial Guinea, Djibouti, Guinea-Bissau, Lesotho, Namibia, Réunion, St Helena, São Tomé, Seychelles, Spanish North Africa, Swaziland, Western Sahara.
Central America: Antigua, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Guadeloupe, Martinique, Montserrat, Netherland Antilles, Panama Canal Zone, Puerto Rico, St Kitts-Nevis, St Lucia, St Pierre and Miquelon, St Vincent, Turks and Caicos, Virgin Islands (UK), Virgin Islands (USA).
South America: Falkland Islands, French Guinea.
Asia: Bahrain, Bhutan, Brunei, East Timor, Gaza Strip, Kuwait, Macau, Maldives, Mongolia, Oman, Qatar, Sikkim, United Arab Emirates.
Europe: Andorra, Faeroe Islands, Gibraltar, Vatican City.

Oceania: American Samoa, Canton and Enderbury Islands, Christmas Island, Cocos Islands, Cook Island, Fiji, French Polynesia, Gilbert Islands, Guam, Johnston Island, Midway Islands, Nauru, New Caledonia, New Hebrides, Niue Islands, Norfolk Islands, Pacific Islands, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Wake Island, Wallis and Futuna Islands.

The results are often aggregated in different ways for presentation. These aggregations are defined below. The numbers and the names given in the first column refer to country codes used in the computer program. Aggregation designated with a * include only those countries of the group for which an explicit national model exists in the BLS.

Group 1: OECD

10	Australia	australia
11	Austria	austria
33	Canada	canada
110	Japan	japan
156	New Zealand	new zealand
231	USA	united states
888	EC	ec
916	Rest World	remaining countries

Group 2: D.M. Econ. - Developed Market Economies

10	Australia	australia
11	Austria	austria
33	Canada	canada
110	Japan	japan
156	New Zealand	new zealand
231	USA	united states
888	EC	ec
916	Rest World	remaining countries

*Group 3: D.M. Econ.**

10	Australia	australia
11	Austria	austria
33	Canada	canada
110	Japan	japan
156	New Zealand	new zealand
231	USA	united states
888	EC	ec

Group 4: CMEA

777	CMEA	cmea

Group 5: Mid Income

9	Argentina	argentina
21	Brazil	brazil
138	Mexico	mexico
901	AFR Oil Exp	africa, oil exporters
906	LAM H CAL Ex	latin america, high income/calorie exporters
907	LAM H CAL Im	latin america, high income/calorie importers
912	NEA Oil Exp	near east asia, oil exporters, high income

Group 6: Low-Mid Inc

59	Egypt	egypt
101	Indonesia	indonesia
114	Kenya	kenya
159	Nigeria	nigeria
216	Thailand	thailand
223	Turkey	turkey
902	AFR M CAL Ex	africa, medium income/calorie exporters
903	AFR M CAL Im	africa, medium income/calorie importers
908	LAM LM	latin america, low-medium income
909	FEA MH CAL Ex	far east asia, medium-high income calorie exporters
910	FEA MH CAL Im	far east asia, medium-high income calorie importers

Group 7: Low Income

41	China	china (exc. taiwan)
100	India	india
165	Pakistan	pakistan
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers
911	FEA LOW	far east asia, low income
913	NEA LM	near east asia, low-medium income

Group 8: Low Income w/o China

100	India	india
165	Pakistan	pakistan
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers
911	FEA LOW	far east asia, low income
913	NEA LM	near east asia, low-medium income

Group 9: Developing

9	Argentina	argentina
21	Brazil	brazil
41	China	china (exc. taiwan)
59	Egypt	egypt
100	India	india
101	Indonesia	indonesia
114	Kenya	kenya
138	Mexico	mexico
159	Nigeria	nigeria
165	Pakistan	pakistan
216	Thailand	thailand
223	Turkey	turkey
901	AFR Oil Exp	africa, oil exporters
902	AFR M CAL Ex	africa, medium income/calorie exporters
903	AFR M CAL Im	africa, medium income/calorie importers
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers
906	LAM H CAL Ex	latin america, high income/calorie exporters
907	LAM H CAL Im	latin america, high income/calorie importers
908	LAM LM	latin america, low–medium income
909	FEA MH CAL Ex	far east asia, medium–high income calorie exporters
910	FEA MH CAL Im	far east asia, medium–high income calorie importers
911	FEA LOW	far east asia, low income
912	NEA Oil Exp	near east asia, oil exporters, high income
913	NEA LM	near east asia, low–medium income

Group 10: Developing w/o China

9	Argentina	argentina
21	Brazil	brazil
59	Egypt	egypt
100	India	india
101	Indonesia	indonesia
114	Kenya	kenya
138	Mexico	mexico
159	Nigeria	nigeria
165	Pakistan	pakistan
216	Thailand	thailand
223	Turkey	turkey
901	AFR Oil Exp	africa, oil exporters
902	AFR M CAL Ex	africa, medium income/calorie exporters
903	AFR M CAL Im	africa, medium income/calorie importers
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers

906	LAM H CAL Ex	latin america, high income/calorie exporters
907	LAM H CAL Im	latin america, high income/calorie importers
908	LAM LM	latin america, low–medium income
909	FEA MH CAL Ex	far east asia, medium–high income calorie exporters
910	FEA MH CAL Im	far east asia, medium–high income calorie importers
911	FEA LOW	far east asia, low income
912	NEA Oil Exp	near east asia, oil exporters, high income
913	NEA LM	near east asia, low–medium income

*Group 11: Mid Income**

9	Argentina	argentina
21	Brazil	brazil
138	Mexico	mexico

*Group 12: Low-Mid Inc**

59	Egypt	egypt
101	Indonesia	indonesia
114	Kenya	kenya
159	Nigeria	nigeria
216	Thailand	thailand
223	Turkey	turkey

*Group 13: Low Income**

41	China	china (exc. taiwan)
100	India	india
165	Pakistan	pakistan

*Group 14: Developing**

9	Argentina	argentina
21	Brazil	brazil
41	China	china (exc. taiwan)
59	Egypt	egypt
100	India	india
101	Indonesia	indonesia
114	Kenya	kenya
138	Mexico	mexico
159	Nigeria	nigeria
165	Pakistan	pakistan
216	Thailand	thailand
223	Turkey	turkey

*Group 15: Developing w/o China**

9	Argentina	argentina
21	Brazil	brazil
59	Egypt	egypt
100	India	india
101	Indonesia	indonesia
114	Kenya	kenya
138	Mexico	mexico
159	Nigeria	nigeria
165	Pakistan	pakistan
216	Thailand	thailand
223	Turkey	turkey

Group 16: China

41	China	china (exc. taiwan)

Group 17: Lprot OECD - Low protected OECD

10	Australia	australia
33	Canada	canada
156	New Zealand	new zealand
231	USA	united states

Group 18: Hprot OECD - High protected OECD

11	Austria	austria
110	Japan	japan
888	EC	ec
916	Rest World	remaining countries

*Group 19: Hprot OECD**

11	Austria	austria
110	Japan	japan
888	EC	ec

Group 20: 901 - 913

901	AFR Oil Exp	africa, oil exporters
902	AFR M CAL Ex	africa, medium income/calorie exporters
903	AFR M CAL Im	africa, medium income/calorie importers
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers
906	LAM H CAL Ex	latin america, high income/calorie exporters
907	LAM H CAL Im	latin america, high income/calorie importers
908	LAM LM	latin america, low–medium income
909	FEA MH CAL Ex	far east asia, medium–high income calorie exporters
910	FEA MH CAL Im	far east asia, medium–high income calorie importers

911	FEA LOW	far east asia, low income
912	NEA Oil Exp	near east asia, oil exporters, high income
913	NEA LM	near east asia, low–medium income

Group 21: 916

916	Rest World	remaining countries

Group 22: World Total

9	Argentina	argentina
10	Australia	australia
11	Austria	austria
21	Brazil	brazil
33	Canada	canada
41	China	china (exc. taiwan)
59	Egypt	egypt
100	India	india
101	Indonesia	indonesia
110	Japan	japan
114	Kenya	kenya
138	Mexico	mexico
156	New Zealand	new zealand
159	Nigeria	nigeria
165	Pakistan	pakistan
216	Thailand	thailand
223	Turkey	turkey
231	USA	united states
777	CMEA	cmea
888	EC	ec
901	AFR Oil Exp	africa, oil exporters
902	AFR M CAL Ex	africa, medium income/calorie exporters
903	AFR M CAL Im	africa, medium income/calorie importers
904	AFR L CAL Ex	africa, low income/calorie exporters
905	AFR L CAL Im	africa, low income/calorie importers
906	LAM H CAL Ex	latin america, high income/calorie exporters
907	LAM H CAL Im	latin america, high income/calorie importers
908	LAM LM	latin america, low–medium income
909	FEA MH CAL Ex	far east asia, medium–high income calorie exporters
910	FEA MH CAL Im	far east asia, medium–high income calorie importers
911	FEA LOW	far east asia, low income
912	NEA Oil Exp	near east asia, oil exporters, high income
913	NEA LM	near east asia, low–medium income
916	Rest World	remaining countries
999	Discrepancy	statistical discrepancy

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While malnutrition and hunger are endemic in many countries, the world's granaries are bursting with nearly 400 million tons of surplus grain. For rational domestic reasons, national governments support their beleaguered agricultural sectors. Collectively they spend upward of $120 billion a year perpetuating excess production and compounding the problem of what to do with the surplus. The sum of national policies has been global mayhem. Protecting domestic markets while off-loading surpluses onto world markets at subsidized prices has wrought havoc with the world food trade.

In all this, the only consensus is that something now has to be done to bring sanity to the World food situation – the only question is what? The debate centers on liberalizing World agricultural trade but there are major uncertainties which compound the problems of securing politically acceptable solutions: who will gain, who might lose and how might the losers be compensated?

This book reports the findings of a major IIASA study on the likely outcomes for different countries of a range of trade liberalization scenarios. The emphasis on distributional as well as on overall effects represents a relevant and timely contribution to the resolution of the current crisis.

ISBN 90-247-3632-3