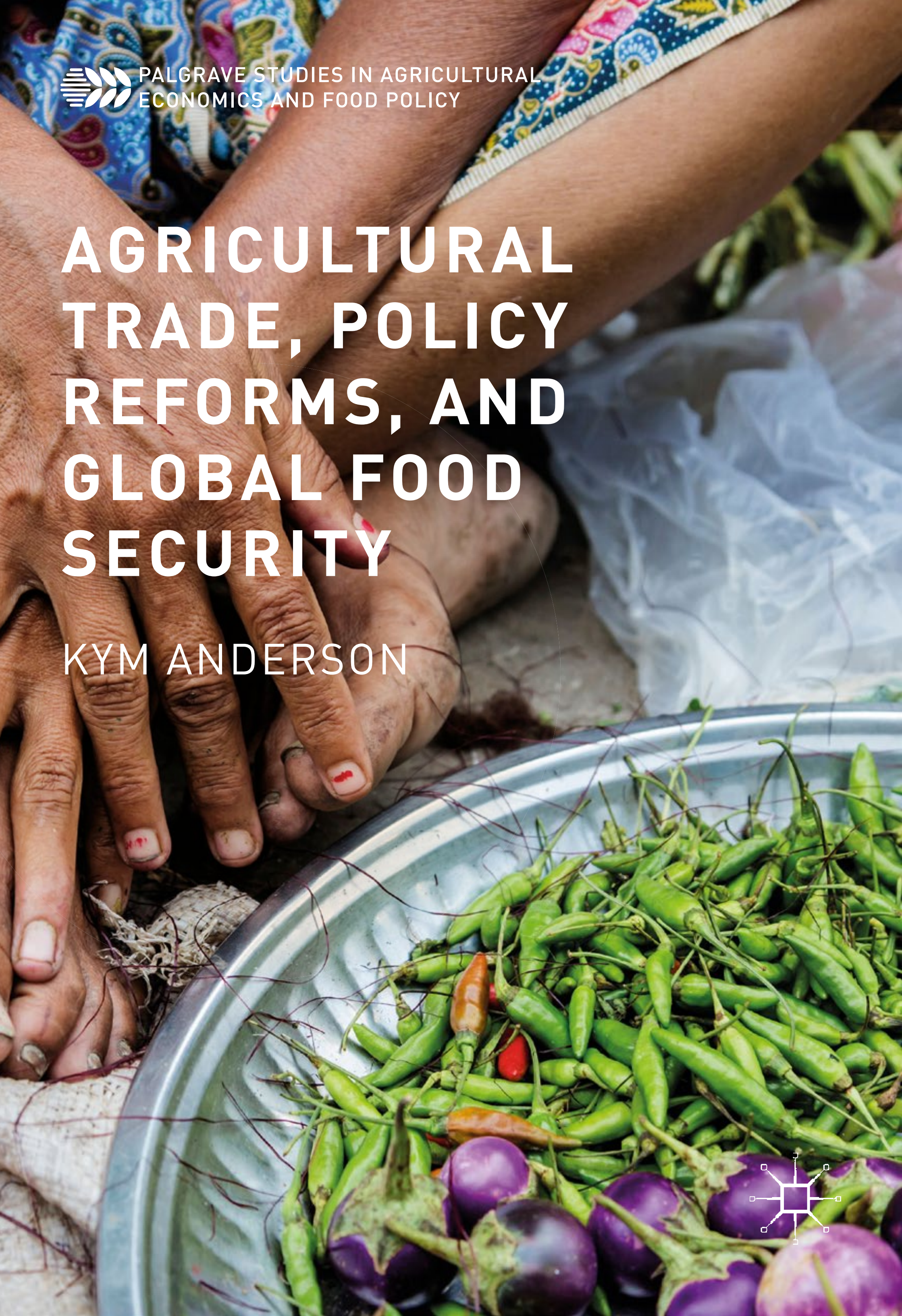
PALGRAVE STUDIES IN AGRICULTURAL ECONOMICS AND FOOD POLICY

# AGRICULTURAL TRADE, POLICY REFORMS, AND GLOBAL FOOD SECURITY

KYM ANDERSON



Palgrave Studies in Agricultural Economics and Food Policy

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**Aims of the Series**

Agricultural and food policy lies at the heart of many pressing societal issues today and economic analysis occupies a privileged place in contemporary policy debates. The global food price crises of 2008 and 2010 underscored the mounting challenge of meeting rapidly increasing food demand in the face of increasingly scarce land and water resources. The twin scourges of poverty and hunger quickly resurfaced as high-level policy concerns, partly because of food price riots and mounting insurgencies fomented by contestation over rural resources. Meanwhile, agriculture's heavy footprint on natural resources motivates heated environmental debates about climate change, water and land use, biodiversity conservation and chemical pollution. Agricultural technological change, especially associated with the introduction of genetically modified organisms, also introduces unprecedented questions surrounding intellectual property rights and consumer preferences regarding credence (i.e., unobservable by consumers) characteristics. Similar new agricultural commodity consumer behavior issues have emerged around issues such as local foods, organic agriculture and fair trade, even motivating broader social movements. Public health issues related to obesity, food safety, and zoonotic diseases such as avian or swine flu also have roots deep in agricultural and food policy. And agriculture has become inextricably linked to energy policy through biofuels production. Meanwhile, the agricultural and food economy is changing rapidly throughout the world, marked by continued consolidation at both farm production and retail distribution levels, elongating value chains, expanding international trade, and growing reliance on immigrant labor and information and communications technologies. In summary, a vast range of topics of widespread popular and scholarly interest revolve around agricultural and food policy and economics. The extensive list of prospective authors, titles and topics offers a partial, illustrative listing. Thus a series of topical volumes, featuring cutting-edge economic analysis by leading scholars has considerable prospect for both attracting attention and garnering sales. This series will feature leading global experts writing accessible summaries of the best current economics and related research on topics of widespread interest to both scholarly and lay audiences.

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# Agricultural Trade, Policy Reforms, and Global Food Security

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# Foreword

The geography of food consumption and production is changing rapidly. The world recently tipped to become majority urban for the first time in history. Urbanization necessarily elongates food supply chains as consumers become increasingly removed in space and time from farm-level production and post-harvest processing. Urbanization is projected to increase markedly in the coming decades. At the same time, population growth will add another 1–2 billion people to the planet this century that will combine with income growth to drive a rapid expansion in the quantity, quality, and diversity of food demanded through markets. Most of these changes will be concentrated in today's low- and middle-income countries, especially in Africa and Asia.

Those same regions face serious challenges in expanding local production to satisfy growing consumer demand. Land and water scarcity in Africa and, especially, Asia limit the possibility of extensification onto arable lands currently uncultivated. Slowing rates of total factor productivity growth in global agriculture raise important questions about the rate at which food supplies can expand on existing farmland in these regions, especially in the face of climate change that threatens to make growing conditions less favorable in the tropics. Meanwhile, climate change could benefit agriculture in temperate zones where food and feed demand expansion is likely to proceed more slowly, although energy policy threatens to divert a growing stream of agricultural output into biofuels production.

The net result is that international trade in agricultural products will necessarily grow more quickly than either consumption or production over the rest of the twenty-first century. In recent decades, 80 %–90 % of food consumed globally has been grown in the country in which it is eaten. Trade has been a crucial shock absorber in the global food economy, operating in that 10 %–20 % margin to transfer surpluses from nations blessed with comparative advantage in agriculture—or with favorable weather shocks—to less fortunate partners, and to provide consumers with great variety of choice. There is strong reason to believe, however, that trade's role in regulating the global food economy will expand sharply over the course of the twenty-first century as climate and the geography of food consumption and production all change.

This matters because for myriad reasons related to the complex political economy of agricultural policy and national security concerns, agriculture has historically been the most protected sector of national economies. A range of tariff and non-tariff barriers have dramatically inflated the costs of cross-border trade. Some of those barriers are rooted in legitimate concerns for food safety and for control of the spread of diseases and pests. But most simply reflect politically motivated anti-competitive policies. For decades, trade negotiators have struggled to trim back the thicket of obstacles that impede global agricultural trade, achieving some progress in the Uruguay Round Agreement on Agriculture negotiated (1986–94). Progress has been slower over the past generation, raising a host of important economic and political questions about agricultural trade policy.

There is perhaps no more learned or celebrated expert on this topic than Kym Anderson. In this volume he offers a tour de force review of the role agricultural trade policy can play in advancing global food security, stabilizing markets that have witnessed unusual price volatility over the past decade, and defusing international tensions stoked by trade wars. Integrating an impressive historical sweep with projections based on cutting-edge modeling—much of which Kym himself has developed—he offers a compelling, integrated vision of the multiple roles agricultural trade liberalization can play in the twenty-first century. Communicating incisive analysis in impressively clear prose, Kym's is the single volume any serious student of agricultural trade policy most needs to read.

For those unfamiliar with the academic research to date on agricultural trade and related policy reforms, I can think of no better scholar to introduce this crucial topic than Kym Anderson. In this volume he offers an extremely clear, careful treatment of a complex issue. Even having studied the subject for many years and contributed a few papers to the relevant literature, I learned a great deal from reading this masterpiece. It is an enormous privilege to include his work in the Palgrave Studies in

Agricultural Economics and Food Policy series. It will prove an essential reference about one of the most important topics in agricultural economics and food policy in the early twenty-first century.

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# Preface

In virtually no part of the world today can the study of agricultural economics and food policy be undertaken in a closed-economy framework. Globalization over the past three decades has helped integrate food markets across countries and continents, just as it did in the first major globalization wave from the 1860s. That first wave came to a halt for a few decades with two world wars and the Great Depression, however. As a consequence of trade policy choices from the 1920s to the 1980s, global hunger and malnutrition fell much less rapidly than needed to be the case. The choices of policies affecting international food trade have been more enlightened since the 1980s, but much scope remains for trade-related policy reforms to reduce poverty, hunger, and malnutrition throughout the world.

This book seeks to show how that can be done. It combines basic trade theory, a brief history of agricultural globalization, reviews of food trade and food policy developments since the 1950s, an understanding of the politics behind past policy choices, and global economic modeling aimed at revealing the prospects to 2030 and the policy options for enhancing global food security.

These pages build on research undertaken jointly with colleagues from various corners of the world, and to whom I am ever grateful. They are too numerous to name here, but many are cited in the references. I am also grateful for the support of various institutions at which I have had the privilege of studying and working. They include (in chronological order) the University of New England, the University of Adelaide, the University of Chicago, Stanford University, the Australian National University, the University of Stockholm, the Research Division in the GATT (now WTO)

Secretariat in Geneva, and the Research Group in the World Bank in Washington DC. Also greatly appreciated has been the financial support for research from various other organizations including (in alphabetical order) the Asian Development Bank, the Australian Research Council, the Ford Foundation, the OECD, the Rockefeller Foundation, the Rural Industries Research and Development Corporation, and the United Nations' Food and Agriculture Organization, the EU Centre for Global Affairs of the University of Adelaide.

My biggest debt though is to my family, and especially my wife Bronwyn, for putting up with me spending many hours at the desk.

Adelaide, Australia Kym Anderson
May 2016

# Acronyms

| | |
|---|---|
| AMS | Aggregate Measure of Support (to farmers, as reported to WTO) |
| ASEAN | Association of South East Asian Nations |
| BOTE | Back-of-the-envelope (model) |
| CGE | Computable general equilibrium (model) |
| CIS | Commonwealth of Independent States (of the former Soviet Union) |
| CPI | Consumer price index |
| CSE | Consumer subsidy equivalent |
| CTE | Consumer tax equivalent |
| DAI | Distortions to agricultural incentives (database) |
| DCs | Developing countries |
| DDA | Doha Development Agenda (of WTO multilateral trade negotiations) |
| ERA | Effective rate of assistance |
| EU | European Union |
| EU15 | The 15 western European members of the EU prior to May 2004 |
| EU25 | From May 2004, the EU15 plus 8 central European countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia) plus Cyprus and Malta |
| EU27 | From January 2007, the EU25 plus Bulgaria and Romania |
| EU28 | From July 2013, the EU27 plus Croatia |
| EUR | Euro (currency) |
| FAO | Food and Agriculture Organization of the United Nations |

| | |
|---|---|
| FTA | Free Trade Agreement |
| FTAAP | Free Trade Area of the Asia Pacific |
| GATT | General Agreement on Tariffs and Trade |
| GDP | Gross domestic product |
| GMO | Genetically modified organism |
| GTAP | Global Trade Analysis Project (and Model) |
| HICs | High-income countries |
| ICT | Information and communication technology (revolution) |
| LDCs | Least developed countries |
| MFN | Most favored nation |
| NAC | Nominal assistance coefficient |
| NAFTA | North American Free Trade Agreements |
| NAMA | Non-agricultural; market access (in DDA negotiations) |
| NRA | Nominal rate of assistance |
| NRP | Nominal rate of protection (from import competition) |
| NTB | Non-tariff barriers to trade |
| OECD | Organization for Economic Cooperation and Development |
| OPEC | Organization of the Petroleum Exporting Countries |
| PSE | Producer support estimate (or earlier, producer subsidy equivalent) |
| R&D | Research and development |
| REER | Real effective exchange rate |
| RCA | Revealed comparative advantage (index) |
| RRA | Relative rate of assistance |
| SDG | Sustainable Development Goal (of the UN) |
| SDT | Special and differential treatment (of developing countries in the DDA) |
| SPS | Sanitary and phytosanitary (trade restrictions) |
| SSA | Sub-Saharan Africa |
| SSM | Special Safeguard Mechanism |
| SSP | Sensitive and Special Products (in the DDA agricultural negotiations) |
| STE | State trading enterprise |
| TBT | Technical barriers to trade |
| TFP | Total factor productivity (growth) |
| TPP | Trans-Pacific Partnership |
| TRQ | Tariff rate quota (on agricultural imports) |
| TSI | Trade specialization index $((X-M)/(X+M))$ |
| TTIP | Transatlantic Trade and Investment Partnership |

| | |
|---|---|
| UN | United Nations |
| URAA | Uruguay Round Agreement on Agriculture |
| VASO | Value-added share of output |
| VAT | Value-added tax |
| WDI | World Development Indicators (published by the World Bank) |
| WPI | Wholesale price index |
| WTO | World Trade Organization |

CHAPTER 1

# Introduction and Summary

During the first decade of this century, real international prices of food and fossil fuels more than doubled—having followed a flat trend for two decades. This was especially shocking for food because its real price had halved over the twentieth century as farm productivity growth outstripped global demand growth (Fig. 1.1). Were these high prices to be a temporary aberration, or the new normal? Observers arguing the latter pointed to the rapid growth of China and other emerging economies. Industrialization in those countries is also seen as adding substantially to this century's global carbon emissions and climate change problems. That, in turn, has triggered demands for alternative energy sources to be encouraged in place of fossil fuels. One policy response in the United States and European Union (US and EU)—subsidies and mandates to encourage the use of biofuels—added to the recent food price increases though raising the demand for grains, sugar and oilseeds for ethanol and biodiesel production.

By early 2016, real food prices in international markets had come back to just one-fifth above the flat trend level in 1985–2005. Part of that decline is due to the prices of petroleum and other fossil fuels falling to less than half their peak levels during 2008–13. At these lower fuel price levels, the only additional demand for farm products by biofuel manufacturers is that due to the mandated increases in the minimum use of biofuels in the US and EU.



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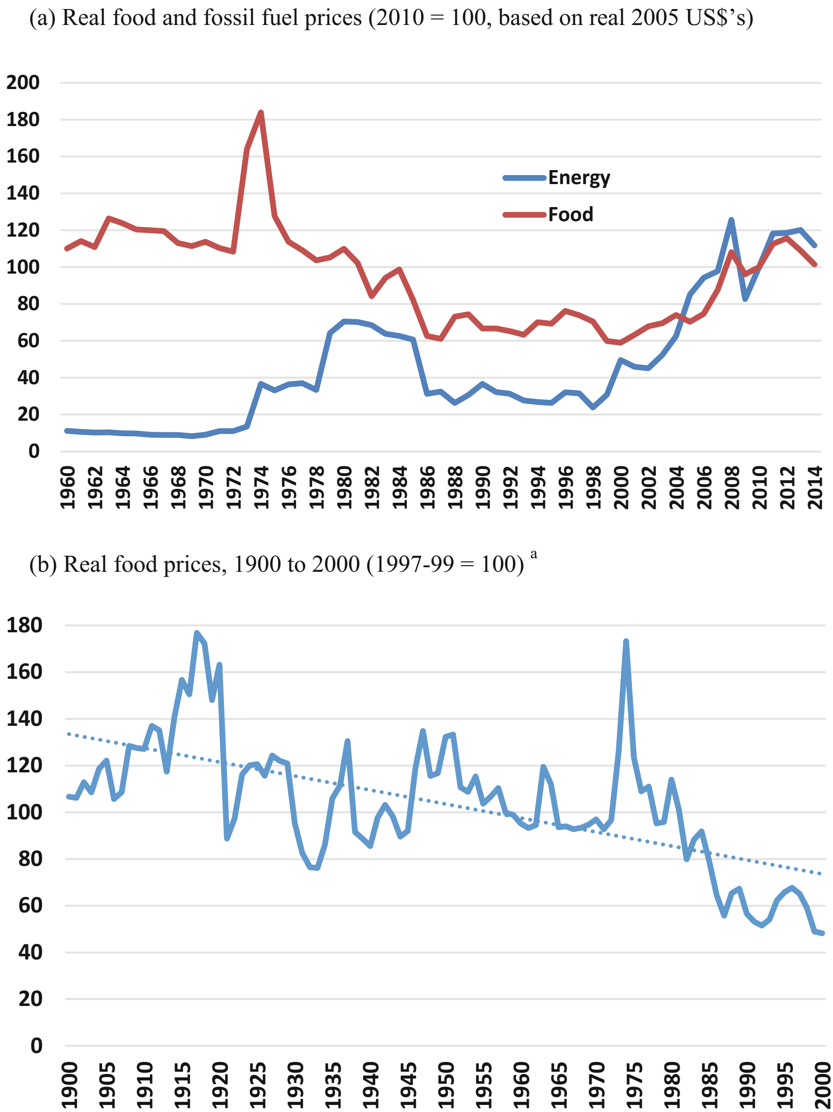


**Fig. 1.1** Real international prices of food and fossil fuel, 1900–2014. (**a**) Real food and fossil fuel prices (2010 = 100, based on real 2005 US dollars). (**b**) Real food prices, 1900–2000 (1997–99 = 100).[a] [a]The deflator is the price of manufactures imported by developing countries.
*Source*: Data from Pfaffenzeller et al. (2007) and World Bank (2016)

This does not mean the new link created in the previous decade between food and fuel prices has been removed, however. On the contrary, with much-expanded global biofuel production capacity in place in 2015 than in 2005,[1] the demand for products such as maize, canola, palm oil, and sugar will rise when the consumer price of fossil fuel rises above a threshold level. That price rise could be temporary because of political instability in the Middle East or elsewhere. Or it could be permanent as a result of higher taxes being imposed on carbon emissions to mitigate local pollution and global climate change. The threshold level is determined by the cost of biofuel production and the extent of the mandated minimum share of fuel consumption that must be biofuels (de Gorter et al. 2015).

Meanwhile, climate changes, due to increases in carbon dioxide and other greenhouse gas emissions, are threatening to disrupt food production across the globe. Some higher latitude regions may be able to produce more, but the current consensus is that, as temperatures rise and rainfall patterns change, global food production will be reduced and be subject to more extreme-weather events (IPCC 2014). It would be reduced even further if greenhouse gas emissions from agricultural production were to be taxed in some way and if some cropland was to be taken out of food production and planted with trees for sequestering carbon.

Considering climate change effects and the biofuels policies that are partly a response to them together, it seems likely that both the average level of international food prices and their volatility around the trend may be greater in coming decades than in the twentieth century. That combination therefore presents a challenge to three key aspects of global food security: food availability, economic accessibility of poor households to those available supplies, and food market stability. This set of challenges is on top of the continuing challenge of meeting the world's demand for food as the global population grows (to perhaps 9 billion by 2050), as per capita incomes rise, and, in particular, as more families in middle-income countries diversify their diet by expanding their per capita consumption of animal products and other non-staple foods as they move to cities. Meanwhile, on the supply side, natural resource constraints will limit crop and animal production growth in numerous locations.

If the global food production is to keep up with the growth in food demand, the productivity of resources employed in agriculture needs to increase. That can happen by investing more in public agricultural research or by removing barriers to transgenic research and development (R&D) by the private sector. But that is not an instant fix because of the considerable lag before R&D's impact is seen in higher output; and it is only possible where governments can obtain a political mandate to do so.

This book focuses on the potential for a more immediate and low-cost way to enhance global food security sustainably, namely, by reforming policies that are distorting food prices and trade. That this will work is not in doubt, since it has been implemented partially to great effect in various places and periods, particularly over the past three decades. But much more can be gained by encouraging policy reform in places yet to start, and by cheering the process to completion in places where reform is still on-going.

Numerous messages come out of the analyses in the chapters that follow, but key ones are summarized here as each chapter's contribution to the book is explained.

## How Trade Boosts Food Security

Chapter 2 begins by defining food security, which refers to the condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Improving food security requires improving the three inter-related elements of food availability, access, and utilization, as well as reducing market instability.

How much access households have to available food supplies depends heavily on their income, assets, remittances, or other entitlements. How well household heads utilize the foods that are accessible to them depends on their knowledge and willingness to ensure a healthy and nutritious diet for all members of their household. That, in turn, depends on the level of education in the household, particularly of adult females, which again is closely related to the household's income and wealth. Thus, food insecurity is a consumption issue that is closely related to household poverty.

Any initiative whose net effect is to raise real incomes may also enhance food security. Openness of each national economy to international trade and investment is one such initiative, because it optimizes the use of resources devoted to producing the world's food, maximizes real incomes globally, and minimizes fluctuations in international food prices and quantities traded. It thus contributes to three components of food security: availability, access, and market stability.

There is overwhelming conceptual and empirical support for the claim that opening to trade can raise the level and growth of national income. It should therefore be considered among the food policy options of national governments, as it can thereby reduce poverty, hunger, and under-nutrition, boost diet diversity, food quality, and food safety, and thus enhance national and global food security. These gains derive not just from the standard static welfare gains from removing trade-distorting policies that enable nations to consume more in general, hence, also more food. Even more important is the fact that openness to trade also can raise an economy's growth rate.

Empirical evidence clearly shows that people respond positively to getting incentives right in product, input, and factor markets, and removing trade barriers can be an important part of that process. In particular, economies that commit to fewer market interventions tend to attract more investment funds and tend to be more innovative because of greater trade in intellectual capital and greater competition, which spur innovation and productivity growth. And if domestic policy reforms include improving the government's capacity to redistribute income and wealth more efficiently and in ways that better match society's wishes, concerns about the inevitable initial distributional consequences of trade liberalization also would be lessened.

## The Long History of Food Globalization

Chapter 3 points out that long-distance agricultural trade has contributed to global economic growth and poverty reduction for millennia. But only in recent centuries has it has done so via international trade in outputs of major foods. Its predominant contribution in earlier periods was through trade in crop seeds or cuttings, breeding animals, and farm production technologies. A few high-valued unprocessed products began to be exported to Europe from the seventeenth century (spices, sugar, tea, coffee, cocoa), but it took until the industrial revolution and the steam engine before large-scale intercontinental trade in foods began. Refrigeration from the late nineteenth century, and air freight services more recently, have allowed fresh perishable products to be traded over long distances too, thereby extending their seasonal availability and adding to diet diversity and nutritional quality.

The Western Asia region was the origin of most of today's major foods apart from rice. They include wheat, barley, and wine grapes as well as domestic cattle, ducks, goats, honey bees, horses, pigs, and sheep. However, some foods that originated in the Americas became globally significant, namely maize, cassava, groundnuts, beans, and sweet and white potatoes. There are also a couple that originated from Africa (sorghum and millet) and a few from East Asia (most notably rice and bananas), along with sugar from New Guinea.

The migration of people, plants, and animals was not without some human and ecological devastation. However, those negative contributions from trade in domesticated plants and animals and their products were minor relative to the enormous contribution agricultural trade made to the world's food supplies: the complementarity between knowledge of local growing conditions on the one hand and new crops and animals and associated technical knowhow on the other led to very substantial growth in global food output. That, in turn, supported growth in the world's population, which increased about 120 % in 1500–1800, compared with only 18 % in the previous three centuries.

Since 1800, the ever-lowering cost of international commerce gradually allowed trade in farm outputs in raw or processed form to be added to long-distance trade in farm inputs. That has led to the prices of farm and other products converging across countries and indeed continents, and hence to relative factor prices also converging.

One would expect this integration, along with unprecedented growth in per capita incomes, to also lead to an expanding variety of foods being available. Yet, just a dozen basic foods account today for three-quarters of both the calories and proteins consumed by the world's population. They are three grains (wheat, rice, and maize), four meats (beef, mutton/lamb, pork, and poultry), two edible oils (from soybean and oil palm), and potatoes, milk, and sugar. Those dozen basic farm products could not have become so dominant in the world without international trade in agricultural inputs/technologies or their products, given the small number of regions of the world from which those key species originated. Certainly, fresh fruits and vegetables along with a plethora of processed foods supplement our diets and provide important micronutrients today, but only a small number of them dominate (bananas, apples, oranges, and other citrus) and have become ubiquitous, again thanks to international trade.

Which countries are expected to dominate in food trade? One of the best-known facts about growing economies is that their farm sector's shares of GDP and employment tend to fall, although less so for countries with a relative abundance of farm land. According to comparative advantage theory, we should expect agricultural trade to occur between relatively lightly populated economies that are well-endowed with agricultural land (relative to labor, capital, and minerals) and those that are densely populated with little agricultural land per worker and lots of industrial capital or minerals.

But sectoral policies also affect trade. In those industrializing economies whose growth has been accompanied by increases in protection from agricultural imports, self-sufficiency in farm products falls less. Likewise, global farm trade is dampened if poor agrarian economies protect their emerging manufacturers from import competition or tax their farm exports or over-value their currency, each of which discourages farm production and encourages domestic food consumption. Other things equal, reforms to such trade-restricting policies cause an agricultural trade growth spurt and result in a higher share of global farm production being traded across national borders. Their impact on the international terms of trade would depend on which of those two sets of reforms dominate in any period. Real prices of agricultural products in international markets would rise as a result of agricultural protection rates being cut, but they fall if and when farm export restrictions are lowered.

Agricultural trade grew as rapidly as trade in non-farm products in the first globalization wave to World War I, but it has grown more slowly than trade in other products since then, in large part because of policy developments. In the nineteenth century, rich countries opened their markets to trade in farm products and took advantage of agricultural development opportunities in their colonies. In the period between World Wars I and II, many countries withdrew from trading, especially in farm products. Then, after World War II, agricultural protectionism grew in industrial economies, while newly independent developing countries taxed their exports of farm products. Those policies continued through to the 1980s, before both country groups began to reform them.

Notwithstanding that history of economically wasteful market-distorting policies, the per capita supply of food available for human consumption globally has been steadily increasing for many decades. It grew especially rapidly for cereals between 1960 and the mid-1980s, thanks to the dissemination of dwarf wheat and rice varieties in Asia and the continuing expansion and improvement of hybrid maize plantings. In the subsequent three decades, the per capita supply of other foods has grown rapidly too.

Not unrelated has been a steady reduction in the number of under-nourished people in the world, of more than 220 million (19 %) since 1990. The largest concentrations of under-nourished people now are in South Asia at 280 million, or 16 % of its population, and in Sub-Saharan Africa, where the prevalence is 23 % (220 million). International trade, and especially market opening though trade policy reforms, can expand aggregate food availability so as to reduce far more that number of undernourished people—and the number living in extreme poverty.

## The Evolution of Agricultural Trade Patterns Since the 1960s

Chapter 4 lays out key developments in global agricultural trade, 'revealed' comparative advantage, and net trade specialization in farm products over the past five decades. Those developments are broadly consistent with expectations from trade theory, even though trade patterns have been distorted by anti-trade policies.

There is concentration in both the commodity and country shares of global exports of farm products. As of 2014, less than ten items made up half of that trade in agricultural products, and two-thirds of the world's exports of farm products are accounted for by just a dozen agricultural-trading economies (treating the EU28 as a single economy). These large food-trading economies range from being very heavily food import- or export-dependent to being close to self-sufficient, but most of the top 20 food-trading nations engage in substantial two-way farm trade as people look to diversify their diets and consume more exotic foods as part of their quest for variety and nutrition. Nonetheless, there is a negative correlation across countries between their agricultural comparative advantage and both per capita income and population density.

Over the past half-century, the share of farm products in national exports has been declining not only for most groups of countries but also for the world as a whole. A persistent decline in comparative advantage in agriculture is evident only for Japan and upper middle-income countries. For the high-income group as a whole, and especially for Western Europe, their comparative advantage in farm products has risen rather than fallen.

One reason for not observing the trends in national farm trade patterns that theory suggests for high-income and low-income countries is the anti-trade bias in many nations' policies that distorts domestic farm product prices relative to those of other tradables. Both China and India showed little sign of moving away from being slight net exporters of farm products through the 1970s, 1980s and 1990s, even though their non-farm sectors were growing strongly. It is only in the past decade that China has switched to being a significant net importer of food, while India has become an even bigger net exporter over the 2005-14 decade. A key reason for the long delay in those two countries becoming net food importers was their gradual move away from very heavily taxing farmers relative to manufacturers in the 1970s and 1980s to assisting them more than manufacturers since the late 1990s.

The pervasive anti-trade bias in policies means only a small share of global agricultural production is traded internationally: just 1/6th for grains and less than 1/12th for livestock products. It is higher for sugar and oilseeds but especially low for rice and dairy products.

One consequence of little food production being traded internationally is that just a few countries dominate each product's international trade. Were there to be less of an anti-trade bias in policies affecting farmer incentives in all countries, it is likely that a larger number of countries would emerge as significant exporters of major food products, and all countries would have a more diversified (and potentially more nutritious) diet.

## Long-Run Trends in Market-Distorting Policies

Chapter 5 begins by pointing out that agricultural protection and subsidies in high-income countries have been depressing international prices of farm products for many decades. Apart from this external adverse influence on farm incomes elsewhere, governments of many newly independent developing countries directly taxed farm exports, as well as harming farmers indirectly with an industrialization strategy that involved restrictions on imports of manufactures and an over-valued currency. Since an important aspect of those price-distorting policies was their anti-trade bias, the quantity of farm products traded internationally was less, which meant that international food prices were more volatile than they otherwise would have been.

Since the mid-1980s, however, many developing country governments have been reforming their agricultural, trade, and exchange rate policies, thereby reducing their anti-agricultural bias. Some high-income countries have reduced their farm price supports too. Associated with those policy reforms are reductions in the distortions to consumer prices of food products. When placed in historical perspective, the reforms since the mid-1980s are as dramatic as the policy changes in the preceding three decades.

Despite those policy reforms, however, the evidence shows that (a) both high-income and developing countries continue to insulate their domestic food markets from the full force of fluctuations in international prices and (b) plenty of diversity in price distortions remains across countries and across commodities within each country. Hence, a continuation of the reform process would boost farm trade, 'thicken' international food markets, and thus not only raise the average level but also lower the volatility of prices in those markets. It would also ensure that the world's productive resources in the farm sector would be put to their best use and so make agricultural production more sustainable.

## Trade, Welfare, and Poverty Effects of Recent and Prospective Trade Reforms

Chapter 6 uses the distortion estimates summarized in the previous chapter in global economy-wide models to estimate the effects of (a) the agricultural and trade policy reforms around the world in the two decades to 2004, the final year of implementation of the Uruguay Round Agreements and just prior to the dramatic rise in world food prices, and (b) the policies remaining at that time. A wide range of global economic effects of those historic and prospective reforms are provided. A number of key messages can be drawn from those model results.

First, they suggest the reforms over the two decades to 2004 brought the world a remarkable three-fifths of the way toward free trade when measured in terms of global economic welfare. Since much of that reform involved reducing anti-agricultural policies in developing countries, it is not surprising that it benefitted developing countries proportionately more than it did high-income countries. Part of that reform also involved a reduction in farm price supports in high-income countries. Together, those and other policy changes raised the developing countries' shares of global farm output and exports by several percentage points relative to what they otherwise would have been.

Had the remaining policies as of 2004 also been liberalized, developing countries would have gained nearly twice as much as high-income countries did (an average economic welfare increase of 0.9 % compared with 0.5 %) from that final step. That is, the model results suggest both the actual reforms from the 1980s and prospective reforms have the effect of reducing international inequality by closing the income gap between high-income and developing countries.

Of those prospective welfare gains from completing the liberalization process, two-thirds would be generated by agricultural policy changes, even though agriculture and food account for less than one-tenth of global GDP and trade. Such is the degree of distortions still remaining in agricultural markets compared with those in other primary sectors and in manufacturing.

Through full liberalization of trade in goods, exports as a share of global production of farm products would rise from 8 to 13 % (excluding intra-EU trade). That would thicken international food markets and thereby reduce the fluctuations in prices and quantities traded in those markets.

Unskilled workers in developing countries—the majority of whom work on farms—would benefit most from such reform, followed by skilled workers and then capital owners. The real unskilled wage across all developing countries would rise 4 %, or nearly five times more than the average increase in net incomes in developing countries. And net farm incomes in developing countries would rise by 6 %, compared with 2 % for non-agricultural value added. Both of these findings suggest poverty and income inequality would fall in developing countries.

As found in previous studies, the poverty results are neither unequivocal nor easy to summarize. But the LINKAGE model estimates that the number of people living in extreme poverty—the number living on less than US$1 a day—in developing countries would drop by 29 million, a reduction of almost 3 %, if the trade policies as of 2004 had been removed. A 15-country set of results from the Global Trade Analysis Project (GTAP) model suggest that the poverty-reducing effects would be somewhat larger, and nine national case studies all find that global trade liberalization would alleviate poverty. Those results are regardless of whether the reform was to involve only agricultural goods or all goods, with the benefits coming roughly equally from reform at home and abroad. The national case studies also find that rural poverty would be cut much more than urban poverty in all cases, whether from reform at home or abroad and whether or not it included non-farm goods.

Full trade liberalization of all goods, or just of agricultural products, would also cause inequality to decline within each of the three developing country regions covered by the sample of countries, and both for own-country and rest-of-world reform. Inequality within the rural or urban household groupings would not alter much following full trade reform, suggesting that trade reform's predominant impact would be to reduce urban–rural inequality.

## The Interface Between Trade and Technology Policies: What Role for Transgenic Crops

Chapter 7 deals with technology policies that have reduced global food production growth and with associated trade policies that diminish the role that food trade can play in boosting global food security. Concerns that products containing genetically modified organisms (GMOs) may be unsafe as food or animal feed, or that GMO seed plantings may have adverse effects on the natural environment or contaminate fields of non-GMO crops, have led some countries to procrastinate on approving their production or use. Those policies have persisted in spite of the fact that there is no evidence that GM crops have greater adverse impacts on health or the environment than non-GM crops. On the contrary, GM crop varieties are reducing the need for agrochemicals that harm the environment and farmer health. Moreover, they could greatly improve the micronutrient content of our food if second-generation biofortified GM varieties such as Golden Rice were also to be embraced.

This GM policy development is unfortunate because modeling results show that these new agricultural biotechnologies promise much to the countries willing to allow GM crop adoption. Yet import barriers to food markets in Western Europe have led many African and Asian governments to ban GM crop production for the fear that their country's agricultural exports even of non-GMO products may otherwise be rejected by concerned governments abroad. Such production bans are shown, through modeling, to generate little if any net benefit to the developing countries imposing them: the domestic consumer loss net of that protectionism boost to African and Asian farmers is far more than the small gain in terms of greater market access to the EU.

The stakes in this issue are thus very high. GM crops offer welfare gains that could alleviate poverty and food insecurity directly, substantially, and relatively rapidly in those countries willing to allow adoption of this new biotechnology. If developing countries do not share the food safety and environmental concerns of Europeans regarding GMOs, their citizens in general, and their poor in particular, have much to gain from allowing imports of GM food, letting their farmers adopt GM crop varieties, and exporting any surpluses that result from the increase in farm productivity. Moreover, those prospective gains from this new technology will increase as climate change proceeds and requires adaptation by farmers to warming and increased weather volatility and higher costs of water for irrigation.

## International Food Price Spikes and Temporary Trade Policy Responses

Chapter 8 begins by pointing out that achieving the UN's core Sustainable Development Goals of permanently eradicating extreme poverty and hunger can be helped more by dealing with high consumer prices of food than by reducing fluctuations in food prices around trend. Nonetheless, loss aversion drives many governments to insulate domestic food markets from gyrations in international prices. Insulation is invoked especially in upswings, but also when international prices slump. It may reduce the volatility of domestic prices in countries that insulate heavily, but the collective impact of such interventions by a large number of countries is non-trivial: it increases the volatility of international prices and thereby increases domestic price volatility in more open countries.

The indicator used to measure the gap between domestic and international food prices was found on average to be substantially lower in two upward price spike periods around 1974 and 2008 (and higher for a downward price spike period around 1986) than in adjacent non-spike periods. Changes in both export and import restrictions contributed to that finding. The basic theory in this chapter tells us that if a similar proportion of the world's food exporters insulate to the same degree as a group of food importers, each group will fully offset the other's attempt to prevent their domestic price from moving as much as the international price. That is, these policy actions are as futile as everyone in a football stadium standing in an attempt to get a better view of the field.

Changes in restrictions on global grain trade are responsible for up to two-fifths, one-fifth, and one-tenth of the rise during 2006–08 in the international prices of rice, maize, and wheat, respectively. That policy action evidently is adding very substantially to the volatility of international food prices.

Moreover, developing countries as a group would probably see less of their people fall into poverty when international food prices spike if they *and all other countries* agreed to abstain from altering trade restrictions in the hope of insulating their domestic markets from such spikes. The only way that price insulation could be effective in reducing global poverty is if the countries that insulate most are those in which the poor are most vulnerable to price spikes.

Since the same basic logic applies when international prices slump, it throws into doubt any virtue in the proposal in the WTO's Doha Round, from a large group of developing countries, for a Special Safeguard Mechanism (SSM) to be established. The proposed SSM would allow developing countries to raise their applied tariffs on specified farm products when either their import price falls or the volume of imports surges beyond threshold levels. The purported price-insulating benefit for farmers in food-importing countries is likely to be illusory because the behavioral responses to a price slump by governments of agricultural-importing countries traditionally has been offset by similar policy reactions by agricultural-exporting countries.

## What Are the Drivers Behind Agricultural Price and Trade Policy Trends?

Chapter 9 explores the domestic political forces behind countries gradually transitioning from negative to positive government assistance to farmers as their per capita incomes grow and the agricultural sector's shares of GDP and employment shrink. It also reflects on the political economy reasons for countries to partially insulate their domestic food markets from spikes up and down in international food prices.

Trade policies pervade as a means of altering the trend level and fluctuations in domestic food prices, even though they are far from being the most efficient or equitable instruments for achieving the objective of averting short- or long-term losses to significant groups in society. Fortunately, the standard reasons for that choice of instrument are altering, as democracy and commercial mass media spread and as costs of becoming informed about policies fall. While that will help to remove any remaining anti-agricultural policy bias in developing countries, those same influences may also lead emerging economies to go beyond a neutral position to a pro-agricultural policy bias as their incomes grow. Given the large gap between their tariff and subsidy bindings and their actual applied rates, developing countries' commitments in the WTO will not be enough to stop that tendency in the foreseeable future—even if the WTO's Doha Round of trade negotiations had resulted in a comprehensive agreement.

## What Might a Multilateral Agreement Under the WTO's Doha Round Have Achieved?

In Chap. 10, empirical modeling of trade reform options makes clear that there is a great deal to be gained from liberalizing merchandise—and especially agricultural—trade. If it were done multilaterally under the WTO's Doha Round, a disproportionately high share of that potential gain could go to developing countries (relative to their share of the global economy). Moreover, it is the poorest people in developing countries that appear to be most likely to gain from global trade liberalization, namely farmers and unskilled laborers in developing countries. To realize that potential gain, it is in agriculture that by far the greatest cuts in bound tariffs and subsidies are required. However, the political sensitivity of farm support programs have made a Doha agreement elusive.

Even so, *ex ante* empirical analysis of the sort provided in the past decade provides countries engaged in such negotiations a better sense of what is at stake with various options. The results show that developing countries would not have had to reform very much under Doha proposals (because of the large gaps between their tariff bindings and applied rates). However, if they exercised their right to undertake lesser tariff cuts than developed countries, they would have gained little in terms of improved efficiency of national resource use.

To realize more of their potential gains from trade, developing and least-developed countries would need to forego some of the Special and Differential Treatment they have previously demanded at the WTO, and perhaps also commit to additional unilateral trade (and complementary domestic) reforms, and invest more in trade facilitation. High-income countries could encourage them to do so by being willing to open up their own markets more to developing country exports and providing more targeted aid.

There was never any guarantee that major gains would flow from the agricultural part of Doha Development Agenda. That is because the size of gains depends on, among other things, the nature of the tariff-cutting formula, the size of the cuts, the extent to which exceptions for Sensitive and Special Products are allowed, whether a tariff cap is introduced, and the extent to which Special and Differential Treatment is invoked by developing countries in terms of their market access commitments. But what is clear is that major gains would be possible if the collective political will to reform protectionist policies multilaterally could be mustered.

## Where Will Food Markets Be by 2030?

Chapter 11 provides projections of food and other markets to 2030 using the global economy-wide GTAP model. Under a range of assumptions about the world's economic growth and structural changes, it appears the world will be able to feed itself adequately in 2030 and at international food prices that in real terms are not greatly different than those just before the global financial crisis and food price spike period of 2008–12.

Asia is projected to continue to become more important in the global economy, especially in markets for primary products. That opens opportunities for natural resource-rich economies to raise their own incomes by expanding their trade with Asia. Those trade growth prospects are greater, the faster Asia grows and the more those food-exporting countries invest in agricultural R&D to boost their farm productivity. But agricultural trade would grow less, as would global food security, the more agricultural protection rises in emerging economies in Asia and elsewhere.

Even if the WTO is unable to conclude its Doha Round, regional trade agreements may continue to be signed. The extent to which they contribute to the integration of the world's food markets depends heavily, though, on the willingness of partners to liberalize agricultural trade alongside that for other goods and services. To date, there has been a tendency to open markets for food less than for other products in regional agreements, just as in multilateral ones. Simulations of the welfare gains to developing countries from a prospective large Asian FTA suggest they would double if agriculture is also freed, and the projected gains to the world as a whole would be four times greater if agriculture is not excluded. This again illustrates the point that trade restrictions are so high for food compared with other products that their removal would dominate the gains from freeing trade.

## Policy Implications and Prospects for Boosting Global Food Security

Chapter 12 reiterates that open markets maximize the benefit that international trade can offer to boost global food security and ensure the world's agricultural resources are used sustainably. The decline in costs of trading internationally reinforces that message, as does climate change. If global warming and extreme-weather events are to become more damaging to food production, then there is all the more reason to be open to international food markets and allow trade to buffer seasonal fluctuations in domestic production. The more countries that do so, the less volatile will be international food prices.

For those countries becoming more food import-dependent as their comparative advantage moves away from agriculture, slowing that process by raising food import barriers worsens rather than improves their national food security, since it reduces economic access to food for the vast majority of households. By contrast, public investments to boost farm productivity—while achieving the same end of reducing import dependence—would enhance national economic growth and food security. Improving the efficiency of markets for all key factors of agricultural production (capital, labor, land, and water) and for inputs such as fertilizer are other ways to improve the sustainable use of the world's agricultural resources.

Developing countries still concerned that their poor households would be too vulnerable if food markets were unrestricted have another option to consider. They can now invoke generic social safety net measures such as conditional targeted income supplements. Those measures can be made more affordable and more equitable if they are targeted at just the most vulnerable households. This option is far more practical now than just a few years ago, thanks to the information technology revolution that has reduced hugely the cost of administering such handouts because they can be provided electronically as direct assistance to even remote households so long as they have access to electronic banking.

As for international efforts to reduce food price volatility, the most obvious option is for WTO member countries to agree collectively to desist from altering their food trade restrictions when prices spike. That would require binding not only import tariffs but also export taxes at zero or low levels. For that to happen, members will first need to find the political will to return to the WTO's multilateral negotiating table. Is it possible that if and when currently negotiated mega-regional free-trade deals are agreed to, there will be an appetite to again embrace multilateralism?

## Note

1. Biofuels and other renewables accounted for only 4 % of the energy consumption in high-income countries and 2.5 % globally in 2014 (BP 2015), while consumption by biofuel producers made up one-quarter of coarse grain use in high-income countries and non-trivial shares of oilseed and sugar use also in such countries as Brazil, Indonesia, and Argentina (OECD/FAO 2015). Hence, food prices affect energy prices hardly at all, while energy prices are affecting maize, oilseed, and sugar prices (de Gorter et al. 2015).

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CHAPTER 2

# How Trade Can Boost Food Security

Imagine a camp during World War II with British and French prisoners, each of whom receives an identical Red Cross food package from time to time. The parcel contains both tea and coffee. Since the British prefer tea to coffee, while the French have the opposite preference, they exchange one beverage for the other. Such 'trade' makes both groups happier.

Or imagine a primitive tribe in a pre-agrarian country of men and women both young and old. The strongest (mostly adult men) spend their time hunting wild animals and carrying their kill back to camp, while women and older children gather wild fruits, nuts, and roots. All members of the tribe may have the same food preferences, and the strong men may well be able to gather fruit more quickly than women and children; but by specializing in tasks in which each group has a comparative (cost) advantage, they collectively bring in a larger quantity and variety of foods than if each person had to both hunt for and gather his or her own food.

These examples illustrate how trade can benefit groups either with the same endowments but different preferences, or with the same preferences but different productive capabilities. Food security is enhanced by a willingness to exchange, and it can be further enhanced if there are differences in skill endowments that make production specialization beneficial.

If one expands on the second example to imagine a second nearby tribe with a different demographic makeup and different mix of hunting and gathering opportunities in their territory, trade between the two tribes



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could exploit their comparative advantages, which, in this case, would be due to differences in both preferences and endowments of land and labor. Should one of the tribes invest time in developing improved hunting or gathering tools, that technological edge would provide a third source of difference in their comparative advantages, adding to the potential gains from inter-tribal trade. In that case, production specialization and exchange not just within but also between tribes would have improved welfare and food security of both tribes. Furthermore, if those gains from trade are sufficient for some members of one tribe to be able to afford to spend more time sewing together furs for clothing or footwear, the potential would arise for trading some of that tribe's manufactured apparel for more of the other tribe's food, contributing even more to both societies' welfare. Or if one of the tribes discovered the benefits of collecting the best seeds and planting them in tilled soil, their new farming operation would provide further scope for production specialization and trade. And if by interacting through trade, the other tribe learns how to select seeds and farm, even more opportunities open up for both tribes to gain from trade.

The improvement in welfare and food security via trade is greater the more hunting, gathering, or cropping by one or more of the trading partners is subject to seasonal fluctuations—as is most plant and animal growth. The direction of trade in surpluses following the harvest season could well be reversed in the off-season, leading to what is called intra-industry trade. This is even truer if one or more regions is subject to natural disasters that can temporarily wipe out food supplies.

Of course, if the two tribes decided to go to war with each other, or if the second tribe formed an alliance with a third tribe that required trade between the first two to cease, the benefits of the initial inter-tribal trade would evaporate. But so long as the first tribe still had skills in hunting and gathering, it would be no worse off in the future than before it began its inter-tribal trade—and it still would have had the benefit of greater welfare and food security throughout that period of trade.

Generalizing from these examples, it is clear that broadening to regional, national, international, and, ultimately, inter-continental and global trade multiplies the gains from production specialization and market exchange and reduces the extent of food insecurity and risk of famine. The increased competition that comes from trade opening also has been shown to boost farm productivity growth (Yu and Nin-Pratt 2011) and overall economic growth (Anderson and Brueckner 2016), and it expands the scope for raising diet diversity and food safety and quality, the demands for which tend to rise with per capita income (Clements and Si 2015).

Recall that food security refers to the condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Improving food security requires improving the three interrelated elements of food availability, access, and utilization, as well as reducing market instability. How much access households have to available food supplies depends heavily on their income, assets, remittances, or other entitlements. How well household heads utilize the foods that are accessible to them depends on their knowledge and willingness to ensure a healthy and nutritious diet for all members of their household. That, in turn, depends on the level of education in the household, particularly of adult females, which again is closely related to household income and wealth or other entitlements.

Thus, food insecurity is a consumption issue that is closely related to household poverty. Any initiative whose net effect is to raise real incomes, especially of the poorest households, may also enhance food security. Since openness to trade raises national income (and increases food diversity, quality, and safety for the reasons mentioned in the earlier parable), it should be considered among the food policy options open to national governments. If all countries were open to international trade and investment, it would optimize the use of resources devoted to producing the world's food, maximize real incomes globally, and minimize fluctuations in international food prices and quantities traded. Openness thus contributes to three components of food security: availability, access, and market stability.

Openness is especially beneficial to food security for two categories of countries: those that are restricting food imports and where the majority of the poor and under-nourished are net buyers of food and those where the majority of the poor and under-nourished are net sellers of food and their governments are restricting food exports. In both cases, reducing those trade restrictions will tend to raise the real income and food security of poor households. As for the other categories of countries (food-importers, where the majority of the poor are net sellers of food, and food-exporters, where the majority of the poor are net buyers of food), opening such economies of trade will still raise the average national income, which, in turn, increases the scope for assisting the poor with more efficient domestic measures. Such measures include increased investments in agricultural R&D and rural infrastructure for the first category and conditional cash e-transfers in the second category (discussed in Chap. 11).

Trade openness has increased dramatically over the past half century, but the world is still a long way short of fully open trade, especially in food products (detailed in Chap. 5). Also, in recent years, politicians in numerous countries have failed to find strong support for trade-liberalizing initiatives, including—indeed especially—at the multilateral level of the WTO. So, before going any further, it is worth reviewing in more detail the potential benefits from trade reform. That is the purpose of this chapter. We begin with the static economic gains from trade arguments and then consider additional dynamic gains.[1] Necessarily, the focus needs to broaden beyond food and agricultural products, since they account for only a small share of global trade in goods and services.

## Static Economic Gains from Own-Country Trade Reform

As just illustrated, the standard comparative static analysis of national gains from international trade emphasizes the economic benefits from production specialization and exchange so as to exploit comparative advantage in situations where a nation's costs of production and/or preferences differ from those in the rest of the world. Distortionary policies such as trade taxes or subsidies diminish those benefits.

More specifically, an export tax or its equivalent lowers the domestic price below the border price of a tradable product such as grain (as does an import subsidy), whereas an import tax or its equivalent raises its domestic price above the border price (as does an export subsidy). Also, an import tax (or export subsidy) is the equivalent of a consumer tax and a producer subsidy, hence lowering it reduces the extent to which the measure assists producers of that tradable product. Conversely, lowering an export tax (or import subsidy), which is the equivalent of a consumer subsidy and a producer tax, reduces the extent to which the measure harms producers of the good in question.

This is part of the more general theory of the welfare effects of market distortions in a trading economy, as summarized by Bhagwati (1971) and Corden (1997). Domestic industries become more productive on average as those with a comparative advantage expand by drawing resources from previously protected or subsidized industries that grow slower or contract following reform.

The gains from opening an economy are larger, the greater the variance of rates of protection among industries—especially within a sector, insofar as resources are more mobile within than between sectors (Lloyd 1974).

Likewise, the more productive domestic firms within industries expand when the economy is opened by drawing resources from less productive firms that contract or go out of business. Indeed, theoretical and empirical studies suggest the shifting of resources within an industry may be more welfare-improving than shifts between industries when protection is cut.[2] Furthermore, if trade barriers are managed by inefficient institutions (such as distributors of import or export quota licenses), gains from the removal of such barriers will be larger than those from the removal of standard trade taxes (Khandelwal et al. 2013).

The static gains from trade opening tend to be greater as a share of national output, the smaller the economy, particularly where economies of scale in production have not been fully exploited and where consumers (including firms importing intermediate inputs) value variety so that intra- and inter-industry trade can flourish. Less-than-full exploitation of scale economies is often the result of imperfect competition being allowed to prevail in the domestic marketplace, which again is more common in smaller and poorer economies where industries have commensurately smaller numbers of firms. This is especially the case in the service sector. One example is sub-sectors such as utilities, where governments have been inclined to sanction monopoly provision.[3] The gain comes from firms having to reduce their mark-ups in the face of greater competition.

Those gains from opening up will be even greater if accompanied by a freeing up of domestic markets and the market for currency exchange. The more stable is domestic macroeconomic policy, the more attractive will an economy be to capital inflows. And the more friendly domestic microeconomic policies are to markets and competition for goods, services, and productive factors, the greater is the likelihood that adjustments by firms and consumers to trade liberalization will lead to a more efficient utilization of national resources, lower consumer prices (in most cases), and greater economic welfare (Corden 1997). If domestic policy reforms included improving the government's capacity to redistribute income and wealth more efficiently and in ways that better matched society's wishes, concerns about the distributional consequences of trade liberalization also would be lessened.

This century has seen vastly increased scope to separate in time and space the various productive tasks along each value chain, thanks to the information and communication technology revolution (Baldwin 2016). Firms are thus increasingly able to take advantage of factor cost differences across countries for specific tasks without having to sacrifice gains from product specialization or move the whole of their production operation offshore (Hanson et al. 2005). Trade in many tasks (e.g., emailing data files) is not even recorded in official trade statistics and so is not directly subject to trade policies. That suggests the variance of import protection across all traded items is even greater than across just recorded trade in goods, so the welfare gains from reducing the latter could well be greater than that captured by conventional trade models.

Trade in services goes alongside and facilitates most trade in goods. Recent data compiled by the OECD/WTO (2016) reveal that nearly one-third of the gross value of exports of goods is made up of services (banking, insurance, transport, etc.). That share was 36 % for food in 2009 and 26 % for agriculture (Fig. 2.1). Hence, freeing up a country's markets for services can boost services trade not only directly but also indirectly via lowering the cost of exporting goods.

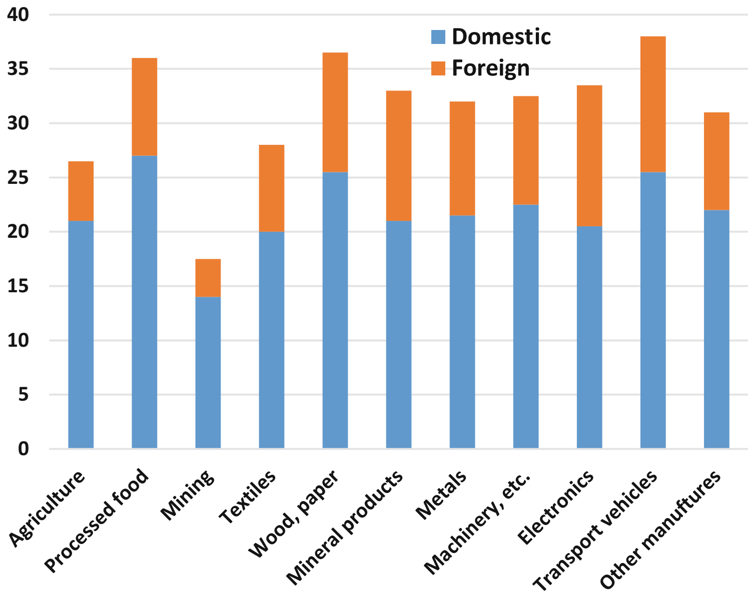


**Fig. 2.1** Share of services in the gross value of exports of agricultural and other goods, all countries, 2009 (%).
*Source*: OECD/WTO (2016)

## Dynamic Economic Gains from Own-Country Trade Reform

The just-outlined standard comparative static analysis needs to be supplemented with links between trade and economic growth. The mechanisms by which openness contributes to growth are gradually getting to be better understood by economists, thanks to the pioneering work of such theorists as Grossman and Helpman (1991) and Rivera-Batiz and Romer (1991) and the literature those studies spawned, including econometric papers based on firm-level databases. Channels through which openness to trade can affect an economy's growth rate include the scale of the market when knowledge is embodied in the products traded, the degree of redundant knowledge creation that is avoided through openness, and the effect of knowledge spillovers (Romer 1994; Taylor 1999; Acharya and Keller 2007). The latest surge of globalization has been spurred also by the technology 'lending' that is involved in off-shoring an ever-rising proportion of production processes. As Baldwin (2016) points out, this joining of a supply chain has made industrialization potentially far less complex and much faster—especially for countries that have reliable workers, have a hospitable business environment, and are located near large industrial countries such as China.

The dynamic gains from openness can be greater when accompanied by reductions in domestic distortions. As one example, Helpman and Itskhoki (2010) develop a two-country two-sector model of international trade in which one sector produces homogeneous products, while the other, which produces differentiated products, has firm heterogeneity, monopolistic competition, searching and matching in its labor market, and wage bargaining (so that some of the workers searching for jobs end up being unemployed). The two countries are similar except for frictions in their labor markets. They show that both countries gain from trade, but that the country with lower labor market frictions gains proportionately more, and that its flexible labor market confers comparative advantage: the flexible country is a net exporter of differentiated products. Either country benefits by lowering frictions in its labor market, although that harms the other country; but a simultaneous proportional lowering of labor market frictions in both countries benefits both of them. Both countries benefit from trade integration (even though it may raise their rates of unemployment), but the flexible country has higher total factor productivity in this model.

When that trade reform includes financial markets, more is gained than just a lower cost of credit. The resulting financial deepening can stimulate growth too (Townsend and Ueda 2010). Kose et al. (2009) add two other indirect growth-enhancing benefits of financial reform: they discipline firms to look after the interests of shareholders better, and they discipline governments to provide greater macroeconomic stability.

Importantly, from a policy maker's viewpoint, the available empirical evidence strongly supports the view that open economies grow faster (see the surveys by USITC 1997; Winters 2004; Billmeier and Nannicini 2009 and Francois and Martin 2010). Notable early macroeconometric studies of the linkage between trade reform and the rate of economic growth include those by Sachs and Warner (1995) and Frankel and Romer (1999). More recent studies also provide some indirect supportive econometric evidence. For example, freeing up the importation of intermediate and capital goods promotes investments that increase growth (Wacziarg 2001). Indeed, the higher the ratio of imported to domestically produced capital goods for a developing country, the faster it grows (Lee 1995; Mazumdar 2001). Greater openness to international financial markets also boosts growth via the stimulation to investment that more risk-sharing generates.

Rodrigeuz and Rodrik (2001) examine a number of such studies and claim the results they surveyed are not robust. However, in a more recent study that revisits Sachs and Warner's data and then provides new time-series evidence, Wacziarg and Welch (2008) show that dates of trade liberalization do characterize breaks in investment and GDP growth rates. Specifically, for the 1950–1998 period, countries that have liberalized their trade (defined as those raising their trade-to-GDP ratio by an average of 5 percentage points) have enjoyed on average 1.5 percentage points higher GDP growth compared with their pre-reform rate.

There have also been myriad case studies of liberalization episodes. In a survey of 36 of them, Greenaway (1993) reminds us that many things in addition to trade policies were changing during the studied cases, so ascribing causality is not easy. That, together with some econometric studies that fail to find that positive link, led Freeman (2004) to suggest that the promise of raising the rate of economic growth through trade reform has been overstated. But the same could be (and has been) said about the contributions to growth of such things as investments in education, health, agricultural research, and so on (Easterly 2001). A more general and more robust conclusion that Easterly draws from empirical evidence, though, is that people respond to incentives. Hence, getting incentives right in product, input, and factor markets is crucial—and removing unwarranted subsidies and trade barriers is an important part of that process. Additional evidence from 13 case studies reported in Wacziarg and Welch (2008) adds further empirical support to that view, as does the fact that there are no examples of autarkic economies that have enjoyed sustained economic growth, in contrast to the many examples since the 1960s of reformed economies that boomed after opening up.

Specifically, economies that commit to less market intervention tend to attract more investment funds, ceteris paribus, which raise their stocks of capital (through greater aggregate global savings or at the expense of other economies' capital stocks). This is consistent with the findings by Faini (2004) that trade liberalization in the 1990s fostered inward foreign investment (and both had a positive impact on investment in education), while backtracking on trade reform had a negative impact on foreign investment. More open economies also tend to be more innovative because of greater trade in intellectual capital (a greater quantity and variety of information, ideas, and technologies, sometimes but not only, in the form of purchasable intellectual property associated with product and process innovations) and because greater competition spurs innovation (Aghion and Griffith 2005; Aghion and Howitt 2006), leading to higher rates of capital accumulation and productivity growth (Lumenga-Neso et al. 2005).[4]

A growing body of industry studies, including the ones based on firm-level survey data that capture the reality of firm heterogeneity, provides additional support for the theory that trade reform boosts the rate of productivity growth.[5] It appears more productive firms are innately better at exporting, so opening an economy leads to its growth and the demise of the least-productive firms (Bernard et al. 2007, 2012). That leads to better exploitation of comparative advantage in terms not only of industries but also of firms within each industry. If those more productive firms are also foreign owned, as is clearly the case in China (Whalley 2010), then being open to FDI multiplies the gains from product trade openness. And if those foreign firms are involved in retailing, and they enter a country with suppliers whose productivity is below best practice, they can put pressure on those suppliers to raise their productivity (and perhaps alert them as to ways to do that). Walmart's influence in Mexico provides one example of this force at work (Javorcik et al. 2008). Furthermore, if the foreign firms are supplying lower cost service inputs into manufacturing, it can boost the productivity growth of local manufacturers using those service inputs, according to a study of the Czech Republic (Arnold et al. 2011).[6]

It need not be that just the most productive firms engage in exporting. For lower productivity firms, incurring the fixed costs of investing in newly opened foreign markets may be justifiable if accompanied by the larger sales volumes that come with exporting. Lower foreign tariffs will induce these firms to simultaneously export and invest in productivity (while inducing higher productivity firms to export without investing more, as in Melitz 2003; Melitz and Ottaviano 2008; and Melitz and Redding 2014). Lileeva and Trefler (2010) model this econometrically using a heterogeneous response model. Unique 'plant-specific' tariff cuts serve as their instrument for the decision of Canadian plants to start exporting to the United States. They find that those lower productivity Canadian plants that were induced by the tariff cuts to start exporting increased their labor productivity, engaged in more product innovation, and had high adoption rates of advanced manufacturing technologies. These new exporters also increased their domestic (Canadian) market share at the expense of non-exporters, which suggests that the labor productivity gains reflect underlying gains in total factor productivity.

Liberalizing international financial flows also has been shown to have boosted economic growth, especially in the first wave of globalization up to 1913 (Schularick and Steger 2010; Bordo and Rousseau 2012). A study by Hoxha et al. (2013) examines potential gains from financial integration and finds that a move from autarky to full integration of financial markets globally could boost real consumption by 9 % permanently in the median developing country and up to 14 % in the most capital-scarce countries.[7]

In short, international trade and investment liberalization can lead not just to a larger capital stock and a one-off increase in productivity but also to higher rates of capital accumulation and productivity growth in the reforming economy because of the way reform energizes entrepreneurs. For growth to be maximized and sustained, though, there is widespread agreement that governments also need to (a) have in place effective institutions to efficiently allocate and protect property rights, (b) allow domestic factor and product markets to function freely, and (c) maintain macroeconomic and political stability (Rodrik 2007; Wacziarg and Welch 2008; Baldwin 2004; Chang et al. 2005).

One paper that has brought these ideas together using a numerical open economy growth model is by Rutherford and Tarr (2002). Their model allows for product variety, imperfect competition, economies of scale, and international capital flows. It is dynamic, so the model can trace out an adjustment path to trade reform; and it is stochastic in that it draws randomly from uniform probability distributions for eight key parameters of the model. They simulate a halving of the only policy intervention (a 20 % tariff on imports) and, in doing so, fully replace the government's lost tariff revenue with a lump-sum tax. That trade reform produces a welfare increase (in terms of Hicksian equivalent variation) of 10.6 % of the present value of consumption in their central model. Systematic sensitivity analysis with 34,000 simulations showed that there is virtually no chance of a welfare gain of less than 3 % and a 7 % chance of a welfare gain larger than 18 % of consumption. Several modeling variants and sensitivity analysis on all the key parameters found that the welfare estimates for the same 10 percentage point tariff cut ranged up to 37 % when international capital flows are allowed and down to 4.7 % when using the most inefficient replacement tax (a tax of capital). The latter result shows that even the very inefficient tax on capital is superior to the tariff as a revenue raiser. Increasing the size of the tariff cuts results in roughly proportional increases in the estimated welfare gains. Large welfare gains in the model arise because the economy benefits from increased varieties of foreign goods, which dominate the decrease in varieties of domestic goods. In order to assess the importance of variety gains, they then assume that one of the two sectors is subject to constant returns to scale and perfect competition (CRS/PC)—and find in that case that the additional varieties do not increase the total factor productivity. Instead, a small welfare gain of about 0.5 % of the present value of consumption emerges, which is of the same order of magnitude as in the many comparative static CRS/PC computable general equilibrium studies. Their results also illustrate the importance of complementary reforms to fully realize the potential gains from trade reform. In particular, the ability to access international capital markets roughly tripled the gains; the use of inefficient replacement taxes significantly reduces the gains. These combined results underscore the point that complementary macroeconomic, regulatory, and financial market reforms to allow capital flows and efficient alternate tax collection are crucial to realizing and multiplying the potentially large gains from trade liberalization.

## What About Social Impacts of Trade Reform?

The above survey provides overwhelming conceptual and empirical support for the claim that opening to trade boosts not just the level but also the rate of growth in incomes in reforming countries. That stream of gains comes while incurring comparatively minor one-off adjustment costs, especially if the reforms are phased in over time (Furusawa and Lai 1999; Matusz and Tarr 2000; Porto and Hoekman 2010). Those net gains allow individuals and governments the freedom to spend more on other pressing problems, thereby indirectly contributing to society's other objectives.[8] But, in addition, trade reform could also contribute directly to some of those goals. This section first focuses on the impact of trade reform on poverty alleviation, since that is the solution to food insecurity as well as many of the world's other problems. It then turns to trade reform's impact more specifically on malnutrition and hunger.

### *Poverty Alleviation*

Evidence presented by Dollar and Kraay (2002), Sala-i-Martin (2006), and others is carefully surveyed by Ravallion (2006). That survey suggests aggregate economic growth differences have been largely responsible for the differences in poverty alleviation across regions (see also Dollar et al. 2014). Initiatives that boost economic growth are therefore likely to be helpful in the fight against poverty, and trade liberalization is such an initiative. But cuts to trade barriers also alter relative product prices domestically and in international markets, which, in turn, affect factor prices. Hence, the net effect on poverty depends also on the way those price changes affect poor households' expenditure and their earnings net of remittances. If the consumer and producer price changes (whether due to own-country reforms and/or those of other countries) are pro-poor, then they will tend to reinforce any positive growth effects of trade reform on the poor.

The effects of trade reform on global poverty can be thought of at two levels: on the income gap between developed and developing countries, and on the poor households within developing countries. On the first, CGE estimates such as by Anderson et al. (2006a, b) and Valenzuela et al. (2009) suggest that current developing countries, which produce just one-fifth of global GDP, would enjoy nearly half of the net present value of the global static plus dynamic gains from reducing trade barriers. Clearly, that will substantially lower the income gap between developed and poorer countries on average.

How poor households within developing countries are affected is more difficult to say (Winters 2002; Winters and Martuscelli 2014). We know that agricultural policies of developed countries could provide a major source of developing country gains from reform, and lowering barriers to textiles and clothing trade also is important. Both would boost the demand for unskilled labor and farm products produced in poor countries. Four-fifths of the world's extreme poor (earning less than US$1.90 a day in 2011 PPP) live in rural areas, and two-thirds work in agriculture (Castañeda et al. 2016; OECD 2003, p. 3). Since many poor rural households are net sellers of farm labor and/or food, one would expect such reforms to reduce the number in absolute poverty. A set of analyses reported in Anderson et al. (2011), in which global and national CGE model results are carefully combined with household income and expenditure survey data for nearly a dozen developing countries,[9] tests this hypothesis. It finds strong support for it in most of the country case studies considered. If full global trade reform was to be undertaken, that study concludes that it would reduce the number of people in extreme poverty by at least 26 million, and 87 million would be alleviated from \$2/day poverty (Anderson et al. 2011, Table 4). Bear in mind, too, that those estimates are from comparative static models, and so are underestimates because they do not include the poverty-reducing dynamic effects on economic growth of such reforms. These points are taken up in more detail in Chap. 6.

### *Malnutrition and Hunger*

Hunger and under-nutrition can be eased by trade not only in goods but also in agricultural technologies, in particular, newly bred varieties of staple crops. The introduction of high-yielding dwarf wheat and rice varieties during the Green Revolution that began in Asia in the 1960s is a previous case in point, whereby producers and consumers shared the benefits in terms of higher farm profits and lower consumer prices for cereals.

A prospective case in point is the possibility of breeding crop varieties that are not only less costly to grow but are 'nutriceuticals' in the sense they contain vitamin and mineral supplements (Bouis 2002). The most promising is the so-called 'golden rice'. Consumers in many poor countries suffer from chronic vitamin A deficiency that can lead to blindness, weakened immune systems, and increased morbidity and mortality for children and pregnant and lactating women. Golden rice has been genetically engineered to contain a higher level of beta-carotene in the endosperm of the grain and thereby provide a vitamin A supplement. By being cheaper and/or more nutritionally beneficial, it would improve the health of poor people and thereby boost their labor productivity. Anderson et al. (2005) estimate that the latter economic benefit from this new technology could be as much as ten times greater than just the traditional benefits of lower production costs—not to mention that poor people would live longer and healthier lives. This new technology has yet to be adopted, however, because the European Union and some other countries will not import from countries whose food may contain genetically modified organisms (GMOs)—even though there is no evidence that GM foods are a danger to human health (see, e.g., King 2003; Fedoroff 2004; EASAC 2013). The cost of that trade barrier to developing countries has been very considerable. These points are taken up in more detail in Chap. 7.

## Key Messages

This survey provides overwhelming conceptual and empirical support for the claim that opening to trade can raise the level and growth of national income, and thereby provide the wherewithal to reduce poverty, hunger, and under-nutrition, to boost diet diversity, food quality, and food safety, and thereby ultimately boost national and global food security. These gains derive from the standard static welfare gains from removing trade-distorting policies that enable nations to consume more in general, hence also more food. Those gains are proportionately greater, the smaller is the national economy, and the greater the current variance of rates of industry assistance or taxation within and between sectors. Those gains from opening up will be even greater if accompanied by a freeing up of domestic markets and the market for currency exchange. And if domestic policy reforms include improving the government's capacity to redistribute income and wealth more efficiently and in ways that better match society's wishes, concerns about the initial distributional consequences of trade liberalization also would be lessened.

Openness to trade also can raise an economy's growth rate. Channels through which that happen include the scale of the market when knowledge is embodied in the products traded, the degree of redundant knowledge creation that is avoided through openness, and the effect of knowledge spillovers. The latest surge of globalization has been spurred also by the technology 'lending' that is involved in off-shoring: joining of a supply chain makes industrialization potentially far less complex and far faster. Again, such gains are greater if accompanied by reductions in domestic distortions. Empirical evidence clearly shows that people respond to getting incentives right in product, input, and factor markets, and removing trade barriers is an important part of that process. In particular, economies that commit to less market intervention tend to attract more investment funds and tend to be more innovative because of greater trade in intellectual capital and greater competition, which spurs innovation and productivity growth.

The next chapter provides a summary of the long history of the evolution of openness in food trade between nations, while Chap. 4 looks in some detail at the food trade patterns over the past half century.

## Notes

1. This survey does not pretend to provide a comprehensive coverage of the gains from trade theory. For more, readers are referred to the handbooks by Grossman and Rogoff (1995) and Harrigan and Choi (2003) and the textbook by Feenstra (2016).
2. Melitz (2003) provides the theory behind this point, and many econometricians have since provided strong empirical support for that theory.
3. The argument for allowing such monopolies is that they could provide greater technical efficiency via their larger scale. The contrary argument is that, being sheltered from competition, they fall so short of that potential so as to be less productive than two or more smaller-scale competing suppliers.
4. More open economies also tend to be less vulnerable to foreign shocks such as sudden stops in capital inflows, currency crashes, and severe recessions (Frankel and Cavallo 2008).
5. For an overview of this new theory, see Helpman et al. (2008).
6. For a survey of the growth effects of opening to trade in services, see Francois and Hoekman (2010).
7. In a case study of Thailand, Townsend and Ueda (2010) estimate welfare gains from financial liberalization as high as 28 %.
8. On the intrinsic benefits of freedom of opportunity and action that freer markets provide people, apart from their positive impact in boosting income and wealth, see Sen (1999). A recent examination of the evidence from globalization suggests that indeed the benefits of greater openness do spread well beyond just narrow economic ones (Potrafke 2014).
9. For more on this methodology, see Hertel et al. (2011).

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CHAPTER 3

# The Long History of Food Globalization

Globalization has to do with the lowering of costs of doing business across space. An important manifestation of it is an expansion of trade across national borders. Natural barriers to trade tend to fall following technological advances in the provision of transport and communication services, while national governmental barriers to international trade are less predictable: they have fallen over the very long term, but around that long-run trend have been both lengthy and occasional short periods when trade barriers have risen in subsets of countries. Much of this book is about those policy developments, but it is easier to understand them by first focusing on the decline in natural trade barriers and its impact on the agricultural competitiveness of various types of countries. To that end, this chapter provides a guide to the impacts of changes in trade cost barriers to global integration of farm product markets and in comparative advantages in agriculture over the centuries. The next chapter then reveals how that has played out in terms of patterns of trade in food and other agricultural products.

Long-distance agricultural trade has contributed to global economic growth and poverty reduction for millennia, but only in recent centuries via inter-continental trade in farmers' outputs. Its predominant contribution in earlier periods was through trade in crop seeds or cuttings, breeding animals, and farm production technologies. A few high-valued unprocessed products began to be exported to Europe in the seventeenth

 
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century, including spices, tea, coffee, cocoa, cotton, tobacco, and (from the West Indies) sugar and rum (Irwin 1991; Milton 1999). But it took Britain's industrial revolution to launch large-scale inter-continental trade in farm products, thanks to the steam engine lowering hugely the cost of transporting bulky products by rail and sea. Agricultural trade was further helped by the development of refrigeration in the late nineteenth century and, in more recent decades, of air freight services that allowed fresh perishable products to be traded over long distances for the first time. That generated gains from greater national specialization in production of certain export crops and extended the seasonal availability of perishable foods for consumers. In recent decades, it has even opened up the possibility for two consuming seasons per year of annual temperate perishables, given the lowered cost of maintaining food safety and quality while transporting food between the northern and southern hemispheres.

After elaborating in the next section of this chapter on these early origins of agriculture and the pre-nineteenth-century role of trade in farm inputs and technologies (drawing on Anderson 2014), the second part of this chapter summarizes the modern drivers of the evolution of agricultural comparative advantage as economies grow. The third section traces the combined impact of the falls in transport costs and food import restrictions on trade during the first globalization wave to 1913. The inter-war period is briefly discussed in the fourth section, before concentrating in the next section more detail on the period since the 1950s in the fifth section. The final section draws conclusions pertinent to the rest of the book.

## Early Origins of Agricultural Globalization

The move from hunter/gatherer to the domestication of crops and animals for food and beverage production began in the Near East and (in the case of rice) China about 8500 BC and possibly earlier (Zohary et al. 2012). Agriculture is thus the world's oldest industry. Thanks to its productivity growth and geographic diffusion, the world has been able to gradually urbanize and eventually industrialize.

For most of the past ten millennia, long-distance agricultural trade has contributed to the process of global economic growth and poverty reduction. That has happened by concentrating trade not on the bulky outputs from farming—whose trade costs were prohibitive until recently—but rather on farm inputs. Most notable among those inputs are crop seeds or cuttings, breeding animals (and their associated diseases picked up by humans), and farm production technologies. Those inputs and technologies were gradually spread beyond their place of origin, which was mostly in the Fertile Crescent. The Near East/Western Asia region was the origin of most of today's major foods apart from rice (thought to have been first domesticated in the Yangtze Valley in China—see Molina et al. 2011). They include wheat, barley, and winegrapes as well as domestic cattle, ducks, goats, honey bees, horses, pigs, and sheep (Hirst 2014; McGovern 2003, 2009). Their diffusion to other regions was the result partly of migrants from the Fertile Crescent becoming coastal colonists in the Mediterranean Basin (Zeder 2008) and partly of adaptation in those colonized settings.

From the 1500s, a similar process of colonization and agricultural development began on other continents. Mostly, it involved input and technology transfers from Europe to their peripheral colonies. However, some plants and animals that originated in the Americas became globally significant. They include bean, cotton, maize, manioc/cassava, groundnut/peanut, rubber, squash, sunflower, sweet potato, tobacco, tomato, and white potato. There are also a couple that originated from Africa (sorghum and millet), a few from Asia (most notably rice and bananas), and one from Oceania (sugar, which is thought to have been first domesticated in New Guinea around 8000 BC).

The migration of people, plants, and animals was not without some human and ecological devastation. Indeed, in some locations, whole communities died from disease transmission (Diamond 1997; Crosby 2003; Nunn and Qian 2010). Numerous exotic weeds became pests too, as did insects attached to imported plants.[1] Food trade also may have contributed to the deaths associated with famines such as in Ireland in 1845 (O'Rourke 1994), Ukraine in 1932–33 (Conquest 1986), and Bengal in 1943 (Sen 1981; Ravallion 1987)—even though the causes were mainly domestic policy failures.[2] However, those negative contributions from trade in domesticated plants and animals and their products were minor relative to the enormous contribution agricultural trade made to the world supplies of food and fiber.

The complementarity between knowledge of local growing conditions on the one hand and new crops and animals and associated technical knowhow on the other (including through the domestic and international transmission of new crop varieties—see Olmstead and Rhode (2007, 2011) and Beddow and Pardey (2015)) led to very substantial output growth. That, in turn, supported population growth. So, even though this exchange of farm inputs may not have accelerated GDP per capita or caused commodity prices to equalize across countries prior to 1800, Jones (2002, Chap. 4) argues that it certainly improved agricultural output and national food security in many countries. Perhaps the most notable beneficiary country is China, where four major crops from the Americas (maize, peanuts, sweet potato, and white potato) were being cultivated within a century of Columbus's voyages. Being dryland crops, they did not stress the country's irrigation capability. Rather, they encouraged the conversion of forests to arable land. Jones (2002, p. 55) notes that this globalizing impact contributed to the world's population increasing about 120 % between 1500 and 1800, compared with only 18 % between 1200 and 1500.[3]

Since 1800, the ever-lowering cost of international commerce gradually allowed trade in farm outputs in raw or processed form to be added to long-distance trade in farm inputs. The development of the steamship played a crucial role in making inter-continental trade cheaper. Harley's index of British ocean freight rates, which was relatively constant between 1740 and 1840, dropped by about 70 % between 1840 and 1910 (Harley 1988). This dramatic decline was mirrored on sea routes worldwide (Findlay and O'Rourke 2007; Mohammed and Williamson 2004). On top of that, the increasing speed of ocean transport has implied cost savings additional to those indicated by freight rate data, especially for perishable products. That has led to the prices of farm and other products converging across countries and, hence, to relative factor prices also converging. As additional evidence of the fall in transport costs, O'Rourke and Williamson (2002) and Findlay and O'Rourke (2007, pp. 402–405) point to the huge declines in commodity price gaps between Europe and both America and Asia between about 1840 and World War I.

In addition to its contribution to that long-run decline in food price gaps across continents, trade between countries has also been hugely important in offsetting short-term seasonal shortfalls in food availability (both within and between years). As a consequence, famines are a thing of the past, except where deliberately contrived by a country's leaders for local political purposes.[4]

With lowered transport costs and the ever-rising incomes of consumers that raise the demand for variety in all things including foods, plus the emergence of modern supermarkets to satisfy those demands, one might expect the range of products available in food markets to have grown exponentially over the past two centuries. That indeed has happened in terms of the *number* of processed food items available in large affluent cities. Even so, just a dozen basic foods account today for 77 % of the calorie intake and 72 % of the protein consumed by the world's population. They are three grains (wheat, rice, and maize), four meats (beef, mutton/lamb, pork, and poultry), two edible oils (from soybean and oil palm), and potatoes, milk, and sugar (FAO 2016a). Those dozen basic farm products could not have become so dominant in the world without international trade in agricultural inputs/technologies or their products, given the small number of regions of the world from which those key species originated. Certainly fresh fruits and vegetables, along with a plethora of processed foods, supplement our diets and provide important micronutrients, but a small number of them dominate (bananas, apples, oranges, and other citrus) and have become ubiquitous, again thanks to international trade.

## Drivers of Agricultural Trade as Economies Grow

One of the best-known facts about growing economies is that their farm sector's shares of GDP and employment tend to fall. The reasons for those declines in a closed economy are well known: low and falling income elasticities of demand for food (Engel 1857) and rapid advances in farm production technologies (Federico 2005; Alston et al. 2010; Fuglie et al. 2012) mean that the domestic prices and quantities of farm relative to non-farm products fall.

It is less obvious that the farm sector of a small *open* economy—especially one with an abundance of farm land relative to other primary resources, labor, and capital—would have to face relative decline as its economy grows. The fact that it nonetheless almost always does has to do with the rising demand for non-tradable goods and especially services as incomes rise. Being non-tradable, enough of those products can be produced only by drawing mobile resources from sectors producing tradables. Thus, agriculture's shares of national GDP and employment tend to fall with the expansion even of open, land-abundant economies (Anderson 1987).

Agriculture's share of national *exports* depends on the country's comparative advantage, however, and so need not fall as the world economy expands. Indeed, the tradability of the sector's output is likely to increase as trade costs are lowered through investments in transport-related infrastructure. If a country's trade costs fall faster than the rest of the world's, and if farm products gain more from that development than non-farm products do, the country may strengthen its agricultural comparative advantage over time (Venables 2004).

According to the workhorse theory of comparative advantage developed in the twentieth century, we should expect agricultural trade to occur between relatively lightly populated economies that are well-endowed with agricultural land and those that are densely populated with little agricultural land per worker (Krueger 1977; Deardorff 1984). Leamer (1987) develops this model further and relates it to paths of economic development. If the stock of natural resources is unchanged, rapid growth by one or more countries relative to others in their availability of produced capital (physical along with human skills and technological knowledge) per unit of available labor time would tend to cause those economies to strengthen their comparative advantage in non-primary products. By contrast, discovery of minerals or energy raw materials would strengthen that country's comparative advantage in mining and weaken its comparative advantage in agricultural and other tradable products, ceteris paribus. It would also boost national income and hence the demand for non-tradables, which would cause mobile resources to move into the production of non-tradable goods and services, further reducing farm and industrial production (Corden 1984). Conversely, a depletion or fall in the prices of mineral, forestry, or fishery resources would strengthen the comparative advantage of agriculture and other sectors producing tradables and weaken the demand for non-tradables.

At early stages of economic development, a country with high trade costs typically is agrarian, with most working on the land and producing the majority of GDP when estimated to include home-produced food. If that country has a relatively small stock of agricultural land (and other natural) resources per worker, labor rewards would be low. As trade costs fall or governmental trade restrictions are removed, the country would develop a comparative cost advantage in unskilled labor-intensive, standard-technology manufactures (as in Japan during the Meiji Restoration, 1868–1912). Then as the stock of industrial and human capital per worker grows, there would be a gradual move toward exporting manufactures that are relatively intensive in their use of physical capital, skills, and knowledge.

Natural resource-abundant economies, however, may attract migrants from more densely populated countries seeking to become farmers in a frontier region, thereby raising the settler economy's total if not the per capita GDP. In such economies, the agricultural sector's share of GDP would fall slower than in economies that are growing equally rapidly but are less land-abundant. And if resource-rich economies invest relatively more in capital (including new technologies) specific to primary production rather than manufacturing, they would not develop a comparative advantage in manufacturing or services until a later stage of development, at which time their exports from those sectors would be relatively capital intensive. This is all the more likely if new technologies developed for the primary sector become increasingly labor-saving as real wages rise—leading potentially to what are known as factor intensity reversals, whereby a primary industry in a high-wage country can retain competitiveness against a low-wage country by adopting capital-intensive new technologies. And agriculture's share of GDP would decline slower if farm productivity growth outpaced that of other sectors—as it did in high-income countries between 1970 and 2007, according to Herrendorf et al. (2014).

Trade patterns are also affected by growth in domestic demands, insofar as preferences are non-homothetic (Markusen 2013). Food has an income elasticity of demand of less than one, for example. While this may dampen somewhat the decline in comparative advantage in farm products in resource-poor emerging economies, it does not do so initially when consumers switch from staples to higher valued foods, including intensively fed livestock. By contrast, at early stages of industrialization and urbanization, the requirements of minerals and energy raw materials for producing such essentials as steel and electricity are quite high, before they decline as the economy matures. This adds to the decline in comparative advantage of the mining sector in rapidly industrializing economies.

The above theory of sectoral changes and evolving comparative advantages has been used successfully to explain the twentieth century flying geese pattern of comparative advantage and then disadvantage in unskilled labor-intensive manufactures as some rapidly growing economies expand their endowments of industrial capital per worker relative to the rest of the world—the classic example being clothing and textiles (Anderson 1992; Ozawa 2009). It has also been used to explain the evolving trade patterns between Asia's resource-poor first- and second-generation industrializing economies and their resource-rich trading partners (see, e.g., Anderson and Smith 1981) and the prolonged importance of agriculture in some New World settler economies such as Australia (Anderson 2016a, b).

But policies also affect trade. Preferential trade arrangements such as customs unions and free trade agreements influence not only the direction of trade of member countries but also its composition because of trade diversion. The commodity composition of a country's trade can depend also on sectoral policies. In those industrializing economies whose growth has been accompanied by increases in protection from agricultural imports, self-sufficiency in farm products falls less. Likewise, global farm trade is dampened if poor agrarian economies protect their emerging manufacturers from import competition or tax their farm exports or overvalue their currency, each of which discourages farm production and encourages domestic food consumption. Other things equal, reforms to such trade-restricting policies cause an agricultural trade growth spurt and result in a higher share of global farm production being traded across national borders.[5] They also raise economic welfare globally and in the reforming countries. Their impact on the international terms of trade would depend on which of those two sets of reforms dominate in any period, with real prices of agricultural products in international markets rising as a result of agricultural protection rates being cut but falling if and when farm export restrictions are lowered.

## The First Big Globalization Wave to 1913

There was a so-called agricultural revolution in Britain from the late seventeenth century, but its biggest impacts were delayed until the industrial revolution delivered machinery and chemical fertilizers, which caused farm productivity growth to accelerate from 1830 (Allen 1999). The labor-saving nature of the new technologies made them also applicable in land-abundant, labor-scarce New World countries, where intra-national transport and communication costs also were plummeting, thanks to steam trains. Hence, once maritime freight cost began to diminish from 1870 with the move to steel-hulled ocean steamships, inter-continental agricultural trade was set for take-off (Jacks 2005, 2006). This allowed primary products (which were then mostly agricultural) to continue to dominate international commerce even while trade in manufactures was rapidly expanding.[6]

A pre-condition for the expansion of grain imports in Europe had been the repeal of Britain's protective Corn Laws in 1846 and then the signing of the Cobden-Chevalier Treaty between Britain and France in 1860. That bilateral treaty contained a most favored nation (MFN) clause, which required any agreed cut in the tariff on each item in the bilateral trade to be applied also to their imports from other countries. It also meant that every European country that subsequently signed a bilateral trade treaty with either Britain or France (and most had done so by 1867) signed onto MFN. Especially important was the Treaty of Frankfurt concluded by Bismarck with France in 1871: its Article XI provided for permanent, unconditional MFN and was thereby a key stabilizer of European commercial policy. The systemic effect of the 1860 Anglo-French accord was thus of much greater significance than its importance to either country alone, as it led to a network of treaties that lowered hugely the average level of import tariff protection.

During the years from 1860 to 1913, the world thereby enjoyed relative serenity in terms of international trade and monetary relations. Even though economic growth then was proceeding at less than half the post-World War II pace, it was very rapid by previous standards, as was international trade growth—notwithstanding the fact that the size of many countries grew over that period (see footnote 5). According to Federico (2005, pages 19 and 29), world exports of both agricultural and non-agricultural goods grew on average at almost 3.5 % per year between 1850 and 1913, well ahead of the annual rate of global farm output growth of 1.1 % between 1870 and 1913.

Given this expansion in global food supplies in the face of an inelastic demand for food, it is not surprising that the real price of farm products began to decline from the late nineteenth century (Fig. 1.1b)—having trended in the opposite direction from the late eighteenth century to the mid-nineteenth century and then fluctuated around a flat trend for the rest of that century (Williamson 2012; Jacks 2013).

When many of the European trade treaties were reaching their expiry date (nearly 50 of them were to expire in the first half of the 1890s), economic difficulties were making their renegotiation contentious. Tariff wars ensued, so that the threat of retaliation—which had served as a deterrent to raising tariffs—was no longer a constraint on trade liberalization reversal. Even though MFN was retained, relations were strained by the absence of bindings on tariffs (to prevent backsliding), of constraints on non-tariff trade-distorting measures, and of legal means to resolve disputes. Furthermore, the unwillingness of America and others to adopt the unconditional MFN principle meant the sustainability of the European commercial policy achievements of that period was far from certain. Indeed, the bilateral treaty regime ended abruptly with the outbreak of World War I in 1914.

## The Inter-War Period

Following World War I, efforts to restore liberal trade centered on international conferences. However, despite the rhetoric in support of open markets, those meetings did not lead to renewed trade treaties with binding commitments to openness based on MFN. With no country willing or able to replace Britain as the hegemon, there was trade policy anarchy (Kindleberger 1989). When economic recession and low agricultural prices hit in the late 1920s, and the USA introduced the Smoot–Hawley tariff hikes of June 1930, governments elsewhere responded with beggar-thy-neighbor protectionist trade policies that together helped drive the world economy into depression (Hynes et al. 2012). The volume of world trade shrunk by one-quarter between 1929 and 1932, and its value fell by 40 %. Over the entire inter-war period, both agricultural and other merchandise trade grew hardly at all. According to Federico (2005, page 22–29), world exports of both agricultural and non-agricultural goods declined by 0.8 % per year between 1925 and 1938, and the real prices of farm products in international markets slumped following their highs during World War I (Fig. 1.1b).

The first attempts to reverse the growth in protection were discriminatory, benefitting Europe's colonies at the expense of other trading partners. Thus, between 1929 and 1938, the share of imports from colonies rose from 30 to 42 % for Britain, from 12 to 27 % for France, and from 20 to 41 % for Japan (Anderson and Norheim 1993). By the end of the 1930s, protectionism was far more entrenched than in the late nineteenth century, when only non-discriminatory tariffs had to be grappled with. Indeed, non-tariff trade barriers were so rife as to make tariffs redundant and hence a return to MFN irrelevant unless and until 'tariffication' of those barriers occurred. For agriculture that took until the World Trade Organization (WTO) came into being in 1995.

## The Most Recent 70 Years

Out of the inter-war trade policy experience came the conviction that a return to the beneficent non-cooperative equilibrium of the nineteenth century was highly unlikely. Instead, Britain and the United States were convinced that liberal world trade required a set of multilaterally agreed rules and binding commitments based on non-discriminatory principles. After much negotiation, that led to the General Agreement on Tariffs and Trade (GATT). It was signed in 1947 by 23 trading countries—12 developed and 11 developing—who at the time accounted for nearly two-thirds of the world's international trade. The GATT provided a forum to negotiate subsequent tariff reductions and changes in rules, along with a mechanism to help settle trade disputes.

Eight so-called rounds of GATT negotiations took place in the subsequent 46 years, as a result of which many tariffs on at least manufactured goods were progressively lowered in most high-income countries. The last of those, the Uruguay Round, culminated in numerous agreements to further reduce trade barriers over the subsequent decade. One of those agreements involved—for the first time—agricultural trade. Another agreement involved the GATT Secretariat being converted into the WTO in January 1995, the membership of which as of July 2016 involves 164 countries/customs territories along with 19 observers that account for more than 98 % of world trade.

Global merchandise trade grew faster in the half century following the GATT's formation than in any other half century in history: between 1950 and 2000, world exports of all goods grew at 5.25 % per year, compared with 3.46 % in 1850–1913 (Federico 2005). However, agricultural trade grew less rapidly than trade in other goods from 1950 and slower than agricultural trade in the first wave of globalization: 3.22 % in 1950–2000 and 3.44 % in 1850–1913 (Table 3.1). As a result, agriculture's proportion of global goods trade fell from 0.5 in 1913 and 1937 to 0.4 in 1951, 0.24 in 1961, 0.12 in 1981, and 0.07 in 2001 and 2011, before rising to 0.09 in 2012–14 (Federico 2005, p. 29; WTO 2015).

The slower growth of farm trade is partly due to the fall in agriculture's share of global GDP (it is now only 3 %, down from more than 50 % not much earlier than 1900). It is also partly due to the recent fragmentation of industrial production into ever more processes and the associated rapid expansion in the number of links in their global value chains (Baldwin and Robert-Nicoud 2014, Baldwin 2016). The latter shows up in the global shares of sectoral exports to sectoral GDP, which rose from 66 to 105 % during 1995–2010 for manufacturing while hardly changing (a rise from 53 to 58 %) for agriculture. Those trends are reflected in the slower

**Table 3.1** Growth in the volume of global agricultural and other merchandise exports, 1850–2013 (% per year)

| | *1850–90* | *1890–1913* | *1919–38* | *1950–2013* |
|---|---|---|---|---|
| Agricultural products | 3.59 | 3.35 | −0.8 | 3.6 |
| Mining products | | | | 3.9 |
| Manufactures | | | | 7.1 |
| All merchandise | 3.63 | 3.62 | −0.8 | 5.9 |

*Sources*: Federico (2005) and WTO (2015) growth of global exports of farm versus all goods (Fig. 3.1) and the rise since 1950 in the share of global farm production that is exported (Fig. 3.2).

Another key contributor to slow farm trade growth, however, has to do with trade-restricting policies. The lack of strong GATT disciplines on agriculture's trade-related policies allowed two separate developments in farm policies between the 1950s and the 1980s: agricultural protection growth in high-income countries and agricultural export taxation in low-income countries. In both Japan and the European Community (EC) in the 1950s, domestic prices exceeded international market prices for grains and livestock products by less than 40 %. By the early 1980s, however, the difference was more than 80 % for Japan and around 40 % for the EC, while still being close to zero for the agricultural-exporting rich countries of Australasia and North America (Anderson et al. 1986, Table 2.5). Virtually all of that assistance to Japanese and European farmers in that period was due to restrictions on imports of farm products. Assistance

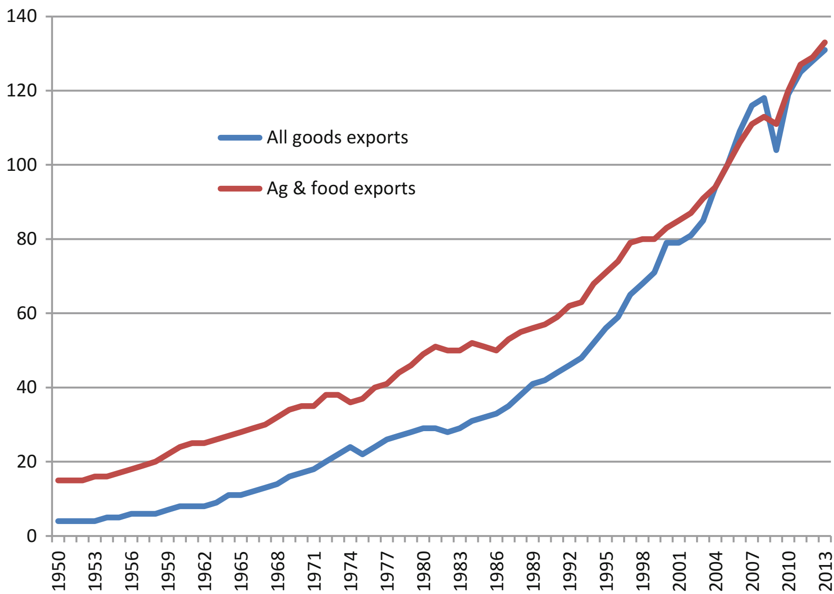


**Fig. 3.1** Volume of global agricultural and total merchandise exports, 1950–2013 (index of value at constant prices, 2005 = 100).
*Source*: WTO (2015)

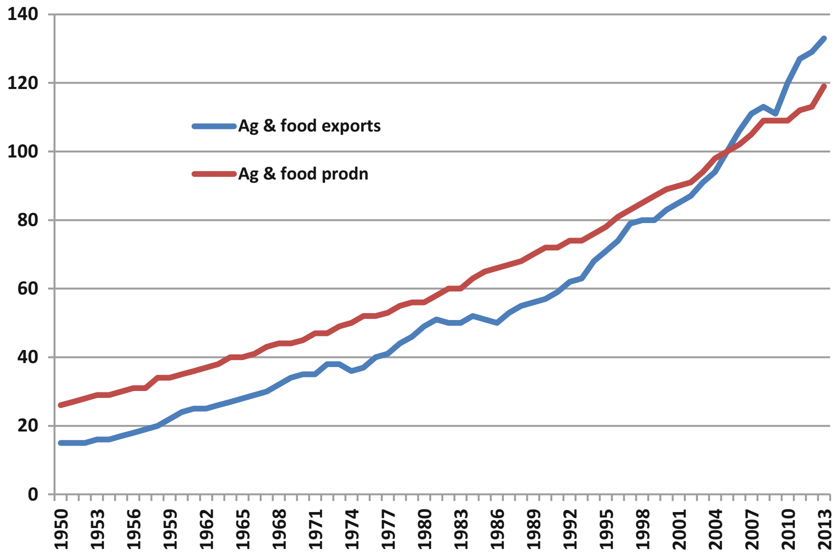


**Fig. 3.2** Volume of global agricultural production and exports, 1950–2013 (index of value at constant prices, 2005 = 100).
*Source*: WTO (2015)

then rose markedly in the mid-1980s, particularly due to a North Atlantic food export subsidy 'war' that was prompted by Western Europe seeking to dispose abroad of a support-induced output surplus.

Meanwhile, developing countries had been heavily discriminating against their farmers. A major study of 18 developing countries from the 1960s to the mid-1980s by Krueger et al. (1988, 1991) shows that the depression of incentives faced by farmers in developing countries has been due partly to various forms of agricultural price and trade policies, including subsidies to food imports in addition to export taxes, and partly to developing countries' non-agricultural policies that hurt their farmers *indirectly*. The two key ones were manufacturing protectionism (which attracts resources from agriculture to the industrial sector) and overvalued exchange rates (which attract resources to sectors producing non-tradables, such as services). Such policies encourage labor to find employment in non-fam activities and discourage the investment of capital in the farm sector—and in agricultural Research and Development (R&D).

Since the 1980s, however, there have been substantial reductions in distortions to agricultural incentives in both high-income and developing countries. Progress has not been uniform across countries and regions, and the reform process is far from complete; but at least the long-term taxing of farm exports has all but disappeared. Associated with that switch toward a more positive policy stance toward agriculture in developing countries has been an increase in public sector investment in agricultural research. As a result, the developing countries' share of global public agricultural R&D has risen by half over the past three decades, from an average of 31 % in 1980–2000 to 45 % by 2011 (Pardey et al. 2016).

Yet many countries still have a strong anti-trade bias in the structure of assistance within their agricultural sector, with import-competing industries being favored most. This means that export-focused farmers are still discriminated against in two respects: by the anti-trade structure of assistance within their own agricultural sectors and by the protection from import competition still afforded farmers in other countries. Furthermore, some developing countries have 'overshot' in the sense that they have moved from taxing to subsidizing their farmers in aggregate. Thus, the variance in rates of assistance across commodities within each country, and in aggregate rates across countries, remains substantial, indicating that resources within the farm sector of each country and globally are still not being put to their best use.

Notwithstanding those economically wasteful market-distorting policies, the per capita supply of food available for human consumption globally has been steadily increasing for many decades. It grew especially rapidly for cereals between 1960 and the mid-1980s, thanks to the dissemination of dwarf wheat and rice varieties in Asia (the 'Green Revolution') and the continuing expansion and improvement of hybrid maize plantings; in the subsequent three decades, the per capita supply of other foods has grown almost as rapidly (Fig. 3.3). This has been possible without expanding the area of land used for agriculture—a major break from the traditional means of increasing food supplies (Evenson and Gollin 2003; Babcock 2015). Also, the rate of growth in farm productivity in Africa and the Middle East is now catching up with that in Asia and Latin America (Fig. 3.4).

Not unrelated has been a steady reduction in the number of under-nourished people in the world and the depth of their food deficit (the difference between actual intake and the minimum daily requirement of those under-nourished, which reflects the skewness of the distribution to the left of the minimum). The number of under-nourished was 1010

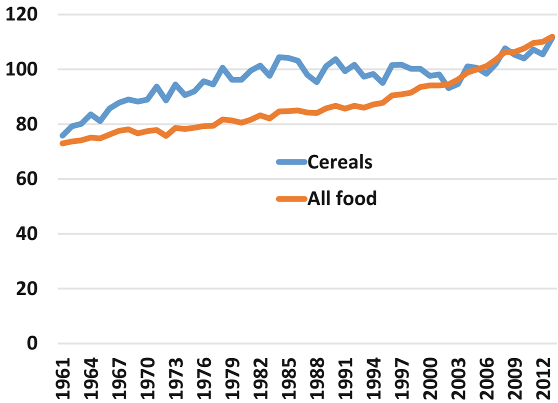


**Fig. 3.3** Index of global net food production per capita, 1961–2013 (2004–06 = 100).
*Source*: FAO (2016b)

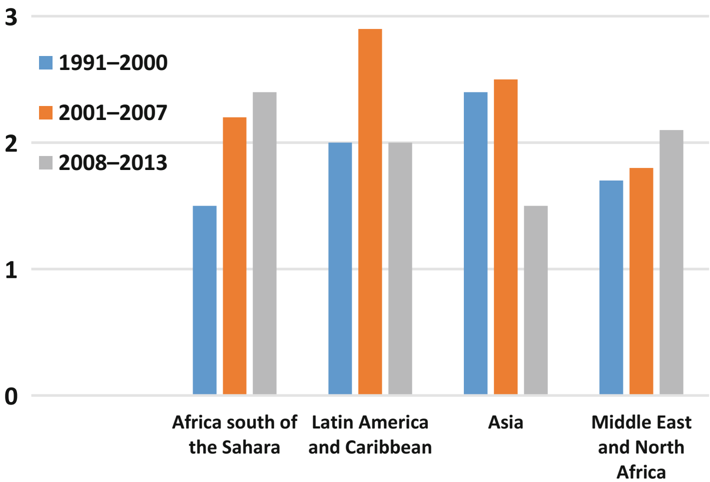


**Fig. 3.4** Average annual growth of agricultural total factor productivity in developing countries, by region, 1991–2013 (%).
*Source*: IFPRI (2016)

million in 1990–92, but it had shrunk to 790 million by 2014–16: a fall from 19 to 11 % of the world's people. Virtually all of that decline was in East and Southeast Asia, where the prevalence fell by three-fifths to just under 10 % (Table 3.2). The largest concentrations of under-nourished people are now in South Asia at 280 million, or 16 % of its population, and in Sub-Saharan Africa, where the prevalence is 23 % (220 million). Those two regions comprise a little over one-third and one-quarter of the world's hungry people, respectively, or a total share of almost two-thirds (FAO 2015).[7] Keep in mind, though, that those global and regional numbers hide the fact that in most developing countries—even middle-income ones—a large proportion of their poorest people are under-nourished: 9 % in China, for example, and 8 % in Indonesia (Fan and Cousin 2015).

Although the decline in under-nutrition has been substantial, 790 million hungry people is still an unacceptable and unnecessarily large number. The rest of this book is about how trade, and especially market opening

**Table 3.2** Prevalence and depth of under-nutrition,[a] by region, 1990–2016

| | *1990–92* | *2000–02* | *2007–09* | *2014–16* |
|---|---|---|---|---|
| (a) Prevalence of under-nourishment (%) | | | | |
| Sub-Saharan Africa | 33.2 | 30.0 | 25.5 | 23.0 |
| South Asia | 23.9 | 18.5 | 17.5 | 15.7 |
| Southeast Asia | 30.6 | 22.3 | 16.3 | 9.6 |
| East Asia | 23.2 | 16.0 | 14.2 | 9.6 |
| Latin America and Caribbean | 14.7 | 11.4 | 7.2 | 5.5 |
| *All low-income economies* | *39.1* | *36.6* | *30.5* | *27.5* |
| *All lower-middle-income economies* | *22.8* | *17.5* | *16.0* | *13.5* |
| **World** | **18.6** | **14.9** | **13.0** | **10.8** |
| (b) Depth of food deficit for the under-nourished (kcal/capita/day) | | | | |
| Sub-Saharan Africa | 247 | 221 | 193 | 176 |
| South Asia | 169 | 130 | 125 | 114 |
| Southeast Asia | 232 | 165 | 118 | 68 |
| East Asia | 182 | 128 | 116 | 76 |
| Latin America and Caribbean | 105 | 83 | 52 | 41 |
| *All low-income economies* | *299* | *274* | *232* | *214* |
| *All lower-middle-income economies* | *161* | *123* | *114* | *95* |
| **World** | **138** | **111** | **98** | **81** |

*Source*: FAO (2016b)

[a]Prevalence of under-nourishment is the share of the population with an average daily calorie intake below the minimum daily requirement; depth of food deficit is the difference between actual intake and the minimum daily requirement of those under-nourished people

though trade policy reforms, can expand aggregate food availability so as to reduce far more that number of under-nourished people—and the number living in extreme poverty.

## Key Messages

Long-distance agricultural trade has contributed to global economic growth and poverty reduction for millennia, but only in recent centuries via inter-continental trade in farmers' outputs. Its predominant contribution in earlier periods was through trade in crop seeds or cuttings, breeding animals, and farm production technologies. Those contributions continue to be important, but trade in crop and livestock products, including processed foods, now dominate.

Agricultural trade grew as rapidly as trade in non-farm products in the first globalization wave to World War I, but it has grown more slowly than trade in other products since then, in large part because of policy developments. In the nineteenth century, rich countries opened their markets to trade in farm products and took advantage of agricultural development opportunities in their colonies. In the period between World Wars I and II, many countries withdrew from trading, especially in farm products. Then after World War II, agricultural protectionism grew in industrial economies, while newly independent developing countries taxed their exports of farm products. Those policies continued through to the 1980s, before both country groups began to reform them.

Notwithstanding that history of economically wasteful market-distorting policies, the per capita supply of food available for human consumption globally has been steadily increasing for many decades. It grew especially rapidly for cereals between 1960 and the mid-1980s, thanks to the dissemination of dwarf wheat and rice varieties in Asia and the continuing expansion and improvement of hybrid maize plantings; in the subsequent three decades, the per capita supply of other foods has grown rapidly. Not unrelated has been a one-fifth reduction in the number of under-nourished people in the world, a drop of more than 220 million since 1990. The largest concentrations of under-nourished people now are in South Asia at 280 million, or 16 % of its population, and in Sub-Saharan Africa, where the prevalence is 23 % (220 million). International trade, and especially market opening through trade policy reforms, can expand aggregate food availability so as to reduce far more that number of under-nourished people—and the number living in extreme poverty.

## Notes

1. A notable example of the latter is Phylloxera, an almost microscopic insect from North America that all but wiped out Europe's wine industry in the late 1800s—but the American winegrape species that was able to tolerate it then provided the solution for rebuilding winegrape production in the affected locations (Campbell 2005).
2. China's 1958–1962 famine during its ironically called Great Leap Forward was a result of Mao's determination to collectivize and heavily tax agricultural production. Official numbers put the death toll at no more than 20 million, others suggested up to 30 million (Lin 1990), but the latest estimate based on 15 years of archival research suggests it involved 36 million deaths and another 40 million who failed to be born (Yang 2012). Dikötter (2010) estimates the toll at 45 million.
3. On the broader questions of whether globalization has contributed to overall economic growth over the past centuries, see the comprehensive literature survey by Meissner (2014).
4. This type of consumption smoothing over time has also been facilitated by international financial integration. See Islamaj and Kose (2016).
5. National borders themselves can and have changed over time, causing some international trade to suddenly be classified as internal trade when countries combine (e.g., Germany in 1989) and the opposite when one country become several (as with the Soviet Union's disintegration in 1991). According to Gancia et al. (2016), in 1820, the world was made up of 125 sovereign states, but that number fell to 54 by 1914, rose to 76 by 1949, and now is more than 190.
6. The ratio of those two sectors' trade values averaged 1.72 during 1876–1895 and 1.76 during 1896–1913, and it was 1.57 even during 1921–1938 (League of Nations 1945, p. 157). By 1960, that ratio was close to 1, and in 2014, it was 0.57—and only 0.27 when minerals and energy raw materials are excluded. Food trade in 2012–2014 was 85 % of all agricultural trade, up from 76 % in 1990 (WTO 2015).
7. That South Asian share of 35 % is the same as the region's share, according to the World Bank (2016), of the world's 897 million people who in 2012 were living on less than US$1.90 a day (in 2011 PPP dollars). However, Sub-Saharan Africa's 27 % share of the world's hungry people is considerably smaller than its 43 % share of global poverty.

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CHAPTER 4

# The Evolution of Food Trade Patterns Since 1960

How consistent with the theory outlined in Section "Drivers of Agricultural Trade as Economies Grow" of the previous chapter are the key developments in global agricultural trade,[1] 'revealed' comparative advantage, and net trade specialization over the past half century? Certainly those trade patterns have been shrunk and distorted by the policies summarized in the final section of Chap. 3 (and detailed in Chap. 5). Indeed, the evidence reviewed in this chapter reveals the slowness with which net imports of farm products have grown in key densely populated, rapidly growing economies. In the most affluent of those countries, it was growth in agricultural protectionism and farm subsidies that slowed net food import growth, while in emerging economies—most notably China, India, and Indonesia—it has been the gradual removal of anti-agricultural/pro-industrial policies since the 1970s and the recent addition of farm subsidies and protection that have allowed them to remain close to food self-sufficient (Anderson 2009b).

This chapter begins with a snapshot of the agricultural trade situation for major products and trading economies as of 2014 and then examines the evolution since 1960 for all economies. It concludes with a brief account of how international prices of primary products relative to manufactures have moved over the past half century.



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## A Snapshot of Global Farm Trade in 2014

Recall from Chap. 3 that just a dozen basic foods account for all but one-quarter of the calorie intake and protein consumed by the world's population. They are three grains (wheat, rice, and maize), four meats (beef, mutton/lamb, pork, and poultry), two edible oils (from soybean and oil palm), and potatoes, milk, and sugar (FAO 2016a). It is therefore not surprising that the FAO data also reveal that grain and livestock together account for more than half of the gross value of global agricultural production (about 23 and 33 %, respectively). As for trade, there are less than ten sets of items that make up half of the world's value of international trade in agricultural and food products. In 2014, those product shares were oilseeds (12 %), meats (10 %), grains (9 %), dairy products (6 %), beverages (cocoa, coffee, and tea, 5 %), grapes and wine (3 %), sugar (3 %), and cotton (2 %).

The 20 largest agricultural trading economies (treating the EU28 as a single economy) in 2014 are listed in Table 4.1, ranked according to their share of global agricultural GDP in that year. Together, those economies comprise all but 8 % of global agricultural output, and more than three-quarters of the world's exports of farm products. In fact, the aggregate global agricultural export share of just the top dozen is two-thirds—and so too is the aggregate global share of the top dozen agricultural importing economies.

Several points are worth stressing from those data in Table 4.1. First, the share of those economies in the world's total GDP is almost as large as their share in agricultural GDP, but that in unsurprising given that the table includes both the largest importers as well as exporters of farm products.

Second, these largest traders are a relatively affluent group of countries: they account for nine-tenths of global GDP but only two-thirds of the world's population (final row of Table 4.1). They are therefore not a very representative sample of the world's sovereign states as of 2014.[2]

Third, these economies range from being very heavily food import- or export-dependent to being close to self-sufficient. One simple way to indicate that with just trade data is to calculate the farm trade specialization index, defined as the net exports as a ratio of the sum of exports and imports of agricultural and food products and hence potentially ranging between −1 and +1 (column 5 of Table 4.1). That index value is virtually −1 for Hong Kong and Saudi Arabia and −0.8 for Japan, reflecting

**Table 4.1** Shares of largest agricultural traders in global agricultural GDP and trade, and in the world's total GDP and population, 2014 (%, net of intra-EU trade)

| | *Agricultural* | | | | *TOTAL GDP* | *Population* |
|---|---|---|---|---|---|---|
| | *GDP* | *Exports* | *Imports* | *(X − M)/ (X + M)* | | |
| China | 22.0 | 5.8 | 12.3 | −0.36 | 13.3 | 18.8 |
| EU28 | 20.0 | 14.0 | 13.3 | 0.03 | 23.7 | 7.0 |
| United States | 18.1 | 14.3 | 11.4 | 0.11 | 22.3 | 4.4 |
| Japan | 5.9 | 0.8 | 6.0 | −0.76 | 5.9 | 1.7 |
| Russia | 3.3 | 2.4 | 6.0 | −0.43 | 2.3 | 2.0 |
| India | 3.0 | 3.5 | 2.0 | 0.27 | 2.6 | 17.8 |
| Brazil | 2.7 | 6.9 | 1.0 | 0.75 | 3.0 | 2.8 |
| Korea, Rep. | 2.6 | 0.9 | 2.6 | −0.49 | 1.8 | 0.7 |
| Mexico | 2.2 | 2.1 | 2.2 | −0.02 | 1.7 | 1.7 |
| Saudi Arabia | 2.1 | 0.0 | 1.8 | −1.00 | 1.0 | 0.4 |
| Canada | 2.0 | 5.4 | 2.8 | 0.32 | 2.3 | 0.5 |
| Australia | 1.9 | 3.1 | 1.2 | 0.44 | 1.9 | 0.3 |
| Indonesia | 1.8 | 3.3 | 1.6 | 0.35 | 2.6 | 3.5 |
| Turkey | 1.1 | 1.3 | 1.5 | −0.07 | 1.0 | 1.0 |
| Argentina | 0.8 | 2.9 | 0.2 | −0.87 | 0.7 | 0.6 |
| Thailand | 0.7 | 3.2 | 1.2 | 0.45 | 0.5 | 0.9 |
| Malaysia | 0.7 | 2.4 | 1.5 | 0.23 | 0.4 | 0.4 |
| New Zealand | 0.4 | 2.2 | 0.4 | 0.69 | 0.2 | 0.1 |
| Vietnam | 0.4 | 2.1 | 1.3 | 0.24 | 0.2 | 1.3 |
| Hong Kong | 0.0 | 0.0 | 1.5 | −1.00 | 0.4 | 0.1 |
| **All of above** | **91.7** | **76.6** | **70.8** | **0.04** | **87.8** | **66.0** |

*Sources*: World Bank (2016) and (WTO 2015) their extreme comparative *disadvantage* in agriculture, and close to +1 for Argentina, Brazil, and New Zealand, reflecting their strong farming comparative advantage. By contrast, the European Union (EU), USA, Mexico, and Turkey each have global farm import shares similar to their export shares and hence a farm trade specialization index close to zero (Fig. 4.1). Since those global trade shares are non-trivial in each case (and comparable to their shares of global GDP), it suggests those four economies engage in considerable intra-sectoral farm trade. Indeed columns 3 and 4 of Table 4.1 reveal that most of the top 20 traders engage in substantial two-way farm trade.[3] Net exports of farm products of major trading regions are fairly clear-cut and consistent with what theory would suggest though (Fig. 4.2), bearing in mind their relative factor endowments as revealed in Table 4.2.

What about all other countries? From the theory outlined in the previous chapter, we should expect, if there were no policies distorting international trade, a negative correlation across countries between the agricultural comparative advantage index or trade specialization index and

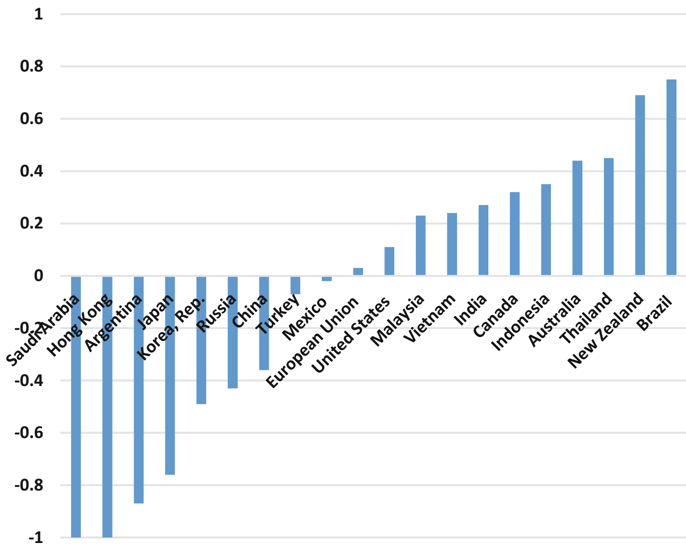


**Fig. 4.1** Net exports as a ratio of the sum of exports and imports of agricultural and food products, major trading economies, 2014.
*Source*: See Table 4.1

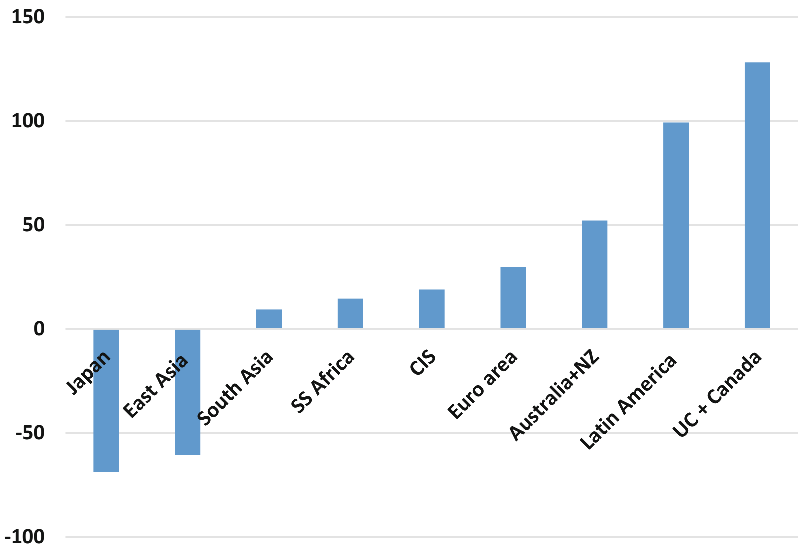


**Fig. 4.2** Net exports of agricultural and food products, major trading regions,[a] 2014 (US$ million). [a]Data are not available for two food-importing regions, namely North Africa and the Middle East.
*Source*: World Bank (2016)

both per capita income and population density. These variables are plotted in Figs. 4.3, 4.4 and 4.5 for the full sample of 145 countries in the World Bank (2016b) database. Figure 4.3 does indeed show a negative relationship between the revealed comparative advantage index and per capita income, although there is a wide scatter of observations. However, for this large sample of countries, there is virtually no relationship between revealed comparative advantage in farm products and arable land per capita (Fig. 4.4) and only weak negative relationship between the farm trade specialization index and per capita income (Fig. 4.5).

## The Evolving Trade Situation Since 1960

How have farm trade patterns changed over the previous half century?[4] In particular, to what extent have economies reduced their dependence on agricultural exports and lost their comparative advantage in farm production as they have advanced, and is that happening earlier and more so for economies less well-endowed in farm land per worker?

**Table 4.2** Key economic and trade indicators of countries, by region, 2014

| | *National relative to world (world = 100)* | | | *Agricultural trade specialization index*[b] |
|---|---|---|---|---|
| | *GNI per capita (Atlas)* | *Land per capita* | *RCA*[a] *agric & food* | |
| Sub-Saharan Africa | 15 | 137 | 158 | 0.12 |
| South Asia | 14 | 16 | 135 | 0.09 |
| East & SE Asia | 57 | 44 | 57 | −0.13 |
| Latin America + Caribbean | 83 | 164 | 192 | 0.39 |
| CIS | 64 | 133 | 136 | 0.14 |
| Euro Area | 363 | 44 | 102 | 0.03 |
| Japan | 389 | 16 | 15 | −0.76 |
| United States and Canada | 509 | 175 | 162 | 0.21 |
| Australia and New Zealand | 520 | 1430 | 233 | 0.56 |

*Source*: Compiled from World Bank (2016)

[a]Revealed comparative advantage index is the share of agriculture and food in national exports as a percentage of that sector's share of global exports

[b]Agricultural trade specialization index is net exports as a ratio of the sum of exports and imports of agricultural and food products (world average = 0)

Certainly, the share of farm products in exports has been declining since the 1960s for most groups of countries, but so too has it for the world as a whole, until recently when international food prices spiked upward (Table 4.3). The index of revealed comparative advantage in agriculture (RCA) is the ratio of those national shares to the global share and is reported in Table 4.4. Over that half century, the average RCA for farm products was 2.1 for low-income countries, 1.6 for lower middle-income countries, 1.4 for upper middle-income countries, and 0.9 for high-income countries (and 0.4 for high-income oil-exporting countries of the Middle East not included in the table). So, in that sense, there is certainly a negative correlation between an agricultural comparative advantage and per capita income during that five-decade period. And the differences in those half century averages might have been greater were it not for the fact that each of those three developing country groups is endowed with arable land per capita at only about three-quarters of the global endowment, and less than half the endowment of the high-income group of countries.

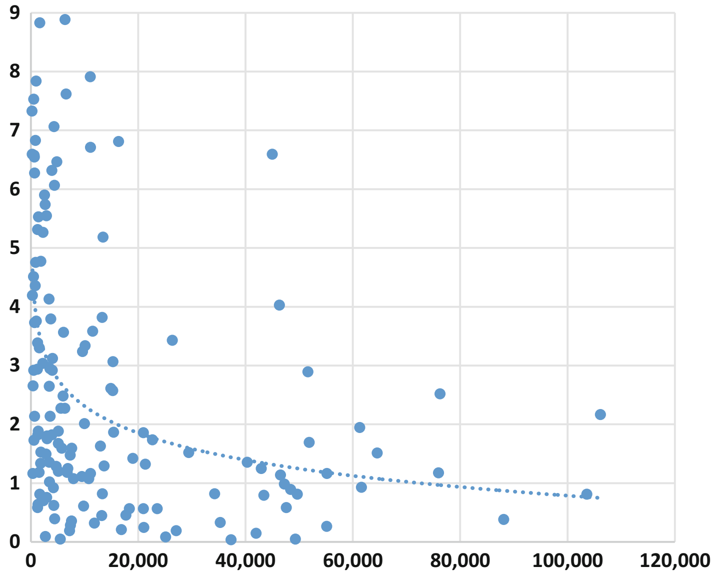


**Fig. 4.3** Relationship between revealed comparative advantage in agriculture[a] and national income per capita (Atlas Method, US dollars), 2014 (logarithmic fit shown as *dotted line*). [a]Revealed comparative advantage index, on the *vertical axis*, is the share of agriculture and food in national exports as a percentage of that sector's share of global exports.
*Source*: Compiled from data in World Bank (2016)

Across time, however, it is only for Japan and the upper middle-income countries in that table where a persistent RCA decline is evident; for the high-income group as a whole, and especially for Western Europe, the RCA has risen rather than fallen. Also, the share of high-income countries in global agricultural GDP has fallen only slowly, from 47 % in the 1970s to 43 % in the 1980 and 42 % in the 1990s, and then back to 45 % in 2014. Moreover, when food imports also are taken into account, as with the trade specialization index, the trend picture is very similar to that for the RCA (compare Table 4.4 with Table 4.5).[5] Given those trends, it is not surprising that the share of high-income countries in global agricultural trade has risen slightly over the past half century, rather than fallen (Table 4.6). According to Valdés and Foster (2012), two-thirds of the nearly 140 developing countries of the world were net agricultural importers in

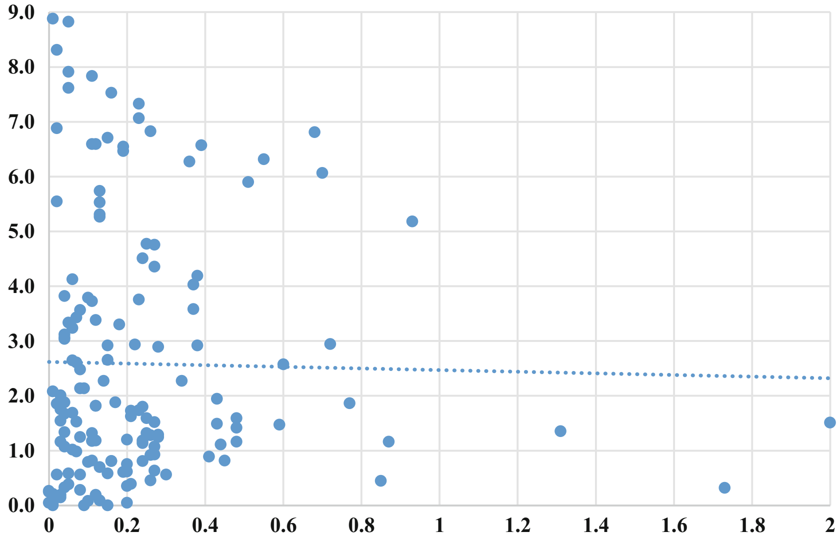


**Fig. 4.4** Relationship between revealed comparative advantage in agriculture[a] and hectares of arable land per capita, 2014 (linear trend fit shown as *dotted line*). [a]Revealed comparative advantage index, on the *vertical axis*, is the share of agriculture and food in national exports as a percentage of that sector's share of global exports.
*Source*: Compiled from data in World Bank (2016)

2005–09, and all but one-fifth net food importers. But that is because they are more competitive in other sectors, as indicated by the fact that their food import bill is only a small fraction of their earnings from exporting other goods: less than 15 % for all regions other than East and Southeast Asia (Fig. 4.6).

There could be several reasons for not observing the trends in national farm trade patterns that theory suggests, but one candidate is the anti-trade bias in many nations' policies that distort domestic farm product prices relative to those of other tradables. That bias is revealed in a recent effort to estimate the extent of such price distortions since the 1950s for 82 countries, which is summarized in the next chapter using two indicators: the nominal and relative rates of assistance to farmers. Table 4.7, which reports regression results seeking to explain the variations across countries and over time in those distortions, suggests that more than half of that

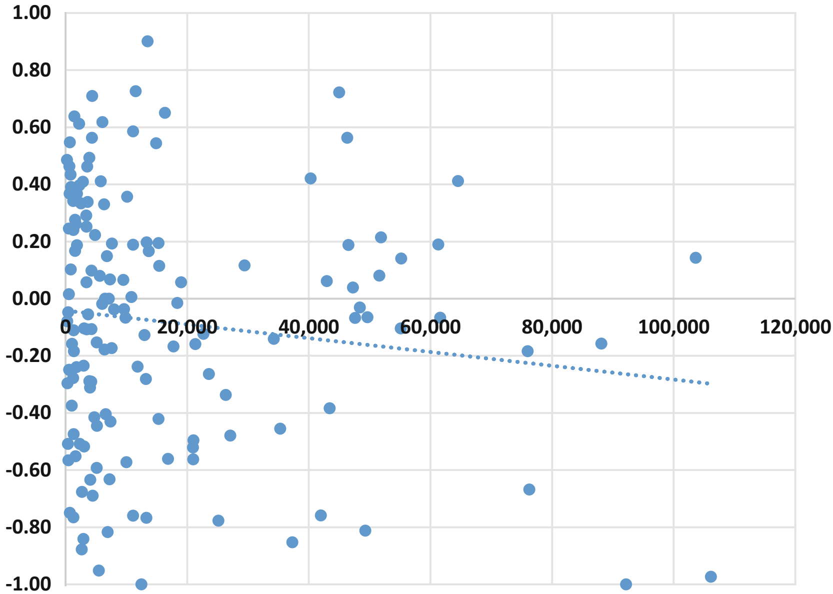


**Fig. 4.5** Relationship between agricultural trade specialization index and national income per capita (Atlas Method), 2014 (linear trend fit shown as *dotted line*). [a]Agricultural trade specialization index, on the *vertical axis*, is net exports as a ratio of the sum of exports and imports of agricultural and food products (world average = 0, but not included in the graph are numerous Middle Eastern food-importing countries).
*Source*: Compiled from data in World Bank (2016)

variation in sectoral average rates of assistance can be explained by national income per capita and arable land per capita. The signs on the estimated coefficients for those variables indicate that assistance has been such as to reduce significantly the extent to which farmers have had to face import competition as their competitiveness declined in the course of their country's economic development, and more so the more densely populated the country.

The NRA regression exercise was repeated for just Asian emerging countries, but at the individual industry level rather than the sectoral level. Again, per capita income is a highly significant explanatory variable, as is the dummy variable indicating import-competing products. The two product comparative advantage indexes also have the expected sign but

**Table 4.3** Share of agricultural products in total merchandise exports, major country groups and world, 1960–2014 (%)

| | *1960s*[a] | *1970s* | *1980s* | *1990s* | *2000–04* | *2014* |
|---|---|---|---|---|---|---|
| Western Europe | 17 | 14 | 13 | 12 | 9 | 11 |
| Japan | 8 | 3 | 2 | 1 | 1 | 1 |
| United States and Canada | 28 | 25 | 20 | 14 | 11 | 13 |
| Australia and New Zealand | 84 | 54 | 45 | 36 | 32 | 25 |
| ***Sub-total: above high-income*** | ***22*** | ***16*** | ***13*** | ***12*** | ***9*** | ***11*** |
| China | 51 | 41 | 20 | 12 | 5 | 3 |
| India | 42 | 36 | 24 | 14 | 8 | 13 |
| All developing countries | | | | | | |
| Upper middle-income | na | 41 | 24 | 15 | 10 | 10 |
| Lower middle-income | na | na | 28 | 18 | 12 | 19 |
| Low-income | 60 | 39 | 29 | 22 | 19 | na |
| **World** | **27** | **21** | **16** | **12** | **9** | **11** |

*Source*: Compiled from World Bank (2016)

[a]1960s is 1961–69, except for China, which is 1965–69 (from Anderson 1990)

are not as significant in the presence of the dummy variable indicating whether the product is import-competing (Table 4.8). That Asian farmers too enjoyed increasing protection as their competitiveness declined helps explain the slowness with which net imports of farm products have grown in the densely populated, rapidly growing East Asian region. That is particularly so for China and India, both of which showed little sign of moving away from being slight net exporters of farm products through the 1970s, 1980s, and 1990s: it is only in the past decade that China has switched to being a significant net importer of agricultural products, while India has become an even bigger net exporter over the 2005–14 decade (Table 4.5). A key contributor to the long delay in those two countries becoming net food importers was their gradual move away from very heavily taxing farmers relative to manufacturers in the 1970s and 1980s to assisting them more than manufacturers by the turn of the century (as reported in the next chapter).

The anti-trade bias of policies in East Asia and many other regions also helps explain the fact that only a small share of global agricultural production is traded internationally: just 1/6th for grains and less than 1/12th for livestock products. It is higher for sugar (one-quarter) and oilseeds (one-third for soybean and four-fifths for palm oil) but especially low for

**Table 4.4** Indexes of revealed comparative advantage in agricultural and manufactured products, 1960–2014[a]

| | *1960s* | *1970s* | *1980s* | *1990s* | *2000–04* | *2014* |
|---|---|---|---|---|---|---|
| *Agricultural goods* | | | | | | |
| Western Europe | 0.6 | 0.7 | 0.8 | 1.0 | 1.1 | 1.0 |
| Japan | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| United States and Canada | 1.0 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Australia and New Zealand | 3.0 | 2.6 | 2.9 | 3.1 | 3.5 | 2.3 |
| ***Sub-total: above high-income*** | ***0.8*** | ***0.8*** | ***0.9*** | ***1.0*** | ***1.0*** | ***1.0*** |
| China | 2.1 | 2.0 | 1.3 | 1.0 | 0.6 | 0.3 |
| India | 1.6 | 1.8 | 1.7 | 1.6 | 1.4 | 1.2 |
| All developing countries | | | | | | |
| Upper middle-income | na | 2.0 | 1.6 | 1.3 | 1.2 | 0.9 |
| Lower middle-income | na | na | 1.8 | 1.5 | 1.4 | 1.7 |
| Low-income | 2.2 | 1.9 | 1.8 | 1.9 | 2.1 | na |
| ***Manufactures*** | | | | | | |
| High-income countries | 1.2 | 1.2 | 1.1 | 1.1 | 1.0 | 1.0 |
| Developing countries | | | | | | |
| Upper middle-income | na | 0.4 | 0.5 | 0.8 | 0.8 | 1.0 |
| Lower middle-income | na | na | 0.6 | 0.8 | 0.8 | 0.7 |
| Low-income | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | na |

*Source*: Compiled from World Bank (2016)

[a]Revealed comparative advantage index is the share of agriculture and food in national exports as a percentage of that sector's share of global exports, hence 1 for the world. 1960s is 1961–69, except for China, which is 1965–69 (from Anderson 1990)

rice and dairy products—and almost always lower for developing countries than for high-income countries (Table 4.9).

One consequence of relatively little food production being traded internationally is that just a few countries dominate each product's international trade. Table 4.10 shows the data for eight major traded foods in 2013. The top four countries account for 90 % of both soybean and oil palm exports and the top six account for 80 % of both rice and sugar, 77 % of maize, and around 70 % of wheat, beef, and milk. One indicator of changes in concentration over time can be captured by the number of countries that are exporting or importing key food products. Table 4.11 reveals that the number of countries exporting them has doubled since the 1970s, while the number importing them has risen by only one-third. Another indicator is the Herfindahl Concentration Index, which indicates more concentration the closer it is to one. Figure 4.7 suggests that concentration of global production in the exporting countries has fallen for

**Table 4.5** Agricultural trade specialization index, 1960–2014[a]

| | *1960s* | *1970s* | *1980s* | *1990s* | *2000–04* | *2014* |
|---|---|---|---|---|---|---|
| Western Europe | −0.34 | −0.22 | −0.11 | −0.05 | −0.03 | 0.03 |
| Japan | −0.72 | −0.80 | −0.84 | −0.87 | −0.84 | −0.76 |
| United States and Canada | 0.11 | 0.24 | 0.25 | 0.21 | 0.08 | 0.16 |
| Australia and New Zealand | 0.73 | 0.71 | 0.68 | 0.65 | 0.62 | 0.47 |
| ***Sub-total: above high-income*** | ***−0.18*** | ***−0.11*** | ***−0.05*** | ***−0.04*** | ***−0.04*** | ***−0.07*** |
| China | 0.10 | 0.07 | 0.08 | 0.10 | −0.16 | −0.40[b] |
| India | −0.12 | 0.15 | 0.18 | 0.29 | 0.10 | 0.33[b] |
| All developing countries | | | | | | |
| Upper middle-income | na | 0.50 | 0.32 | 0.17 | 0.10 | −0.09 |
| Lower middle-income | na | na | 0.30 | 0.14 | 0.09 | −0.13 |
| Low-income | na | 0.25 | 0.17 | 0.14 | 0.07 | na |
| **World** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

*Source*: Compiled from World Bank (2016)

[a]Agricultural trade specialization index is net exports as a ratio of the sum of exports and imports of agricultural and food products (so ranging between −1 and +1, positive for net exporters, and the world index is zero). 1960s is 1961–69, except for China, which is 1965–69 (from Anderson 1990)

The final column for China and India refer to 2010–14; their index values in 2005–09 were −0.22 and 0.25, respectively (based on FAOSTAT data)

**Table 4.6** Shares of global agricultural trade, by country group, 1960s to 2014 (%)

| | *1960s* | *1970s* | *1980s* | *1990s* | *2000–04* | *2014* |
|---|---|---|---|---|---|---|
| High-income countries | 58 | 58 | 63 | 72 | 67 | 69 |
| Upper middle-income | na | 20 | 14 | 11 | 12 | na |
| Other developing | na | 22 | 23 | 17 | 21 | na |
| | 100 | 100 | 100 | 100 | 100 | 100 |

*Source*: Compiled from World Bank (2016)

all of those key products virtually every decade since the 1970s and is high only for maize and soybean. Were there to be less of an anti-trade bias in policies affecting farmer incentives in all countries, it is likely that an even larger number of countries would emerge as significant exporters of major food products. That would reduce the concern in some potentially food-importing countries that they would feel too vulnerable to supply disruption if they were to allow themselves to become more import-dependent.

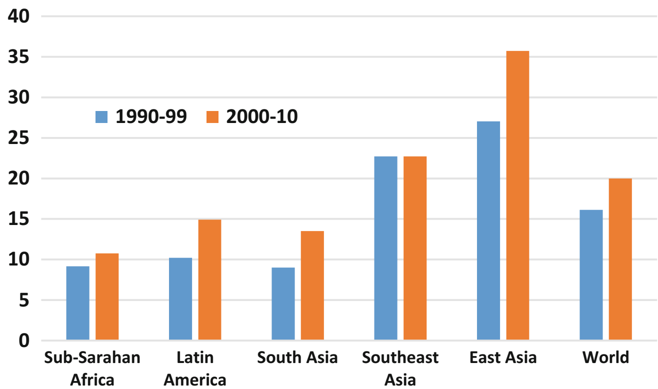


**Fig. 4.6** Food imports as a percentage of total merchandise exports, developing country regions, 1990–99 and 2000–10.
*Source*: Diaz-Bonilla (2015), based on FAOSTAT data

**Table 4.7** OLS regression results to explain national average agricultural NRAs and RRAs,[a] 1955–2007

| *Dependent variable* | *NRA* | *NRA* | *NRA* | *RRA* |
|---|---|---|---|---|
| Explanatory variables | | | | |
| Log(real GDP per capita) | 0.207* (0.00535) | −0.943* (0.0614) | −0.943* (0.0558) | −0.713* (0.0657) |
| Log(real GDP per capita) squared | | 0.0741* (0.00395) | 0.0743* (0.00359) | 0.0627* (0.00418) |
| Log(arable land per capita) | | | −0.204* (0.00851) | −0.228* (0.00933) |
| Constant | −1.356* (0.0422) | 2.875* (0.229) | 2.593* (0.208) | 1.382* (0.250) |
| Number of observations | 2584 | 2584 | 2551 | 2336 |
| Adjusted $R^2$ | 0.37 | 0.44 | 0.55 | 0.59 |

*Source*: Anderson et al. (2010 Tables 2.11 and 2.12)

[a]NRA is the average across all farm products of the nominal rates of assistance to farmers; RRA is the relative rate of assistance to farmers versus producers of other tradables (see Chap. 5)

[b]Standard errors are in parentheses and significance levels are shown at the 99 % by *

**Table 4.8** OLS regression results to explain national nominal rates of assistance to individual farm industries, Asian developing economies, 1960–2004[c]

| *Dependent variable:* | *NRA* | *NRA* | *NRA* | *NRA* |
|---|---|---|---|---|
| Explanatory variables | | | | |
| Ln GDP per capita | −0.38* | −0.28* | −0.44* | −0.38* |
| | (−0.10) | (−0.9) | (−0.10) | (−0.11) |
| Ln GDP per capita squared | 0.23* | 0.19* | 0.22* | 0.21* |
| | (−0.03) | (−0.02) | (−0.03) | (−0.03) |
| Import-competing product | | 0.39* | 0.39* | 0.39* |
| | | (−0.04) | (−0.04) | (−0.04) |
| RCA index[a] | | | | −0.04 |
| | | | | (−0.03) |
| TSI[b] | | | −0.03 | |
| | | | (−0.10) | |
| Constant | −0.49* | 0.23* | −0.19 | −0.08 |
| | (−0.12) | (−0.11) | (−0.09) | (−0.10) |
| Number of observations | 2766 | 2766 | 2594 | 2594 |
| Adjusted $R^2$ | 0.14 | 0.28 | 0.29 | 0.29 |
| Country fixed effects | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes |

*Source*: Anderson (2010)

[a]RCA, the revealed comparative advantage index, is the share of a product in national exports as a ratio of that product's share of global exports

[b]TSI is the trade specialization index, defined as net exports of a product as a ratio of the sum of exports and imports of that product

[c]The dependent variable for regressions is NRA by commodity and year. Standard errors are in parentheses and the significance level is shown at the 99 %

## Trends in the Variability and Diversity of Food Consumption

The variability of global production of key food items is greater than the variability of consumption, indicating the important role that changes in stocks can play in stabilizing global food availability. The variability of both has been less in the 1995–2010 period than during 1970–95 (Table 4.12). On the supply side, that could be associated with changes in technologies and input use that reduce yield variability, or with changes in the location of production, but it is contrary to what one might have expected as climates change and with the perceived increase in extreme

**Table 4.9** Share of production exported for key farm products, high-income countries and all countries, 2000–03 (%)

| | *High-income countries* | *All countries* |
|---|---|---|
| Rice | 32 | 7 |
| Wheat | 49 | 24 |
| Maize | 20 | 15 |
| Cassava | na | 6 |
| Soybean | 38 | 31 |
| Groundnut | na | 2 |
| Palm oil | na | 80 |
| Sugar | 31 | 25 |
| Cotton | 31 | 11 |
| Beef | 23 | 17 |
| Pig meat | 21 | 9 |
| Poultry | 19 | 15 |
| Milk products | 7 | 4 |

*Source*: Anderson (2009a, Table B.8)

**Table 4.10** Top six exporting countries for eight key traded farm products, 2013 (% by value of global exports of each product)

| *Wheat* | | *Rice* | | *Maize* | | *Sugar, raw* | |
|---|---|---|---|---|---|---|---|
| USA | 21 | India | 34 | USA | 20 | Brazil | 54 |
| Canada | 13 | Thailand | 18 | Brazil | 18 | Thailand | 9 |
| France | 12 | USA | 9 | Argentina | 17 | Australia | 7 |
| Australia | 12 | Pakistan | 9 | Ukraine | 11 | Guatemala | 6 |
| Russia | 7 | Viet Nam | 7 | France | 7 | Mexico | 3 |
| Germany | 5 | Italy | 3 | India | 4 | Cuba | 3 |
| **TOP SIX** | 71 | TOP SIX | 80 | TOP SIX | 77 | TOP SIX | 80 |

| *Soybean + oil* | | *Oil palm* | | *Beef, boneless* | | *Milk, powder* | |
|---|---|---|---|---|---|---|---|
| Brazil | 36 | Indonesia | 47 | Brazil | 18 | New Zealand | 45 |
| USA | 33 | Malaysia | 36 | Australia | 18 | Argentina | 7 |
| Argentina | 12 | Netherlands | 5 | USA | 15 | Netherlands | 7 |
| Paraguay | 4 | PNG | 1 | Netherlands | 7 | Australia | 4 |
| Canada | 3 | Thailand | 1 | Ireland | 6 | France | 3 |
| Netherlands | 2 | Germany | 1 | New Zealand | 5 | UAE | 3 |
| TOP SIX | 90 | TOP SIX | 92 | TOP SIX | 68 | TOP SIX | 69 |

*Source*: FAO (2016c)

**Table 4.11** Number of exporting and importing countries for key food products, 1970–2009

| | *1970s* | | *1980s* | | *1990s* | | *2000s* | |
|---|---|---|---|---|---|---|---|---|
| | *Exporters* | *Importers* | *Exporters* | *Importers* | *Exporters* | *Importers* | *Exporters* | *Importers* |
| Wheat | 36 | 136 | 40 | 146 | 61 | 162 | 91 | 177 |
| Maize | 58 | 142 | 55 | 149 | 80 | 169 | 102 | 196 |
| Rice | 63 | 175 | 61 | 175 | 90 | 202 | 114 | 219 |
| Sugar | 60 | 165 | 56 | 174 | 81 | 207 | 111 | 222 |
| Beef | 62 | 159 | 64 | 175 | 82 | 202 | 109 | 216 |
| Milk | 48 | 184 | 49 | 186 | 81 | 206 | 116 | 219 |
| Soybean | 30 | 71 | 38 | 91 | 63 | 118 | 87 | 161 |

*Source:* Liapis (2012)

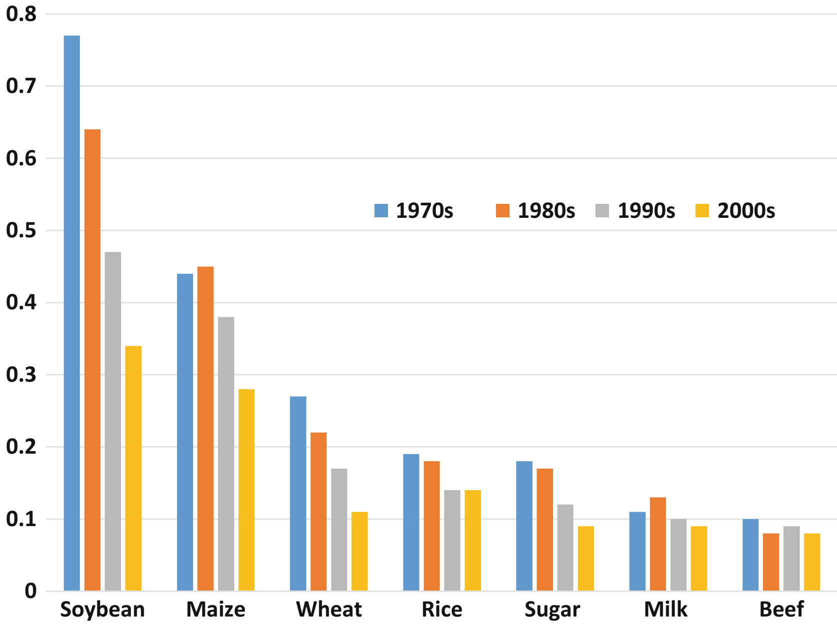


**Fig. 4.7** Herfindahl Concentration Index of production of key food products among the countries exporting them, 1970–2009.
*Source*: Liapis (2012)

**Table 4.12** Coefficient of variation of global production and consumption of key food products, 1970–2010

| | *Production* | | *Consumption* | |
|---|---|---|---|---|
| | *1970–94* | *1995–2010* | *1970–94* | *1995–2010* |
| Soybean | 11.0 | 8.8 | 9.0 | 7.2 |
| Maize | 8.1 | 6.0 | 5.3 | 4.5 |
| Wheat | 5.7 | 4.4 | 4.4 | 2.0 |
| Rice | 4.4 | 3.2 | 4.1 | 2.2 |
| Sugar | 4.7 | 5.1 | 4.3 | 3.1 |
| Milk | 7.9 | 5.0 | 7.4 | 5.8 |
| Beef | 3.7 | 2.2 | 3.6 | 2.4 |

*Source*: Liapis (2012)

weather events. On the demand side, it could be a result of financial deepening, which provides more options for households to borrow in times of greater need and repay the loans when higher incomes allow. At the individual country level, the breaking of the link between production and consumption because of consumption smoothing through time can be the result of greater openness to trade in food, and even in capital (Islamaj and Kose 2016).

Openness to trade also allows diets to become more diversified and, therefore, potentially more nutritious[6]. The extent to which that is happening can be seen by comparing indexes of diversity of national food production versus national food availability. Remans et al. (2014) provide estimates of two diversity indexes: the Shannon entropy diversity index, which reflects how many different types of food items there are in the country, and a modified functional attribute diversity index, which reflects the diversity in the nutrients provided by the different food items. According to those estimates averaged over the 2000–09 decade, both indicators are greater (=more diversity) in availability than in production, especially in terms of nutrients (Table 4.13). This is expected to continue with economic growth and urbanization,[7] but it will have more potential to do so the more open is each economy.

**Table 4.13** Indexes of diversity of national food production and availability, by developing country region, 2000–09

| | *Shannon entropy diversity index* | | *Modified functional attribute diversity index* | |
|---|---|---|---|---|
| | *Production* | *Availability* | *Production* | *Availability* |
| South Asia | 0.71 | 0.85 | 0.13 | 0.71 |
| East Asia | 0.76 | 0.88 | 0.12 | 0.71 |
| Sub-Saharan Africa | 0.80 | 0.83 | 0.05 | 0.71 |
| Middle East and N Africa | 0.92 | 0.86 | 0.08 | 0.82 |
| Europe and Central Asia | 0.82 | 0.88 | 0.08 | 0.80 |
| Latin America | 0.78 | 0.92 | 0.08 | 0.80 |

*Source*: Remans et al. (2014)

## Trends in Real International Prices of Farm Products

To conclude this chapter before turning to examine in more detail the evolution of agricultural price- and trade-distorting policies since the 1950s, recall from the previous chapter that the real price in international markets for farm products followed a steep downward trend throughout the twentieth century. That was also the case for many minerals and metals (Pfaffenzeller et al. 2007). Also, the price trend for fossil fuels had been flat for many decades through to the early 1970s. However, when the Organization of the Petroleum Exporting Countries (OPEC) cartelized by agreeing in 1973 on restrictive production quotas, the US dollar price of oil in international markets quadrupled, and it doubled again in 1979–80 following the Islamic Revolution in Iran. Agricultural prices spiked upward in 1973–74 also, in part because the Soviet Union chose unexpectedly to enter the international grain market after a crop shortfall; but they and the oil price fell in the mid-1980s and stayed flat for nearly two decades (Fig. 1.1a).

Price spikes in markets as competitive as those for farm products, minerals, and metals rarely last long because they stimulate a positive production response on the supply side of the market and also substitution toward cheaper alternatives on the demand side. Also, they can boost innovation, which can contribute to the subsequent return to a downward trend in those prices. Even the tightly controlled OPEC cartel was able to keep oil prices high for only a dozen years, while non-OPEC producers of oil, plus producers of other fossil and alternative fuels, geared up their supply capacities.

Soon after the recent turn of the century, however, the real prices of primary products began rising unexpectedly, with food and energy prices moving in parallel (Fig. 1.1a). The relative importance of the various drivers of those price spikes are still being debated by econometricians, but certainly the preceding rundown in global stocks contributed to the spike in grain prices in 2007–08 (Wright 2011). That was exacerbated by alterations in grain trade restrictions in response to that spike (Martin and Anderson 2012; Anderson and Nelgen 2012; Jensen and Anderson 2016), as discussed in Chap. 8. Also, the demand for maize in the USA and oilseeds in the EU as inputs into biofuels was bolstered by subsidies and mandates in those countries from the mid-2000s. That policy change was a response to both the rising price of fossil fuels and calls for decarbonizing energy supplies to slow carbon emission and global warming.

Simultaneously, rapid growth in Asian incomes, especially in China and India, and associated changes in diets toward more protein consumption, have been adding to the long-run growth in demand for food and animal feed products globally.

Supply responses by farmers in the subsequent two years reduced the peak food prices of 2008–12 by about 15 %, and they fell a similar additional amount in 2015. As of early 2016, they were still about one-fifth above the flat trend level during 1985–2005 though, suggesting supply growth is still catching up with demand growth globally. How future prices might trend is an issue addressed in Chap. 11.

## Key Messages

Developments in global agricultural trade, 'revealed' comparative advantage, and net trade specialization in farm products over the past five decades are broadly consistent with expectations from trade theory, despite the fact that those trade patterns have been distorted by price-distorting anti-trade policies.

There is concentration in both the commodity and country shares of global exports of farm products. As of 2014, less than ten items made up half of that trade in agricultural products, and two-thirds of the world's exports of farm products are accounted for by just a dozen agricultural trading economies (treating the EU28 as a single economy). These large food-trading economies range from being very heavily food import- or export-dependent to being close to self-sufficient, but even those close to food self-sufficiency engage in considerable intra-sectoral farm trade. Indeed, most of the top 20 food-trading nations engage in substantial two-way farm trade as people look to diversify their diets and consume more exotic foods as part of their quest for variety. Nonetheless, there is a negative correlation across countries between their agricultural comparative advantage and both per capita income and population density.

Over the past half century, the share of farm products in exports of all goods has been declining for not only most groups of countries but also for the world as a whole. A persistent decline in comparative advantage in agriculture is evident only for Japan and for upper middle-income countries. The comparative advantage in farm products has risen rather than fallen for the high-income group as a whole, and especially for Western Europe.

One reason for not observing the trends in national farm trade patterns that theory suggests for high-income and low-income countries is the anti-trade bias in many nations' policies that distort domestic farm product prices relative to those of other tradables. Both China and India showed little sign of moving away from being slight net exporters of farm products through the 1970s, 1980s, and 1990s, even though their non-farm sectors were growing strongly: it is only in the past decade that China has switched to being a significant net importer of food, while India has become an even bigger net exporter over the 2005–14 decade. A key reason for the long delay in those two countries becoming food importers was their gradual move away from very heavily taxing farmers relative to manufacturers in the 1970s and 1980s to assisting them more than manufacturers since the late 1990s.

The pervasive anti-trade bias means only a small share of global agricultural production is traded internationally: just 1/6th for grains and less than 1/12th for livestock products. It is higher for sugar and oilseeds but especially low for rice and dairy products. One consequence of little food production being traded internationally is that just a few countries dominate each product's international trade. Were there to be less of an anti-trade bias in policies affecting farmer incentives in all countries, it is likely that a larger number of countries would emerge as significant exporters of major food products, and all countries would have a more diversified diet.

## Notes

1. Agricultural trade is mostly about food, with non-food farm products such as cotton and wool comprising in aggregate less than one-eighth of global agricultural trade. Therefore, throughout this chapter and elsewhere in the book, the words agriculture and food are used synonymously. Processed food accounts for about two-fifths of global food trade, a share that has been fairly constant in recent decades.
2. Recall from Chap. 2 that national borders have changed markedly over time, with the number of sovereign states rising from 76 in 1949 to more than 190 today (Gancia et al. 2016). World Bank (2016b) data for the variables discussed in this chapter are available for 145 economies.
3. The propensity for intra-sectoral trade is growing as people look to diversify their diets and consume more exotic foods as part of their quest for variety.
4. The availability and reliability of annual global production and trade data increased greatly from 1960, hence that starting point. The period 2005–2013 was one of three price spikes in international food and energy markets and so is not representative of long-run trends (see Fig.1.1a of Chap. 1). Hence, the decadal tables in this section end with just 2000–2004 and 2014 data.

5. A corollary to the declining comparative advantage of upper middle-income countries in farm products is their rapid rise in manufacturing export competitiveness, led by China. High-income countries accounted for more than 90 % of global manufacturing exports until the late 1980s, and that share was still 80 % in 2000–2004. But it has since plummeted, and was just 56 % in 2014. Hence, the manufacturing RCA for upper middle-income countries has risen dramatically, from barely 0.4 in the 1960s to mid-1980s to 0.8 in the 1990s and 1.1 by 2014 (so now slightly above that for high-income countries—see lower part of Table 4.4).
6. Some observers worry about the advertising strength of multinational processing or retail companies selling low-priced processed foods, some of which may be considered less nutritious than the more-expensive traditional foods they replace (Hawkes, Grace and Thow 2015). In such circumstances, there are more-efficient policy responses than preventing such trade or foreign direct investment (which, by limiting competition, may simply lead to higher-cost domestic firms providing a smaller range of similar but more-expensive foods). A more-appropriate response is to ensure there is adequate nutritional information available (e.g., on product labels); and education campaigns could guide consumers to healthy food choices, regardless of whether the firms processing or retailing the available foods are local- or foreign-owned.
7. In 1950, just 30 % of the world's population lived in urban areas. That share had reached 50 % by 2015 and is projected to reach two-thirds by 2050, with even the poorest region (Sub-Saharan Africa) having the majority of its population in urban areas, according to the United Nations (Bloom 2016).

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CHAPTER 5

# Market-Distorting Policies: Long-Run Trends and Short-Run Insulation

Agricultural protection and subsidies in high-income (and a few upper-middle-income) countries have been depressing international prices of farm products for many decades, thereby lowering the earnings of farmers and associated rural businesses in developing countries (Johnson 1991). Those policies almost certainly added to global inequality and poverty, since historically at least three-quarters of the world's poorest people live in rural areas and two-thirds depend directly for their main income on agriculture in developing countries (Castañeda et al. 2016). As well as this external adverse influence on incomes of farmers in developing countries, their own governments taxed them following independence until at least the 1980s. This involved both directly taxing farm exports and in some cases (in-kind) production, as well as harming farmers indirectly with an import-substituting industrialization strategy that involved restrictions on imports of manufactures and an overvalued currency (Krueger et al. 1988, 1991). An important aspect of those price-distorting policies was their anti-trade bias: they reduced the quantity of farm products traded internationally. Such 'thinning' of the international market meant that its prices have been more volatile than they otherwise would have been. That is unfortunate because volatility bothers market participants, and so national governments tend to insulate somewhat their domestic food markets from international price volatility—adding further to those fluctuations in international prices.



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Since the mid-1980s, however, many developing country governments have been reforming their agricultural, trade and exchange rate policies, thereby reducing their anti-agricultural bias. Some high-income countries have reduced their farm price supports too, making it easier for developing countries to compete in international food markets (Anderson 2009, 2010). Both groups of countries, however, continue to have an anti-trade bias in their policies, and to insulate their domestic food markets from international price fluctuations. Also, in the most advanced developing economies, the gradual removal of their previous discrimination against the agricultural sector is being followed by rising levels of support for their farmers.

This chapter begins by providing evidence on the extent to which countries have insulated their domestic food market from volatility in world food markets before and after the mid-1980s when many countries' policy reforms began. It then outlines ways of measuring the price-distorting impacts of policies (which have reformed considerably over the past half-century), before summarizing empirical evidence of domestic price distortions that has recently been compiled (see Anderson and Nelgen 2013) for the more than five decades since the mid-1950s. When placed in historical perspective, the reforms from the mid-1980s are as dramatic as the policy changes in the previous three decades. Therefore, in tracing the impacts of those farm and food policy developments since the 1950s, it is helpful to subdivide the period into the years to the mid-1980s, which were characterized by policies that were strongly anti-trade, and the subsequent two decades which saw the gradual undoing of those policies. Despite those policy reforms, the evidence shows that countries continue to insulate their food markets from international price fluctuations, and to assist more their import-competing farmers. Also, plenty of diversity in distortions remains across countries, and across commodities within each country. Hence, a continuation of the reform process would still expand farm trade, 'thicken' international food markets, and thus not only raise the mean but also lower the volatility of prices in those markets.

## How Much Are Domestic Food Markets Insulated from International Price Fluctuations?

The domestic price of a farm product will never move to exactly the same extent of the price of that product in the international marketplace for a number of reasons. For example, the domestic product may be differentiated in various ways from the product being trade internationally, and transport costs are unlikely to move by the same proportion as the international price of the product. But perhaps the biggest reason for domestic food prices moving less than international ones is that the majority of producers and consumers dislike price volatility and so they persuade their national government to insulate them from it. That can be done to some extent automatically simply by applying a specific rather than an *ad valorem* import tariff (i.e., so much per ton rather than a percentage of the import price). It can also be achieved by varying the *ad valorem* rate of import or export taxation (or subsidization) of a product, or by imposing import or export quotas/quantitative restrictions.

A standard way to indicate the extent of insulation is to estimate the proportion of any international price fluctuation that is transmitted to domestic markets within 12 months. Following Nerlove (1972) and Tyers and Anderson (1992, pp. 65–75), this approach assumes that associated with the border price $p_t^*$ there is a 'target' domestic price $\overline{p}_t$, toward which policy ensures that the actual domestic price, $p_t$, moves only sluggishly. Changes in this target price might respond incompletely, even in the long run, to corresponding changes in the border price. If all prices are expressed in logarithms, the target domestic price then has the following relationship with the border price:

$$\overline{\mathrm{p}}_t = \mathrm{p}_0 + \phi_{LR}\left(\mathrm{p}_t^* - \mathrm{p}_0^*\right) \tag{5.1}$$

where $\phi_{\mathrm{LR}}$ is the long-run price transmission elasticity and the values of $p_0$ and $p_0^*$ are the domestic and border prices in the base period. In the short run, the actual domestic price adjusts only partially each year to any change in the target domestic price:

$$p_t - p_{t-1} = \delta\left(\overline{p}_t - p_{t-1}\right) \tag{5.2}$$

where the parameter $\delta$ gives the fraction of the ultimate adjustment that takes place in one year. By substituting (5.1) into (5.2) to eliminate the unobservable target price, the following reduced form, which is suitable for fitting to data, is obtained:

$$p_t = \delta\left(p_0 - \phi_{LR} p_0^*\right) + \left(1 - \delta\right) p_{t-1} + \delta\phi_{LR} p_t^* = a + bp_{t-1} + cp_t^* \tag{5.3}$$

If the current US dollar prices are expressed in logarithms, the short-run (one-year) elasticity of price transmission, call it $\phi_{SR}$, is simply $\delta$ times the long-run elasticity. Thus, the estimate of the short-run elasticity is the regression coefficient $c$ and the long-run elasticity estimate is $c/(1 - b)$.

Nelgen (2012) uses this partial-adjustment geometric distributed lag formulation to estimate short-run price transmission elasticities for nine key food products for a sample of 82 countries (half of which are developing) for two periods: 1965–85 and 1985–2010. Table 5.1 summarizes those short-run estimates. The unweighted average across these nine key food products was 0.68 in 1965–85, suggesting that within one year, only two-thirds of the movement in international prices of farm products was transmitted domestically on average. The developing country average was only 0.55 in that period, while for high-income countries it was 0.72. What is perhaps more surprising is that those elasticities are no higher in 1985–2010. On the contrary, they are lower for high-income countries and for the world as a whole, while remaining unchanged for developing countries. These estimates are consistent with a study by Minot (2011) of 11 Sub-Saharan African countries. Despite using a somewhat different methodology, he estimated short-run price transmission elasticities for key staple foods that averaged 0.63 for that region.

**Table 5.1** Border-to-domestic short-run price transmission elasticities, key food products, high-income and developing countries, 1965–85 and 1985–2010

| | *High-income countries* | | *Developing countries* | | *All countries* | |
|---|---|---|---|---|---|---|
| | *1965–85* | *1985–2010* | *1965–85* | *1985–2010* | *1965–85* | *1985–2010* |
| Rice | 0.75 | 0.18 | 0.54 | 0.54 | 0.57 | 0.49 |
| Wheat | 0.56 | 0.55 | 0.38 | 0.60 | 0.51 | 0.55 |
| Maize | 0.95 | 0.72 | 0.66 | 0.54 | 0.87 | 0.63 |
| Soybean | 1.00 | 0.76 | 0.79 | 0.70 | 0.96 | 0.73 |
| Sugar | 0.44 | 0.45 | 0.49 | 0.42 | 0.48 | 0.43 |
| Milk | 0.76 | 0.42 | 0.17 | 0.69 | 0.60 | 0.51 |
| Beef | 0.70 | 0.73 | 0.76 | 0.51 | 0.64 | 0.66 |
| Pigmeat | 0.62 | 0.69 | 0.51 | 0.36 | 0.71 | 0.51 |
| Poultry | 0.72 | 0.73 | 0.66 | 0.63 | 0.82 | 0.68 |
| **Unweighted average** | **0.72** | **0.58** | **0.55** | **0.55** | **0.68** | **0.58** |

Source: Nelgen (2012, Appendix Table B.1), based on the sample of 82 countries included in Anderson and Nelgen (2013)

## Indicators of National Distortions to Prices

The most common indicators of government interventions in agricultural markets of high-income countries and a few large middle-income countries are the producer and consumer support estimates (PSEs and CSEs) and related measures that have been computed annually by the OECD (2015). Those estimates only begin in 1986 though, and they refer only to the farm sector with no comparable numbers for nonfarm sectors.

For present purposes, it is helpful to go back further in time, to include also the world's developing countries since they account for half of global agricultural production, and to compare the price-distorting effects of government policies on farm products with those affecting the tradable products of other sectors of the economy. A World Bank study summarized in Anderson (2009) sought to do that for 82 countries that together account for more than 90 % of the world's population and global trade, employment, GDP, and poverty.

For that World Bank study, the nominal rate of assistance (NRA) for each farm product in any country has been defined as the percentage by which government policies have directly raised gross returns to farmers above what they would be without the government's intervention (or lowered them, if NRA < 0—see Anderson et al. 2008).[1]

That has been used to estimate a weighted average NRA for all covered products (accounting for more than two-thirds of the gross value of national farm production in each of the studied countries that in turn account for more than 90 % of global agriculture). The NRA is calculated using the value of production at undistorted prices as weights (unlike the PSEs and CSEs computed by OECD, which are expressed as a percentage of the distorted price and so cannot exceed 100 %).

To that NRA for covered products is added a 'guesstimate' of the NRA for non-covered products and an estimate of the NRA from non-product-specific forms of assistance or taxation in each country.[2] Each farm industry is classified either as import-competing, or a producer of exportables, or a producer of non-tradables (with its status sometimes changing over the years). That classification makes it possible to generate for each year the weighted average NRAs for import-competing and exportable farm products, thereby providing an indication of the extent of anti-trade bias.

Also computed for the World Bank project is a production-weighted average NRA for non-agricultural tradables, for comparison with that for agricultural tradables via the calculation of a percentage relative rate of assistance (RRA), defined as RRA = 100 × [(100 + $NRAag^t$)/(100 + $NRAnonag^t$) − 1], where $NRAag^t$ and $NRAnonag^t$ are the percentage NRAs for the tradables parts of the agricultural (including non-covered) and non-agricultural sectors, respectively.[3] Since the NRA cannot be less than −100 % if producers are to earn anything, nor can the RRA (since the weighted average $NRAnonag^t$ is non-negative in all 82 country case studies). And if both of those sectors are equally assisted, the RRA is zero. This measure is useful in that if it is below (above) zero, it provides an internationally comparable indication of the extent to which a country's sectoral policy regime has an anti- (pro-)agricultural bias (Anderson et al. 2008).

The extent to which consumers are taxed or subsidized also was examined by that World Bank project. To do so, a consumer tax equivalent (CTE) is calculated by comparing the price that consumers pay for their food and the international price of each food product at the border. Differences between the NRA and the CTE arise from distortions in the domestic economy that are caused by transfer policies and taxes/subsidies that cause the prices paid by consumers (adjusted to the farm gate level) to differ from those received by producers. In the absence of any other information or of farm inputs taxes or subsidies, the CTE for each tradable farm product is assumed to be the same as the NRA from border distortions.

In calculating the NRAs and CTEs for each sector of the economy, the methodology outlined in Anderson et al. (2008a) also includes the implicit trade tax distortions generated by dual or multiple exchange rates, drawing on the methodology of Dervis et al. (1981).

The cost of government policy distortions to incentives, in terms of resource misallocation, tends to be greater the greater the variation of NRAs across industries within the sector (Lloyd 1974). A simple indicator of dispersion is the standard deviation of the covered industries' NRAs. However, it is helpful to have a single indicator of the impact of the sector's price-distorting policies on overall welfare or trade at any time, and to trace its path over time and make cross-country comparisons. To that end, the family of indexes first developed by Anderson and Neary (1994, 2005) under the catch-all name of trade restrictiveness indexes has been drawn on to generate indicators of distortions imposed by each country's agricultural policies on its economic welfare, and also on its agricultural trade. Lloyd et al. (2010) define and estimate a welfare reduction index (WRI) and a trade reduction index (TRI) for the same 82 countries. Both the WRI and TRI take into account that, for some covered products, the producer distortions (NRA) differ from the distortions faced by consumers (CTE). As their names suggest, these two new indexes, respectively, provide a single indicator of the direct welfare- or trade-reducing effects of distortions to consumer and producer prices of covered farm products from all agricultural and food price and trade policy measures in place.

Specifically, the TRI (or WRI) is that *ad valorem* trade tax rate which, if applied uniformly to all farm commodities in a country that year, would generate the same reduction in trade (or economic welfare) as the actual cross-commodity structure of agricultural NRAs and CTEs for that country, other things equal.

The WRI measure provides an indicator of the partial equilibrium welfare cost of agricultural price-distorting policies better than the NRA because it recognizes that the welfare cost of a government-imposed price distortion is related to the square of the price wedge. It thus captures the disproportionately higher welfare costs of peak levels of assistance or taxation, and is larger than the mean NRA or CTE and is positive regardless of whether the government's agricultural policy is favoring or hurting farmers.

## Empirical Estimates of Policies' Distortions to Prices: NRAs

To gauge how farmer incentives in high-income and developing countries have evolved since the 1950s, we draw on the time-series evidence from the above-cited World Bank study compiled by Anderson and Valenzuela (2008), summarized in Anderson (2009), and updated to 2011 by Anderson and Nelgen (2013). Of the 82 countries in that study, more than half are developing countries. It turns out that the NRA and CTE in that database are very highly correlated for most products in all countries, reflecting the dominance of border trade measures among the policies adopted. For that reason, and to conserve space, only producer price distortions are reported in this section.

In both Japan and the European Community in the 1950s, domestic prices exceeded international market prices for grains and livestock products by less than 40 %. By the early 1980s, however, the difference was considerably larger, while still being close to zero for the agricultural-exporting rich countries of Australasia and North America (Anderson et al. 1986, Table 2.5). Virtually all of the assistance to Japanese and European farmers in that period was due to restrictions on imports of farm products.

Assistance in high-income countries rose markedly in the mid-1980s though, particularly due to the North Atlantic food export subsidy 'war'. This prompted the launch of the GATT's Uruguay Round and saw the OECD begin to compute annual PSEs and CSEs for its member countries. For the OECD (whose country membership was expanding gradually), producer support rose slightly between 1986–88 and 2012–14 in US dollar terms (from an average of US$238 to US$251 billion per year), but, when expressed as a share of support-inclusive returns to farmers, it came down from 37 % to 18 %. Because of some changes in support instruments, including switching to measures that are based on non-current production or on long-term resource retirement, the share of that assistance provided via market price support measures has fallen from more than three-quarters to barely two-fifths. When the PSE payment is expressed as a percentage of undistorted prices to make it like an NRA, the fall is from 58 % to 22 % between 1986–88 and 2012–14 (OECD 2015). This indicator suggests that high-income country policies have become considerably less trade-distorting, at least in proportional terms, even though farmer support in high-income countries has continued to grow in nominal US dollar terms because of growth in the value of farm output in those high-income countries.

As for developing countries outside Northeast Asia, the main comprehensive set of pertinent estimates over time was, until recently, for the period just prior to when reforms became widespread. They were generated as part of a major study of 18 developing countries from the 1960s to the mid-1980s by Krueger et al. (1988, 1991). That study by the World Bank shows that the depression of incentives facing farmers has been due only partly to various forms of agricultural price and trade policies, including subsidies to food imports. Much more important in many cases were those developing countries' non-agricultural policies that hurt their farmers *indirectly*. The two key ones were manufacturing protectionism (which attracts resources from agriculture to the industrial sector) and overvalued exchange rates (which attract resources to sectors producing non-tradables, such as services).

The more recent World Bank database, as updated by Anderson and Nelgen (2013), covers 45 developing countries but also 13 European transition economies as well as 24 high-income countries. The results from that study (which are compared with the earlier Krueger/Schiff/Valdés ones in Anderson 2010) reveal that there have been substantial reductions in distortions to agricultural incentives in developing countries over the past three decades. They also reveal, however, that progress has not been uniform across countries and regions, and that the reform process is far from complete. More specifically, many countries still have a wide dispersion in NRAs for different farm industries, and in particular have a strong anti-trade bias in the structure of assistance within their agricultural sector.

The global summary of those new results is provided in the following series of figures. Figure 5.1 reveals that the NRA to farmers in high-income countries rose steadily over the post-World War II period through to the end of the 1980s, apart from a dip when international food prices spiked around 1973–74. After peaking at more than 50 % in the mid-1980s, when real international food prices were at a near-record low (see Fig. 2.1), the average agricultural NRA for high-income countries has fallen substantially. This is so even when the new farm programs that are somewhat 'decoupled' from directly influencing production decisions are included. For developing countries, too, the average NRA for agriculture has been moving toward zero, but from a level of around –25 %

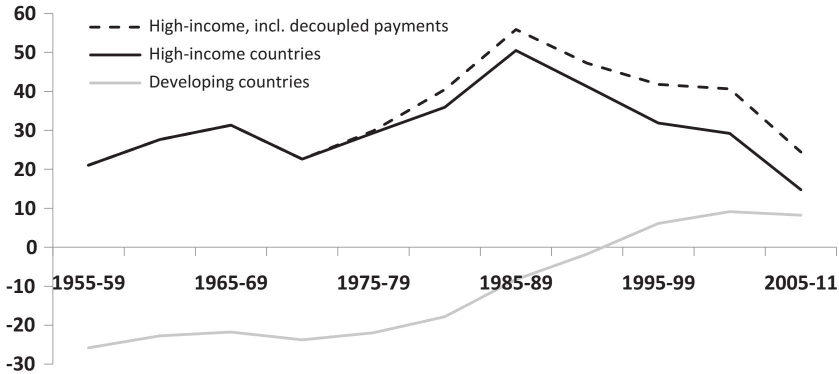


**Fig. 5.1** NRAs to agriculture in high-income and developing countries 1955–2011 (%). Source: Anderson (2009, Chap. 1), updated from estimates in Anderson and Nelgen (2013)(Five-year weighted averages, with decoupled payments included in the *dashed line*. The non-EU transitional economies of Central and Eastern Europe and Central Asia (ECA) are included in the high-income country group.)

between the mid-1950s and early 1980s. Indeed it 'overshot' in the 1990s by becoming positive, but it is less than half the average NRA for high-income countries.

These NRA changes mean there has been a dramatic change in the proportions of the global farm population facing negative versus positive NRAs, and in the proportions of the global value (at undistorted prices) of agricultural production facing various NRAs. This is illustrated in Fig. 5.2. The global data underlying that figure involve a transfer from farmers to consumers or governments of US$83 billion and from consumers or governments to farmers of US$182 billion per year in the 1980s, hence an annual net transfer to farmers of US$99 billion globally. By the 2000s, however, the annual transfer from farmers had diminished greatly such that the net transfer to farmers had trebled to US$298 billion globally—despite the reduced rate of support for farmers in high-income countries.

Associated with those policy reforms are reductions in the distortions to consumer prices of food products. Since the 1980s the aggregate global transfer to food consumers has shrunk considerably, but so too has the aggregate global transfer from food consumers. This is depicted in Fig. 5.3, which shows the proportion of the global nonfarm population facing various levels of food consumer taxes or subsidies.

The developing country average NRA conceals the fact that the exporting and import-competing sub-sectors of agriculture have very different NRAs. While the average NRA for farm product exporters in developing countries has been negative throughout (coming back from –50 % in the 1960s and 1970s to almost zero in 2000–10), the NRA for import-competing farmers in developing countries has fluctuated around a trend rate that has risen from 10 % and 30 %—and it even reached 40 % in the years of low international prices in the mid-1980s (Fig. 5.4). This suggests that export-focused farmers in developing countries are still discriminated against by farm policies in two respects: by the anti-trade structure of assistance within their own agricultural sectors, and by the protection still afforded farmers in high-income countries. That anti-trade bias also reflects the more general fact that NRAs are not uniform across commodities, which in turn indicates that resources within the farm sector of each country are not being put to their best use—a point picked up in the next chapter.

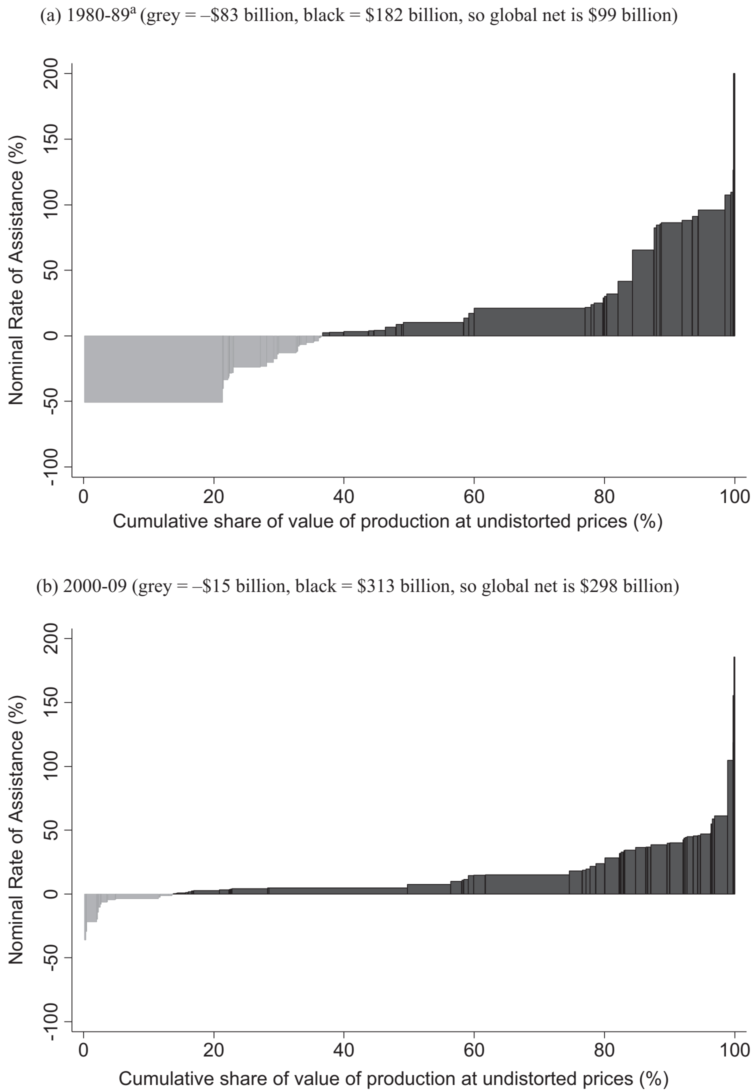


**Fig. 5.2** Proportions of the global value (at undistorted prices) of agricultural production facing various NRAs, 1980–89 and 2000–09. (**a**) 1980–89 (*gray* = – US$83 billion, *black* = US$182 billion, so global net is US$99 billion). (**b**) 2000–09 (*gray* = – US$15 billion, *black* = US$313 billion, so global net is US$298 billion). *Source*: Generated from estimates in Anderson and Nelgen (2013)

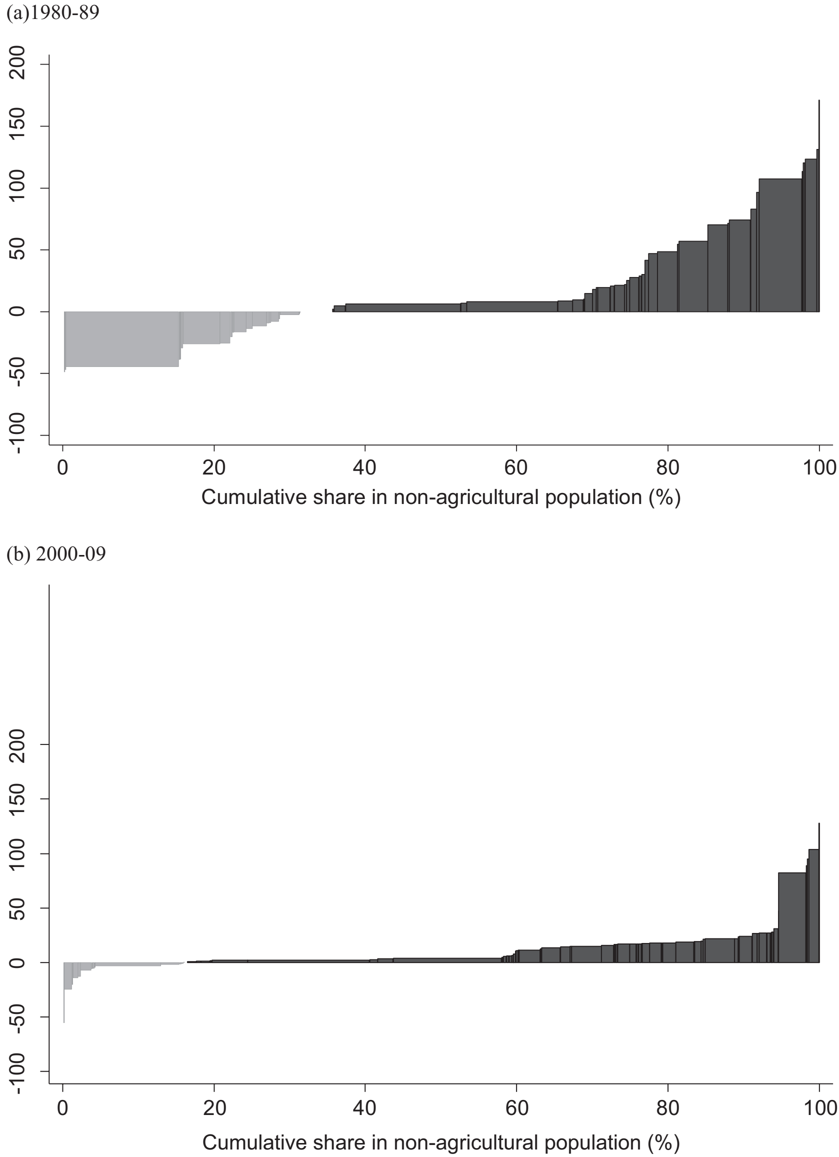


**Fig. 5.3** Proportions of global nonfarm population facing various consumer tax equivalents on their purchases of farm products, 1980–89 and 2000–09. (**a**) 1980–89. (**b**) 2000–09. Source: Generated from estimates in Anderson and Nelgen (2013)

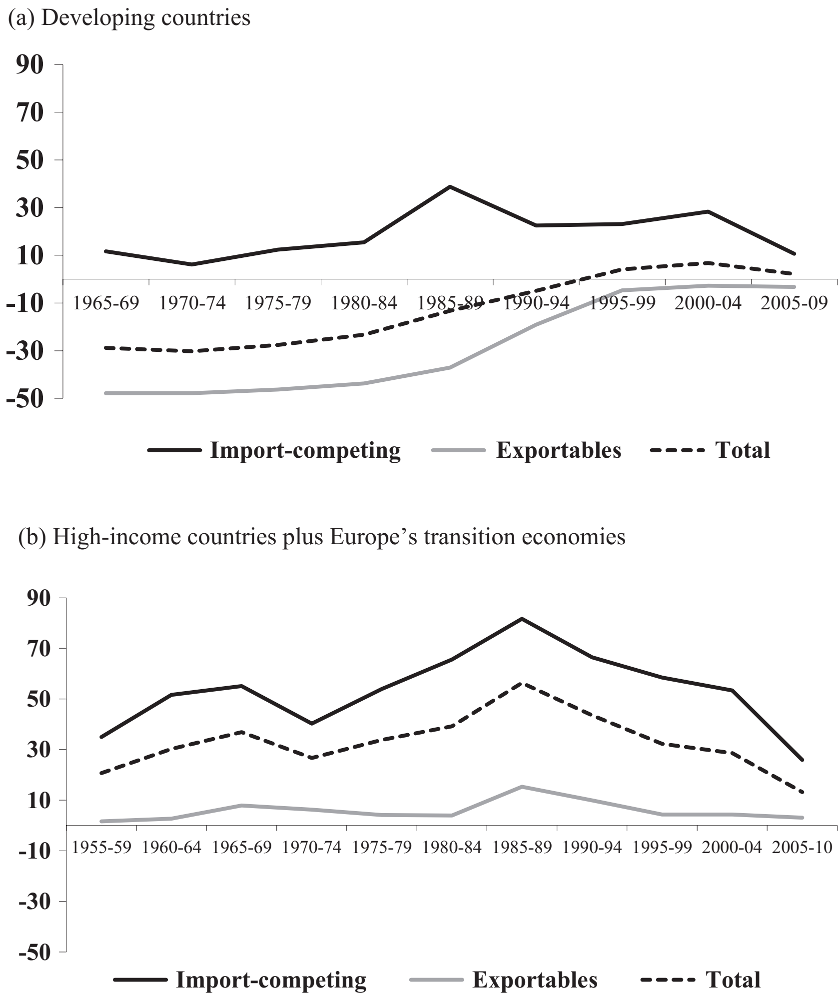


**Fig. 5.4** NRAs to exportable, import-competing, and all agricultural products in developing and high-income countries, 1955–2010 (%). (**a**) Developing countries. (**b**) High-income countries plus Europe's transition economies. Source: Anderson (2009, Chap. 1), updated using Anderson and Nelgen (2013)

## Empirical Estimates of Policies' Distortions to Prices: RRAs

The improvement in farmers' incentives in developing countries is understated by the above NRA estimates, because those countries also have reduced their assistance to producers of non-agricultural tradable goods, most notably manufactures. The decline in the weighted average NRA for manufacturers, depicted in Fig. 5.5, was greater than the increase in the average NRA for tradable agricultural sectors for the period to the mid-1980s, and both caused the estimated RRA to rise somewhat. For the period since the mid-1980s, changes in both sectors' NRAs have contributed almost equally to the further improvement in farmer incentives. The RRA for developing countries as a group went from minus 46 % in the second half of the 1970s to just above zero in the first decade of the present century. This increase (from a coefficient of 0.54 to 1.01) is equivalent to an almost doubling in the relative price of farm products, which is a huge change in the fortunes of developing country farmers in just one generation. China was among the key countries contributing to this major change and, in its case, reducing the overvaluation of its official exchange rate was an important part of its reform.[4] China's RRA rose from –61 % in 1981–84 to –31 % in 1990–94, 1 % in 2000–04, and 17 % in 2010–14. India's RRA similarly rose, albeit somewhat slower than China's, from –41 % in the 1970s to –12 % in the 1990s and 12 % in 2000–10. These are two of the most important developing economies to have policy regimes that have transitioned from taxing to subsidizing farmers relative to producers of other tradable products—but they are certainly not the only ones. Korea and Taiwan preceded them by a quarter century, and seven other developing countries monitored by the OECD also have reached the status of having an NRA at least half the current average for the OECD as a whole (Fig. 5.6).

Another way to illustrate the extent of the dramatic changes since the 1980s in RRAs is to show the changes in the proportions of the global farm population facing various RRAs (Fig. 5.7).

An attempt has been made by Anderson (2013) to extend the RRA series back to 1900 for today's high-income and developing countries (Table 5.2). Those estimates are mapped in Fig. 5.8 against the log of real per capita income (from Maddison, see Bolt and van Zanden 2014) for today's high-income countries and, from 1962, for today's developing countries. The latter group's observations are the three left-most dots in

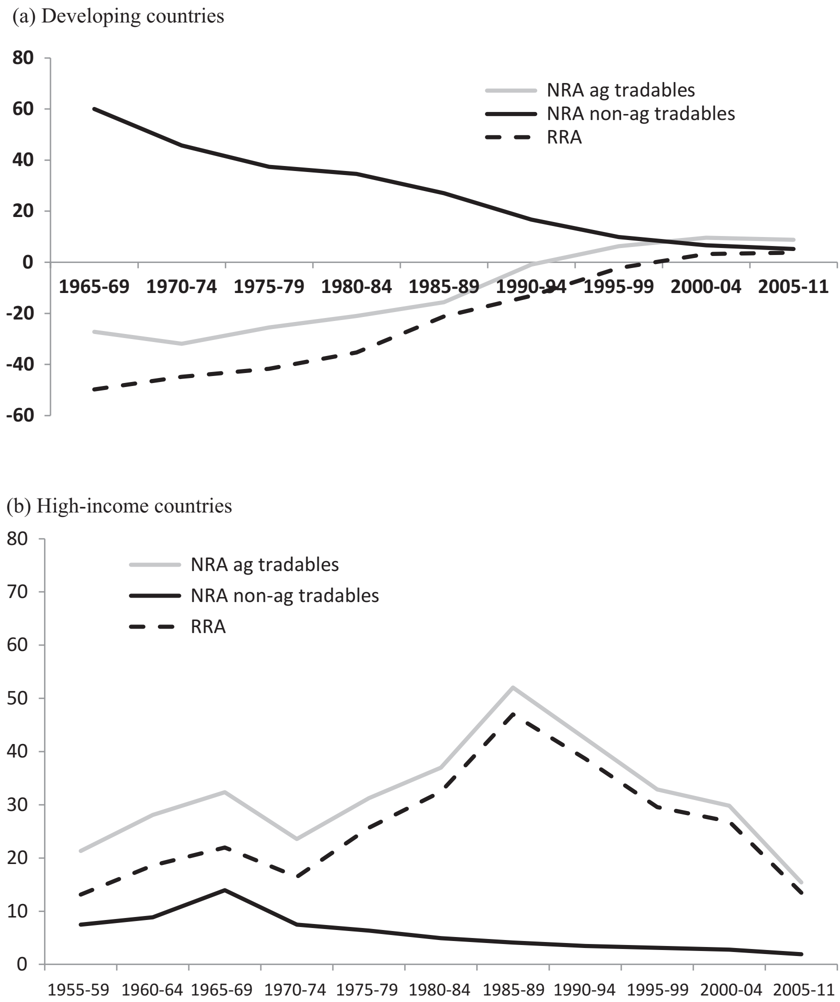


**Fig. 5.5** Developing and high-income countries' NRAs to agricultural and non-agricultural tradable sectors, and RRAs 1955–2011 (%). (**a**) Developing countries. (**b**) High-income countries. Source: Anderson (2009, Chap. 1), updated from estimates in Anderson and Nelgen (2013) (Five-year averages. Calculations use farm production-weighted averages across countries. RRA is defined as $100 \times [(100 + \text{NRAag}^t)/(100 + \text{NRAnonag}^t) - 1]$, where $\text{NRAag}^t$ and $\text{NRAnonag}^t$, respectively, are the NRAs for the tradable segments of the agricultural and non-agricultural sectors.)

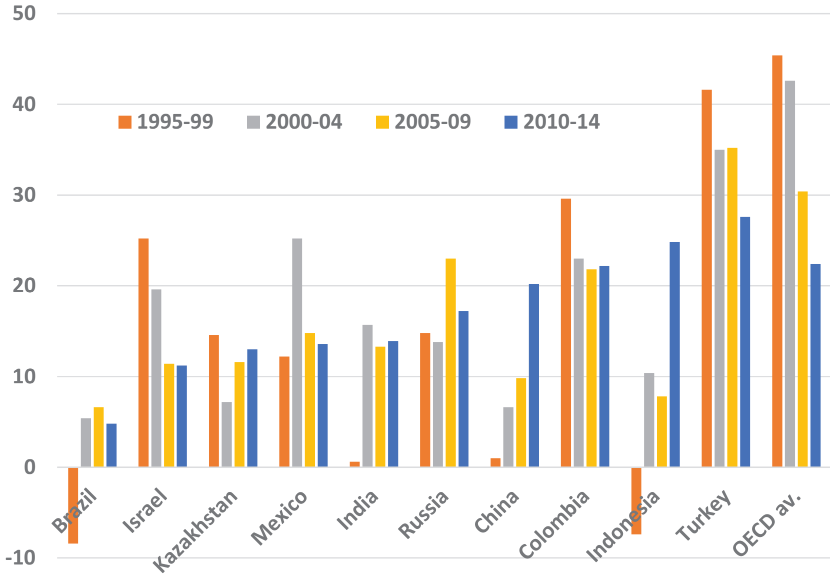


**Fig. 5.6** Nominal rates of assistance to agriculture in key emerging countries and the OECD, 1995–2014
*Source*: OECD (2015)
(The Indian estimates are from Anderson and Nelgen (2013) and its final period refers to just 2010. The *final bars* refer to the average NRA for all member countries of the OECD.) (%).

Fig. 5.8, suggesting that this group phased out its negative average RRA much faster, and at a much lower real per capita income level, than did today's high-income group (who did so in the latter 1930s).

## Empirical Estimates of Policies' Distortions to Prices: TRIs and WRIs

The averages hide the fact that there are still a wide range of NRAs across both countries and commodities (Fig. 5.9). Because the cost of government policy distortions in terms of resource misallocation within a country tend to be greater the greater the dispersion of commodity NRAs, it is informative to also report estimates of the TRI and WRI. The WRI recognizes that the welfare cost of a government-imposed price distortion is related to the square of the price wedge, and both indexes are appropriately

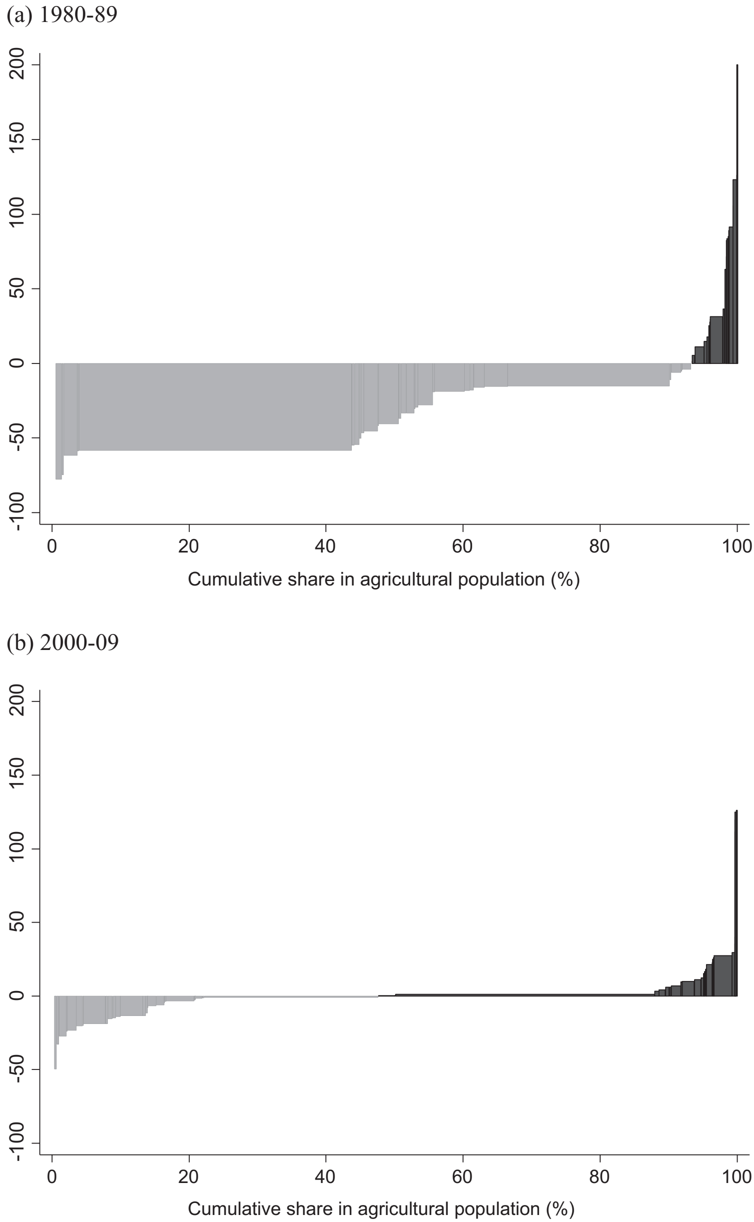


**Fig. 5.7** Proportions of global farm population facing various RRAs, 1980–89 and 2000–09. (**a**) 1980–89. (**b**) 2000–09. Source: Generated from estimates in Anderson and Nelgen (2013)

**Table 5.2** NRAs and RRAs, developing and high-income countries, 1900–2004 (%)

| | *1900* | *1925* | *1931* | *1937* | *1962* | *1982* | *2004* |
|---|---|---|---|---|---|---|---|
| *Developing countries* | | | | | | | |
| NRA agriculture | –15 | –15 | 5 | –14 | –24 | –21 | 9 |
| – Exportables | –20 | –20 | 0 | –20 | –47 | –41 | 0 |
| – Import-competing | 5 | 5 | 20 | 10 | 13 | 17 | 22 |
| NRA non-ag. tradables | 10 | 15 | 30 | 30 | 58 | 35 | 8 |
| **RRA** | **–23** | **–26** | **–19** | **–34** | **–52** | **–41** | **1** |
| *High-income countries*[a] | | | | | | | |
| NRA agriculture | 10 | 10 | 30 | 30 | 31 | 43 | 16 |
| – Exportables | 0 | 0 | 0 | 0 | 7 | 12 | 7 |
| – Import-competing | 15 | 15 | 50 | 45 | 46 | 58 | 22 |
| NRA non-ag. tradables | 30 | 23 | 37 | 21 | 11 | 3 | 1 |
| **RRA** | **–15** | **–11** | **–5** | **7** | **18** | **39** | **15** |

*Source*: Anderson (2013)

[a]High-income countries include Eastern Europe and the former Soviet Union (whose NRAs are assumed to equal the averages for other high-income countries)

positive regardless of whether the government's policy is favoring or hurting producers in a particular sector.

The cross-commodity variability of NRAs around the overall national sectoral average each year was no less in the most recent decade than it was in the three previous decades for both the developed and the developing country groups, suggesting that the reduction in the mean NRA has not been accompanied by a fall in the variance across commodities within the sector. This is why the WRI in Fig. 5.10a is still well above zero.

A crucial component of the NRAs' (and CTEs') commodity product dispersion is that the agricultural policy regime across countries still tends to have an anti-trade bias. This bias has declined over time for the developing country group, mainly because of declines in agricultural export taxation and in spite of growth in their agricultural import protection. For the high-income group, the anti-agricultural trade bias has also declined over time, despite a rise and then decline in agricultural export subsidies that offset slightly a similar trajectory in import protection. Hence, the inverted U-shaped trends in the TRI for both country groups reported in Fig. 5.10b.

These two indicators suggest that the adverse trade and welfare effects of agricultural policies of the mid-1980s have lessened since then, notwithstanding the large range of NRAs that Fig. 5.9 reveals still remain across

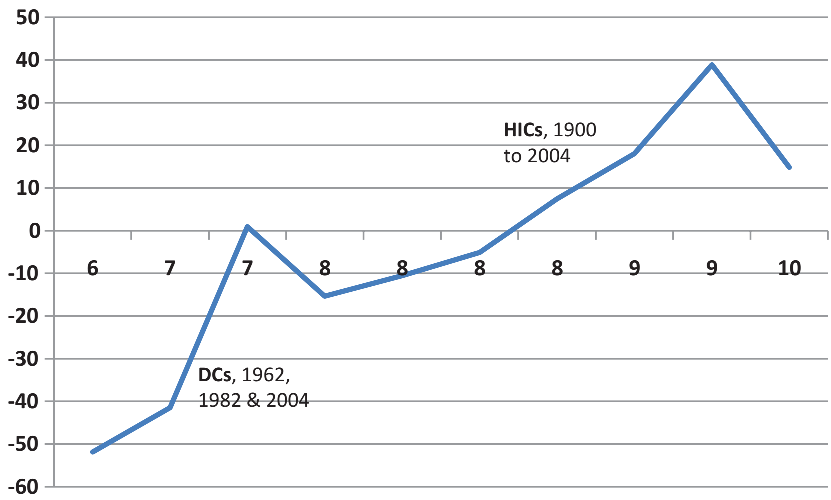


**Fig. 5.8** RRAs, high-income countries, 1900–2004, and developing countries, 1962–2004, mapped against log of real per capita income (%).
Source: Based on estimates in Anderson (2013)
(Real per capita income data, shown in natural logs on the horizontal axis, are from Maddison (see Bolt and van Zanden 2014).)

countries and commodities. But there have also been declines in manufacturing protectionism over the past few decades, as revealed in Fig. 5.5.

The WRI is also helpful in checking on the changing relative importance of various policy instruments. Among the trade-distorting policy instruments, it is clear from Fig. 5.11 how much export taxes have been phased out by developing countries while assistance to import-competing agricultural sub-sectors of developing countries has grown, according to the WRI estimates. Among the high-income countries, the growth of decoupled, more direct income-support measures in Western Europe means that region now has a far different pattern of assistance than that in Northeast Asia where border-measure supports continue to dominate (Fig. 5.12). That conclusion is also drawn from the OECD's PSE estimates, which contrast the relatively high proportion of support that is not directly market-distorting for US and Western European farmers versus the dominance of such measures in the so-called BRICS emerging economies (Fig. 5.13).

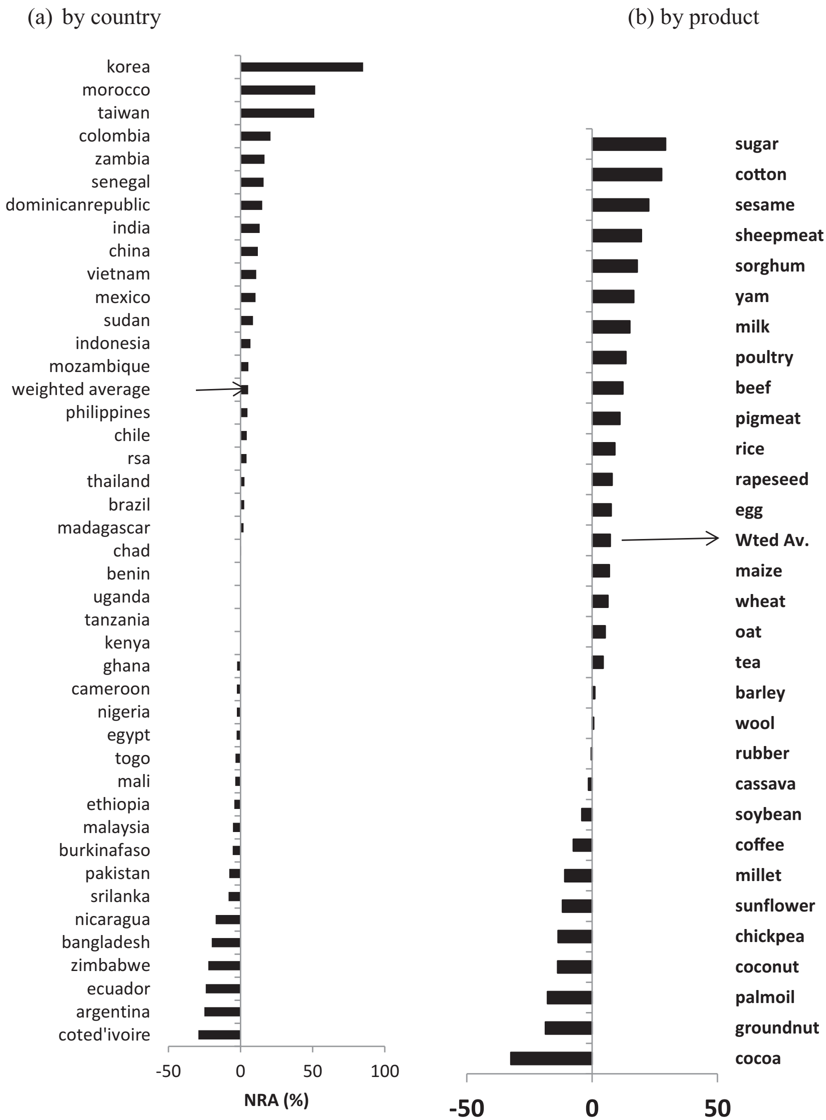


**Fig. 5.9** NRAs across developing countries and across products globally, 2005–10 (%). (**a**) By country. (**b**) By product. Source: Derived from estimates in Anderson and Nelgen (2013)

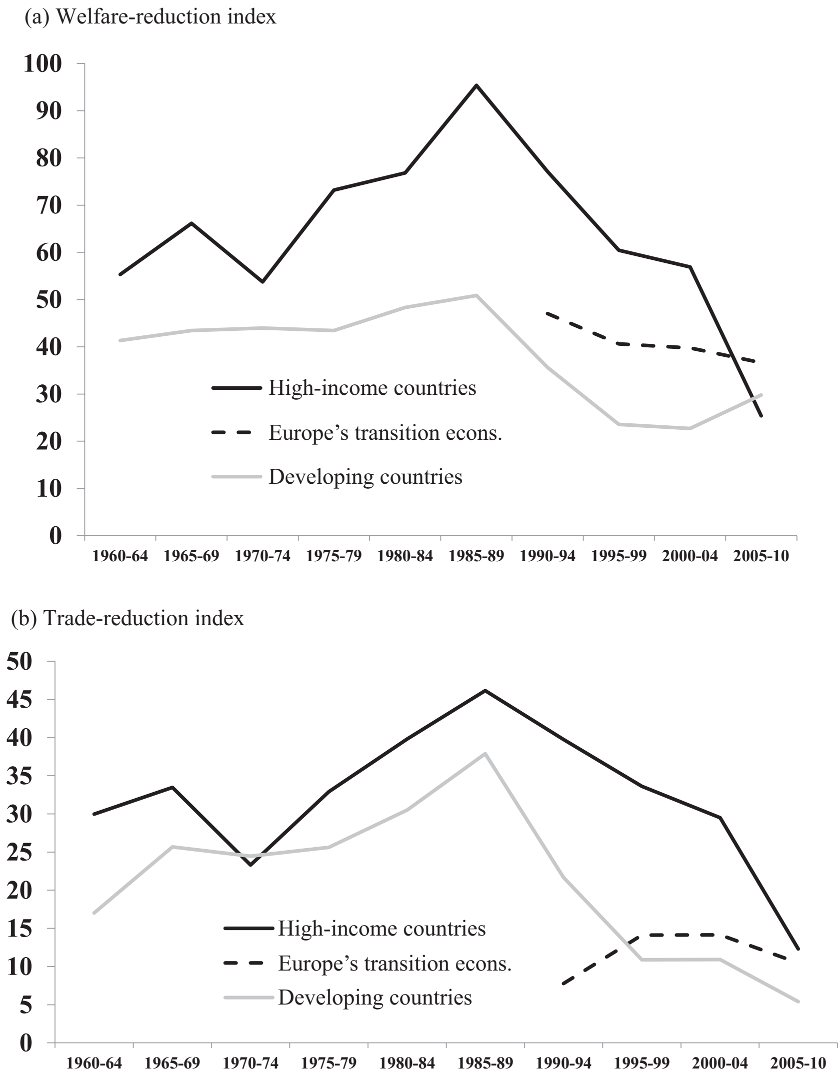


**Fig. 5.10** WRIs and TRIs among high-income, transition, and developing countries for tradable farm products, 1960–2010 (%). (**a**) Welfare reduction index. (**b**) Trade reduction index. Source: Lloyd, Croser, and Anderson (2010), updated from Anderson and Nelgen (2013)

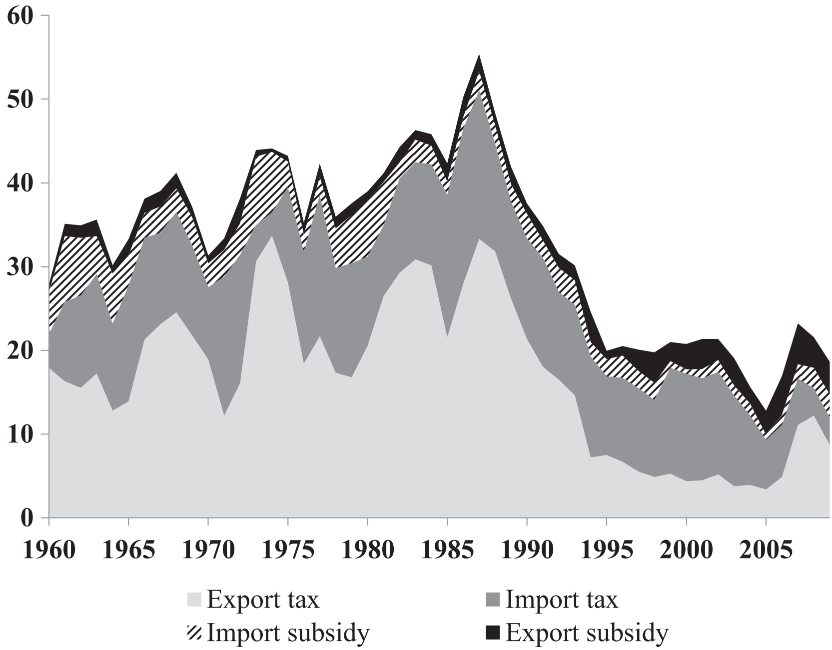


**Fig. 5.11** Contributions of various instruments to the border component of the WRI for developing countries, 1960–2009 (%). Source: Derived from estimates reported in Croser and Anderson (2011), updated using Anderson and Nelgen (2013)

Useful though the TRI and WRI estimates are as supplements to the NRA and RRA, a better feel for how much overall trade policy reform has taken place, relative to how much still remains to be done before markets are undistorted and economic welfare is not compromised, can be obtained from a global economy-wide model.[5] That is the focus of the next chapter.

## Key Messages

Agricultural protection and subsidies in high-income countries have been depressing international prices of farm products for many decades. As well as this external adverse influence on farm incomes elsewhere, governments of newly independent developing countries often directly taxed farm

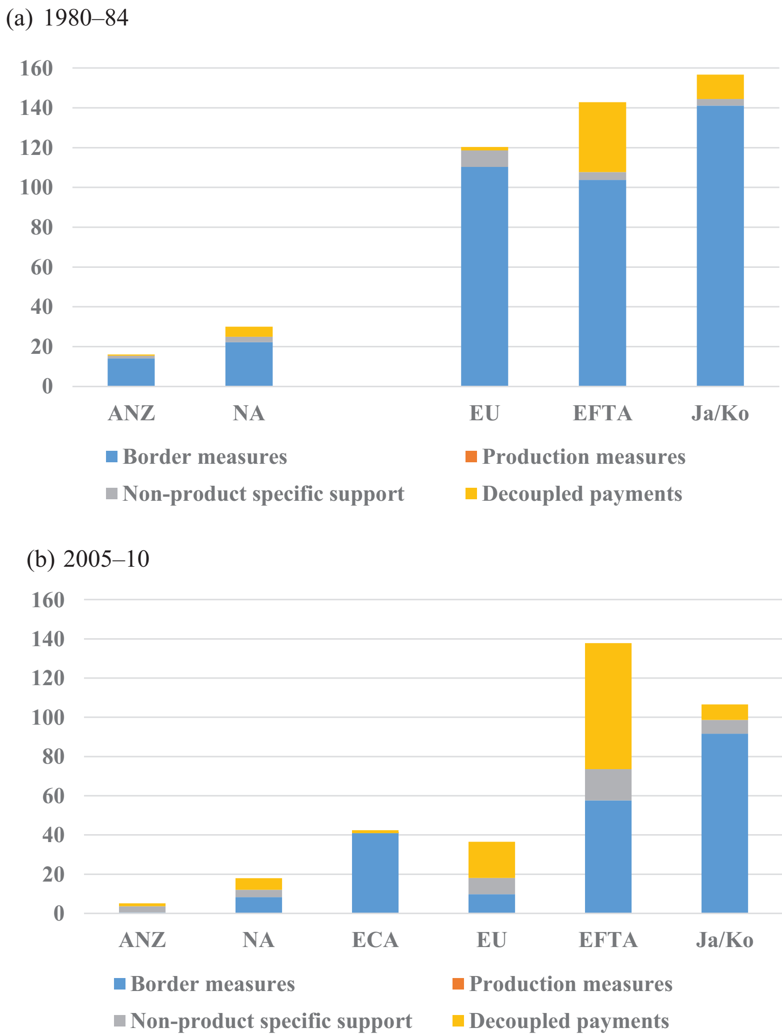


**Fig. 5.12** Contributions of various policy instruments to the producer component of the WRI, selected high-income and transition countries, 1980–84 and 2005–10 (%). (**a**) 1980–84. (**b**) 2005–10. Source: Croser and Anderson (2011), updated using Anderson and Nelgen (2013)

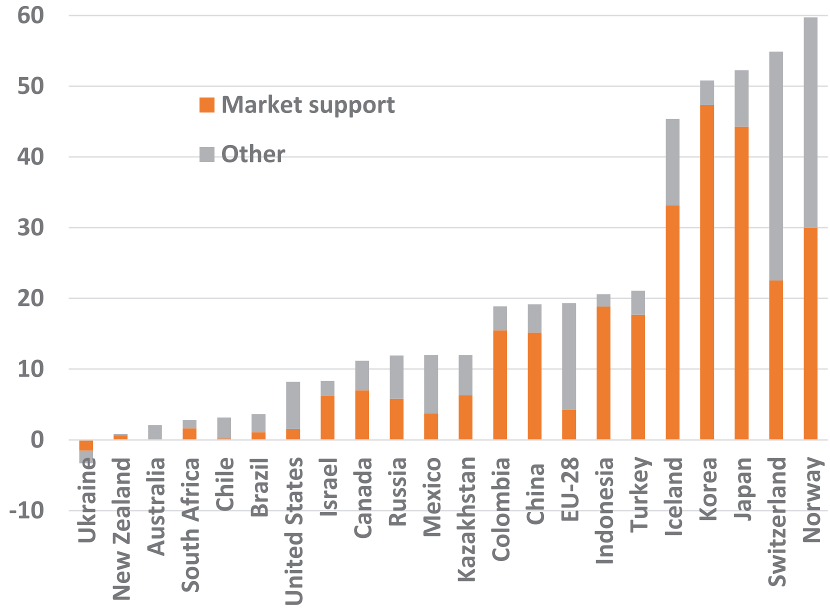


**Fig. 5.13** Contributions of market-distorting and other policy instruments to the producer support estimate (PSE), high-income and emerging countries, 2012–14 (%). Source: OECD (2015)

exports, as well as harming farmers indirectly with an industrialization strategy that involved restrictions on imports of manufactures and an overvalued currency. Since an important aspect of those price-distorting policies was their anti-trade bias, they reduced the quantity of farm products traded internationally. This meant that food prices have been more volatile in international markets than they otherwise would have been.

Since the mid-1980s, though, many developing country governments have been reforming their agricultural, trade and exchange rate policies, thereby reducing their anti-agricultural bias. Some high-income countries have reduced their farm price supports too. Associated with those policy reforms are reductions in the distortions to consumer prices of food products. When placed in historical perspective, the reforms since the mid-1980s are as dramatic as the policy changes in the preceding three decades.

Despite those policy reforms, however, the evidence shows that (a) both high-income and developing countries continue to insulate their domestic food markets from the full force of fluctuations in international prices, and (b) plenty of diversity in price distortions remains across countries, and across commodities within each country. In particular, export-focused farmers in developing countries are still discriminated against by farm policies in two respects: by the anti-trade structure of assistance that remains within their own agricultural sector, and by the assistance still afforded farmers in high-income countries. Hence a continuation of the reform process would boost farm trade, 'thicken' international food markets, and thus not only raise the average level but also lower the volatility of prices in those markets. It would also ensure that productive resources within the farm sector of each country would be put to their best use.

## Notes

1. It therefore takes account of not only trade taxes-cum-subsidies but also non-tariff measures (NTMs) that alter prices. Of course some of those NTMs, including domestic regulations and standards, may be introduced to overcome externalities and thus may raise rather than lower national welfare (Beghin et al. 2015; Swinnen et al. 2016). In such cases the NRA is an imperfect indicator of distortions, but these cases are expected to have only a very minor influence on the empirical trends reported below.
2. Since the 1980s, governments of some high-income countries have provided so-called 'decoupled' assistance to farmers too (Orden et al. 1999; Gardner 2002; Swinnen 2008; Josling and Tangermann 2015). However, because that support in principle does not distort resource allocation, its NRA has been computed separately and is not included in the World Bank study for direct comparison with the NRAs for other sectors or for developing countries.
3. Farmers are affected not just by prices of their own products but also by the incentives non-agricultural producers face. That is, it is *relative* prices and hence *relative* rates of government assistance that affect producer incentives. Eighty years ago, Lerner (1936) provided his Symmetry Theorem that proved that in a two-sector economy, an import tax has the same effect as an export tax. This carries over to a model that also includes a third sector producing only non-tradables (Vousden 1990).
4. In China, the distortion in the domestic market for foreign currencies was gradually reduced in an indirect way, by allowing exporters to sell an increasing share of their foreign currency earnings on a higher-priced secondary market that (unlike in many other countries with an overvalued currency) was legal. This lowered the trade tax equivalent of that distortion over time, and hence its impact on the NRA for farm and nonfarm sectors, depending

on the extent to which they were net-exporting or net-importing sectors. That currency market distortion made China's RRA estimates about one-fifth larger than they would have been in the mid-1980s, but that difference gradually fell to zero by the mid-1990s (Huang et al. 2009, Table 3.5).

5. One other common indicator of distortions to producer incentives is the effective rate of protection or, more generally, of assistance (ERA). Popularized by Balassa (1965) and Corden (1966), the ERA indicates the extent to which producer *value added* has been raised by national policies affecting both output and input prices, as distinct from the NRA, which indicates how much the *gross earnings* from production are raised by those policies. The ERA is still a partial equilibrium measure like the NRA though, and while it can give a better indication of resource misallocation than the NRA, it is not needed if one has access to a general equilibrium, economy-wide model.

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CHAPTER 6

# Estimating Trade, Welfare, and Poverty Effects of Trade Policy Reforms

With the estimates of the extent of distortions to agricultural incentives given in the previous chapter, it is possible to estimate the trade, welfare, and various other effects of price-distorting policies using economic models of markets. The capacity to do such modeling has evolved gradually and accelerated over the past two decades. This chapter begins by briefly surveying that methodological history. It then summarizes some results from modeling of the economic impact of the trade policy reforms between the early 1980s and 2004, by which time the Uruguay Round Agreements were fully implemented by World Trade Organization (WTO) members. The reforms over that quarter century were substantial. However, when compared with what could have happened if the price distortions of 2004 were removed, it is clear that—notwithstanding the enormity of reaching a historic multilateral agreement on agriculture during the Uruguay Round—national food markets were still far from being as open as markets for other primary products and manufactured goods. In addition to summarizing the trade and economic welfare effects of completing that trade reform process, the third section of the chapter also provides estimates of the possible effects on poverty levels, taking account of their impact on both the income and expenditure of poor households as food and other prices are changed.



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## History of Modeling Effects of Agricultural and Trade Policies

The simplest way of estimating the effects of distortions to agricultural incentives in national markets is to use single-product markets. This is a partial equilibrium (PE) model. If it involves several farm commodities whose markets interact, it is still partial in that it does not include the rest of the economy. Empirical models that are economy-wide are called computable general equilibrium (CGE) models. The genesis of both types is briefly summarized in this section, as a background to the rest of the chapter in which results from CGE models are presented to show the effects of (a) the trade-related policy reforms that were implemented over the two decades to 2004 and (b) remaining policies (by comparing actual markets in 2004 with those that would result from freeing up all merchandise trade regionally or globally).

### *Partial Equilibrium National and Global Models*

The national cost in terms of economic welfare of policies that distort domestic prices comprises a production component and a consumption component. In PE, they are the Harberger (1959) deadweight welfare cost triangles in a supply–demand diagram. This ignores the costs of lobbying for and then administering the policy and of 'leakages' in such forms as corruption at the customs post and smuggling in the case of trade policies. Empirical studies commonly assume that perfect competition and constant returns to scale operate, thereby under-estimating the cost of distortions in so far as imperfect competition and increasing returns are present. Nonetheless, this basic approach has been the workhorse of countless PE studies of the cost of price-distorting policies, and they have great appeal to the policy community. That appeal no doubt is partly because the approach is relatively easy to explain.

Corden (1957) developed what might be considered the first comprehensive methodology that, with the seminal paper by Johnson (1960), has provided the foundation for the subsequent empirical analysis of the economic welfare cost of distortions in both PE and general equilibrium. With the growth in computing power, the economics profession has been able to go well beyond measuring just the cost of policies. Single-commodity, single-country PE studies have been supplemented and often superseded by the development of multi-commodity industry or sectoral PE models of world markets and economy-wide single- or multi-country CGE models.

The impetus to generate better global models of agricultural markets came in the early 1980s as it became clear that agriculture was likely be included in a substantial way in the up-coming (Uruguay) round of multilateral trade negotiations—for the first since the General Agreement on Tariffs and Trade (GATT) began in the late 1940s (Josling et al. 1996). An early model by Valdes and Zietz (1980) of the International Food Policy Research Institute (IFPRI) was a direct application of the Corden/Harberger/Johnson PE methodology for a large number of agricultural products.[1] Each product market was considered independent of the others (zero cross-price elasticities). IFPRI has since replaced that with the multi-product IMPACT model (International Model for Policy Analysis of Agricultural Commodities and Trade), which has been gradually improved over the years and is now one of the most sophisticated multi-country PE models of the world's food markets. However, it only includes the net trade of each country and so does not provide bilateral trade details (Robinson et al. 2015).

Another model that took inter-dependence into account was developed by Tyers (1984) for the grain and meat markets and applied initially to analyze the European Community's Common Agricultural Policy (Anderson and Tyers 1984). That model was subsequently expanded to include the highly protected sugar and dairy sectors and became the basis for the empirical work reported in the World Bank's 1986 *World Development Report* in time for the launch of the Uruguay Round in September that year (Tyers and Anderson 1986).

Meanwhile, several international agencies and the US Department of Agriculture began building similar models.[2] However, they are mostly comparative static, deterministic, and with policies exogenously included. The Tyers' model, by contrast, is dynamic, stochastic, and with endogenous policies affecting domestic prices and stockholding. Being dynamic allowed it to trace the annual path of adjustment when projecting markets forward in time. Its stochastic feature allowed production uncertainty and hence price variability to be included via probability distributions associated with each commodity's production level. By including international-to-domestic price transmission elasticities, it is able to capture endogenously the insulation effect of agricultural trade policies, in addition to their protective effect. It also incorporates equations based on empirical analysis of stock-level responses to price and quantity changes in each country. Full details of the model, including the ways in which it captures the economic welfare consequences of shocks and its database and protection estimates, are provided in Tyers and Anderson (1992). An important conclusion from their study is that, had both high-income and developing countries moved to free trade in 1990, the average level of international food prices would have changed little (because of the offsetting effects of removing farm protectionism in high-income countries and agricultural export taxation in developing countries), but the variability of international food prices would be reduced by two-thirds (because of removing the very considerable insulating component of both country groups' policies).

Even though these models did not distinguish internationally traded products by the country of origin, as proposed by Armington (1969), they were very influential in raising public awareness during the Uruguay Round of the spillover effects of national agricultural policies on international food markets. Specifically, they provided explicit estimates of the impacts of growth of agricultural protection levels in the 1980s on the global food production, consumption, and trade, on the mean and variance of domestic and international food prices, and on national and global economic welfare (as measured by equivalent variations in income).

The estimated costs of protection as captured by those models was probably a reasonable economic welfare measure for high-income countries because agriculture is a small part of those economies (less than 3 % of GDP) and the distortions to their non-farm tradable sectors is small relative to those for agriculture. For poorer countries, however, agriculture is a much larger share of GDP and employment, and their industrial sectors are often highly protected from import competition. In such cases, a cut in low levels of agricultural protection could actually worsen national economic welfare, yet such PE models would suggest there would be an economic gain. Also, multilateral agricultural reform is not undertaken in isolation but—in the Uruguay Round at least—as part of a package of trade reforms affecting all sectors. For these reasons, global PE models began to be superseded from the early 1990s as CGE models became more disaggregated with the growth in capacity and speed of computers and in the quality of the required data. Even so, PE models remain in wide use when they contain detailed disaggregations of food markets by country, commodity, primary factors of production and intermediate inputs, as with IFPRI's IMPACT (Robinson et al. 2015).

### *National and Global CGE Models*

Economy-wide CGE models began appearing in the 1970s and were being used routinely for policy analysis in a number of high-income countries by the early 1980s. For example, building on Evans (1972) pioneering work, the first detailed model built for Australia, known as ORANI (Dixon et al. 1982), produced results for a wide range of policy issues and made a major impact on policy debate during Australia's dramatic microeconomic reform decade of the 1980s (Powell and Snape 1993). As noted in a number of literature surveys (Shoven and Whalley 1984, Robinson 1989 and Francois and Martin 2010), CGE models were also beginning to be built at that time for developing countries, an early example being Dervis et al. (1982). Since then, many of these national models have become far more sophisticated and, in particular, have added regional, occupational, and household disaggregations and become dynamic (as, e.g., in the transforming of the Australian ORANI model into the MONASH model—see Dixon and Rimmer 1998). The latter feature allows forecasting though time and hence can show paths of adjustment to shocks.

Global CGE models were slower in coming, since they require so much more data than national or regional models. Early examples are Whalley (1985) and Deardorff and Stern (1986, 1990), with the latter having more country and commodity details. Initial efforts to apply CGE models to agricultural protection issues are reported in Goldin and Knudsen (1990), but the quality of the models and applications rose dramatically over the 1990s. For example, the Australian Government's Industry Commission began building a global CGE model for trade negotiation purposes (the SALTER model—see Jomini et al. 1991). A copy of that model was taken to the Purdue University and, since the early 1990s, has been improving constantly and made publicly available as the so-called GTAP model and database (Global Trade Analysis Project—see Hertel 1997). The extraordinary efforts by Tom Hertel to train users and recruit willing helpers to revise and update the production, trade, and protection data and improve the theory in the model have resulted in hundreds of people becoming users and thousands of simulation experiments being published since its creation (see www.gtap.agecon.purdue.edu). That openness, which has been characteristic of some other CGE modeling groups too, has been a great spur to modeling innovations.

The basic GTAP model is similar in architecture to the Australian ORANI model, but more complex versions are being developed all the time.[3] Both are very consistent with the standard neoclassical trade theory, which is the basis of the predictions outlined in the section on Drivers of Agricultural Trade of Chap. 3 as to how trade patterns would be at any point in time. Trade and related policy analysis is now possible for any of the 140 countries or country groups in Version 9 of the GTAP model (calibrated to 2004, 2007, and 2011) and any of its 57 sectors of production (20 agricultural and processed food sectors, 22 other manufacturing sectors, and 15 services sectors). Since Armington elasticities are included, bilateral as well as total trade effects can be explored. This enables far more sophisticated analyses of bilateral, regional, and multilateral trade negotiations than was possible when the GATT's Uruguay Round got under way in the late 1980s.

GTAP is of course not the only such global CGE model, but it is certainly the most widely used. Others were also used in the *ex post* analysis of the Uruguay Round (see the various chapters in Martin and Winters 1996) and are being used for *ex ante* analyses of WTO trade negotiations and the numerous bilateral and other preferential free-trade-area proposals that have become fashionable again in recent years.[4] The one used for many years at the World Bank, the LINKAGE model (van der Mensbrugghe 2005), is a close relative of the GTAP model. Since the results reported in the next section of this chapter come from that model, its features are worth elaborating here by way of example.[5]

### *The Global LINKAGE Model*

The LINKAGE model is a relatively straightforward CGE model but with some characteristics that distinguish it from other comparative static models such as the GTAP model. Factor stocks are fixed, which means that the extent of unemployment (if any) in the baseline remains unchanged in the case of labor. Producers minimize costs subject to constant returns to scale production technology, consumers maximize utility, and all markets—including for labor—are cleared with flexible prices. There are three types of production structures. Crop sectors reflect the substitution possibilities between extensive and intensive farming; livestock sectors reflect the substitution possibilities between pasture and intensive feeding; and all other sectors reflect standard capital/labor substitution. There are two types of labor, skilled and unskilled, and the total employment of each is assumed fixed (so no change in baseline unemployment levels). There is a single representative household per modeled region, allocating income to consumption using the extended linear expenditure system. Trade is modeled using a nested Armington structure in which aggregate import demand is the outcome of allocating domestic absorption between domestic goods and aggregate imports, and then aggregate import demand is allocated across source countries to determine the bilateral trade flows.

Government fiscal balances are fixed in US dollar terms, with the fiscal objective being met by changing the level of lump-sum taxes on households. This implies that losses of tariff revenues are replaced by higher direct taxes on households. The current account balance also is fixed. Given that other external financial flows are fixed, this implies that *ex ante* changes to the trade balance are reflected in *ex post* changes to the real exchange rate. For example, if import tariffs are reduced, the propensity to import increases and additional imports are financed by increasing export revenues. The latter typically is achieved by a depreciation of the real exchange rate. Finally, investment is driven by savings. With fixed public and foreign saving, investment comes from both changes in the savings behavior of households and changes in the unit cost of investment. The model only solves for relative prices, with the numéraire, or price anchor, being the export price index of manufactured exports from high-income countries. This price is fixed at unity in the base year.

The GTAP database, which is used in this model, includes bilateral tariffs that capture not only reciprocal but also non-reciprocal preferential trade agreements, the latter providing low-income exporting countries with duty-free access to protected markets of high-income countries. This allows the user to take into account the fact that future reform may cause a decline in the international terms of trade for those developing countries that are enjoying preferential access to agricultural and other markets of high-income countries (in addition to those that are net food importers because their comparative advantage is in other sectors such as labor-intensive manufacturing).

The version of the LINKAGE model used in the next section is based on an aggregation involving 24 sectors and 52 regions spanning the world. There is an emphasis on agriculture and food, which comprise half of those 24 sectors. Note that, consistent with the WTO, Korea and Taiwan are included in the 'developing country' category.[6]

## National and Global Effects of Policy Reforms Since the Early 1980s

How different would the world have been if changes in the agricultural and merchandise trade policies and in farm subsidies globally since 1980–84 had not happened? To answer that question, Valenzuela, van der Mensbrugghe and Anderson (2009) used the LINKAGE model with its

2004 calibration of world markets after adapting its protection structure so that its distortions to agricultural incentives matched those for 2004 as compiled by Anderson and Valenzuela (2008). That baseline of the world economy is then compared with a scenario in which 1980–84 distortion rates replace those for 2004. The 2004 base for this study is pertinent because that was the last year of implementation of the GATT's Uruguay Round Agreements and just before international food and energy prices started rising above their long-run trend and trade policy responses began to kick in (analysis of which is postponed to Chap. 8).

The price distortions of those two periods are summarized in Table 6.1. For high-income countries, all three elements of agricultural support as well as tariffs on non-farm products fell over those two decades. For developing countries, the changes are more mixed: taxes on farm production and exports were mostly removed, tariffs on non-farm goods were reduced, but tariffs on food imports rose by one-third on average. Clearly, a model is required to estimate the net effects of such complex changes, particularly because they vary considerably across regions.

**Table 6.1** Structure of price distortions in global goods markets, 1980–84 and 2004 (%)

| | *1980–84* | | | | *2004* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Primary agriculture and lightly processed food* | | | *Other goods* | *Primary agriculture and lightly processed food* | | | *Other goods* |
| | *Domestic support* | *Export subsidy* | *Tariff* | *Tariff* | *Domestic support* | *Export subsidy* | *Tariff* | *Tariff* |
| **High-income countries** | **6.6** | **20.9** | **24.0** | **2.4** | **2.6** | **7.2** | **22.3** | **1.2** |
| **Developing countries** | **–0.6** | **–11.0** | 16.4 | **25.6** | **1.4** | **0.0** | **21.8** | **7.5** |
| Africa | –0.3 | –2.5 | 17.0 | 12.6 | –0.8 | 0.1 | 20.4 | 11.2 |
| East Asia | –5.6 | –21.5 | 24.3 | 29.6 | –0.3 | 0.0 | 41.6 | 6.7 |
| South Asia | 3.5 | –7.1 | 10.7 | 72.6 | 7.2 | 1.7 | 6.9 | 20.2 |
| Latin America | 3.8 | –9.6 | 9.8 | 15.7 | –0.2 | –1.4 | 7.2 | 6.7 |
| Eastern Europe and Central Asia | 0.8 | –2.6 | 13.8 | 9.6 | 0.8 | –0.3 | 15.9 | 4.8 |

*Source*: Valenzuela et al. (2009)

The effects of partially liberalizing high-income countries' agricultural policies and reducing the anti-agricultural and anti-farm trade policy biases in developing countries over the two decades to 2004 are examined simultaneously. The comparison is shown without and with liberalization also of non-agricultural trade policies to sense the relative contribution of the latter. The results begin with global and national economic welfare effects, then changes in the terms of trade, adjustments to quantities produced and traded, effects on factor rewards, and then percentage changes to agricultural value added (net farm income) relative to value added in the rest of the economy.

### *Global and National Economic Welfare*

The LINKAGE model results suggest that, without the policy reforms over the preceding two decades, the world in 2004 would have been worse off by US$233 billion per year. (All results in this chapter are in 2004 US dollars.) The distribution across regions of that change in economic welfare (or equivalent variation in income), reported in Table 6.2, suggests

**Table 6.2** Economic welfare impact of going back to 1980–84 policies, by country/region (relative to the 2004 benchmark, in 2004 US dollars and %)

| | *Total real income gain p.a. (US$ billion)* | *Change in income due just to change in terms of trade (US$ billion)* | *Total real income gain as percentage of 2004 benchmark*[a] | |
|---|---|---|---|---|
| **Developing countries** | **–73.1** | **49.3** | **–1.0** | **(0.7)** |
| North Africa | 0.6 | 0.1 | 0.3 | (0.0) |
| Sub-Saharan Africa | –3.4 | 1.7 | –1.0 | (0.5) |
| East Asia | –61.5 | 19.9 | –2.2 | (0.7) |
| South Asia | –10.8 | 6.5 | –1.7 | (1.0) |
| Latin America | –7.1 | 13.7 | –0.4 | (0.8) |
| Middle East | 2.6 | 0.4 | 0.5 | (0.1) |
| Eastern Europe and Central Asia | 6.5 | 7.1 | 0.5 | (0.6) |
| **High-income countries** | **–159.9** | **–50.8** | **–0.7** | **(–0.2)** |
| **World total** | **–233.0** | **–1.5** | **–0.8** | **(0.0)** |

Source: Valenzuela et al. (2009)

[a]Numbers in parentheses refer to that due to terms of trade effects

two-thirds of those dollars accrued to high-income countries. However, as a share of national income, developing countries gained more, with an average increase of 1.0 % compared with 0.7 % for high-income countries. The results vary across developing countries, ranging from slight losses in a few cases to large proportional increases in such cases as China, Mozambique, and Nigeria.

The right-hand pair of columns in Table 6.2 shows the amount of that welfare gain due to changes in the international terms of trade for each country. For developing countries as a group, the terms of trade effect is adverse, while the opposite is the case for high-income countries. Nonetheless, even though those terms of trade changes reduced their gains from improved efficiency of domestic resource use, developing country economies benefited proportionately more than high-income economies from those policy reforms in the two decades to 2004.

### *Decomposing the Contribution to Welfare of Changes in National Terms of Trade*

To understand the contribution to welfare of the changes in international terms of trade shown in Table 6.2, it is necessary to first examine the changes in import and export prices for farm and other products. For developing countries as a group, their terms of trade have worsened because of these reforms for two sets of reasons: their export prices have been lowered by 0.4 % for non-agricultural goods, while their import prices have hardly been affected; and their lowered export prices (0.6 %) for farm products have been compounded by 16 % higher prices for their agricultural and food imports. The net effect is a deterioration of 1.7 % in their terms of trade. By contrast, high-income countries enjoyed an improvement of 0.8 % in their terms of trade as a result of the policy changes, partly from non-farm products but mostly from farm products, where the improvement in their export prices more than offset the higher prices of their imports (Table 6.3).

### *Quantities Produced and Traded*

The retrospective results suggest that, as a result of the reforms of the past two decades, the developing countries' aggregate shares of global output and exports of textiles and apparel have grown by about 3 percentage points, while the shares for other non-farm products have changed by

**Table 6.3** Impact of going back to 1980–84 policies on indexes of real[a] export and import prices, by region (%)

| | *% change in export prices* | | | *% change in import prices* | | | *% change in terms of trade* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Agriculture* | *Manuf.* | *Total* | *Agriculture* | *Manuf.* | *Total* | *Agriculture* | *Manuf.* | *Total* |
| **Developing countries** | **0.6** | **0.4** | **0.4** | **–15.7** | **0.0** | **–1.3** | **16.3** | **0.4** | **1.7** |
| North Africa | 1.6 | 0.5 | 0.6 | –9.2 | 0.5 | –0.9 | 10.7 | 0.1 | 1.5 |
| Sub-Saharan Africa | –12.8 | –0.5 | –2.1 | –18.7 | 0.3 | –1.8 | 5.9 | –0.8 | –0.3 |
| East Asia | –1.8 | 0.2 | 0.2 | –7.1 | –0.6 | –1.1 | 5.4 | 0.8 | 1.3 |
| South Asia | 6.6 | 5.5 | 5.6 | –6.8 | 0.1 | –0.8 | 13.4 | 5.5 | 6.4 |
| Latin America | 5.4 | 0.5 | 1.1 | –12.1 | 0.4 | –0.5 | 17.5 | 0.2 | 1.6 |
| Middle East | –2.2 | –0.6 | –0.7 | –25.6 | 0.3 | –2.6 | 23.4 | –0.9 | 1.9 |
| Eastern Europe and Central Asia | 3.9 | 0.4 | 0.6 | –28.6 | 0.5 | –1.8 | 32.5 | –0.1 | 2.4 |
| **High-income countries** | **–24.0** | **0.2** | **–1.7** | **–17.9** | **0.4** | **–0.8** | **–6.2** | **–0.2** | **–0.8** |
| **World total** | **–17.6** | **0.3** | **–1.0** | **–17.0** | **0.3** | **–1.0** | **–0.6** | **0.0** | **0.0** |

*Source*: Valenzuela et al. (2009)

[a]Relative to the numeraire which in this version of the LINKAGE model is the price of high-income countries' exports of manufactures

no more than 1 percentage point. Their shares in agricultural and food markets, however, have changed more: their share of the world's primary agricultural exports has risen from 43 to 55 % and the output share from 58 to 62 %; even their shares of processed foods have risen by 1 percentage point. The rises have occurred in nearly all agricultural industries, the exceptions being rice and sugar, where the growth in protectionism in high-income countries has been greatest.

The share of global production of farm products that are exported (excluding intra–European Union (EU) trade) is slightly smaller as a result of the reforms, in contrast to the 5 percentage point rise for textiles and clothing and the 3 point rise for other manufactures. Agriculture's 8 % share in 2004 remains in stark contrast to the 31 % share for other primary products and to around 25 % for all other goods (first columns of Table 6.4). This 'thinness' is an important contributor to the volatility of international prices for these weather-dependent farm products.

The fact that the past two decades of reform have not made agricultural production more traded globally is illuminating. The findings summarized in Chap. 5 show that the reforms in developing and high-income countries over the past two decades reduced the anti-trade bias in the agricultural trade of developing countries but increased that bias in high-income countries (thanks in part to the cut in their export subsidies). According to this LINKAGE model result, the latter slightly more than offset the former in terms of their aggregate impact on the global share of farm production that is traded.

The impacts on agricultural and food output and trade for various countries and regions imply that farm trade would have been two-thirds bigger in real value terms had the past two decades of reform not occurred. On the export side, that is almost entirely due to high-income countries, whose exports would have been more than twice as large had they not lowered their export subsidies and developing countries not lowered their export taxes (column 5 of Table 6.5). The global value of agricultural and food output, however, is virtually unchanged (just 3.6 % less). This suggests that, in aggregate, the reform-induced output decline of high-income countries (11 %) more than fully offsets the reform-induced output expansion of developing countries (3 %). The big economies of East and South Asia, as well as Latin America, all enjoyed increased farm output because of the past quarter-century's reforms. In real value terms, developing countries as a group would have had to import 50 % more

**Table 6.4** Impact of going back to 1980–84 policies on shares of global output exported, and developing country shares of global output and exports, by product (%)

| | *Share of global output exported*[a] | | *Developing countries' share of global output* | | *Developing countries' share of global exports*[a] | |
|---|---|---|---|---|---|---|
| | *Benchmark* | *1980–84* | *Benchmark* | *1980–84* | *Benchmark* | *1980–84* |
| Paddy rice | 1 | 2 | 81 | 85 | 56 | 21 |
| Wheat | 16 | 19 | 67 | 56 | 25 | 10 |
| Other grains | 11 | 14 | 55 | 45 | 35 | 17 |
| Oil seeds | 21 | 23 | 69 | 60 | 54 | 34 |
| Plant-based fibers | 25 | 44 | 74 | 72 | 50 | 72 |
| Vegetables and fruits | 9 | 8 | 72 | 69 | 69 | 56 |
| Other crops | 14 | 12 | 49 | 45 | 75 | 62 |
| Cattle, sheep, etc. | 2 | 2 | 43 | 41 | 56 | 53 |
| Other livestock | 4 | 6 | 65 | 57 | 43 | 41 |
| Wool | 13 | 14 | 82 | 80 | 16 | 14 |
| Beef and sheep meat | 7 | 6 | 27 | 26 | 31 | 24 |
| Other meat products | 7 | 10 | 32 | 21 | 42 | 2 |
| Vegetable oils and fats | 20 | 19 | 52 | 49 | 80 | 73 |
| Dairy products | 5 | 8 | 29 | 31 | 28 | 54 |
| Processed rice | 5 | 6 | 76 | 79 | 85 | 60 |
| Refined sugar | 8 | 22 | 52 | 69 | 78 | 95 |
| Other food, beverages, and tobacco | 9 | 7 | 35 | 35 | 50 | 54 |
| Other primary products | 31 | 30 | 64 | 65 | 76 | 78 |
| Textile and wearing apparel | 28 | 23 | 53 | 50 | 74 | 71 |
| Other manufacturing | 24 | 21 | 32 | 33 | 43 | 42 |
| Services | 3 | 3 | 20 | 20 | 31 | 31 |
| Agriculture and food | 8 | 9 | 46 | 44 | 54 | 48 |
| Primary agriculture | 8 | 9 | 62 | 58 | 55 | 43 |
| Processed foods | 8 | 9 | 37 | 36 | 52 | 51 |

*Source*: Valenzuela et al. (2009)

[a]Excluding intra-EU trade

farm products in 2004 had the reforms not taken place over those two decades, while high-income countries would have had to import nearly 80 % more (last column of Table 6.5).

Combined with the export effects, that means the food and agricultural self-sufficiency ratio would have been very slightly lower in developing countries and slightly higher in high-income countries (Table 6.6). The extent of this reform on the tradability of different products is shown in Table 6.7. Sugar, milk products, and cotton would have been exported more from developing to high-income countries had the latter group's assistance to those industries not grown over the past two decades.

The net consequences of these impacts on the share of farm production exported by regions are shown in Table 6.8. For developing countries as a group, there is no change in its 9.5 % share, while the share for high-income countries is reduced by 3 percentage points, by their export subsidy cuts and other reforms, to 13 % (including intra-EU trade).

### *Product Prices*

How did different agricultural and manufacturing goods' average prices in international markets change with liberalization of distortionary

**Table 6.5** Impact of going back to 1980–84 policies on agricultural and food output and trade, by country/region (relative to benchmark data, in 2004 billion US dollars and %)

| | *US$ billion* | | | *% change relative to baseline* | | |
|---|---|---|---|---|---|---|
| | *Output* | *Exports* | *Imports* | *Output* | *Exports* | *Imports* |
| **Developing countries** | **–62.8** | **8.1** | **80.5** | **–3.2** | **4.9** | **50.3** |
| North Africa | –0.4 | 1.2 | 2.1 | –0.7 | 35.2 | 21.4 |
| Sub-Saharan Africa | 5.5 | 2.7 | 5.9 | 4.3 | 15.5 | 50.0 |
| East Asia | –34.0 | –0.1 | 28.4 | –5.4 | –0.2 | 51.2 |
| South Asia | –8.4 | –3.8 | 1.4 | –2.8 | –41.2 | 12.3 |
| Latin America | –22.5 | –13.8 | 6.5 | –6.9 | –20.6 | 26.8 |
| Middle East | 7.3 | 10.3 | 12.2 | 7.1 | 154.2 | 58.6 |
| Eastern Europe and Central Asia | –10.3 | 11.6 | 23.9 | –2.6 | 53.4 | 91.6 |
| **High-income countries** | **195.8** | **256.1** | **183.7** | **11.0** | **110.8** | **78.3** |
| **World total[a]** | **133.0** | **264.2** | **264.2** | **3.6** | **66.9** | **66.9** |

Source: Valenzuela et al. (2009)

[a]Excluding in tra-EU trade

**Table 6.6** Impact of going back to 1980–84 policies on self-sufficiency[a] in agricultural and other products, by region (%)

| | *High-income countries* | | *Developing countries* | | *Africa* | | *Latin America* | | *East Asia* | | *South Asia* | | *Eastern Europe and Central Asia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* |
| Paddy rice | 101 | 108 | 100 | 99 | 97 | 96 | 93 | 79 | 100 | 100 | 101 | 100 | 95 | 94 |
| Wheat | 141 | 190 | 88 | 79 | 67 | 61 | 80 | 59 | 68 | 43 | 100 | 98 | 102 | 96 |
| Other grains | 108 | 124 | 94 | 88 | 94 | 97 | 98 | 100 | 88 | 76 | 103 | 103 | 103 | 95 |
| Oil seeds | 104 | 124 | 97 | 88 | 104 | 102 | 140 | 110 | 66 | 64 | 100 | 99 | 106 | 103 |
| Plant-based fibers | 161 | 168 | 88 | 83 | 177 | 141 | 94 | 78 | 54 | 11 | 93 | 91 | 104 | 243 |
| Vegetables and fruits | 90 | 94 | 105 | 103 | 108 | 107 | 153 | 134 | 102 | 100 | 99 | 100 | 99 | 98 |
| Other crops | 90 | 94 | 113 | 107 | 138 | 115 | 143 | 122 | 110 | 115 | 104 | 103 | 90 | 91 |
| Cattle, sheep, etc. | 100 | 100 | 100 | 100 | 101 | 101 | 102 | 101 | 98 | 97 | 100 | 100 | 102 | 103 |
| Other livestock | 101 | 98 | 100 | 102 | 101 | 103 | 101 | 104 | 99 | 99 | 100 | 100 | 99 | 106 |
| Wool | 161 | 167 | 92 | 91 | 103 | 103 | 103 | 102 | 78 | 74 | 96 | 95 | 96 | 96 |
| Beef and sheep meat | 101 | 106 | 97 | 95 | 96 | 94 | 108 | 104 | 83 | 86 | 126 | 110 | 95 | 89 |
| Other meat products | 100 | 149 | 100 | 82 | 92 | 74 | 121 | 83 | 101 | 92 | 96 | 91 | 96 | 74 |
| Vegetable oils & fats | 95 | 100 | 103 | 100 | 69 | 86 | 141 | 115 | 115 | 116 | 78 | 73 | 93 | 92 |
| Dairy products | 103 | 101 | 94 | 102 | 76 | 80 | 97 | 100 | 78 | 77 | 99 | 99 | 102 | 109 |
| Processed rice | 99 | 104 | 100 | 99 | 69 | 72 | 94 | 89 | 104 | 104 | 104 | 100 | 92 | 94 |
| Refined sugar | 98 | 69 | 102 | 130 | 95 | 173 | 131 | 239 | 98 | 103 | 96 | 92 | 98 | 96 |
| Other food, beverages, and tobacco | 99 | 99 | 103 | 103 | 101 | 100 | 108 | 107 | 105 | 107 | 106 | 104 | 100 | 100 |
| Other primary products | 76 | 74 | 122 | 123 | 180 | 181 | 148 | 152 | 84 | 85 | 75 | 88 | 115 | 116 |
| Textile and clothing | 81 | 86 | 123 | 119 | 98 | 104 | 104 | 106 | 144 | 134 | 144 | 129 | 101 | 105 |
| Other manufacturing | 101 | 100 | 98 | 99 | 77 | 77 | 96 | 97 | 106 | 107 | 90 | 95 | 95 | 94 |

*(continued)*

**Table 6.6** (continued)

| | *High-income countries* | | *Developing countries* | | *Africa* | | *Latin America* | | *East Asia* | | *South Asia* | | *Eastern Europe and Central Asia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* | *2004 benchmark policies* | *1980–84* |
| Services | 101 | 101 | 101 | 100 | 101 | 101 | 100 | 100 | 101 | 101 | 100 | 99 | 101 | 101 |
| Agriculture and food | 100 | 104 | 101 | 100 | 100 | 100 | 112 | 109 | 100 | 97 | 100 | 99 | 99 | 99 |

Source: Valenzuela et al. (2009)

[a]Self-sufficiency is defined as domestic production as a percentage of domestic consumption measured in value terms at f.o.b. prices

**Table 6.7** Impact of going back to 1980–84 policies on shares of production exported and of consumption imported, by product (%)

| | *Share of production exported* | | | | *Share of consumption imported* | | | |
|---|---|---|---|---|---|---|---|---|
| | *High-income countries*[a] | | *Developing countries* | | *High-income countries*[a] | | *Developing countries* | |
| | *2004 benchmark* | *1980–84* | *2004 benchmark* | *1980–84* | *2004 benchmark* | *1980–84* | *2004 benchmark* | *1980–84* |
| Paddy rice | 3 | 10 | 1 | 0 | 2 | 4 | 1 | 2 |
| Wheat | 37 | 40 | 6 | 3 | 11 | 10 | 17 | 22 |
| Other grains | 15 | 21 | 7 | 5 | 9 | 13 | 11 | 16 |
| Oil seeds | 31 | 37 | 16 | 13 | 26 | 22 | 16 | 21 |
| Plant-based fibers | 50 | 45 | 17 | 44 | 18 | 18 | 26 | 59 |
| Vegetables and fruits | 10 | 12 | 9 | 7 | 18 | 16 | 4 | 4 |
| Other crops | 7 | 8 | 21 | 16 | 16 | 13 | 11 | 10 |
| Cattle, sheep, etc. | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Other livestock | 6 | 8 | 3 | 4 | 6 | 9 | 3 | 3 |
| Wool | 60 | 59 | 2 | 2 | 35 | 36 | 10 | 11 |
| Beef and sheep meat | 6 | 6 | 7 | 5 | 5 | 4 | 10 | 11 |
| Other meat products | 6 | 13 | 9 | 1 | 6 | 10 | 8 | 18 |
| Vegetable oils and fats | 8 | 10 | 31 | 29 | 12 | 11 | 26 | 27 |
| Dairy products | 5 | 6 | 4 | 14 | 2 | 7 | 10 | 12 |
| Processed rice | 3 | 11 | 5 | 5 | 4 | 9 | 5 | 5 |
| Refined sugar | 4 | 4 | 12 | 30 | 5 | 33 | 10 | 13 |
| Other food, beverages, and tobacco | 7 | 5 | 12 | 11 | 8 | 6 | 9 | 8 |
| Other primary products | 20 | 18 | 37 | 36 | 38 | 39 | 22 | 20 |
| Textile and wearing apparel | 15 | 13 | 39 | 33 | 30 | 25 | 23 | 19 |
| Other manufacturing | 20 | 18 | 32 | 27 | 19 | 18 | 32 | 27 |
| Services | 3 | 3 | 5 | 5 | 2 | 2 | 5 | 5 |
| Agriculture and food | 7 | 8 | 9 | 10 | 8 | 8 | 8 | 10 |

*Source*: Valenzuela et al. (2009)

[a]Including intra-EU trade

**Table 6.8** Impact of going back to 1980–84 policies on shares of agricultural and food production exported, by country/region (%)

| | *2004 benchmark* | *1980–84* |
|---|---|---|
| **Developing countries** | **9.5** | **9.5** |
| North Africa | 6.3 | 7.9 |
| Sub-Saharan Africa | 13.8 | 13.5 |
| East Asia | 8.4 | 7.7 |
| South Asia | 3.7 | 2.4 |
| Latin America | 18.1 | 16.3 |
| Middle East | 7.4 | 14.2 |
| Eastern Europe and Central Asia | 6.8 | 9.1 |
| **High-income countries** | **13.0** | **15.9** |
| **World total (including intra-EU trade)[a]** | **11.4** | **13.1** |
| **World total (excluding intra-EU trade)** | **8.1** | **8.7** |

*Source*: Valenzuela et al. (2009)

[a]Including intra-EU trade

agricultural policies and other protection? That depends not only on the changes in the nominal rates of assistance but also on the relative size of each sub-sector and the different degrees of responsiveness of inputs to changes in relative output prices, and also on the method used to weigh different countries' price changes. According to the LINKAGE model with its default elasticities and (Paasche) weighting methods, the average real price in international markets would have been 13 % lower for agricultural and food products had policies not changed over those two decades to 2004 (Table 6.9). International prices for farm goods were higher in 2004 despite the substantial reduction in the anti-agricultural policy bias in developing countries since the early 1980s: the effect of that is evidently more than offset by the reduction in agricultural tariffs and subsidies in high-income countries.

### *Factor Rewards*

The relatively small percentage changes in net national economic welfare, reported in Table 6.2, hide the fact that redistributions of welfare among groups within each country following trade reform can be much larger. This is clear from the impacts on real rewards to labor, capital, and land that are reported in Table 6.10, where factor rewards are expressed in real terms

**Table 6.9** Impact of going back to 1980–84 policies on real international product prices[a] (% relative to 2004 baseline)

| | |
|---|---|
| Paddy rice | –11.6 |
| Wheat | –15.4 |
| Other grains | –27.5 |
| Oil seeds | –8.6 |
| Sugar cane and beet | –0.5 |
| Plant-based fibers | 0.8 |
| Vegetables and fruits | 2.8 |
| Other crops | 2.6 |
| Cattle, sheep, etc. | 0.5 |
| Other livestock | –2.0 |
| Raw milk | 0.4 |
| Wool | –1.9 |
| Beef and sheep meat | –15.0 |
| Other meat products | –45.5 |
| Vegetable oils and fats | –1.4 |
| Dairy products | –8.5 |
| Processed rice | 0.6 |
| Refined sugar | –2.5 |
| Other food, beverages, and tobacco | 0.1 |
| Textile and wearing apparel | 1.4 |
| Other manufacturing | 0.3 |

*Source*: Valenzuela et al. (2009)

[a]Model numéraire is the export price index of high-income countries' manufactured exports

by deflating by the aggregate consumer price index. Those results suggest that the reforms raised the food price index by a half percentage point while lowering the overall CPI index by one-fifth of a point. Unskilled workers in developing countries, according to these results, are better off from reform than skilled workers or capital owners; and if they are also agricultural landowners, they have gained from increased rewards for that factor too. For high-income countries, consistent with standard trade theory, skilled workers gained at the expense of unskilled workers and agricultural land rents halved over what they otherwise would have been. Those European and Northeast Asian farmers renting agricultural land would have benefited from the large fall in farm rental costs, more or less offsetting the fall in prices for their output, while rents of landowners in those countries would decline. Their loss is relative to the no-reform baseline, which ignores the fact that such farm landowners have long enjoyed protection-inflated returns, for decades prior to the 1980s in some cases.

**Table 6.10** Impact of going back to 1980–84 policies on real factor prices,[a] by country/region (relative to the benchmark data, %)

| | *Unskilled wages* | *Skilled wages* | *Capital[b] user cost* | *Land[b] user cost* | *Aggregate CPI* | *Food CPI* |
|---|---|---|---|---|---|---|
| **Developing countries** | **–2.1** | **–1.7** | **–1.5** | **–4.1** | **1.0** | **0.4** |
| North Africa | 0.3 | 0.1 | –0.2 | –1.1 | 0.3 | –0.7 |
| Sub-Saharan Africa | 0.1 | 0.6 | 1.2 | –1.5 | –1.4 | –3.1 |
| East Asia | –4.5 | –3.7 | –3.4 | –6.2 | 0.7 | 1.9 |
| South Asia | –4.1 | –4.7 | –1.7 | –6.6 | 5.4 | 4.7 |
| Latin America | 0.0 | –0.1 | –0.2 | –8.1 | 2.2 | 0.2 |
| Middle East | 0.6 | 0.7 | 0.2 | –4.3 | –1.2 | –3.9 |
| Eastern Europe and Central Asia | 0.2 | –0.1 | 0.2 | 4.1 | –0.2 | –1.6 |
| **High-income countries** | **0.4** | **–0.7** | **–0.4** | **102.1** | **–0.1** | **–1.2** |
| **World total** | **–0.1** | **–0.9** | **–0.7** | **21.1** | **0.2** | **–0.5** |

*Source*: Valenzuela et al. (2009)

[a]Nominal factor prices deflated by national aggregate consumer price index (CPI), shown in column 5

[b]The user cost of capital and land represents the subsidy inclusive rental cost

### *Sectoral Value Added*

Of special interest in terms of these policies' impact on inequality and poverty is how they have affected the value added in agriculture, in other words, net farm income. For poverty, it matters how much that indicator changes in absolute terms in lower income countries (given that two-thirds of the world's poor are farmers in developing countries), while for within-country inequality, it matters also how much it changes relative to value added in non-farm sectors. These results are reported in Table 6.11.

The results show that for developing countries as a group, value added in agriculture is 4.9 % higher than it would have been without reform over the past two decades, compared with just 0.4 % for non-agriculture. A similar-sized improvement has occurred in high-income countries for non-agriculture, but net farm incomes there would have been 36 % higher without the global reforms. For East Asia and Latin America the gain to farmers is twice as much, for South Asia and North Africa it is less than half as much, and for Sub-Saharan Africa, the gain is just above the developing countries' average. However, among the countries listed in Africa, net

**Table 6.11** Impact of going back to 1980–84 policies on sectoral value added, agricultural and all-sector policy changes (relative to 2004 benchmark data)

| | *US$ billion* | | | | *%* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Agricultural polices* | | *All sectors' policies* | | *Agricultural polices* | | *All sectors' policies* | |
| | *Agric* | *Non-agric* | *Agric* | *Non-agric* | *Agric* | *Non-agric* | *Agric* | *Non-agric* |
| High-income countries | –58.5 | 28.6 | 144.2 | –143.1 | –14.7 | 0.1 | 36.2 | –0.5 |
| Australia | 2.7 | 11.7 | 0.2 | –0.5 | 13.7 | 2.1 | 1.2 | –0.1 |
| Canada | 0.7 | –4.6 | 5.9 | 2.8 | 5.3 | –0.5 | 45.7 | 0.3 |
| EU15 | –47.4 | –45.9 | 36.6 | 14.7 | –25.4 | –0.4 | 19.6 | 0.1 |
| Japan | –7.6 | 93.2 | 7.3 | –149.3 | –16.8 | 2.3 | 16.1 | –3.7 |
| New Zealand | 2.7 | 4.4 | 0.5 | 0.8 | 57.2 | 5.4 | 9.8 | 0.9 |
| Rest of Western Europe | –3.6 | –8.4 | 88.3 | –25.8 | –25.8 | –1.3 | 631.3 | –4.0 |
| United States | –6.0 | –25.2 | 5.3 | 17.6 | –5.3 | –0.2 | 4.6 | 0.2 |
| Hong Kong and Singapore | 0.0 | 3.4 | 0.1 | –3.4 | 2.2 | 2.1 | 10.3 | –2.1 |
| Developing countries | 44.4 | 145.6 | –38.8 | –32.1 | 5.6 | 1.9 | –4.9 | –0.4 |
| North Africa | –0.3 | 1.8 | –0.1 | 0.7 | –1.1 | 0.8 | –0.3 | 0.3 |
| Sub-Saharan Africa | –0.6 | –2.0 | –2.2 | –1.3 | –0.8 | –0.5 | –3.1 | –0.3 |
| East Asia | 12.6 | 102.8 | –23.6 | –81.4 | 4.7 | 3.5 | –8.9 | –2.8 |
| South Asia | –10.7 | –2.1 | –3.5 | 16.2 | –6.7 | –0.3 | –2.2 | 2.7 |
| Latin America | 40.7 | 34.6 | –10.8 | 40.2 | 37.0 | 2.3 | –9.8 | 2.7 |
| Middle East | 8.9 | 6.1 | –0.4 | –5.7 | 25.4 | 0.9 | –1.1 | –0.8 |
| Eastern Europe and Central Asia | –6.2 | 4.4 | 1.7 | –0.9 | –5.2 | 0.3 | 1.5 | –0.1 |
| World total | –14.2 | 174.2 | 105.4 | –175.2 | –1.2 | 0.5 | 8.8 | –0.5 |

*Source*: Valenzuela et al. (2009)

farm incomes would increase substantially only in Mozambique, Zambia, and Zimbabwe, and for the continent as a whole, they would fall very slightly (by less than 1 %). That is partly because non-agricultural primary sectors—in which numerous African countries have a strong comparative advantage—expanded (raising Africa's self-sufficiency in that sector from 182 to 191 %), and that, in turn, boosted production and employment of non-tradables. Net farm incomes are estimated to have fallen also in Bangladesh and Vietnam, but there it is textiles and clothing that expanded.

## Prospective Effects of Removing 2004 Price-Distorting Policies Globally

As of 2004 (at the conclusion of implementing the Uruguay Round Agreements and just before international food prices started rising way above trend), a considerable range of distortions to food prices remained, as did a strong anti-trade bias in agricultural policies for many countries (Table 6.1). Furthermore, non-agricultural protectionism was still rife in some developing countries, and domestic agricultural supports were still substantial in high-income (and some middle-income) countries.

To what extent were government trade and subsidy policies in 2004 still reducing farm incomes in developing countries and thereby prolonging inequality *across* countries in farm household incomes? And to what extent were those policy-induced price distortions depressing value added more in primary agriculture than in the rest of the economy of developing countries, thereby potentially raising inequality and poverty *within* those countries? With farm incomes well below non-farm incomes in most developing countries, and with agriculture there being intensive in the use of unskilled labor, policies that lower agricultural relative to non-agricultural value added, and wages for the unskilled relative to skilled wages and capital earnings, would have exacerbated inequality and poverty.

Answers to these two questions are provided in Anderson et al. (2010a). They draw on the same LINKAGE model used in the previous section to assess how agricultural markets, factor prices, and value added in agriculture versus non-farm sectors would have changed if all such distortionary policies were removed (holding aggregate government taxes and spending constant by use of a lump-sum consumption tax).

The comparative static results (assuming full adjustment) are summarized here for the key regions of the world, beginning with national economic welfare, where the impact of agricultural versus non-farm policies is highlighted. While no one anticipates a move to completely free markets in the near future, the analysis serves as a benchmark to suggest what is at stake in terms of further reforms, either unilaterally or via regional or multilateral trade negotiations. It also provides a better indication of agricultural comparative advantages in different parts of the world than is available by looking at actual trade and self-sufficiency indicators in the distortion-ridden situation of 2004.

The LINKAGE model results suggest that the global gains from completing the liberalization would have been US$168 billion per year. That

**Table 6.12** Regional and sectoral sources of the welfare gains from the full liberalization of global merchandise trade, 2004 (2004 US dollars and %, relative to the 2004 benchmark data)

| | *Gains by region, US$ billion* | | | *Share of regional gain, %* | | |
|---|---|---|---|---|---|---|
| | *Developing* | *High-income* | *World* | *Developing* | *High-income* | *World* |
| *Developing countries liberalize* | | | | | | |
| Agriculture and light processing | 31.8 | 3.9 | 35.6 | 48.6 | 3.8 | 21.2 |
| Manufacturing and services | 5.6 | 36.7 | 42.3 | 8.6 | 35.9 | 25.2 |
| Total | 37.4 | 40.6 | 77.9 | 57.2 | 39.6 | 46.5 |
| *High-income countries liberalize* | | | | | | |
| Agriculture and light processing | 15.1 | 66.4 | 81.6 | 23.2 | 64.9 | 48.6 |
| Manufacturing and services | 12.8 | –4.6 | 8.2 | 19.6 | –4.5 | 4.9 |
| Total | 28.0 | 61.8 | 89.8 | 42.8 | 60.4 | 53.5 |
| *All countries liberalize* | | | | | | |
| Agriculture and light processing | 46.9 | 70.3 | 117.2 | 71.8 | 68.7 | 69.9 |
| Manufacturing and services | 18.4 | 32.1 | 50.5 | 28.2 | 31.3 | 30.1 |
| Total | 65.3 | 102.3 | 167.7 | 100.0 | 100.0 | 100.0 |

*Source*: Anderson et al. (2010a)

compares with the above estimate of US$233 billion from the partial reforms of the previous two decades, suggesting those actual reforms brought the world three-fifths of the way toward full liberalization, from a global economic welfare viewpoint. Fully two-thirds of that gain results from agricultural policies and about three-fifths from policies of high-income countries (Table 6.12).

Developing countries would gain nearly twice as much as high-income countries in welfare terms if 2004 agricultural and trade policies had been removed globally (an average welfare increase of 0.9 %, compared with 0.5 % for high-income countries). In this broad conception of the world as just two large country groups, global reform would reduce international inequality. The results vary widely across developing countries, however: India would suffer some slight losses and some Sub-Saharan African countries would suffer exceptionally large adverse terms of trade changes. The

LINKAGE study also finds that net farm incomes in developing countries would rise by 5.6 %, compared with 1.9 % for non-agricultural value added, if those policies were eliminated. This suggests that inequality between farm and non-farm households in developing countries would fall. By contrast, in high-income countries, net farm incomes would fall by 15 % on average, compared with a slight rise for real non-farm value added. That is, inequality between farm households in developing countries and those in high-income countries would fall substantially. If only agricultural policies were removed, these results would not change much (see columns 2 and 3 of Table 6.13). This underscores the large magnitude of the distortions from agricultural, as compared with non-agricultural, trade-related policies.

Developing countries' share of the world's primary agricultural exports has risen from 55 to 64 % and the output share increased from 62 to 65 %, and their share of processed food output has increased 3 percentage points too.

The share of global production of farm products that are exported (excluding intra-EU trade) rises from 8 % in 2004 to 13 % with full liberalization. This reduction in the 'thinness' of international food markets would reduce the volatility of international prices substantially.

**Table 6.13** Effects of full global liberalization of agricultural and all merchandise trade on national economic welfare and real sectoral GDP, by region, 2004 (% change relative to benchmark data)

| | *All sectors' policies* | *Agricultural policies* | | *All sectors' policies* | |
|---|---|---|---|---|---|
| | *Economic welfare (EV)* | *Agric GDP* | *Non-ag GDP* | *Agric GDP* | *Non-ag GDP* |
| East and South Asia | 0.9 | -0.3 | 0.7 | 0.5 | 2.9 |
| *of which China* | *0.2* | *2.8* | *0.2* | *5.7* | *3.0* |
| *India* | *−0.2* | *−6.1* | *1.4* | *−8.3* | *−0.3* |
| Africa | 0.2 | 0.1 | 0.8 | −0.9 | 0.0 |
| Latin America | 1.0 | 36.3 | 2.8 | 37.0 | 2.3 |
| **All developing countries** | **0.9** | **5.4** | **1.0** | **5.6** | **1.9** |
| Eastern Europe and Central Asia | 1.2 | −4.4 | 0.3 | −5.2 | 0.3 |
| All high-income countries | 0.5 | −13.8 | 0.2 | −14.7 | 0.1 |
| **World total** | **0.6** | **−1.0** | **0.4** | **−1.2** | **0.5** |

*Source*: Anderson et al. (2010a)

The LINKAGE study also reports that unskilled workers in developing countries—the majority of whom work on farms—would benefit most from reform (followed by skilled workers and then capital owners). The average change in the real unskilled wage across developing countries would be an increase of 3.5 %. However, the most relevant consumer prices for poor people relate to food and clothing. This includes those many poor farm and other rural households who earn most of their income from their labor and are net buyers of food. Hence, deflating by a food and clothing price index rather than the aggregate CPI provides a better indication of the welfare change for those workers. As shown near the bottom of the final column of Table 6.14, the real unskilled wage across developing countries would rise by 5.9 % with that deflator. That is, inequality between unskilled wage earners and the much wealthier owners of capital (human or physical) within developing countries would fall with full trade reform.

Explicit assessment of the likely impacts of trade policy reform on poverty using the LINKAGE model requires use of an elasticities approach. This involves taking the estimated impact on average real household income and applying an estimated income to poverty elasticity to estimate the impacts on the poverty headcount index for each country. Focus on the change in the average wage of unskilled workers deflated by the food and clothing CPI, and assume those workers are exempt from the direct income tax imposed to replace the lost customs revenue following trade reform (a realistic assumption for many developing countries). Under their full merchandise trade reform scenario, developing countries would have 2.7 % fewer people living on less than US$1 a day. The proportional reduction is much higher in China and Sub-Saharan Africa, each falling around 4 %. It is even higher in Latin America (7 %) and South Asia excluding India (10 %). By contrast, the number of extremely poor in India is estimated to rise by 4 %.[7] Under the more moderate definition of poverty—people living on no more than US$2 per day—the number of poor in developing countries would fall by nearly 90 million compared with an aggregate baseline level of just under 2.5 billion in 2004, or by 3.4 % (Table 6.14).

Hertel and Keeney (2010), drawing on the widely used global economy-wide GTAP model, adopt the same price distortions as in the above study and run the same scenarios, but they generate more explicit poverty effects for a sample of 15 developing countries for which they have detailed household survey data. This multi-country study covers five Asian countries (Bangladesh, Indonesia, Philippines, Thailand, and Vietnam), as well

**Table 6.14** Effects of full global merchandise trade liberalization on the incidence of extreme poverty, 2004

| | *Average unskilled wage change, real*[a] *(%)* | *Baseline headcount* | | *New levels, US$1/day* | | *New levels, US$2/day* | | *Change in number of poor from baseline levels* | | *Change in number of poor from baseline levels* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *US$1/day* | *US$2/day* | *Headcount* | *Number of poor* | *Headcount* | *Number of poor* | *US$1/day* | *US$2/day* | *US$1/day* | *US$2/day* |
| | | *(%)* | *(%)* | *(%)* | *million* | *(%)* | *million* | *million* | *million* | *%* | *%* |
| East Asia | *4.4* | 9 | 37 | 8 | 151 | 34 | 632 | –17 | –52 | –10.3 | –7.6 |
| China | *2.1* | 10 | 35 | 9 | 123 | 34 | 440 | –5 | –12 | –4.0 | –2.7 |
| Other East Asia | *8.1* | 9 | 50 | 6 | 29 | 42 | 192 | –12 | –40 | –30.1 | –17.1 |
| South Asia | *–1.9* | 31 | 77 | 32 | 454 | 78 | 1124 | 8 | 8 | 1.8 | 0.7 |
| India | *–3.8* | 34 | 80 | 36 | 386 | 82 | 883 | 15 | 15 | 4.2 | 1.7 |
| Other South Asia | *4.0* | 29 | 94 | 26 | 68 | 92 | 241 | –8 | –7 | –9.9 | –2.7 |
| Sub–Saharan Africa | *5.3* | 41 | 72 | 39 | 287 | 70 | 508 | –11 | –14 | –3.8 | –2.7 |
| Latin America | *4.1* | 9 | 22 | 8 | 44 | 21 | 115 | –3 | –6 | –6.8 | –4.7 |
| Middle East/North Africa | *14.3* | 1 | 20 | 1 | 3 | 13 | 40 | –2 | –19 | –36.4 | –32.7 |
| **All developing countries** | ***5.9*** | **18** | **48** | **18** | **944** | **46** | **2462** | **–26** | **–87** | **–2.7** | **–3.4** |
| Developing exluding China | *6.5* | 21 | 52 | 20 | 820 | 50 | 2022 | –21 | –74 | –2.5 | –4.7 |
| **Eastern Europe and Central Asia** | ***4.5*** | **1** | **10** | **1** | **4** | **9** | **43** | **–0** | **–4** | **–6.8** | **–8.0** |

*Source*: Anderson et al. (2010a using the LINKAGE model)

[a]Nominal unskilled wage deflated by the food and clothing CPI

as four African countries (Malawi, Mozambique, Uganda, and Zambia) and six Latin American countries (Brazil, Chile, Colombia, Mexico, Peru, and Venezuela). Overall, the study concludes that removing current farm and trade policies globally would tend to reduce poverty, primarily via agricultural reforms (Table 6.15). The unweighted average for all 15 developing countries is a headcount decline in extreme poverty (<US$1 a day) of 1.7 %. The average fall for the Asian sub-sample is twice that, however—and it is in Asia where nearly two-thirds of the world's extremely poor people live (although their sample did not include China and India). These GTAP model results are close to the LINKAGE model results summarized above.

The final column of Table 6.15 reports the percentage change in the national poverty headcount when the poor are not subject to the income tax rise that would be required to replace the trade tax revenue lost following trade reform. This change in assumption generates a significant change in the implicit income transfer from non-poor to poor households, thereby generating a marked difference in the predicted poverty alleviation: trade reforms go from being marginally poverty-reducing in most of the 15 cases to being considerably poverty-reducing in all cases. With this latter assumption, reform reduces the poverty rate by roughly one-quarter in Thailand and Vietnam, for example. Overall, the regional and total average extent of poverty alleviation is around four times larger with this tax assumption than when the poor are levied with income taxes to replace lost trade tax revenue. The unweighted averages of poverty headcount reduction for the three regions shown in the final column of Table 6.15 are remarkably similar to the population-weighted averages from the LINKAGE model with a similar tax-replacement assumption: the latter's 17 % for Asia excluding China and India and 6.4 % for Latin America are just slightly above the GTAP model's 14 and 5.7 %, respectively.

Anderson et al. (2010b) also report results from ten more detailed individual country case studies and compare these with the above results from global models. Like the global models, these individual country case studies focus on the same price-distorting policies of 2004, but they include more sectoral and product disaggregation than the global models and consider multiple types of households and types of labor. The national results for real GDP and household consumption suggest that GDP would increase from full global trade reform in all ten countries, but only by 1–2 %. Given the falling consumer prices, real household consumption would increase considerably more in most cases. Generally, these numbers

**Table 6.15** Effects of full global liberalization of the agricultural and merchandise trade on the incidence of extreme poverty using the GTAP model, 2004 (percentage point change using US$1 a day poverty line)

| | *Default tax replacement* | | | *Alternative tax replacement (poor are exempt)* |
|---|---|---|---|---|
| | *Agriculture-only reform* | *Non-agriculture-only reform* | *All merchandise reform* | *All merchandise reform* |
| **Asia** | | | | |
| Bangladesh | –0.3 | 0.5 | 0.3 | –5.3 |
| Indonesia | –1.1 | 0.5 | –0.6 | –5.2 |
| Philippines | –1.4 | 0.4 | –1.0 | –6.4 |
| Thailand | –11.2 | 0.9 | –10.3 | –28.1 |
| Vietnam | –0.5 | –5.3 | –5.7 | –23.6 |
| **Africa** | | | | |
| Malawi | –1.6 | –0.3 | –1.9 | –5.6 |
| Mozambique | –1.2 | 0.2 | –1.0 | –4.3 |
| Uganda | –0.0 | 0.1 | 0.1 | –6.0 |
| Zambia | –0.0 | 0.1 | 0.1 | –2.0 |
| **Latin America** | | | | |
| Brazil | –2.5 | 0.4 | –2.2 | –10.0 |
| Chile | –4.8 | 0.1 | –4.6 | –12.3 |
| Columbia | –0.7 | 0.6 | –0.1 | –4.1 |
| Mexico | 0.8 | 0.4 | 1.1 | –0.5 |
| Peru | –0.6 | –0.2 | –0.8 | –5.2 |
| Venezuela | 0.2 | 0.7 | 0.9 | –2.1 |
| **Unweighted averages** | | | | |
| **– Asia** | **–2.9** | **–0.6** | **–3.5** | **–13.7** |
| **– Africa** | **–0.7** | **0.1** | **–0.7** | **–4.5** |
| **– Latin America** | **–1.3** | **0.3** | **–1.0** | **–5.7** |
| **– All 15 DCs** | **–1.7** | **–0.1** | **–1.7** | **–8.0** |

Source: Hertel and Keeney (2010, Table 4.5)

are a little larger than those generated by the global LINKAGE model, but they are generally much lower than would be the case had the authors used dynamic models. They therefore share the feature of the global models of under-estimating the poverty-alleviating benefits of trade reform, given the broad consensus that trade liberalization increases economic growth, which is, in turn, a major contributor to poverty alleviation.

The comparative Tables 6.16 and 6.17 summarize the national results for the incidence of extreme poverty and income inequality, respectively, resulting from own-country, rest-of-world, or global full liberalization of agricultural or all goods trade. One should not necessarily expect the unweighted averages of the poverty results for each region to be similar to the above-discussed ones generated by Hertel and Keeney (2010), but for comparative purposes, the latter's unweighted averages of national poverty effects for each of the key developing country regions are reported in brackets in the last four rows of Table 6.16. In each case, the total effects on poverty are sub-divided into rural and urban.

According to the individual country results, poverty is reduced in all countries by both global agricultural and, with the exception of the Philippines, non-agricultural liberalization (Table 6.16c). When all merchandise trade is liberalized, the extent of reduction ranges from close to zero to about 3.5 percentage points, except for Pakistan, where it is more than 6 points. On average, nearly two-thirds of the alleviation is due to non-farm trade reform, with the important exception of Brazil, where agricultural reform is the major contributor to its large pro-poor outcome. The latter result is despite the presence of tariff protection for Brazil's poor import-competing farmers and is a consequence of the increase in the demand for unskilled labor following liberalization, which evidently outweighs the poverty impact of removing farm tariffs. The contribution of own-country reforms to the fall in poverty appears to be equally as important as rest-of-world reform on average, although there is some considerable cross-country divergence in the extent of this for both farm and non-farm reforms.

The poverty alleviation is sub-divided in parts (a) and (b) of Table 6.16 into rural and urban sources. A glance at the final column of that part of the table reveals that rural poverty is cut much more than urban poverty in every case. That is true for both farm and non-farm trade reform, as well as for own-country and rest-of-world reform. Since the rural poor are much poorer on average than the urban poor, this would lead one to expect trade reform to reduce inequality also.

Indeed, the results at the bottom of Table 6.17c for this sample of countries show that inequality would decline in all three developing country regions following full trade liberalization of all goods, or just agricultural products, and both for own-country and rest-of-world reform. The effect of non-farm trade reform on its own is more mixed, providing another reason to urge trade negotiators not to neglect agricultural reform

**Table 6.16** The impact of reform on the incidence of extreme poverty, selected developing countries (percentage point change using national or US$1 a day poverty line)

| | *Base* | *Agriculture-only reform* | | | *Non-agriculture-only reform* | | | *All merchandise reform* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *(%)* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* |
| *(a) Rural poverty* | | | | | | | | | | |
| China (US$2/day) | 58 | 0.3 | –1.4 | –1.1 | 0.2 | –0.5 | –0.3 | 0.5 | –1.9 | –1.4 |
| Indonesia | 29 | 0.1 | –1.1 | –1.1 | –0.2 | –3.2 | –3.3 | –0.1 | –4.3 | –4.4 |
| Pakistan | 38 | –1.4 | –0.1 | –1.5 | –6.2 | –1.1 | –7.1 | –7.6 | –1.2 | –8.6 |
| Philippines | 49 | 0.0 | –0.6 | –0.3 | 0.6 | –0.3 | 0.2 | 0.6 | –0.9 | –0.1 |
| Thailand | 30 | 0.3 | –1.6 | –1.3 | –3.8 | 0.7 | –3.1 | –3.5 | –0.9 | –4.4 |
| Mozambique | 36 | –1.6 | 0.0 | –1.6 | –0.5 | –1.5 | –2.0 | –2.1 | –1.5 | –3.6 |
| South Africa | 17 | –0.3 | –0.3 | –0.7 | –0.8 | 0.0 | –0.8 | –1.1 | –0.4 | –1.4 |
| Brazil | na | na | na | na | na | na | na | na | na | na |
| Nicaragua | 63 | –0.7 | 0.3 | –0.4 | –0.6 | –0.3 | –0.9 | –1.3 | 0.0 | –1.3 |
| *(b) Urban poverty* | | | | | | | | | | |
| China (US$2/day) | 3 | 0.0 | 0.0 | 0.0 | 0.0 | –0.1 | –0.1 | 0.0 | –0.1 | –0.1 |
| Indonesia | 12 | –0.1 | –0.3 | –0.4 | –0.1 | –1.7 | –1.8 | –0.2 | –2.0 | –2.2 |
| Pakistan | 20 | –2.4 | –0.1 | –2.7 | 4.7 | –1.4 | 3.1 | 2.3 | –1.5 | 0.4 |
| Philippines | 19 | 0.8 | –0.9 | –0.2 | 1.2 | –0.7 | 0.3 | 2.0 | –1.6 | 0.1 |
| Thailand | 6 | 0.0 | –0.8 | –0.7 | –3.3 | 0.2 | –3.2 | –3.3 | –0.6 | –3.9 |
| Mozambique | 37 | –0.5 | 0.0 | –0.5 | –0.4 | –1.3 | –1.7 | –0.9 | –1.3 | –2.2 |
| South Africa | 4 | –0.1 | –0.2 | –0.3 | –0.4 | 0.0 | –0.4 | –0.5 | –0.2 | –0.7 |
| Brazil | na | na | na | na | na | na | na | na | na | na |
| Nicaragua | 27 | 0.3 | –0.5 | –0.2 | –1.0 | 1.4 | 0.4 | –0.7 | 0.9 | 0.2 |
| *(c) Total poverty* | | | | | | | | | | |
| China (US$2/day) | 36 | 0.2 | –0.8 | –0.6 | 0.1 | –0.4 | –0.3 | 0.3 | –1.2 | –0.9 |
| Indonesia | 23 | –0.0 | –0.8 | –0.8 | –0.1 | –2.7 | –2.8 | –0.1 | –3.5 | –3.6 |

(*continued*)

**Table 6.16** (continued)

| | *Base* | *Agriculture-only reform* | | | *Non-agriculture-only reform* | | | *All merchandise reform* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *(%)* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* |
| Pakistan | 31 | –1.6 | –0.1 | –1.8 | *–3.6* | *–1.2* | *–4.6* | –5.2 | –1.3 | –6.4 |
| Philippines | 34 | 0.4 | –0.6 | –0.1 | *0.7* | *–0.3* | *0.2* | 1.1 | –0.9 | 0.1 |
| Thailand | 14 | 0.1 | –1.1 | –0.8 | *–3.5* | *0.4* | *–3.3* | –3.4 | –0.7 | –4.1 |
| Mozambique | 36 | –1.3 | 0.0 | *–1.3* | *–0.4* | *–1.4* | *–1.8* | –1.7 | –1.4 | *–3.1* |
| South Africa | 10 | –0.2 | –0.3 | *–0.5* | *–0.6* | *–0.1* | *–0.6* | –0.8 | –0.3 | *–1.1* |
| Brazil | 31 | –0.5 | –2.3 | –2.8 | –0.4 | –0.1 | *–0.5* | *–0.9* | *–2.4* | –3.5 |
| Nicaragua | 41 | –0.1 | *–0.2* | –0.3 | *–0.9* | *0.8* | *–0.1* | –1.0 | *0.6* | –0.4 |
| ***Unweighted averages:*** | | | | | | | | | | |
| **– Asia** | ***28*** | ***–0.2*** | ***–0.7*** | *(–2.9)*<br>***–0.8*** | ***–1.2*** | ***–0.8*** | *(–0.6)*<br>***–2.2*** | ***–1.5*** | ***–1.6*** | *(–3.5)*<br>***–3.0*** |
| **– Africa** | ***32*** | ***–0.8*** | ***–0.2*** | *(–0.7)*<br>***–0.9*** | ***–0.5*** | ***–0.7*** | *(0.1)*<br>***–1.2*** | ***–1.3*** | ***–0.9*** | *(–0.7)*<br>***–2.1*** |
| **– Latin America** | ***36*** | ***–0.3*** | ***–1.3*** | *(–1.3)*<br>***–1.6*** | ***–0.7*** | ***0.4*** | *(0.3)*<br>***–0.3*** | ***–1.0*** | ***–0.9*** | *(–1.0)*<br>***–2.0*** |
| **– All 9 DCs** | ***43*** | ***–0.4*** | ***–0.6*** | *(–1.7)*<br>***–1.0*** | ***–0.9*** | ***–0.6*** | *(–0.1)*<br>***–1.5*** | ***–1.3*** | ***–1.2*** | *(–1.7)*<br>***–2.6*** |

*Source*: Country case studies in Parts II to IV of Anderson et al. (2010b) plus (in the case of the unbolded numbers in brackets in the final four rows), from Hertel and Keeney (2010) as reported in the last four rows of Table 6.15

[a]Numbers in italics for individual countries are implied assuming linearity holds; numbers do not always add because of either rounding or interaction effects

**Table 6.17** Impact of reform on the incidence of income inequality, national case studies (percentage point change in Gini Coefficient)

| | *Base* | *Agriculture-only reform* | | | *Non-agriculture-only reform* | | | *All merchandise reform* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *(%)* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* |
| *(a) Rural* | | | | | | | | | | |
| China | 0.32 | 0.0 | –0.2 | *–0.2* | *0.0* | *0.0* | *0.0* | 0.0 | –0.2 | *–0.2* |
| Indonesia | 0.29 | 0.0 | 0.0 | 0.0 | *0.1* | *0.0* | *0.1* | 0.1 | 0.0 | 0.1 |
| Pakistan | 0.26 | –0.1 | –0.0 | –0.1 | *0.3* | *0.0* | *0.3* | 0.2 | –0.0 | 0.2 |
| Philippines | 0.43 | 0.2 | –0.1 | 0.1 | *0.3* | *0.0* | *0.1* | 0.5 | –0.1 | 0.2 |
| Thailand | 0.33 | 0.0 | 0.5 | 0.5 | *0.4* | *0.0* | *0.4* | 0.4 | 0.5 | 0.9 |
| Mozambique | na | na | na | na | na | na | na | na | na | na |
| South Africa | 0.63 | –0.1 | –0.1 | *–0.2* | *–0.3* | *0.0* | *–0.3* | –0.4 | –0.1 | *–0.5* |
| Brazil | na | na | na | na | na | na | na | na | na | na |
| Nicaragua | na | na | na | na | na | na | na | na | na | na |
| *(b) Urban* | | | | | | | | | | |
| China | 0.26 | 0.0 | 0.1 | *0.1* | *0.0* | *–0.1* | *–0.1* | 0.0 | 0.0 | *0.0* |
| Indonesia | 0.36 | 0.0 | –0.1 | –0.1 | *0.3* | *0.3* | *0.6* | 0.3 | 0.2 | 0.5 |
| Pakistan | 0.40 | –0.1 | –0.0 | –0.1 | *–1.9* | *0.0* | *–1.9* | –2.0 | –0.0 | –2.0 |
| Philippines | 0.48 | 0.3 | –0.2 | 0.1 | *0.1* | *0.0* | *0.1* | 0.4 | –0.2 | 0.2 |
| Thailand | 0.15 | 0.1 | 0.6 | 0.7 | *0.5* | *0.0* | *0.5* | 0.6 | 0.6 | 1.2 |
| Mozambique | na | na | na | na | na | na | na | na | na | na |
| South Africa | 0.62 | –0.1 | –0.1 | *–0.2* | *–0.5* | *0.0* | *–0.5* | –0.6 | –0.1 | *–0.7* |
| Brazil | na | na | na | na | na | na | na | na | na | na |
| Nicaragua | na | na | na | na | na | na | na | na | na | na |
| *(c) Total* | | | | | | | | | | |
| China | 0.44 | 0.1 | –0.4 | *–0.3* | *0.0* | *–0.1* | *–0.1* | 0.1 | –0.5 | *–0.4* |

(*continued*)

**Table 6.17** (continued)

| | *Base* | *Agriculture-only reform* | | | *Non-agriculture-only reform* | | | *All merchandise reform* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *(%)* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* | *Unilateral* | *rest of world* | *Global* |
| Indonesia | 0.34 | 0.0 | –0.1 | –0.1 | *0.2* | *0.2* | *0.4* | 0.2 | 0.1 | 0.3 |
| Pakistan | 0.34 | –0.1 | –0.0 | –0.2 | *–3.2* | *–0.1* | *–3.1* | –3.3 | –0.1 | –3.3 |
| Philippines | 0.51 | 0.3 | –0.2 | 0.1 | *0.1* | *0.0* | *0.1* | 0.4 | –0.2 | 0.2 |
| Thailand | 0.34 | 0.1 | 0.7 | 0.8 | *0.4* | *0.0* | *0.4* | 0.5 | 0.7 | 1.2 |
| Mozambique | 0.48 | –1.2 | –0.1 | *–1.3* | *–0.3* | *0.2* | *–0.1* | –1.5 | 0.1 | *–1.4* |
| South Africa | 0.67 | –0.1 | –0.1 | *–0.2* | *–0.4* | *0.0* | *–0.4* | –0.5 | –0.1 | *–0.6* |
| Brazil | 0.58 | –0.2 | –1.4 | *–1.6* | 0.1 | –0.1 | *0.0* | *–0.1* | *–1.5* | –1.7 |
| Nicaragua | 0.53 | –0.1 | *0.1* | 0.0 | *–0.1* | *–0.2* | *–0.3* | –0.2 | *–0.1* | –0.3 |
| ***Unweighted averages:*** | | | | | | | | | | |
| **– Asia** | ***0.39*** | ***0.1*** | ***–0.0*** | ***0.1*** | ***–0.5*** | ***0.0*** | ***–0.5*** | ***–0.4*** | ***–0.0*** | ***–0.4*** |
| **– Africa** | ***0.58*** | ***–0.7*** | ***–0.1*** | ***–0.8*** | ***–0.4*** | ***0.1*** | ***–0.3*** | ***–1.0*** | ***–0.0*** | ***–1.0*** |
| **– Latin America** | ***0.56*** | ***–0.2*** | ***–0.7*** | ***–0.8*** | ***0.0*** | ***–0.2*** | ***–0.1*** | ***–0.2*** | ***–0.8*** | ***–1.0*** |
| **– All 9 DCs** | ***0.59*** | ***–0.2*** | ***–0.2*** | ***–0.4*** | ***–0.3*** | ***–0.0*** | ***–0.3*** | ***–0.5*** | ***–0.2*** | ***–0.7*** |

*Source*: Country case studies in Parts II to IV of Anderson et al. (2010b)

[a]Numbers in italics are implied assuming linearity holds; numbers do not always add because of either rounding or interaction effects

in trade negotiations. Both rest-of-world and global agricultural reform lead to a reduction in inequality in every country in the sample except Thailand (plus the Philippines slightly for global reform), whereas unilateral agricultural reform reduces (or leaves constant) inequality in a small majority of countries, with China, the Philippines, and Thailand being the exceptions (but the latter effects are small). Non-farm global reform increases inequality slightly in three countries. In the case of Indonesia, the inequality-increasing impact of non-farm reform more than offsets the egalitarian effect of farm trade reform, whereas both types of reform increase inequality in the case of the Philippines and Thailand.

Inequality within the rural or urban household grouping is not altered very much by trade reform as compared with overall national inequality (compare parts (a) and (b) with part (c) of Table 6.17). This underlines the point that trade reform would tend to reduce urban--rural inequality predominantly rather than inequality within either region of each country.

Several of the national studies investigate impacts of reforms that could complement trade reforms, most notably different approaches to deal with the elimination of trade tax revenues. If these revenues can be recouped through taxes that do not bear on the poor, then the impacts of reform for poverty reduction are more favorable. The China study focuses on the important issue of reducing the barriers to migration out of agriculture by improving the operation of land markets and reducing the barriers to mobility created by the *Hukou* system. These measures, and international trade liberalization that increases China's market access, are found to reduce poverty such that a combination of these measures would benefit all major household groups.

In summary, the benefits for the world's poor from the full liberalization of global merchandise trade would come more from agricultural rather than non-agricultural reform; and, within agriculture, more from the removal of substantial support provided to farmers in high-income countries than from developing country policy reform. According to the economy-wide model results summarized above, such reform would raise the real earnings of unskilled workers in developing countries, most of whom work in agriculture. Their earnings would rise relative to both unskilled workers in high-income countries and other income earners in developing countries. This would thus reduce inequality both within developing countries and between developing and high-income countries, in addition to reducing poverty. The studies all find global trade liberalization to be poverty alleviating, regardless of whether the reform involves only agricultural goods or all goods, with the benefit to developing countries coming roughly equally from reform at home and abroad. They also find that rural poverty would be cut much more than urban poverty in all cases.

## What About Costs of Adjustment to Policy Reform?

Measuring both the benefits and the costs of liberalizing trade is still an inexact science, despite the huge amount of progress that has been made over the past two decades in global CGE modeling. The real costs of adjustments to trade policy changes, and how they are spread over time for different groups, have been ignored in the above calculus. Those one-off costs may in fact be only a small fraction of the benefits that flow for years after a reform (Matusz and Tarr 2000). The adjustment required also tends to be small when compared with the changes due to exchange rate fluctuations, technological improvements, preference shifts, and other economic shocks and structural developments associated with normal economic growth (Porto and Hoekman 2010). However, those costs occur at the outset of any trade policy reform process and are often concentrated sectorally and geographically, and so weigh heavily on any political debate.

## Key Messages

The results presented above are from just a handful of recent modeling studies, but they are chosen because they illustrate the wide range of global economic effects of both the trade policy reforms that took place in the two decades to 2004 and the policies still in place at that time. A number of key messages can be drawn from those model results.

First, they suggest the reforms over the two decades to 2004 brought the world a remarkable three-fifths of the way toward free trade when measured in terms of global economic welfare. Since much of that reform involved reducing anti-agricultural policies in developing countries, it is not surprising that it benefitted developing countries proportionately more than high-income countries. Part of that reform also involved a reduction in farm price supports in high-income countries. Together, those and other policy changes raised the developing countries' shares of global farm output and exports by several percentage points compared with what they would have been otherwise.

Had the remaining policies as of 2004 also been liberalized, developing countries would have gained nearly twice as much as high-income countries (an average economic welfare increase of 0.9 % compared with 0.5 %) from that final step. That is, the model results suggest both the actual reforms from the 1980s and prospective reforms have the effect of reducing international income inequality by closing the income gap between high-income and developing countries.

Of those prospective welfare gains from completing the liberalization process, two-thirds would be generated by agricultural policy changes, even though agriculture and food account for less than one-tenth of global GDP and trade. Such is the degree of distortions still remaining in agricultural markets compared with those in other primary sectors and in manufacturing.

Through full liberalization of trade in goods, exports as a share of global production of farm products would rise from 8 to 13 % (excluding intra-EU trade). That would thicken international food markets and thereby reduce the fluctuations in prices and quantities traded in those markets.

Unskilled workers in developing countries—the majority of whom work on farms—would benefit most from reform, followed by skilled workers and then capital owners. The average change in the real unskilled wage across all developing countries would rise 4 %, or nearly five times more than the average increase in net incomes in developing countries. And net farm incomes in developing countries would rise by 6 %, compared with 2 % for non-agricultural value added. Both of these findings suggest poverty and income inequality would fall in developing countries.

As found in previous studies, whether based on *ex post* econometrics (as in Harrison 2007) or *ex ante* economy-wide simulation (as in Hertel and Winters 2006), the poverty results are not unequivocal nor are they easy to summarize. But the LINKAGE model estimates that the number of people in developing countries in extreme poverty—the number living on less than US$1 a day—would drop by 29 million, a reduction of almost 3 %, if the trade policies as of 2004 had been removed. The 15-country results from the GTAP model suggest that the poverty-reducing effects would be somewhat larger, and the nine national case studies all find global trade liberalization to be poverty alleviating, regardless of whether the reform was to involve only agricultural goods or all goods, with the benefit coming roughly equally from reform at home and abroad. The latter studies also find that rural poverty would be cut much more than urban poverty in all cases, whether from reform at home or abroad and whether or not it included non-farm goods.

Full trade liberalization of all goods, or just of agricultural products, also would cause inequality to decline within each of the three developing country regions covered by the sample of countries, and both for own-country and rest-of-world reform. Inequality within the rural or urban household grouping would not alter much following full trade reform, suggesting that trade reform's predominant impact would be to reduce urban-rural inequality.

The mechanism through which governments adapt to the fall in tariff revenue is also shown to be crucial. If it is assumed (realistically) that the poor do not have to bear any of the burden of replacing trade taxes, instead of sharing it proportionately, the estimated degree of poverty alleviation is about four times greater in the 15 countries studied with the GTAP model.

One final point. The estimates of the economic welfare benefits of trade liberalization reported above are rather modest when expressed as a percentage of GDP. Recall though that they are based on comparative static CGE models. They therefore do not include the dynamic gains from trade reform, which, as explained in Chap. 2, are likely to be several times larger. The above-estimated effects of reform on poverty also therefore should be thought of as lower bound estimates of the extent of alleviation that could follow from further trade liberalization.

## Notes

1. An even earlier pioneering study of a single commodity, sugar, was by Snape (1963, 1969).
2. They included the USDA's SWOPSIM model (Roningen 1986), IIASA's model (Parikh et al. 1988), and the OECD's Trade Mandate Model (Huff and Moreddu 1989). A survey of these twentieth-century models is provided in van Tongeren et al. (2001).
3. Among the model modifications that have been incorporated for particular applications are scale economies and imperfect competition (Francois 1998), dynamics through capital accumulation (Francois and McDonald 1996), and those plus foreign direct investment (Dee et al. 2000). In addition, computational tools for practical policy analysis have been developed to enable systematic sensitivity analysis (Pearson and Arndt 2000) and decomposition of economic welfare results (Huff and Hertel 2001).
4. A list of other global economic models can be found at https://www.gtap.agecon.purdue.edu/about/data_models.asp.

5. An aggregated version of LINKAGE has since developed into the ENVISAGE model (the Environmental Impact and Sustainability Applied General Equilibrium), which is specifically designed for estimating also the effects of greenhouse gas emissions by including detailed energy and climate modules (van der Mensbrugghe 2010).
6. The more affluent economies of Hong Kong and Singapore are in the high-income category, but their influence on the results is not noticeable because they have close to free-trade policies anyway.
7. The rise in India is partly because of the removal of the large subsidies and import tariffs that assist Indian farmers and partly due to the greater imports of farm products raising the border price of those imports.

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CHAPTER 7

# The Interface Between Trade and Technology Policies

Governmental barriers to trade can take many forms. Import tariffs and export taxes historically have been the most common, not least because they raise government revenue (in addition to altering producer and consumer prices domestically). But many non-tariff barriers (NTBs) also limit trade. Some are technical barriers to trade (TBTs), for example, relating to product quality or safety (Swinnen et al. 2016). Others are sanitary or phytosanitary (SPS) restrictions aimed at preventing the importation of pests and diseases that might affect human, plant, or animal health. The ostensible aim of those NTBs is to ensure national welfare is not reduced by importing such products. However, since these restrictions also benefit domestic producers by lowering competition from imports, such barriers commonly are set higher than is optimal from a national welfare viewpoint (Swinnen and Vandemoortele 2012). Indeed, some of those barriers prevent any imports. Not surprisingly, that has led to trade disputes being brought to the WTO, many of them food-related (Santana and Jackson 2012).

This chapter is about barriers to trade in one particular category of goods, namely those containing genetically modified organisms (GMOs) produced by biotechnologists. GM crops have been grown commercially for more than 20 years, comprising 180 million hectares of cropland in eight high-income countries (46 % of the area) and 20 developing countries (54 % of the area) as of 2015, with another 40 countries that do



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not produce them importing and consuming GM crop products (James 2015). There has thus been substantial consumer acceptance of this still relatively new technology in both high-income and developing countries. As for producer benefits, a recent meta-analysis of 147 studies of the impacts of GM crops by Klümper and Qaim (2014) concludes that on average GM technology adoption has reduced chemical pesticide use by 37 %, increased crop yields by 22 %, and increased farmer profits by 68 %. It also found that yield and profit gains are higher in developing countries than in high-income countries. Those gains are not the only contributors to farm total factor productivity (TFP) growth in adopting countries, but it is clear from Fig. 7.1 that key developing countries that have adopted

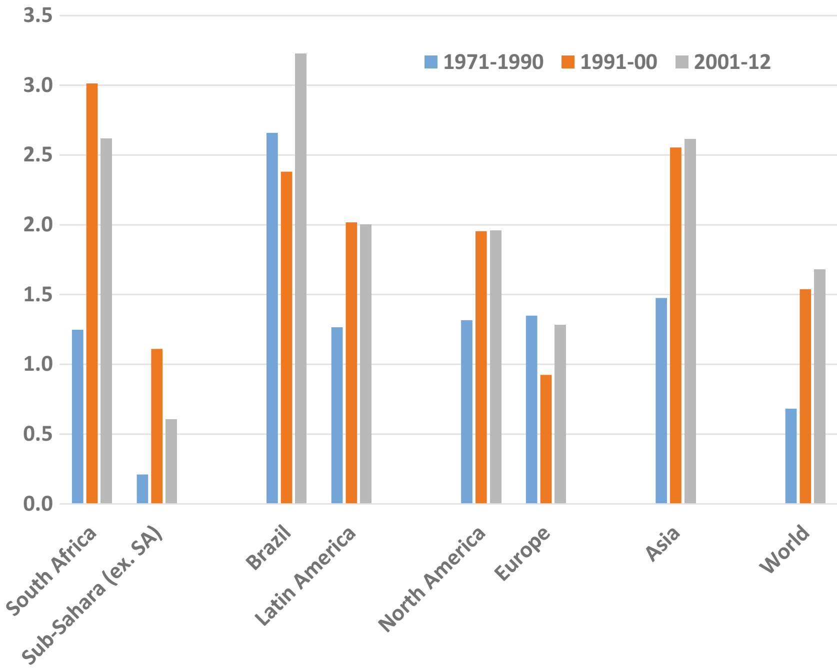


**Fig. 7.1** Agricultural total factor productivity growth, selected countries,[a] and regions, 1971–2012 (% per year). [a]Countries adopting GMOs are South Africa, Brazil, and North America (USA and Canada). *Source*: http://ers.usda.gov/data-products/international-agricultural-productivity.aspx, accessed 25 April 2016. See also Fuglie et al. (2012)

GM technology have had faster farm TFP growth over recent years and faster than other countries in their region, as is also true for the USA and Canada compared with Europe.

In numerous non-adopting countries, people worry that products containing GMOs may be unsafe as food or animal feed, or that GMO seeds where planted will have adverse effects on the natural environment or contaminate fields of non-GMO crops. Barriers to the importation of products that may have GMOs have therefore been erected by some countries—in spite of the fact that there is no evidence that GM crops have greater adverse impact on health or the environment than other crops developed by alternative technologies used in plant breeding (King 2003; Fedoroff 2004; EASAC 2013; Barrows et al. 2014; House of Commons 2015). On the contrary, GM crop varieties are reducing the need for agrochemicals that harm the environment and farmer health, and they have the potential to greatly improve the micronutrient content of our food, in addition to rapidly improving productivity growth on farms (Qaim 2016).[1]

Those import barriers by countries in Western Europe and elsewhere in turn have led many governments to ban GM crop production for the fear that their country's agricultural exports even of non-GMO products may then be rejected by concerned governments abroad.

Such barriers thus reduce the global supply of food in two ways: by reducing the extent to which the world's food can be produced in the lowest-cost countries at any point in time and by slowing the growth in farm productivity over time. Productivity is slowed because such trade restrictions reduce the incentive for public and private sector researchers to develop better GM varieties. This is unfortunate because agricultural biotechnologies, and especially transgenic crops, have enormous potential to boost food security in developing countries by offering higher incomes for farmers, fewer environmental and farmer health risks, and lower-priced and prospectively better quality foods for consumers (Zilberman et al. 2007).

The purpose of this chapter is to provide estimates of the benefits foregone by trade policies that discourage GM crop production. It begins with a brief history of both agricultural technology development leading up to the introduction of GM crops and policy reactions to that new biotechnology. It then presents three sets of estimates based on the global economy-wide GTAP model. The first set focuses on how national welfare has been affected by this new technology in GM-adopting countries, in the European Union (EU), and in non-adopting developing countries.

The results suggest the foregone economic welfare gains from crop biotechnology adoption are very large and that those benefits would be diminished only very slightly by the EU's restriction on imports of GM foods. That is, if developing countries retain bans on GM crop production simply in an attempt to maintain access to EU markets for non-GM products, the loss to their food consumers as well as to farmers in those developing countries is huge relative to the slight loss that might be incurred from not retaining EU market access. The second set of modeling results focuses on the prospects for developing countries should they be willing to adopt GM rice and wheat. The third set focuses on the prospective welfare gains for developing countries from adopting GM cotton.

## Brief History of Agricultural Technology Developments and of Policy Reactions to GM Biotechnology

Up until the nineteenth century, the pace of improving the productive efficiency and quality of the world's food crops had been slow (Diamond 1997). Then, following a century of wheat improvements (Olmstead and Rhode 2002, 2011), hybrid varieties dramatically increased average corn yields from the 1940s (Griliches 1958; Beddow and Pardey 2015) and dwarf varieties of high-yielding wheat and rice caused what became known as the Green Revolution in Asia and elsewhere from the 1960s (Evenson and Gollin 2003; Ruttan 2004). Those new dwarf varieties made a major contribution to global food security: they boosted real incomes of the adopting farmers, the vast majority of whom were among the world's poorest households; they lowered prices for net buyers of cereals both in the adopting countries and, through trade, in other parts of the world; and they had a major effect on global food security and human welfare through reducing child mortality (Rosegrant et al. 2014). Moreover, that expansion in global food security was possible without having to expand the agricultural land frontier (Babcock 2015).

Those technological developments of the past six decades contributed to an acceleration of the long-term decline in real international food prices so that, by the mid-1980s, they were below 1930s' levels (Figure 1.1a). That, in turn, led to complacency about the need for further agricultural research. As a result, growth in public funding for such research fell substantially in both rich and poor countries (Pardey et al. 2013, 2016)—despite overwhelming evidence that this is a very high payoff investment area (Alston et al. 2000). In particular, the aid agencies and foundations reduced their support for the Consultative Group on International Agricultural Research (CGIAR) and for complementary national agricultural research systems in developing countries—which quickly led to fears that food crop productivity growth would become slower (Runge et al. 2003).

The emergence of new agricultural biotechnologies, and in particular transgenic crop varieties, in the 1990s seemed to offer new hope that the private sector might fill this lacuna.

However, to those early hopes were added three concerns in some people's minds. One was that a small number of huge biotech firms would capture most of the gains from the new agricultural biotechnology. This ignores the fact that competition among those firms forces down the selling price of new seeds, and that farmers will only adopt the new technology if they perceive a net benefit to themselves.

A second concern was that those firms would not invest in poor countries where profits might be slim because of poor protection of intellectual property rights, the high cost of getting over national regulatory barriers, and small commercial seed markets (Pray and Naseem 2007). In so far as these characteristics prevail, the solution lies in improving property rights, streamlining the regulatory processes, and opening up the seed market to more competition.

The third concern was that Europeans and others would reject the technology because of environmental and food safety concerns, thereby thwarting export market prospects for adopters of the transgenic crops (Pinstrup-Andersen and Schioler 2000; Paarlberg 2003, 2009). That third concern was vindicated by the EU's imposition, in late 1998, of a *de facto* moratorium on the production and importation of food products that may contain genetically modified organisms (GMOs). The EU's moratorium helped to constrain widespread adoption to just three GM food/feed crops (maize, soybean, and canola) in three countries where production had already taken off by 1998, namely the USA, Argentina, and Canada. Even when the other important GM crop is added (cotton), those three countries continued to dominate GM production until recently when Brazil and India joined that group (James 2015)—in India's case solely because of cotton so far.

In May 2004, the EU replaced its moratorium with new regulatory arrangements, but they involve such onerous and laborious segregation, identity preservation, and labeling requirements as to be almost as restrictive of exports of GM products as was the moratorium. With a number of other countries also imposing strict labeling regulations on GM foods (Carter and Gruere 2006), and even private importing firms seeking GM-free foods (Gruère and Sengupta 2009), biotech firms are diverting more of their R&D investments away from food. At the same time, the public agricultural research system has been shy about investing heavily in this technology—including the CGIAR, which depends heavily on rich-country grants from EU member states.

How are these events affecting food security in developing countries, where food security can be thought of as everyone having access to the minimum amount of basic food that is necessary for survival, that is, having the wherewithal to grow or to purchase a minimum basket of food? Transgenic crops can boost food security in either of two ways: by improving a farm household's net real earnings (including the implicit value of subsistence food production but also earnings from cash crops such as cotton), or by lowering the price or improving the quality of the food brought by a non-farm household. The real price of food in international markets would be lowered because of farm productivity growth in any trading countries that adopt the new technology, and that would reduce food prices in the domestic market of all countries that are at least somewhat open to trade.

What has been the impact on developing country welfare of the limited adoption of GM varieties so far and of the EU's reaction to that, and what would be the impacts of wider adoption of GM crops? This question is addressed by considering, first-generation corn and oilseed GM crops in the next section, the prospective adoption of first- or second-generation (nutritionally enhanced) rice and wheat in the following section, and then the adoption of GM cotton in the next. This is done by drawing on empirical data and some simulation results from the multi-country, multi-product model of the global economy known as GTAP (described in the first section of Chap. 6).

China and India are the most significant developing countries to consider, in the sense that they housed the majority of the world poor (Chen and Ravallion 2010, Castañeda et al. 2016), they comprise almost one-third of the world's production and consumption of grain (and even more of cotton), and they (especially China) have the potential to rapidly apply and disseminate this new biotechnology. But Sub-Saharan Africa is also of crucial concern, given its extreme poverty and strong dependence still on agriculture for employment and export earnings and, in some cases, on food aid imports (which can be problematic if food provided as aid is not GM free, as was the case for US shipments to southern Africa in 2002).

## Initial National Welfare Effects in GM-Adopting Countries, in the EU, and in Non-Adopting Developing Countries

To estimate the welfare consequences of policies affecting GM crop adoption, a model of the world economy is needed. The results summarized in this section make use of the global model known as GTAP (see Hertel 1997).[2] Specifically, the base case in the GTAP model, which for this chapter is calibrated to 1997 just prior to the EU moratorium being imposed, is compared with an alternative set of simulations, whereby the effects of adoption of currently available GM varieties of maize, soybean, and canola by the first adopters (Argentina, Canada, and the USA) is explored without and then with the EU *de facto* moratorium on GMOs in place.[3] Plausible assumptions about the farm productivity effects of these new varieties and the likely percentage of each crop area that converts to GM varieties are taken from the available literature on that era including Marra et al. (2002), Qaim and Zilberman (2003), and Huang et al. (2004).[4]

**Table 7.1** Estimated economic welfare effects of GM coarse grain and oilseed adoption by various countries (equivalent variation in income, 1997 US$ million per year)

| | *US, CAN, and ARG adopt* | | *All countries adopt* | |
|---|---|---|---|---|
| | *Without policy response* | *With EU moratorium* | *Without policy response* | |
| | *Sim 1a* | *Sim 1b* | *Sim 1c* | *EV as % of GDP (sim 1c)* |
| Argentina | 312 | 247 | 287 | 0.11 |
| Canada | 72 | 7 | 65 | 0.01 |
| USA | 939 | 628 | 897 | 0.01 |
| EU-15 | 267 | −3145 | 595 | 0.01 |
| Southern African Customs Union | 3 | 7 | 9 | 0.01 |
| Rest of Sub-Saharan Africa | −2 | 14 | 60 | 0.03 |
| Rest of the world | 700 | 1027 | 2204 | 0.02 |
| **WORLD** | **2290** | **−1243** | **4047** | **0.013** |

*Source*: Anderson and Jackson (2005)

The estimated national economic welfare effects of the first set of these shocks are summarized in Table 7.1. Assuming no adverse reaction by consumers or trade policy responses by governments, the first column shows that the adoption of GM varieties of coarse grains and oilseeds by the USA, Canada, and Argentina would have benefited the world by almost US$2.3 billion per year, of which US$1.3 billion is reaped in the adopting countries, while Asia and the EU enjoy most of the rest (through an improvement in their terms of trade as net importers of those two sets of farm products). The only losers in that scenario are countries that export those or related competing products. Australia and New Zealand lose slightly (not shown in Table 7.1) because their exports of grass-fed livestock products are less competitive with now cheaper grain-fed livestock products in GM-adopting countries. But so too do the countries of Sub-Saharan Africa (SSA excluding South Africa), although again only slightly. South Africa gains slightly as a net importer of coarse grains and oilseeds.

Column 2 of Table 7.1 shows the effects when the EU's moratorium is taken into account. The gains to the adopting countries are one-third less, the EU loses instead of gains (not accounting for the value EU consumers place on being certain they are not consuming food containing GMOs), and the world as a whole is worse off (by US$1.2 billion per year, instead of better off by US$2.3 billion, a difference of US$3.5 billion) because the gains from the new technology would be more than offset by the massive increase in agricultural protectionism in the EU due to its import restrictions on those crop products from GM-adopting American countries. For SSA other than South Africa, however, welfare would be US$46 million per year greater than in Sim 1b because in Sim 1c African farmers are able to sell into the EU with less competition from the Western Hemisphere. As a proportion of GDP, those economies gain three times as much as does South Africa (see final column of Table 7.1).

However, if by adopting the technology in the EU the rest of the world also became uninhibited about adopting GM varieties of these crops, global welfare would be increased by nearly twice as much as it would when just North America and Argentina adopt, and almost all of the extra global gains would be enjoyed by developing countries. If one believes the EU's policy stance is determining the rest of the world's reluctance to adopt GM varieties of these crops, then the cost of the EU's moratorium to people outside the EU15 was up to US$0.4 billion per year for the three GM-adopting countries (compare columns 2 and 3 of Table 7.1) and US$1.1 billion per year for other developing countries early this century.

Those estimates under-state the global welfare cost of the EU's policy in at least four respects, however. First, the fact that the EU's stance has induced some other countries to also impose similar moratoria on GM food crops (if not cotton) has not been taken into account. Sri Lanka was perhaps the first developing country to ban the production and importation of GM foods. In 2001, China did the same (with some relaxation in 2002), having been denied access to the EU for some soy sauce exports because they may have been produced using GM soybeans imported by China from the USA. Second, these are comparative static simulations that ignore that fact that GM food R&D is on-going and that investment in this area has been reduced considerably because of the EU's extreme policy stance as biotech firms redirect their investments toward pharmaceuticals and industrial crops instead of food crops. Third, the gains for the biotech firms that produce GM seeds are ignored in these results (and all subsequent simulations reported below). Fourth, the above results refer to GM adoption just of coarse grains and oilseeds. The world's other two major food crops are rice and wheat, for which GM varieties have been developed and are close to being ready for commercial release.

## How Might GM Rice and Wheat Adoption Affect Developing Countries?

The above numbers refer to adoption only of GM food crop varieties currently in production. If first-generation (i.e., farm productivity enhancing) GM rice and wheat adoption also were to be allowed at the rates assumed in footnote 4, global welfare would be increased by nearly twice as much (compare bottom row of column 3 of Tables 7.1 and 7.2: US$7.5 versus US$4.0 billion) because the market for those two crops is even larger than for coarse grains and oilseeds. Again, though, SSA economies would gain little if they do not participate, with the benefit in terms of enhanced competitiveness from abstaining in the presence of the EU moratorium being very minor relative to the foregone productivity benefits from adopting the new technology. Comparing columns 2 and 3 of Table 7.2, these results suggest SSA would be better off by more than US$130 million per year if the world were to embrace first-generation GM technology for all four groups of food crops rather than for just coarse grains and oilseeds.

While second-generation (nutritionally enhanced) GM rice and wheat have not yet been commercialized, several varieties have been approved for field trials and environmental release in various parts of the world. An early

**Table 7.2** Estimated economic welfare effects of GM coarse grain, oilseed, rice, and wheat adoption by various countries (equivalent variation in income, 1997 US$ million per year)

| | *US, CAN, ARG, CHN, and IND adopt* | | *All countries adopt* | |
|---|---|---|---|---|
| | *Without policy response* | *With EU moratorium* | *Without policy response* | |
| | *Sim 2a* | *Sim 2b* | *Sim 2c* | *EV as % of GDP (sim 2c)* |
| Argentina | 350 | 285 | 312 | 0.12 |
| Canada | 83 | –23 | 63 | 0.01 |
| US | 1045 | 754 | 1041 | 0.01 |
| China | 841 | 833 | 899 | 0.25 |
| India | 669 | 654 | 669 | 0.14 |
| EU15 | 355 | –4717 | 810 | 0.01 |
| Southern African Customs Union | 7 | 11 | 15 | 0.01 |
| Rest of Sub-Saharan Africa | 5 | 27 | 187 | 0.11 |
| Rest of the world | 964 | 1322 | 3509 | 0.03 |
| **WORLD** | **4308** | **–892** | **7506** | **0.024** |

*Source*: Anderson and Jackson (2005)

study found that, even under conservative adoption and consumption assumptions, introducing Golden Rice in the Philippines could decrease the number of disability-adjusted life years (DALYs) lost due to Vitamin A deficiency by between 6 and 47 % (Zimmermann and Qaim 2004). That is equivalent to an increase in unskilled labor productivity of up to 0.53 %. Based on those findings, Anderson et al. (2005) represent these health impacts with an assumed 0.5 % improvement in unskilled labor productivity in all sectors of Golden Rice-adopting Asian developing economies. Given the low nutrition levels of poor workers in Africa, and the fact that nutritionally enhanced GM varieties of wheat and other foods would soon follow if Golden Rice were to be adopted in Asia and Africa, we assume the productivity of unskilled labor would rise by 2 % following adoption of second-generation GM crops. We also assume no direct impact on the productivity of skilled laborers, who are rich enough to already enjoy a nutritious diet.[5] And to continue to err on the conservative side, we assume second-generation GM crop varieties are no more productive in the use of factors and inputs than traditional varieties net of segregation and identity preservation costs, even though there is evidence to suggest they may indeed be input-saving.[6]

Table 7.3 suggests this second-generation GM technology could have a major impact on poor people's welfare: if it were to be adopted in SSA, for example, its estimated gain is 18 times as great as it would be if the GM varieties were just farm productivity enhancing (compare Sims 2c and 3a). And again, this startling result is independent of whether the EU maintains its moratorium (compare Sims 3a and 3b). Needless to say, adopting these second-generation GM varieties in the developing countries of Asia would add far more, given the large population of rice and wheat consumers in Asia. Anderson et al. (2005) show that even Golden Rice on its own could add US$3.2 billion per year to developing country economic welfare.

## What Difference Can GM Cotton Make to Developing Country Welfare?

Cotton is produced predominantly for its fiber, even though oil from cottonseed becomes part of the world's edible oil supply. That does not mean it has no role in reducing under-nutrition in the world, however. On

**Table 7.3** Estimated economic welfare effects of GM crop adoption with Sub-Saharan Africa's being second-generation, nutritionally enhanced rice and wheat (equivalent variation in income, 1997 US$ million per year)

| | *US, CAN, ARG, CHN, and IND adopt first-generation GM coarse grains, oilseeds, rice and wheat, and SSA adopts 2nd generation rice and wheat* | |
|---|---|---|
| | *Without EU moratorium* | *With EU moratorium* |
| | *Sim 3a* | *Sim 3b* |
| Southern African Customs Union | 1786 | 1789 |
| Rest of Sub-Saharan Africa | 1824 | 1846 |
| **All Sub-Saharan Africa** | **3610** | **3635** |

*Source*: Anderson and Jackson (2005)

the contrary, cotton is one of the world's oldest cash crop. Traditionally, its processing has been a source of value adding within the household of cotton-growing farmers in Asia, Latin America, the Middle East, and Africa for millennia, both in terms of providing raw material for spinning and weaving into home-made fabric and clothing and for selling to processors and traders (Beckert 2014). Raising its productivity is therefore a potential source of growth in rural incomes, including those of the world's poorest farm households.

GM cotton production began in the USA in 1996, but the spread of GM cotton to large developing countries in the new millennium has been rapid. By 2009, GM varieties accounted for half of all land sown to cotton globally. Since then, India has become the world's largest producer of cotton, raising the share of its cotton area planted to GM varieties—which was zero in 2001—from five-sixths in 2009 to nine-tenths by 2015 (James 2015). The USA and China account for much of the rest, with the other early adopters being Australia and South Africa.

A study by Anderson et al. (2008b) estimates the impact adoption by those first four countries had on global welfare prior to India joining the group in 2002, and how much greater would be that impact once India came on board and other producing countries were to promote widespread adoption of GM cotton varieties. Their results are drawn again from the global GTAP model.

That study reveals that world cotton output hardly changed between 1996 and 2001. This is because the output gains in the first four GM-adopting countries were offset by output losses in the non-adopting countries, which were driven by the downward pressure on the average price of cotton in international markets (which fell by 2.5 % as a result of this initial adoption, according to that study).[7] Globally, both value added by cotton farmers and the value of cotton exports were reduced by about 1 % and by more than that in most non-adopting regions. The largest regional changes in value added in cotton production are in Sub-Saharan Africa, with a rise of 3.5 % in South Africa and a fall of 4.4 % in the rest of Sub-Saharan Africa by 2001. Among the GM cotton adopters, estimated value added in cotton production fell in both the USA and China, in part because of the decline in export prices. This is not to say individual farmers in those countries were irrational in adopting GM cotton, because had they not, they would have still suffered from the product price fall, following adoption by other farmers, but would not have had a productivity improvement to partly offset it.

The net economic welfare effects of this initial adoption of GM cotton are summarized in Table 7.4. For all four adopting countries, this was positive despite the loss due to their terms of trade deterioration, while welfare improved in all non-adopting regions but one. This is because they are net importers of cotton and so enjoy an improvement in their terms of trade and a greater flow of imports. The exceptional non-adopting region is Sub-Saharan Africa (excluding South Africa), which, as a net exporter of cotton, faces lower cotton export prices and also has resources move to sectors in which it had a lesser comparative advantage. Globally, annual economic welfare is estimated to have been enhanced by more than US$0.7 billion from GM cotton adoption as of 2001, plus whatever net profits accrued to the biotech and seed firms (which are not explicitly modeled).

In the next scenario, in which all other countries then adopt GM cotton, cotton output in the early-adopting countries falls in response to the output expansion in newly adopting regions. If Sub-Saharan Africa continues to procrastinate, its cotton output, value added, and exports would fall even further; but if it also were to embrace this technology, its cotton industry would expand more than any other region's and would more than make up its losses to 2001 from adoption by the first four adopters. Global welfare is boosted very much more with greater adoption by developing countries. Even without Sub-Saharan Africa adopting, it would jump to US$2.0 billion per year. But adoption by Sub-Saharan Africa would raise that global benefit to US$2.3 billion, with two-thirds of that extra US$0.3 billion being enjoyed by Africa (more than offsetting its earlier loss because of adoption by others up to 2001), and the rest by cotton-importing regions. Asia's developing countries that are net importers of cotton gain even if they grow little or no cotton, not only because of greater imports but also because the international price of that crucial input into their textile industry would be lowered further by an average of 4.1 % when Sub-Saharan Africa also adopts, as compared with 2.5 % from GM adoption by just the first four adopting countries). With complete catch-up as in this third scenario, the gains to Central Asia, Sub-Saharan Africa, and South Asia are 10, 13, and 23 times greater than the global gains when expressed as a percentage of regional GDP (last column of Table 7.4). South Asia's values are especially large because it is a large producer of both cotton and textiles. In the light of these results, it is not surprising that both India and Pakistan have adopted GM cotton so rapidly and so completely.

**Table 7.4** Effects of GM cotton adoption on national economic welfare as of 2001 (equivalent variation in income, 2001 US$ million)

| | *4 countries adopt* | | *All but SSA adopt* | | *All including SSA adopt* | | |
|---|---|---|---|---|---|---|---|
| | *TFP Shock (%)*[a] | *Welfare change (US$ million)* | *TFP Shock (%)* | *Welfare change (US$ million)* | *TFP Shock (%)* | *Welfare change (US$ million)* | *Welfare change (% of GDP)* |
| Adopters as of 2001 | | | | | | | |
| USA | −5 | 324 | 0 | 61 | 0 | 57 | 0.001 |
| China | −2.5 | 162 | 2.5 | 113 | 2.5 | 100 | 0.009 |
| Australia | −5 | 26 | 0 | −14 | 0 | −28 | −0.008 |
| South Africa | −5 | 2 | 0 | 5 | 0 | 12 | 0.010 |
| Non-adopters as of 2001 | | | | | | | |
| Other high-income countries | 0 | 147 | 5 | 271 | 5 | 337 | 0.003 |
| Eastern Europe and Central Asia | 0 | 5 | 5 | 325 | 5 | 317 | 0.048 |
| Southeast Asia (excl. China) | 0 | 36 | 5 | 31 | 5 | 63 | 0.009 |
| South Asia | 0 | 14 | 5[b] | 964 | 5[b] | 970 | 0.158 |
| Middle East and North Africa | 0 | 14 | 5 | 157 | 5 | 175 | 0.020 |
| Sub-Saharan Africa (excl. SA) | 0 | −17 | 0 | −18 | 15 | 187 | 0.091 |
| Latin America and Carib. | 0 | 29 | 5 | 124 | 5 | 135 | 0.007 |
| **World** | | **742** | | **2018** | | **2323** | **0.007** |

[a]By applying a negative TFP shock to cotton production, we examine how the world would have been had that productivity gain from cotton GM adoption not taken place in these countries (but for comparative purposes, we express the welfare results with the opposite signs)

[b]Except for India, where the TFP is 15 %

*Source*: Anderson et al. (2008)

## Caveats

As with all CGE modeling results, the above are subject to a number of qualifications. One has to do with the way food consumer preferences are handled. The estimated market and welfare effects vary with the elasticities of substitution assumed between GM and non-GM varieties of a product. Anderson et al. (2002) examine this issue and show that this is unlikely to be an important issue because results do not vary much as those elasticities (which are set very low for Europe and Northeast Asia and at moderate levels elsewhere) are altered.

Of more importance is that there is no satisfactory way of valuing any loss of welfare for consumers who would like to avoid consuming foods containing GMOs but cannot if such foods are introduced into their marketplace without credible labeling. Since the above studies assume that loss to be zero (following WHO 2005), they over-state the gains from adopting this technology to that extent. An alternative way to cope with this issue is to introduce a cost of segregation and identity preservation. That has been done implicitly by choosing conservative cost savings due to the new technology, saying they were net of any fees charged for segregation and identity preservation. If such fees were a high share of the farm gate price, it would be unprofitable to market many GM varieties if that was a required condition of sale. But some suggest those costs could be miniscule—at least in developed economies—on the grounds that such segregation is increasingly being demanded by consumers of many conventional foods anyway (e.g., different grades or varieties or attributes of each crop) so the marginal cost of expanding such systems to handle genetic modification would not be great, at least in countries that have already shown a willingness to pay for product differentiation.

The version of the GTAP database used in this chapter's modeling (unlike in Chap. 6) does not include tariff preferences enjoyed by Africans exporting to the EU. In so far as they enjoy preferences on the products considered above, then African exporters are currently receiving the domestic EU price minus trading costs (including the share of the tariff rent enjoyed by the importing firms). That price would be raised by the EU moratorium on GM products, but whether that rise would be greater or less than the rise in the international price of GM-free varieties sold to the EU under non-preferential conditions is unclear. In practice, this issue is likely to be of minor importance though for two reasons. One is that the EU's most-favoured-nation (MFN) tariffs on coarse grains and oilseeds are low and hence so is the margin of preference. The other is that many exporters find the rules of origin so complicated that it is cheaper for them just to pay the regular import duty rather than try to take advantage of tariff preferences.

In all these simulations, it is assumed for simplicity that there are no negative environmental risks net of positive environmental benefits associated with producing GM crops, and that there is no discounting and/or loss of market access abroad for other food products because of what GM adoption does for a country's generic reputation as a producer of 'clean, green, safe food'. In fact some GM crops (e.g., cotton) will reduce not only negative environmental externalities but also farmers' health risks associated with spraying pesticides (see Hossain et al. 2004; Qaim 2016, Chap. 3).

It is difficult to know how close to the mark is our assumed boost to unskilled labor productivity following adoption of second-generation GM varieties (see Stein et al. 2008). But even if it is a gross exaggeration, discounting heavily the massive magnitude of the estimated welfare gain from adopting such varieties would still leave a large benefit—particularly bearing in mind that developing countries are being offered this technology at no cost by its private sector developers, and that the above studies included no valuation of the non-pecuniary gain in well-being for sufferers of malnutrition. The cost of adapting the off-the-shelf technology to local conditions in Africa may well be non-trivial, however, and may require a better functioning agricultural research system than has operated in the past four decades (as evidenced by Africa's relatively poor take-up of the previous Green Revolution—see Evenson and Gollin 2003).

Perhaps most importantly, the above comparative static modeling assumes first-generation GM technology delivers just a one-off increase in total factor productivity for that portion of a crop's area planted to the GM varieties. But what is more likely is that, if/when the principle of GM crop production is accepted, there would be an increase in the *rate* of agricultural factor productivity growth into the future. Similarly, second-generation GM varieties with additional health attributes such as those associated with Golden Rice would be quicker in coming on stream the more countries embraced the technology. And biotech firms would be encouraged to invest more in non-food GM crop varieties too (adding to the success already achieved with GM cotton) if there was an embracing of currently developed GM crop varieties by Sub-Saharan African and other developing countries. Hence, the present value of future returns from GM adoption may be many times the numbers shown above. For that reason, care is needed in interpreting cases where our results suggest that when rich countries introduce trade barriers against GM products, food-importing developing countries benefit. This is because our analysis does not take into account that moratoria have slowed the investment in agricultural biotechnology, and so reduced future market and technological spillovers to developing countries from that prospective R&D.

## Key Messages

Concerns that products containing GMOs may be unsafe as food or animal feed, or that GMO seed plantings may have adverse effects on the natural environment or contaminate fields of non-GMO crops, have led to technology policies that have reduced global food production growth and associated trade policies that diminish the role that food trade can play in boosting global food security. Those policies have persisted in spite of the fact that there is no evidence that GM crops have greater adverse impacts on health or the environment than non-GM crops. On the contrary, GM crop varieties are reducing the need for agrochemicals that harm the environment and farmer health. Moreover, they could greatly improve the micronutrient content of our food if second-generation biofortified GM varieties such as Golden Rice were also to be embraced.

This GM policy development is unfortunate because the above modeling results show that these new agricultural biotechnologies promise much to the countries willing to allow GM crop adoption. Yet import barriers to food markets in Western Europe in turn have led many African and Asian governments to ban GM crop production for fear that their country's agricultural exports even of non-GMO products may then be rejected by concerned governments abroad. Such production bans, according to the above modeling results, generate little if any net benefit to the developing countries imposing them: the domestic consumer loss net of that protectionism boost to African and Asian farmers is far more than the small gain in terms of greater market access to the EU.

The stakes in this issue are thus very high. GM crops offer welfare gains that could alleviate poverty and food insecurity directly, substantially, and relatively rapidly in those countries willing to allow adoption of this new biotechnology. If developing countries do not share the food safety and environmental concerns of Europeans regarding GMOs, their citizens in general, and their poor in particular, have much to gain from allowing imports of GM food, letting their farmers adopt GM crop varieties, and exporting any surpluses that result from the increase in farm productivity. Moreover, those prospective gains from this new technology will increase as climate change proceeds and requires adaptation by farmers to changes in weather patterns and in particular to increased weather volatility and higher costs of water for irrigation.

## Notes

1. The environmental and food safety concerns have been strongly voiced by non-government organizations (NGOs) over the past more than two decades. That position has attracted many donations to NGOs, who understandably do not want to alter it just because the science has become clearer and does not support it. Another reason behind European decisions to not allow GM crops may be because European life science companies had the upper hand in chemicals-based crop protection technologies but were behind US firms in the agricultural biotech field (Graff and Zilberman 2004; Graff et al. 2009).
2. This section draws on results presented in Anderson and Jackson (2005), which, in turn, have been inspired by earlier global modeling analysts including Nielsen and Anderson (2001), Stone et al. (2002), and van Meijl and van Tongeren (2004).
3. This has to be done in a slightly inflating way in that the GTAP model is not disaggregated below 'coarse grains' and 'oilseeds'. However, in the current adopting countries (Argentina, Canada, and the USA), maize, soybean, and canola *are* the dominant coarse grains and oilseed crops.
4. The study assumes 45 % of US and Canadian coarse grain production is GM and, when they adopt, all Latin American countries and Australia are assumed to adopt GM coarse grains at two-thirds the level of the USA, while all other countries are assumed to adopt GM coarse grains at one-third the level of US adoption. For oilseeds, it is assumed that 75 % of oilseed production in the USA, Canada, and Argentina (and Brazil when we allow it) is GM. Again, other Latin American countries and Australia are assumed to adopt at two-thirds the extent of the major adopters and the remaining regions adopt at one-third the extent of the major adopters. For the prospective rice scenarios in the next section, major assumed adopters, including the USA, Canada, China, India, and all other Asian countries, are assumed to produce 45 % of their crop using GM varieties. All other regions adopt at two-thirds this rate. Prospective GM wheat adoption is assumed to occur to the same extent as coarse grain adoption for all regions. The GM varieties are assumed to enjoy higher total factor productivity than conven-

tional varieties to the extent of 7.5 % for coarse grains, 6 % for oilseeds, and 5 % for wheat and rice. The simulations are able to estimate the equivalent variations in income, measured in 1997 US$, that would result from these assumed degrees of adoption and productivity growth for the GM potion of each crop and its consequence effect on markets. Today, these adoption rates look very conservative, since they are above 90 % in all the major adopting countries now (James 2015).

5. There would also be non-pecuniary benefits of people feeling healthier, and less expenditure on health care, but these too are ignored so as to continue to err on the conservative side.
6. Bouis (2002, 2007) and Welch (2002) suggest nutritionally enhanced rice and wheat cultivars are more resistant to disease, their roots extend more deeply into the soil, so they require less irrigation and are more drought resistant, they release chemical compounds that unbind trace elements in the soil and thus require less chemical inputs, and their seeds have higher survival rates.
7. That estimated price fall would have been somewhat less had GM corn and soybean adoption also been included at the same time, since that would have reduced the extent of diversion of resources to cotton.

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CHAPTER 8

# International Food Price Spikes and Temporary Trade Policy Responses

Between mid-2005 and mid-2008, real food prices in international markets rose by 65 % and, within that group, cereal prices rose 130 %. They began to drop back toward trend late in 2008, only to rise steeply again by end 2010 along with the prices of energy raw materials. Then, for a third time in five years, cereal prices peaked yet again at end 2012 (Fig. 8.1). Since more than half the budget of poor households in developing countries is spent on food, this had the potential to greatly exacerbate poverty. Such a combination of high and fluctuating food prices understandably raises food security concerns. One response by numerous developing country governments, on this as on previous occasions, was to alter their food trade restrictions to reduce the transmission of those spikes to their domestic food markets.

However, the set of factors influencing the *trend level* of food prices is not the same as the set affecting the *volatility* of food prices around that long-run trend. Also, the distributional and especially poverty effects of fluctuating prices—and of policy responses to them—differ from those associated with changes in the trend price level. This pair of facts is important to recognize because, unless societies and governments clarify what concerns them most, it is not possible to identify the most appropriate policy actions to ease those concerns.



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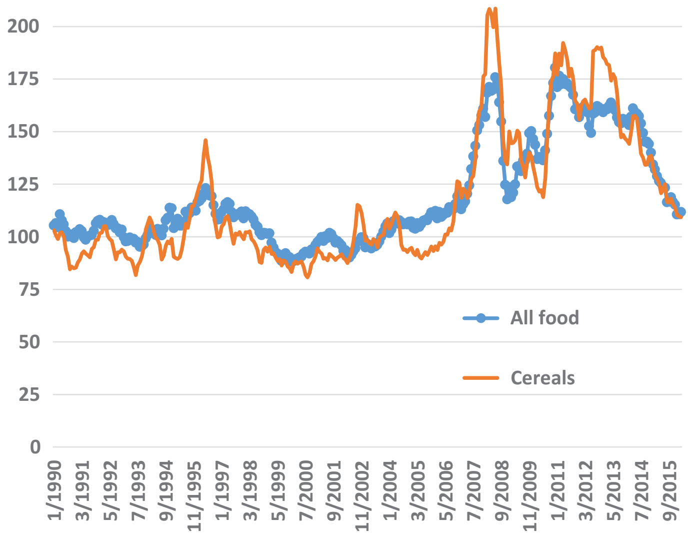



**Fig. 8.1** Monthly real food price indexes in international markets, January 1990 to March 2016 (2002–04 = 100). *Source*: http://www.fao.org/worldfoodsituation/foodpricesindex/en/, accessed 19 April 2016

From the viewpoint of meeting the United Nations' prime long-run Sustainable Development Goals of permanently eradicating extreme poverty and hunger, the concern over high prices should take precedence over concerns about fluctuating prices. Certainly, some groups are harmed by fluctuating food prices, but others can benefit or at least adapt with agility (Barrett and Bellemare 2011).

Even so, governments of low-income countries are prone to respond in a knee-jerk attempt to reduce the extent of the rise in the domestic market price. This can be effective in reducing the volatility of domestic prices in reactive countries, but the collective impact of these interventions by a large number of countries is to increase the volatility of international prices—and thereby to increase the domestic price volatility in more open countries. Moreover, the only way that price insulation can be effective in reducing global poverty is if the countries that insulate most are those in which the poor are most vulnerable to price spikes.

Is it possible that the insulating policy responses of developing countries transfer the food price volatility to high-income countries that are much better placed to manage this volatility? That would require high-income countries to be not using insulating policies themselves and to be significant players in world food trade. It turns out that despite the abolition of variable import levies following the Uruguay Round and the move to decouple payments as a means of supporting rich-country farmers, farm policies of high-income countries still do provide some insulation from price fluctuations abroad. Also, those countries account for a small fraction of global production and trade in some food staples. For example, their shares are less than 5 % in the case of rice, which is particularly sensitive in many poor countries. Thus, they provide little opportunity to absorb price volatility in that product.

This chapter explains conceptually, and illustrates empirically, how insulation measures do little to advance national food security or reduce global poverty and how collectively they imperil global food security. The empirical evidence of the extent to which insulation measures have exacerbated the spike in international food prices is first provided using a single-commodity, partial equilibrium, back-of-the-envelope (BOTE) model and then using the Global Trade Analysis Project (GTAP) economy-wide global computable general equilibrium (CGE) model. Despite their different features, the results from these two different approaches are surprisingly similar in that they both conclude that insulating policy action added very substantially to the 2006–08 spike in international food prices. So, while this widespread practice of price insulation can stabilize domestic prices in countries that insulate to a greater than average degree, it *destabilizes* domestic prices in those countries that insulate to a less-than-average degree. Since, by definition, not all countries can insulate by more than the average, price insulation measures cannot reduce price volatility in all countries. Rather, it merely redistributes volatility from high-insulator to low-insulator countries.

The chapter then explores the extent to which such actions prevented vulnerable people from falling into extreme poverty in 2008. The results show that had there been no spillover effect on international prices from those actions, there would have been some countries in which a poverty increase was alleviated. However, once the exacerbating impact on international prices of many countries so acting is taken into account, the results suggest that those actions pushed more people into poverty than would have happened in the absence of government responses.

## Drivers and Effects of Domestic Market Insulation Actions: Theory

Even in the absence of generic national social safety nets, governments may be able to directly assist consumers when international prices spike upward (or assist farmers when prices slump) at lower economic cost and more effectively than via altering their restrictions on trade. But trade measures are very often considered by policy makers to be the only feasible political instrument available to them for quick action. In such cases, when international food prices rise above trend, agricultural export restrictions tighten in food-exporting countries and food import restrictions are eased (or import subsidies introduced or raised) in countries that are net importers of food—and conversely when international food prices fall below trend.

Corden (1997, pp. 72–76) suggests that pattern of intermittent border interventions implies a conservative social welfare function. A social objective function that represents this type of preference has been suggested by Jean et al. (2011) and is closely related to one developed by Freund and Özden (2008). Specifically, Jean, Laborde and Martin's model predicts that the higher the international price of food in any year relative to its long-run trend value, the lower will be the rate of distortion of domestic food prices that year, other things equal. More than that, the key coefficient in their model is one minus the coefficient of price insulation in the international-to-domestic price transmission equation estimated by Tyers and Anderson (1992). It suggests that such policy makers will adjust their rates of distortion to domestic food prices to partially offset deviations of international prices from their trend value.

An export tax or its equivalent lowers the domestic price below the border price of a tradable product such as grain (as does an import subsidy), whereas an import tax or its equivalent raises its domestic price above the border price (as does an export subsidy). Hence, it is not surprising that governments, in seeking to protect domestic consumers from an upward spike in international food prices, consider a change in trade measures as an appropriate response, since that raises the consumer subsidy/lowers the consumer tax equivalent of any such measure.

However, such domestic market insulation using trade measures is inefficient, possibly inequitable, and may add to rather than reduce poverty. An import tax (or export subsidy) is the equivalent of a consumer tax and a producer subsidy, hence lowering it also reduces the extent to which the measure assists producers of the product in question. Likewise, since an export tax (or import subsidy) is the equivalent of a consumer subsidy and a producer tax, raising it not only helps consumers but also harms farmers. If farming is discouraged, the demand for labor on farms falls, and with it the wages of unskilled workers not only in farm jobs but also in non-farm jobs—and more so the more agrarian is the economy. Thus, while poor households may benefit on the expenditure side from a measure that reduces the extent to which the price of food would otherwise rise, they could be harmed on the earnings side if they are sellers of food or suppliers of unskilled labor. Such trade policy responses therefore could add to rather than reduce poverty.

In the case of a small food-exporting country unable to influence its terms of trade, an increase in export restrictions is likely to reduce its national economic welfare because such measures distort domestic production in addition to lowering the consumer price of food.[1] Trade measures are wasteful too if it is only the poorest consumers who need to be helped, since a trade measure affects all food consumers in the country.

Conversely, in the case of opposite changes to trade measures aimed at protecting farmers from a spike *downward* in international prices, it is consumers who are inadvertently harmed by such trade policy responses, and all producers rather than just the poorest are helped—and in proportion to their output, thereby adding to farm income inequality.

Not only are trade measures *inefficient* in protecting a needy group from being harmed by a temporary shock to international food markets, but they are also *ineffective* if many countries respond similarly. The ineffectiveness comes about because trade barriers of *both* food-exporting *and* food-importing countries often are altered in an effort to prevent the transmission of the international price shock. To see why this leads to ineffective outcomes, it is helpful to refer to Fig. 8.2, which depicts the international market of food, which involves, in a normal year, the excess supply curve ($ES_o$) for the world's food-exporting countries and the excess demand curve for the world's food-importing countries ($ED_o$). In the absence of any trade costs such as for transport, equilibrium would be at $E_o$ with $Q_o$ units traded at international price $P_o$.

An adverse season in, say, some exporting countries, at a time when global stocks are low, would shift the excess supply curve leftward to $ES_1$.[2] If there were no policy responses, the equilibrium would shift from $E_o$ to $E_1$ and the international price and quantity traded across national borders would change from $P_o$ and $Q_o$ to $P_1$ and $Q_1$.

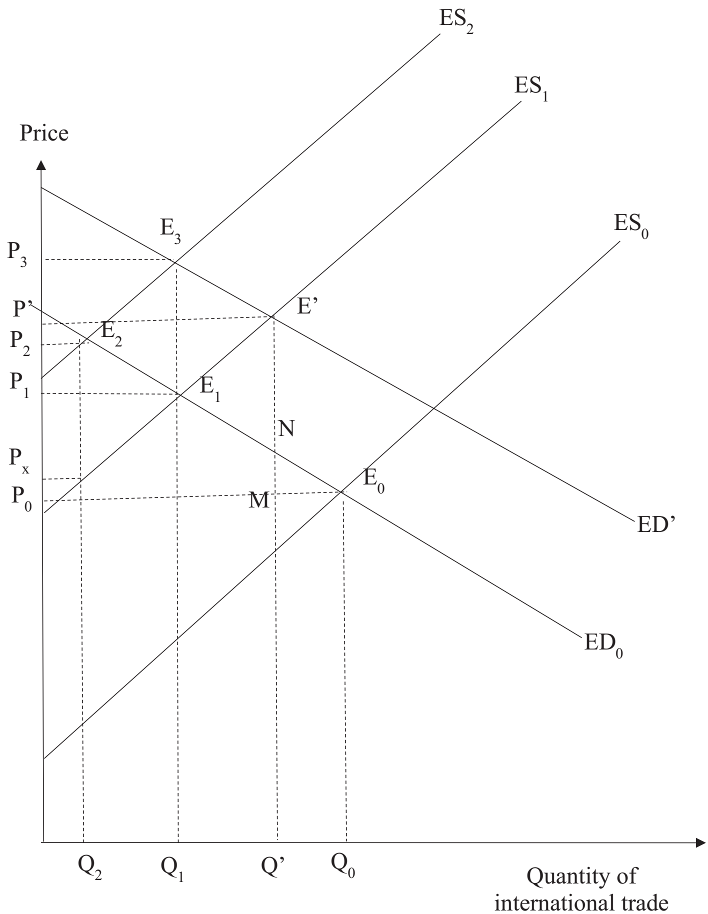



**Fig. 8.2** Effects of offsetting export barrier increases and import barrier reductions in the international market for food in response to an exogenous supply shock from $ES_0$ to $ES_1$. *Source*: Author's depiction

However, if the higher international price prompts governments to alter their trade restrictiveness, there will be additional effects.

Suppose some of the food-exporting countries choose to impose or raise a food export tax (or, in the extreme, impose an export ban). That would move the excess supply curve in Fig. 8.2 further to the left, say to $ES_2$. This would move the equilibrium to $E_2$ and raise the international price further to $P_2$—but the domestic price in those export-restricting countries would be $P_x$, which is below $P_1$. Such a reaction thus provides in those exporting countries partial insulation from the initial exogenous shock to the international market. Furthermore, their combined actions reduce aggregate exports to $Q_2$ and cause the international terms of trade to turn further in their favor because of the additional reduction in available supplies on the international market. That means, however, that food-importing countries face an even higher international price at $P_2$ instead of $P_1$.

Alternatively, suppose some protective food-importing countries were to reduce their barriers to food imports in response to the international price rising from $P_0$ to $P_1$. That would shift the excess demand curve to the right, say to ED′. In that case, the new equilibrium would be at E′, involving Q′ units traded at international price P′. That response would provide in those food-importing countries partial insulation from the initial exogenous shock to the international market: their domestic price would be only MN instead of ME′ above the pre-shock price of $P_o$ in Fig. 8.2. However, such combined actions by the importing countries would cause the international terms of trade to turn further against them.

What if both country groups intervene, each seeking to at least offset the effect on their domestic price of the initial exogenous shock and the other country group's policy response? In practice, the more one group seeks to insulate its domestic market, the more the other group is likely to respond. The example of such actions shown in Fig. 8.2 involves the curves shifting simultaneously to $ES_2$ and ED′, in which case, the international price is pushed even higher to $P_3$, while the domestic price in each country group would be lower by $E_3E_1$. That is, in that particular illustrated case, the domestic price (and the quantity traded internationally, $Q_1$) is exactly the same as if neither country group's governments had altered their trade restrictions. The terms of trade would now be even better for the food-exporting country group, and even worse for food-importing countries, than if only one of the groups altered their trade barriers. Aggregate global welfare would be the same as it would be if neither country group so altered its trade restrictions, but there would be an economic welfare transfer from food-importing to food-exporting countries, via the terms of trade change, equal to areas $P_1E_1E_3P_3$.

Conversely, if the exogenous weather shock was of the opposite sort (a bumper harvest), which even after purchases by stockholders depressed the international price, and if governments sought in that case to protect their farmers from the full force of the price fall, the international price fall would be accentuated to the benefit of food-importing countries.

Clearly, such attempted price insulation exacerbates international price volatility while doing little or possibly nothing to assist those most harmed by the initial exogenous weather shock.

## Estimating Effects of Insulation on International Prices Using a Back-of-the-Envelope Model

With the help of some simplifying assumptions, it is possible to estimate the extent to which government reactions contribute to any international food price spike with relatively little information. Martin and Anderson (2012) point out that this can be done by assuming a homogenous product whose global market equilibrium condition, assuming perfect competition and zero trade costs, is where aggregate global demand equals global supply:

$$\Sigma_i \left( S_i \left( p_i \right) + v_i \right) - \Sigma_i D_i \left( p_i \right) = 0 \tag{8.1}$$

where $S_i$ is the supply in country i; $p_i$ is the country's domestic price; $v_i$ is a random weather-related exogenous production shift variable for that country; and $D_i$ is demand in country i (assumed to be not subject to shocks from year to year). Assume further that border measures are the only price-distorting policy intervention to be used, in which case, we can define a single variable for the power of the trade tax equivalent, $T_i = (1 + t_i)$, where $t_i$ is country i's rate of tax on trade.

Totally differentiating Eq. (8.1), rearranging it, and expressing the results in percentage change form yields the following expression for the impact of a set of changes in trade distortions on the international price $p^*$, assuming the policy changes are independent of the exogenous supply shocks:

$$\hat{p}^* = \frac{\sum_i H_i \hat{v}_i + \sum_i \left( H_i \gamma_i - G_i \eta_i \right) \cdot \hat{T}_i}{\sum_i \left( G_i \eta_i - H_i \gamma_i \right)} \tag{8.2}$$

where p* is the proportional change in the international price; $v_i$ is an exogenous stochastic shock to output such as might result from above- or below-average weather; $\eta_i$ is the price elasticity of demand; $\gamma_i$ is the price elasticity of supply; $G_i$ is the share, at the international price, of country i in global demand; and $H_i$ is the share of country i in global production. That is, the impact of a change in trade distortions by country i on the international price depends on the importance of that country in global demand and supply ($G_i$ and $H_i$), as well as the responsiveness of its production and consumption to price changes in the country (as represented by $\gamma_i$ and $\eta_i$).

If it is assumed that output cannot respond in the short run and that inventory levels are low enough so that stock adjustments have limited effect (as is typically the case in a price spike period—see Wright 2011), then $_{\gamma i}$ = 0. If one further assumes that the national elasticities of final demand for the product ($\eta_i$) are the same across countries, then Eq. (8.2) reduces to

$$\sum i\, G_i\, T_i = T \tag{8.3}$$

which is simply the negative of the consumption-weighted global average of the $T_i$'s, denoted by T.

However, if the changes in trade restrictiveness are not independent of the exogenous supply (or any other) shocks, then

$$p^* = T + R + (T * R), \tag{8.4}$$

from which it follows that R = (p* − $T$)/(1 + $T$), where R refers to the rest of the influences on p*. In that case, and if the interaction term is distributed proportionately, the contribution of the changes in trade restrictiveness to the international price change, in proportional terms, is

$$\frac{\hat{T}}{\hat{T} + R}.$$

With these equations in hand, we can examine the estimates of national annual changes in distortions to domestic cereal prices attributable to changes in restrictions when international food prices spike severely.

Those distortions are captured in the estimates of nominal rates of assistance (NRA) for individual farm products that are detailed in Chap. 5 and available in Anderson and Nelgen (2013).[3]

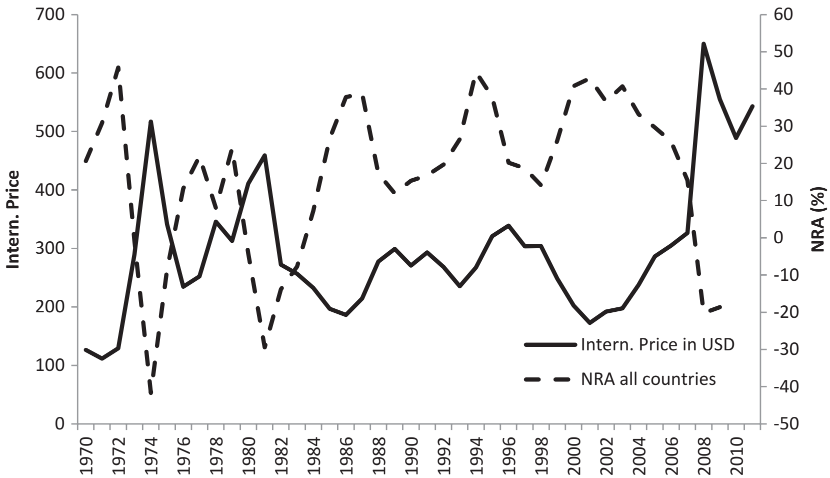
Pertinent to the present chapter is the fact that around the long-run trends in NRAs for each country, there is much fluctuation from year to year in individual product NRAs. NRAs are negatively correlated with deviations from trend in the international price of the product in question, and the most notable cases are grains: the coefficients of correlation between their international price and national NRAs for the full sample of countries from 1970 to 2010 are −0.74 for rice, −0.40 for wheat, and −0.55 for maize (Fig. 8.3).

It is clear from Fig. 8.1 that the largest upward spikes in the international food price index for decades were in 2006–08. The most extreme spike periods prior to the 2008 spike are those around 1974 (an upward price spike) and around 1986 (a downward price spike). In Table 8.1, we focus on the annual average nominal assistance coefficient (NAC = 1 + NRA/100)[4] in the spike year plus the two years each side of it, relative to the longer period either side of each short spike period.

The expectation is that the NAC would be lower in the upward spike periods than in the average of the two adjoining longer non-spike periods, and conversely for the downward spike period around 1986. That is indeed what is evident in Table 8.1, where the spike periods are shown in bold italics. Notice that the NAC changes in the two upward price spikes are negative in all but one minor case, while those in the downward spike period are all positive. That is true for both high-income and developing countries. More importantly, from the viewpoint of this chapter, it is also true for both grain-exporting and grain-importing country groups.

How much do NAC changes contribute to the upward price spikes? Martin and Anderson (2012) point out that insulating policies generate a classic collective-action problem akin to when a crowd stands up in a stadium to get a better view: those that remain seated get the worst view and so are induced to stand as well. This collective action not only is ineffective from a national viewpoint but also generates an international public ‘bad’ by amplifying the volatility in international food prices, and hence also the volatility of the income transfers associated with terms-of-trade changes. It also involves a transfer between food-importing and food-exporting countries, akin to tall people benefitting at the expense of short ones when all stand up in the stadium.

(a) Rice




(b) Wheat

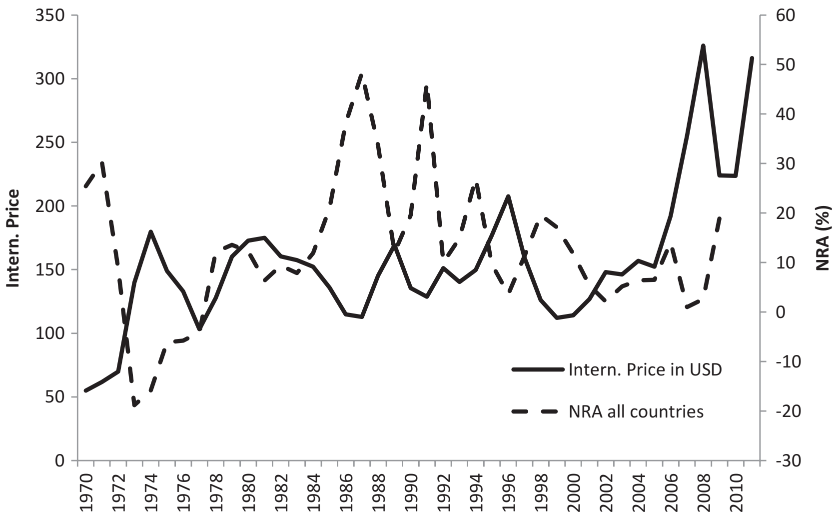



**Fig. 8.3** Rice and wheat NRAs and their international price, 82 countries, 1970–2011 (*left axis* is international price in current US dollar, *right axis* is weighted average NRA in %). (**a**) Rice and (**b**) wheat. *Source*: Based on NRA estimates and indicator prices in Anderson and Nelgen (2013)

**Table 8.1** Average annual NACs[a] for key cereals, developing and high-income countries, 1965–2010

| | *Developing countries* | | | | | | *High-income countries* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1965–72* | ***1972–76*** | *1976–84* | ***1984–88*** | *1988–2006* | ***2006–09*** | *1965–72* | ***1972–76*** | *1976–84* | ***1984–88*** | *1988–2006* | ***2006–10*** |
| Rice | 0.97 | ***0.91*** | 1.02 | ***1.27*** | 1.29 | ***1.17*** | 1.23 | ***1.07*** | 1.37 | ***2.37*** | 2.19 | ***1.25*** |
| Importers | 1.06 | ***0.99*** | 1.09 | ***1.35*** | 1.34 | ***1.24*** | 1.85 | ***1.70*** | 2.28 | ***4.20*** | 4.84 | ***1.71*** |
| Exporters | 0.76 | ***0.65*** | 0.78 | ***1.02*** | 1.14 | ***0.87*** | 0.99 | ***0.81*** | 1.01 | ***1.92*** | 1.50 | ***1.03*** |
| Wheat | 1.10 | ***0.90*** | 1.10 | ***1.18*** | 1.19 | ***1.10*** | 1.37 | ***0.91*** | 1.38 | ***1.95*** | 1.43 | ***1.06*** |
| Importers | 1.12 | ***0.89*** | 1.09 | ***1.18*** | 1.23 | ***1.13*** | 1.41 | ***0.90*** | 1.46 | ***2.09*** | 1.71 | ***1.38*** |
| Exporters | 1.01 | ***0.94*** | 1.24 | ***1.36*** | 0.93 | ***0.99*** | 1.20 | ***0.97*** | 1.08 | ***1.46*** | 1.18 | ***0.99*** |
| Maize | 1.09 | ***0.99*** | 1.03 | ***1.18*** | 1.07 | ***1.11*** | 1.39 | ***1.22*** | 1.36 | ***1.60*** | 1.34 | ***1.07*** |
| Importers | 1.20 | ***1.14*** | 1.15 | ***1.29*** | 1.12 | ***1.13*** | 1.42 | ***1.24*** | 1.41 | ***1.70*** | 1.42 | ***1.09*** |
| Exporters | 0.95 | ***0.78*** | 0.85 | ***0.87*** | 1.00 | ***1.05*** | 1.03 | ***1.02*** | 1.04 | ***1.18*** | 1.07 | ***1.01*** |

*Source*: Anderson and Nelgen (2012)

[a]Unweighted average of national NACs each year, averaged over the number of years in each period where NAC = (1 + NRA/100)

**Table 8.2** Contributions of policy-induced trade barrier changes to changes in the international prices of key agricultural products, 1972–74 and 2006–08

| | *1972–74* | *2006–08* |
|---|---|---|
| *Consumption-weighted proportional decline in NAC, that is—$T^{a}$* | | |
| Rice | 0.56 | 0.37 |
| Wheat | 0.30 | 0.12 |
| Maize | 0.21 | 0.08 |
| *Proportional international price rise,* $p^*$ | | |
| Rice | 3.00 | 1.13 |
| Wheat | 1.57 | 0.70 |
| Maize | 1.35 | 0.83 |
| *Proportional contribution of changed trade restrictions to the international price change* | | |
| Rice | 0.27 | 0.40 |
| Wheat | 0.23 | 0.19 |
| Maize | 0.18 | 0.10 |

*Source*: Anderson and Nelgen (2012)

[a] $T$ is the negative of the weighted average of proportional changes in national NACs over the period, using national shares of global consumption valued at undistorted prices ($G_i$'s) as weights

We show above that, with some simplifying assumptions, the proportional contribution to international price changes resulting from changes in national trade restrictions is dependent on $T$ and R, where $T$ is the negative of the global consumption-weighted average proportional change in the NAC for each product and R is 'other' influences, calculated as $R=(p^{*}-T)/(1+T)$. Estimates of those indicators are summarized for the key grains in Table 8.2.

For rice, the cumulative proportional decline in the NAC shown in the first row of Table 8.2 is 0.37 between 2006 and 2008. The comparable numbers for wheat and maize are 0.12 and 0.08, respectively. According to the World Bank (2011) data, the international price of rice increased by 113 % between 2006 and 2008 and the prices of wheat and maize rose by 70 and 83 %, respectively (middle rows of Table 8.2). Thus, these estimates suggest that altered trade restrictions during the 2006–08 period caused international prices to be higher by 0.40 for rice, 0.19 for wheat, and 0.10 for maize (bottom third of Table 8.2). The unweighted average of these three, at 0.23, is the same as that for 1972–74 (first column of Table 8.2), although the price spikes were somewhat larger then.

It is possible to apportion those policy contributions between country groups. In Table 8.3, we report the contributions of high-income versus developing countries and also of exporting versus importing countries. During 2006–08, developing countries were responsible for the majority of the policy contribution to the price spikes of all three grains, whereas in 1972–74, the opposite was the case except for rice. As for exporters versus importers, it appears that exporters' policies had the majority of the influence, other than that for wheat in the 1970s, but importers made a very sizeable contribution as well. This is an important finding, since it has been mostly exporting countries who were blamed for exacerbating the recent food price spike.

With changes in trade restrictions contributing to the spike in international food prices, the question arises as to how effective those interventions are in limiting the rise in domestic prices? That is, how much did domestic grain prices rise relative to international prices? The proportional rise in the international price *net of* the contribution of changed trade restrictions is $R/(T+R)$. That fraction, when multiplied by the international price rise shown in the middle part of Table 8.3, is reported in the second column of Table 8.4, where it is compared with the proportional rises in the domestic price in our sample of countries. The numbers for 2006–08 suggest that, on average for all countries in the sample, domes-

**Table 8.3** Contributions[a] of high-income and developing countries, and of importing and exporting countries, to the proportion of the international price change that is due to policy-induced trade barrier changes, 2006–08

| | *Total proportional contribution* | *High-income countries' contribution* | *Developing countries' contribution* | *Importing countries' contribution* | *Exporting countries' contribution* |
|---|---|---|---|---|---|
| *Anderson and Nelgen (2012)* | | | | | |
| Rice | 0.40 | 0.02 | 0.38 | 0.18 | 0.22 |
| Wheat | 0.19 | 0.09 | 0.10 | 0.07 | 0.12 |
| Maize | 0.10 | 0.05 | 0.05 | 0.03 | 0.07 |
| *Jensen and Anderson (2017)* | | | | | |
| Rice | 0.30 | 0.001 | 0.299 | 0.040 | 0.260 |
| Wheat | 0.07 | 0.002 | 0.064 | 0.027 | 0.039 |
| Maize | 0.11 | 0.045 | 0.068 | 0.024 | 0.090 |

*Source*: Anderson and Nelgen (2012), with its first column coming from bottom one-third of Table 8.2, and Jensen and Anderson (2017)

[a]Expressed such that the two numbers in each subsequent pair of columns add to the total proportion shown in column 1 of each row

**Table 8.4** Comparison of the domestic price rise with the rise in international grain prices net of the contribution of changed trade restrictions, rice, wheat, and maize, 2006–08 (%, unweighted averages)

| | *International price rise* | | *Domestic price rise* | | |
|---|---|---|---|---|---|
| | *Including contribution of changed trade restrictions* | *Net of contribution of changed trade restrictions* | *All countries* | *Developing countries* | *High-income countries* |
| *Anderson and Nelgen (2012)* | | | | | |
| Rice | 113 | 68 | 56 | 48 | 74 |
| Wheat | 70 | 56 | 77 | 65 | 81 |
| Maize | 83 | 75 | 73 | 62 | 82 |
| *Jensen and Anderson (2017)* | | | | | |
| Rice | 113 | 79 | 57 | 53 | 93 |
| Wheat | 70 | 65 | 59 | 41 | 71 |
| Maize | 83 | 74 | 68 | 61 | 73 |

*Source*: Anderson and Nelgen (2012) and Jensen and Anderson (2017) tic prices rose slightly more than the adjusted international price change for wheat and only slightly less for maize and just one-sixth less for rice. The extent of insulation was greater in developing countries, especially for wheat and maize,[5] which is consistent with the finding from the middle columns of Table 8.3 that their policy makers contributed more to the price spike than governments of high-income countries. This recent experience contrasts with the early 1970s, when high-income countries were much more insulated than they were recently. These results suggests that the combined responses by governments of all countries have been sufficiently offsetting as to have done very little to insulate domestic markets from the recent international food price spike.

## Estimating Effects of Insulation on International Prices Using a Global CGE Model

To keep the above BOTE analysis as simple as possible, it was assumed that the price elasticity of demand is the same in all countries, and all cross-price elasticities of supply and demand are zero, so no interaction with livestock or other farm product markets, nor among the three cereals, was entertained. They estimate that altered border restrictions on trade were responsible for about two-fifths of the rise in the international price for rice, about one-fifth for wheat, and one-tenth for maize.

A more recent study examines this issue using the GTAP model of the world economy, but it focuses just on the wheat market (Rutten et al. 2013). That study considers only a small rise in the international price, assumed to be due to a drought in Australia, and examines, as arch-typical examples of responses elsewhere, the impact of India imposing a tax on its wheat exports and Tanzania lowering its wheat import tariff.[6]

This section revisits this policy issue but does so more comprehensively than in the previous section. Like Rutten et al. (2013), the standard GTAP multi-product, multi-country model of the global economy is employed (Hertel 1997). Such a model makes it possible to estimate the extent to which changes in trade restrictions contributed to that 2006–08 spike in food prices without the restrictions on price elasticities that were necessary for the above back-of-the-envelope study, instead accepting the medium-term elasticities incorporated in the GTAP model's standard parameter set (Jensen and Anderson 2017).

This new GTAP modeling study goes beyond Rutten et al. (2013) (and Bouët and Laborde 2012) in several respects. First, it focus on rice and coarse grains in addition to wheat. Second, it draws on the same NAC distortion estimates as used by Anderson and Nelgen (2012), so as to be directly comparable with the above BOTE analysis. Those NACs are used to alter the GTAP version 8.1 protection database's estimates of national trade restrictions on those cereals as of 2006. Third, the NAC-estimated changes in actual national trade restrictions between 2006 and 2008 for each of those cereals are used to simultaneously calibrate exogenous supply shocks and consequent policy adjustments for each country. Fourth, we carefully simulate the observed international cereal price spikes of 2006–08 including the associated changes in government interventions around the world in that period and estimate the contribution of the latter to the former.

Figure 8.2 depicts just one product, but in practice, the international prices of various foods do not move identically. Also, some products are close substitutes in farm production and/or in consumption by final consumers; and feed grains are major inputs into many countries' livestock industries and so affect the latter's product prices to varying extents too. Since overall agricultural trade and national economic welfare effects of a spike in one grain's price depend on those interactions, it is more desirable to use a multi-commodity rather than single-commodity model to capture the full effects of government responses to a price spike. This is especially so when several food prices rise simultaneously but to different extents. And given that policy responses differ also from country to country, a multi-country model is needed. With such a model that includes some supply response over the three-year period under consideration, differing demand elasticities across countries, and non-zero cross-price elasticities and demand and supply among farm and food products, the estimated contributions of policy actions to the grain price spikes in 2006–08 are likely to be less than the BOTE estimates reported in the previous section of this chapter.

The model used here is the same well-known global general equilibrium model known as GTAP that is introduced in Chap. 5. No alterations are made to the model, and its standard closure and medium-term behavioral parameters are used. In particular, it retains the model's standard elasticities, including the (rather low) cross-price elasticities within the agricultural sector. The price responsiveness of producers and consumers may be a little higher in this model than is appropriate for a short-run shock of the type being focused on in this study; in which case, the impact on international prices of the policy responses to the exogenous shocks will be under-estimated (in contrast to the results from the above BOTE analysis, which are likely to be over-estimated because of its assumed zero price elasticities).

The GTAP model's version 8.1 database (Narayanan et al. 2012) divides the global economy into 134 countries/regions with 57 sectors/product groups. Among these commodities, rice, wheat, and coarse grains (of which all but one-tenth is maize) are specified separately, providing a snapshot of the world's grain production, consumption, and trade among different countries as of 2007. Since this analysis focuses on the contribution of changes in the extent to which domestic and trade policy measures affect the price spikes experienced during 2006–08, the GTAP database is recalibrated to reflect the domestic policies in the initial pre-price spike year of 2006. Those policy distortions are then shocked to move the 2006 NRA-updated GTAP database to 2008 NRA levels of support in a scenario described below. To make reporting of model results easier, the GTAP's 134 countries/regions and 57 sector/product groups are aggregated to 34 regions and 11 sectors, keeping the major grain countries as separate economies, before running the simulation.

As mentioned in the previous section, the observed increases during 2006–08 in international prices for rice, wheat, and maize in current US dollars were 113 %, 70 % and 83 %, respectively (World Bank 2011). The domestic producer and consumer prices in each country would have been altered by the same amount had there been no change in the NRA and CTE of each of these grains in each country and no exogenous shocks domestically over that period. That two-part assumption makes it possible to use the information in the NRA database on changes in national grain price distortions to estimate, as a residual, the extent to which there have been exogenous shocks that, together with the international price spikes, stimulated the changes in trade restrictiveness of national policies. The exogenous shocks in 2006–08 were a combination of weather-related supply shortfalls, a building up of public stockholdings in such countries as India, and a surge in demand for farm products for biofuel production (Wright 2011). For simplicity of modeling, however, it is assumed here that they are the result of just the former, causing a drop in each country's grain productivity. The NRA estimates together with the international price changes then provide an estimate of the extent of that supply shortfall in each country.

Turning to the GTAP results, the NRA adjustments in the various countries during 2006–08 together had an estimated non-trivial impact on international grain prices. This is especially so for rice, where just under one-third of the rise in that period (34 of 113 %) is attributed to NRA changes. For coarse grains, nearly one-ninth of their rise of 83 % is attributed to NRA changes. Only in the case of wheat is the contribution of NRA changes estimated to be of minor importance (1/15 of the 70 % rise in its international price). Changes in export measures were responsible for most of the impact on the price in the case of both rice and coarse grains, whereas more than one-fifth of the impact in case of wheat came from a loosening of import restrictions.

The NRA changes also made a contribution to the rise in the international prices of other crop and livestock products. However, that contribution is estimated to be minor, amounting to less than 1/30 in each of those cases and insignificantly in the case of the 'Other processed foods' aggregate. Hence, the omission of this effect in the earlier BOTE study appears to be of little consequence.

Almost all of the contribution of changing NRAs to the rice price rise comes from developing countries. This result is unsurprising, since that is where most of the world's rice production and consumption takes place. By contrast, in the case of wheat, the NRA changes of high-income countries contribute as much as the NRA changes of developing countries. The coarse grain case is in between, with the NRA changes of developing countries contributing nearly twice as much as those of high-income countries.

The exogenous shock plus the changes in trade restrictions reduce the global quantity of grain produced and consumed, but by less than 5 % for each grain. In the case of rice, one-eighth of that is due to changed trade restrictions, while the policy contribution in the case of the other grains is very minor. When aggregated across all primary and processed foods, the total quantity decline is 3 % for both the high-income and developing country groups. Only 1/30 of that drop in global food consumption (0.1 %) is due to the change in NRAs, the rest is due to the simulated supply shock.

The aggregate quantity of grain traded internationally is estimated to have risen 3 % during 2006–08 as a consequence of changes in NRAs. The negative impact on that quantity traded from the tightening of grain export restrictions was more than offset by the positive impact of the lowering of both import restrictions (tariff suspensions and the like) and domestic price supports.

In terms of the aggregate contribution of altered NRAs to the grain price rises internationally, the coarse grain estimates from the earlier BOTE analysis are remarkably close to those from the GTAP model, the latter one being only one-tenth higher than the former. For rice the GTAP ones are just one-quarter lower than the BOTE one. In the case of wheat, however, the GTAP estimate is only one-third of the BOTE one.

The GTAP results suggest that for rice, the main contributors via lowered import restrictions are Indonesia and the Philippines, and the main contributors via higher export barriers are (in order) India, Pakistan, Thailand, and China. In the case of wheat, Japan and India contributed most on the import side, while the main contributors on the export side are Argentina, Pakistan, and China. China, Argentina, Central Asia, and India are the dominant contributors, as exporters, to the rise in the international price of coarse grains, while Western Europe is the main contributor among the importers.

Those country rankings of price spike contributors based on the GTAP results are quite different from the BOTE-based ones. The key reason for the difference is that the GTAP model's estimates depend on the change in the net trade of each country, whereas the BOTE estimates depend on each country's contribution to global consumption (based on the BOTE study's simplifying assumption of no supply responsiveness over this period). It is thus unsurprising that the estimates by these two methods of the net policy contributions are not identical. It is therefore also unsurprising that the relative contributions to those price rises of individual countries, and hence of high-income and developing country groups, differ across the two studies. Both country groups' NRA changes are estimated to make almost equal contributions to the international price changes for wheat and coarse grains in the BOTE analysis; but developing countries play a much larger role in the GTAP results (as they do for rice in both studies). The price impacts of exporting countries' NRA changes dominate those of grain-importing countries in all three cases in both studies, but the extent of that domination is much greater in the GTAP study for rice (Table 8.3). So, even though the BOTE and GTAP studies generate similar estimates of *aggregate* global effects of changes in NRAs on the spikes in international cereal prices, the elements that contribute to that aggregate result vary considerably between this and the BOTE study. That is, while the overall policy message of the BOTE study remains—and indeed is reinforced by the present study—the contributions from the various countries' policy actions are now more evident.

How much did the NRA changes lessen the rise in the domestic prices of grains? Table 8.4 first compares the actual rise in the international prices (column 1) with the estimates of what those rises would have been had NRAs not changed (column 2, as would have been the case if, e.g., all domestic and border price-distorting policy instruments were set at fixed ad valorem rates). The latter are lower than the former to the extent of the estimated contribution of altered NRAs reported in column 1 of Table 8.3. They are thus dissimilar for the two studies except for coarse grains, where the GTAP study suggests a smaller contribution from altered trade restrictions.

The right-hand half of Table 8.4 shows how much domestic prices actually rose during 2006–08 for their respective groups of countries. (The GTAP results involve all countries, whereas the BOTE ones involve only a sub-set of countries, hence the two sets of numbers are not identical.) On average, in the GTAP results, domestic prices rose nearly one-quarter less than the adjusted international price change for rice, but only slightly less for wheat and coarse grains. The extent of insulation was greater in developing countries, which is not inconsistent with the finding from the middle columns of Table 8.2 that their policy makers contributed more to the price spike than governments of high-income countries. These results, like those reproduced in the upper half of Table 8.4 from the BOTE analysis, suggest that the combined responses by governments of all countries have been sufficiently offsetting as to do very little to insulate domestic markets from the 2006–08 international food price spike.

The above empirical findings can be summarized as follows:

- The changes in restrictions on global grain trade during 2006–08 are responsible for around 1/3rd, 1/10th, and 1/15th of the observed increases in the international prices of rice, coarse grains, and wheat, respectively.
- Those altered trade restrictions caused domestic price increases to be only one-quarter less than what they otherwise would have been on average across all countries for rice and only 1/11th less in the case of wheat and coarse grains.
- The changes in trade restrictions enlarged the transfers in economic welfare from food-importing to food-exporting countries because of the respective changes in their international terms of trade.

These results are surprising. The BOTE estimates reported in the previous section may have greatly exaggerated the extent to which governmental variations in trade restrictions contributed to the grain price spikes of

2006–08 because of their numerous zero price elasticity assumptions and their treatment of each grain independently. Yet even with the economy-wide GTAP model that includes livestock and all other agricultural industries, and that treats the price changes of the three grains simultaneously and has non-zero price elasticities, the aggregate results from this study are only a little smaller than those of the BOTE analysis. This study thus underscores the key conclusion from the earlier BOTE one, which is that, in a many-country world, the actions of grain-exporting countries are being offset by those of import-competing countries such that market-insulating interventions are rather ineffective in achieving their stated aim of avoiding large domestic price rises when international food prices spike—and they also have the undesirable effect of adding to international price spikes.

## How Did Insulation Alter National and Global Poverty in 2008?

It is clear from above that variable trade restrictions contribute non-trivially to the instability of international food prices. But did those policy actions have the net effect of preventing more people from falling below the poverty line? A study by Anderson et al. (2014) makes use of household income and expenditure survey data and the BOTE methodology in Martin and Anderson (2012) to get at least a partial answer (ignoring responses to the quantities produced and consumed and to wage rates, which are assumed to not change in the short run). For a sample of 30 developing countries, including the biggest such as China, India, Indonesia, Nigeria, and Pakistan, it first identifies what proportion of each nation's households are net buyers of grains and oilseeds. It then examines how much international prices for those products rose during 2006–08, how much domestic prices rose, and how much international prices would have risen had no countries insulated. The results suggest insulation behavior by developing country governments prevented an extra 82 million people temporarily falling below the US$1.25 a day poverty line *had those government responses had no impact on international food prices.*

However, because those actions exacerbated the international price spike, the number of people saved from falling into poverty by that insulating behavior is estimated to be less than the number of those pushed into poverty, by 7.5 million (Table 8.5). It is in just two populous countries, Nigeria and Pakistan, that there are significant net reductions in poverty because of their governments' policy responses.

**Table 8.5** Poverty effects of countries insulating themselves from the 2006–08 spike in international food prices

| | *Estimated change in millions of poor people …* | |
|---|---|---|
| | *… ignoring international price effects* | *… including international price effects* |
| Indonesia | 1.6 | 0.1 |
| China | –5.7 | 3.6 |
| India | –59.0 | 4.4 |
| Pakistan | –9.9 | –5.9 |
| Nigeria | –4.4 | –1.2 |
| Other Sub-Saharan Africa | –0.9 | 0.7 |
| Rest of world | –4.3 | 5.6 |
| **World** | **–81.6** | **7.5** |

*Source*: Anderson et al. (2014)

That is, developing countries as a group would probably see less of their people fall into poverty when international food prices spike if they *and all other countries* agreed to abstain from altering trade restrictions aimed at insulating their domestic markets from international price fluctuations. The only way that price insulation could be effective in reducing global poverty is if the countries that insulate most are those in which the poor are most vulnerable to price spikes (Anderson et al. 2016).

## What About When International Food Prices Slump?

The logic captured in Fig. 8.2 applies in an equal but opposite way when international food prices spike downward. If loss aversion drives governments to insulate domestic markets from gyrations in international prices in upswings, one would expect similar political forces to operate to protect farmers from price downswings. Indeed, it has been shown theoretically that loss aversion alone can be enough to drive such policy actions even in the absence of pressures from the vested interest of groups affected adversely (Dissanayake 2016).

The NRAs during the low-price period of the mid-1980s provide some support for that notion: they tend to be higher than the average NRAs in the more normal price periods either side of 1984–88 (Table 8.1).

One other strong piece of evidence of governments being willing to engage in loss-averting trade policy action when prices slump has been clear in the Doha Round of multilateral trade negotiations at the World Trade Organization (WTO). An agricultural Special Safeguard Mechanism (SSM) has been proposed by some developing country members of WTO that would allow them to raise their applied tariffs on specified farm products when either their import price falls or the volume of imports surges beyond threshold levels (WTO 2008). This proposed SSM has been one of the most contentious issues in the agricultural negotiations of the WTO and was the issue that triggered the suspension of Doha Round negotiations in 2008.

Among the criticisms of the SSM proposal have been that it would be available to a large number of WTO members, it would require no commitments to further liberalization, it would allow import tariffs to increase above their bound rates for many products, and there would be no requirement to use an injury test nor to compensate adversely affected trading partners (Blustein 2009; Wolfe 2009; WTO 2010; Grant and Meilke 2011). Others have made the point that the developing countries that are net exporters of affected farm products would be harmed by an SSM (de Gorter et al. 2009; Finger 2010). And the innovative economic modeling of the SSM by Grant and Meilke (2006) and Hertel et al. (2010) as it might apply to wheat is also critical of the proposal.

Even if an SSM was established, would it benefit the food-importing developing countries proposing it? A recent paper by Thennakoon and Anderson (2015) demonstrates that the expected benefits (from avoiding the transmission of an international price slump to their domestic market) may be illusory. The illusion stems from not acknowledging that, historically, the behavioral responses to international price slumps by governments of agricultural-importing countries have not been dissimilar to those of agricultural-exporting countries. When this fact is taken into account, the loss-averting domestic producer benefits of the SSM are reduced and potentially eliminated. Moreover, each international price slump is exacerbated by those responses, making it more difficult for those countries trying to cope without altering their trade restrictions and so raising the probability that they eventually will join the insulating group of countries and thus deepen and prolong the international price slump. Thennakoon and Anderson (2015) test the basic theory underlying the price-slump equivalent of Fig. 8.2 using time series data for rice.[7] Their results reveal that both of the unacknowledged facts mentioned above are indeed important in the case of rice, which suggests the proposed SSM would deliver at most only a small fraction of the purported loss-averting benefits.

## What Role for Public Stocks of Food Staples?

It is commonly assumed in developing countries that public stockholding of basic foods is essential to ensure national food security, rather than simply relying on international markets to boost domestic availability in periods of domestic shortfall. Large countries especially worry about food import dependence, fearing they may not be able to afford to pay what it would take if their shortfall coincided with shortfalls elsewhere and a consequent hike in international food prices. India, for example, is proud of its record at stabilizing domestic prices of its staple foods, which has been partly the result of holding large stocks of wheat and rice (Saini and Gulati 2016; Gouel et al. 2016).

However, public stockholding can be extremely expensive, and, almost inevitably, it leads to corruption and physical spoilage. Also, decisions as to when to alter the level of stocks can be manipulated by the government to suit its political purposes. That tends to crowd out private stockholding both domestically and abroad because private agents cannot then predict when the government will build or run down those public stocks.

If societies nonetheless want to have access to a stockpile, it would be far cheaper to do that in collaboration with other countries to spread the risk and lower the per unit cost. Since the 2008 rice price spike, there has been a more concerted effort to share a regional rice stockpile, but it is not yet seen as a panacea by participating countries' leaders, who fear they may not be able to access that stockpile as and when they would like (Mujahid and Kornher 2016).

## Key Messages

Achieving the UN's core Sustainable Development Goals of permanently eradicating extreme poverty and hunger can be helped more by dealing with the high consumer prices of food than by reducing fluctuations in food prices around a lower trend level. Nonetheless, loss aversion drives many governments to insulate domestic food markets from gyrations in international prices. They do so especially in upswings, but also when international prices slump. This can reduce the volatility of domestic prices in countries that insulate heavily, but the collective impact of such interventions by a large number of countries is to increase the volatility of international prices—and thereby to increase domestic price volatility in more open countries.

The indicator used to measure the gap between domestic and international food prices was found to be substantially lower in the two upward price spike periods around 1974 and 2008 (and higher for the downward price spike period around 1986) than in adjacent non-spike periods. Export and import restrictions contributed to that finding. The basic theory in this chapter tells us that if a similar proportion of the world's food exporters insulate to the same degree as a group of food importers, each group will offset the other's attempt to prevent their domestic price from moving as much as the initial international price shock. It is as futile as everyone in a football stadium standing in an attempt to get a better view of the field.

Changes in restrictions on global grain trade are responsible for up to two-fifths, one-fifth, and one-tenth of the rise during 2006–08 in the international prices of rice, maize, and wheat, respectively. That policy action evidently is adding very substantially to the volatility of international food prices.

Moreover, developing countries as a group would probably see less of their people fall into poverty when international food prices spike if they *and all other countries* agreed to abstain from altering trade restrictions in the hope of insulating their domestic markets from such spikes. The only way that price insulation could be effective in reducing global poverty is if the countries that insulate most are those in which the poor are most vulnerable to price spikes.

Since the same basic logic applies when international prices slump, it lessens any virtue in the proposal in the WTO's Doha Round, from a large group of developing countries, for a SSM to be established. The proposed SSM would allow developing countries to raise their applied tariffs on specified farm products when either their import price falls or the volume of imports surges beyond threshold levels. The purported price-insulating benefit for farmers in food-importing countries is likely to be illusory because the behavioral responses to a price slump by governments of agricultural-importing countries traditionally has been offset by similar policy reactions by agricultural-exporting countries.

## Notes

1. Variable trade restrictions can also affect long-term investments and hence economic growth rates. Williamson (2008) found evidence for this during the nineteenth century. Drawing on a broad range of developing country case studies, Bevan et al. (1990) and Collier et al. (1999) suggest that faster economic growth would result from allowing producers access to high prices in those rare occasions when they spike, rather than taxing away that gain. According to the evidence in their case studies, this is because governments have been more prone than farm households to squander the windfall either in poor investments or in extra consumption.
2. The same shift would occur if in some exporting countries there was a sudden new demand for grains, such as for use in generating more biofuels when the price of fossil fuels spiked or when new or higher biofuel subsidies and mandates are introduced—as occurred in the United States and European Union around 2006 (Josling and Tangermann (2015, pp. 125–132) and de Gorter et al. (2015)).
3. In principle, we should be using ad valorem consumer tax equivalents (CTEs), but in practice, the estimated NRAs are very close to the CTEs for cereals because the price distortions are predominantly due to trade measures at each country's border.
4. The national NACs are averaged across countries without using weights, so that each polity is treated as an equally interesting case. The aggregate estimates therefore differ from those reported for country groups in Anderson (2009, 2010) where production weights are used to calculate NRA averages (and consumption weights for CTE averages).
5. For political economy analyses of policy actions in 14 individual developing countries as well as in the United States and European Union during this period, see Pinstrup-Andersen (2015).
6. Another economy-wide study that also focuses just the wheat price spike is by Bouët and Laborde (2012). It uses their MIRAGE model and an earlier GTAP database (Version 7, for 2004).
7. Rice provides one-fifth of the calories consumed by the world (the same as wheat), and almost 30 % (twice wheat's share) of the calories consumed in low-income food-deficit countries. Developing countries account for all but one-sixth of the world's rice consumption and production (FAO 2016).

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CHAPTER 9

# Political Economy of Trade Policy Trends and Aberrations

Throughout history, the agricultural sector has been subjected to perhaps more heavy-handed governmental interventions than any other sector. As reported in Chap. 6, agricultural trade-related policies in 2004 accounted for an estimated two-thirds of the global welfare cost of all merchandise trade distortions, even though the agricultural and food sector represents less than one-tenth of global GDP and trade. Clear patterns of market interventions across countries and trends over time are evident in the estimates of price distortions laid out in Chap. 5, where it is also noted that trade policy measures historically have been the dominant instrument of government intervention, and almost always with an aggregate anti-trade bias. Also, Chaps. 5 and 8 show that around those long-run trends in price distortions are temporary changes in intervention as countries seek to insulate their domestic markets from international food price fluctuations and occasional spikes.

These findings beg several questions, answers to which affect in important ways the final two chapters, which focus on trade prospects and opportunities for further policy reform to improve global food security and sustainability. Those questions include: Why do countries tend to transition from taxing to assisting their farmers relative to producers of other tradables as their economies develop, and do it with a strong anti-trade bias? Why do all countries insulate their domestic markets to some extent from international price fluctuations and especially



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sharp price spikes? Why did the richest countries begin to reduce their assistance to farmers after the 1980s, and move away from trade measures to ones somewhat decoupled from production? Why the large differences in assistance between farm commodities within most countries? And will developing countries that are phasing out their anti-agricultural policies retain open markets, or will they follow earlier-industrializing countries down the agricultural protection path? This chapter addresses those questions in turn.

## Why Have Farmers Been Taxed in Poor Countries and Subsidized in Rich Ones?

Political economy theories to explain the pattern of agricultural distortions across countries and over time made some progress in the 1980s, but in recent years it has accelerated. Theorists are focusing on improving our conceptualization of the issue and suggesting hypotheses, while others have been compiling appropriate data and yet others have been using political econometrics to test those hypotheses (see, e.g., Anderson 2010; Rausser et al. 2011; Anderson et al. 2013; Swinnen 2017). But even the earlier analyses can take us some way toward understanding the evolution of agricultural price-distorting policies. Anderson (1995), for example, suggests the following factors distinguish the domestic polities of developing and high-income countries.

First, in a poor agrarian economy (PAE), urban wage earners and hence their employers care a great deal about the price of food, and are relatively well organized. Farmers, by contrast, are numerous but poorly organized, and many are so small as to be able to sell only a little or none of their output in the market. In a rich industrial economy (RIE), by contrast, farm products (especially net of post-farmgate costs) represent a small fraction of urban household expenditure and hence of real wages. Also, urban households are far more numerous and so suffer from a free-rider problem of collective action in RIEs, just as farmers do in PAEs.

Second, a typical PAE has the majority of its workforce employed in agricultural pursuits and relatively few in manufacturing, whereas in RIEs there could be up to ten times as many engaged in industrial jobs as on farms. Altering the domestic price of farm relative to industrial products thus has a far bigger impact on the price of mobile labor in a PAE than in an RIE. Industrial capitalists therefore are more likely to be able to lobby successfully for (and governments face less opposition to) taxes on agricultural exports and on imports of manufactured goods in PAEs, whereas agricultural interests are more likely to be able to lobby successfully for (and governments face less opposition to) agricultural subsidies and food import tariffs in RIEs.

And third, high costs of collecting taxes other than at the border in PAEs make them much more likely than RIEs to employ trade taxes and thus be prone to an anti-trade bias in their sectoral policies, and high costs of dispersing funds make PAEs less fiscally capable of subsidizing any sector. By definition, the PAE has a comparative advantage in agricultural goods; hence this anti-trade bias adds to the anti-agricultural bias in PAE policies.

To get a feel for the magnitudes of these incentives to lobby, Anderson (1995) uses a realistic set of parameters for a simple 3-sector version of each of those two economies (the third sector being non-traded services). Each sector has specific capital but the same homogenous labor is employed in all sectors. The PAE has agricultural shares of GDP and employment of 60 %, while those shares in the RIE are one-twentieth as large. Income tax rates are adjusted whenever a policy change is introduced such that overall tax collections are unchanged, and in the PAE, it is assumed that farmers pay no income tax because the cost of collection from each poor farm household would exceed the revenue raised. The real after-tax incomes of four household types are considered: farmers, nonfarm wage earners, industrial capitalists, and those owning capital in the sector producing non-tradables.

The model suggests that industrial capitalists each have ten times more incentive to seek policies that assist manufacturing and reduce agricultural prices in the PAE than do industrial capitalists in the RIE. They also suggest that the proportional benefit to those industrial capitalists in the PAE is more than ten times the proportional loss that such a trade policy regime imposes on each farm household. The difference in distributional effects is not quite so extreme in the RIE, but even there farmers would gain five times as much as industrial capitalists would lose per household from a trade policy regime that favors agriculture at the expense of manufacturing.

With such vast asymmetries between the opposite effects on gainers and losers in each economy (the weighted average of which is the deadweight loss to society), it follows that even if the gainers do not have strong political influence, they may still be able to lobby successfully for policies that boost their income simply because there is little effective opposition from the losers. This is even more so when account is taken of the larger problem of free-riding for the losers as compared with the more concentrated gainers in each of those economies.

Together these forces lead one to expect to observe countries gradually switching from a negative to a positive agricultural nominal rate of assistance (NRA) as their per capita income grows and the agricultural sector's shares of GDP and employment shrink, and more so if the economy's agricultural comparative advantage declines in the process of that development. That is, such a transition away from taxing to protecting farmers could be expected to be related to growth in per capita income and in agricultural comparative disadvantage, and to be higher for import-competing than exported farm products.

This hypothesis has been tested econometrically by Anderson (2010a Chap. 2) for nine key food products, using the NRA estimates described in Chap. 5 for 82 countries over the years 1955–2007. Specifically, the following equation was estimated to explain variation across countries and over time in the NRA for product $i$:

$$NRA_i = f\left(YPC\left(YPC\right)^2 LPCX_i\right) \tag{9.1}$$

where YPC is the log of real per capita national income, LPC is the log of arable land per capita (an indicator of agricultural comparative advantage), and $X_i$ is a dummy variable that takes the value 1 for an exportable and zero if the product is import-competing that year. The results are summarized in Table 9.1. The variables in these simple regression results are all statistically significant, virtually all have the hypothesized sign, and according to the adjusted $R^2$ values the equations explain between one-third and one-half of the variation in the NRAs for those products over those 53 years. There are evidently other forces at work in addition to just those three variables, but they all would appear to have been non-trivial contributors in the past.

It should be kept in mind, though, that trade measures are far from first-best policy instruments to assist net buyers of food in poor agrarian countries or farmers in rich industrial countries. First, border measures alter producer incentives in the opposite way to their price effect on consumers, so one can be helped only at the expense of the other (unless additional measures are introduced to neutralize the adverse effect). Second, when the farmer is helped by the policy in the rich country, that help is in proportion to marketed output; and when the net buyer of food is helped by the intervention in a poor country, such households are assisted in proportion to their expenditure on food. In both cases, the measure

**Table 9.1** Regression results to account for variations in product NRAs across 82 countries, 9 key food products, 1955–2007 (using ordinary least-squares regression)

| | *Log (real GDP per capita)* | *Log (real GDP per capita) sq.* | *Log (arable land per capita)* | *Exportable dummy*[a] | *Constant* | *No. of obs.*[a] | *Adjusted $R^2$* |
|---|---|---|---|---|---|---|---|
| Rice | –2.014*** | 0.156*** | –0.392*** | –0.727*** | 5.946*** | 1281 | 0.50 |
| | (0.154) | (0.0100) | (0.0222) | (0.0453) | (0.570) | | |
| Wheat | –0.895*** | 0.0689*** | –0.162*** | –0.397*** | 2.730*** | 1661 | 0.33 |
| | (0.117) | (0.00735) | (0.0161) | (0.0369) | (0.458) | | |
| Maize | –0.419*** | 0.0325*** | –0.166*** | –0.194*** | 1.261*** | 1525 | 0.20 |
| | (0.0943) | (0.00606) | (0.0146) | (0.0294) | (0.356) | | |
| Soybean | 0.959*** | –0.0425** | –0.548*** | –0.127 | –5.239*** | 703 | 0.31 |
| | (0.344) | (0.0212) | (0.0368) | (0.0892) | (1.365) | | |
| Sugar | –0.925*** | 0.0781*** | –0.239*** | –0.450*** | 2.833*** | 1648 | 0.31 |
| | (0.193) | (0.0123) | (0.0277) | (0.0601) | (0.727) | | |
| Milk | –0.879*** | 0.0844*** | –0.356*** | –0.401*** | 1.962 | 1389 | 0.32 |
| | (0.301) | (0.0184) | (0.0322) | (0.0847) | (1.203) | | |
| Beef | –0.763*** | 0.0667*** | –0.280*** | –0.317*** | 1.771** | 1426 | 0.43 |
| | (0.205) | (0.0122) | (0.0194) | (0.0467) | (0.849) | | |
| Pigmeat | 1.406*** | –0.0716*** | –0.313*** | 0.190*** | –6.754*** | 1213 | 0.28 |
| | (0.211) | (0.0125) | (0.0186) | (0.0445) | (0.885) | | |
| Poultry | –1.693*** | 0.118*** | –0.485*** | –0.307*** | 5.785*** | 1304 | 0.29 |
| | (0.351) | (0.0209) | (0.0301) | (0.0795) | (1.460) | | |

Source: Anderson (2010a, , Table 2.14)

[a]Observations are included only in years when the product is tradable. The constant coefficient refers to import-competing goods, whereas for exportables, the coefficient on the exportable dummy needs to be added to the coefficient for the constant

involves a larger transfer than is necessary to reach the most needy. That makes trade policies not just inefficient, for the usual reason of reducing the potential gains form trade, but also inequitable as transfer instruments. And in the case of the farmer, that assistance gets built into the price of fixed farm assets, mostly land. It therefore benefits the landowner at the time the policy is introduced. However, when that person sells the land, the next owner enjoys no benefit from the assistance policy after covering the interest on the extra needed to finance that land purchase (Floyd 1965; Johnson 1991). In subsequent periods when the new owners feel farm earnings are not keeping up with incomes of nonfarm households, they will lobby for a further boost to the nominal rate of agricultural assistance.

We know from the trade theory summarized in Chap. 2 that trade measures are more costly to society than more direct domestic measures for helping certain groups, so why are they so prevalent? One commonly assumed reason is that trade policies are more covert than direct subsidies that appear in the government's budget papers each year, and do not involve raising more direct tax revenue to pay for such subsidies (Magee et al. 1989). But it is also illuminating to again examine the simulation results from the simple CGE model in Anderson (1995). They show that in the PAE, where the government's main concern is to keep down the price of food for nonfarm households (see Byerlee and Sain 1986), a consumer food price subsidy has quite different distributional effects to a trade policy that taxes food exports. The latter involves an implicit agricultural production tax (in addition to an implicit food consumption subsidy) that lowers wages and hence boosts urban capitalists' real incomes. If a domestic food consumer price subsidy of, say, 10 % is used, the real after-tax incomes of urban capitalists would fall by 3 %, but if instead a food export tax of 10 % is used, their real after-tax income would increase by 40 % according to Anderson (1995). It is therefore not surprising that a farm export tax has so often been preferred to a direct food consumer subsidy as a way of keeping down urban food prices—not to mention the greater fiscal difficulty in a poor economy with a direct subsidy than with a trade tax.

Recall too that farmers gradually become a smaller share of the workforce and voting population as an economy develops, and eventually may even shrink in absolute numbers. That reduces their free-rider problem of acting collectively to lobby, and at the same time reduces the cost of farm-support policies to each urban household (which affects their opposition to such policies). Also, farmers often form cooperatives as the share of purchased intermediate inputs in total farm costs rises, and those cooperatives can, on behalf of farmers, lobby just like urban industrialists (Olson 1965).

However, the declining marginal political cost of providing such a support policy may eventually reverse, for three reasons. One is that the farm assistance may be sufficient to eventually induce a surplus of food that can only be disposed of with far more visible export subsidies—as happened in the European Community in the latter 1970s and 1980s. A second and related reason is that the food security justification for supporting the farm sector looks hollow from that point in time, and it leads to traditional food-exporting countries intensifying their diplomatic pressure for protectionist countries to reform—as happened around the time of the launch of the GATT's Uruguay Round in 1986. And a third is that ever-higher farm prices encourage the use of ever-higher doses of chemical fertilizers and pesticides, which causes environmentalists to oppose farm subsidies. With this combination of changing political forces at work, a point could be reached where the political benefits of supporting the shrinking farm sector is outweighed by the political costs to the government, and the assistance rug is pulled from under the sector (Cassing and Hillman 1986).

## Why Do Countries Insulate Their Domestic Food Markets from International Price Fluctuations?

Most farm households are either net sellers of food (whose incomes are thus positively correlated with food prices) or net buyers of food because they find they can earn more by specializing in other enterprises (e.g., cash crops or livestock)—as do nonfarm households. The presumption is often made that the food security of households that are net buyers of food is negatively correlated with food prices. However, that need not be the case for those whose incomes are closely linked to the demand for farm labor. Thus it is an empirical question as to whether a food price rise (fall) boosts a country's aggregate food security: among other things, it depends on whether the proportion of households close to the poverty line that are net sellers of food or farm-type labor services exceeds (is below) the proportion of households in other categories.

If food prices spike upwards as often and as much as they spike downwards, the net effect on various types of households over time will be roughly zero. Even so, it seems many governments have a desire to smooth inter-temporal variations in domestic food prices and quantities that openness to international markets otherwise would involve, perhaps because their electoral cycle is shorter than the international price cycles. This preference for policies that insulate domestic prices from year-to-year changes around desired levels (that may or may not differ from international prices) can be specified in a conservative governmental objective function (Corden 1997, pp. 72–76).[1] An objective function that represents this type of preference has been suggested by Jean et al. (2011) and is closely related to one developed by Freund and Özden (2008), in which lobbying by those groups expecting to lose plays a role.[2] Dissanayake (2016) has extended that analysis to show that if trade policies are the only feasible instruments available to act in time, then society's loss aversion alone is sufficient to expect governments to temporarily change the trade restrictiveness of policies in order to cushion the domestic price effects of short-term shocks to international prices. That is, when international prices rise above trend, we should expect rates of import protection or export subsidies on food to fall (or food export taxation or import subsidies to rise). Presumably this will happen more in countries where households that are net buyers of food have stronger political clout than net sellers of food. And conversely when international prices slump.

Even though trade measures are commonly used to reduce the transmission of international food price hikes to the domestic market, they are far from first-best policy instruments to avert short-term losses—except perhaps in some least-developed countries where no other interventions are feasible (Pinstrup-Andersen 2015). First, border measures help net food buyers in proportion to their expenditure on food. That makes them very inefficient transfer instruments: only a fraction of that transfer helps the poor food-insecure households that are net buyers, and it does so at the expense of those poor households that are net sellers of food. And second, trade restrictions that raise the domestic food price above what it would otherwise be in low-price periods help net food sellers but at the expense of net buyers of food, and that help to farmers will be in proportion to their marketed output and so again will be a far larger transfer than is needed for the social protection of just low-income net food sellers.

## Why Did Agricultural Price Distortions Decline After the 1980s?

Some agricultural and trade policy developments of the past half-century have happened quite suddenly and been transformational: examples are decolonization in Africa and elsewhere around 1960, the creation of the Common Agricultural Policy (CAP) in Europe in 1962, the introduction of flexible exchange rates from the 1970s, the opening of markets in China in 1979 and in Eastern Europe (following the fall of the Berlin Wall) in 1989, and then in the republics of the former Soviet Union after its demise in 1991. Other policy developments have been more gradual, most notably the liberalization, deregulation, privatization, and democratization in many countries from the mid-1980s. Less notable have been the policy changes that occur gradually in the course of economic development as incomes grow and comparative advantages evolve, yet even those patterns can and have been subject to disruption: as shown in Chap. 5, since the 1980s many countries have begun to reform their agricultural trade policies.

To what extent can the lens of political economy explain those reforms to agricultural trade policies since the 1980s? Various schools of thought in political economy have provided insights into the conflicts between the public interest and special interests that naturally emerge in the design and implementation of public policies in general. A recent paper has surveyed the relevance of that literature as it affects agricultural and food markets (Anderson et al. 2013). This section reviews possible explanators of farm policy changes over the past three decades, over and above the income redistributional forces, relative costs of collective action by interest groups, and loss aversion concerns discussed in the two preceding sections.

One important change in developing countries has been the spread of democracy. Olper et al. (2014) exploit the time-series and cross-sectional variation in the agricultural distortions database compiled by Anderson and Valenzuela (2008) to show that democratization reduced agricultural taxation and increased agricultural import protection because most such political transitions occurred in poor countries with many farmers.

Another change is in communication technologies and mass media. Information plays a crucial role in political markets, organization, and policy design. Downs's (1957) 'rationally ignorant voter' principle means that it is rational for voters to be ignorant about certain policy issues if the costs of information are higher than the (potential) benefit of being informed. Hence policies get introduced that create concentrated benefits and dispersed costs, since the information costs are relatively large for those who carry the burden of financing transfers and relatively small for those who receive the benefits (Rausser 1992).

As a result, forces that change information costs may cause changes in policies. One example is enhanced rural communication infrastructure, either through public investments (as in many high-income countries earlier in the twentieth century) or through technological innovations and commercial distribution (as in the recent increase in mobile-phone use in rural areas of developing countries).

An associated influencing factor is the spread of commercial mass media. While television and radio were always commercial in countries such as the USA, that was not the case in many other countries where, until relatively recently, radio and television were mostly publicly owned and many newspapers were linked to political parties. Access to mass media, the internet, and smartphones empower people politically, and a more informed and politically active electorate increases the incentives for a government to be responsive (Besley and Burgess 2001; Strömberg 2004). Mass media can alter the landscape of political competition. As explained above, group size (e.g., the number of farmers versus the number of food consumers in the economy) helps determine lobbying effectiveness. Olper and Swinnen (2013) argue that mass media will increasingly weaken the political power of small groups (in rich countries, farmers; in poor countries, urban food consumers) and reinforce that of large groups (in rich countries, consumers and urban interests; in poor countries, farmers). Thus, mass media favors rural interests (and thus lowers the anti-agricultural policy bias) in poor countries but urban interests (and thus lowers the pro-agricultural policy bias) in rich countries.

Another influence in developing countries since the 1980s has been the impact of international financial institutions (such as the World Bank and the International Monetary Fund) and the policy conditions they impose as part of their lending to developing countries. The structural-adjustment programs in Africa and Latin America in the 1980s and the programs in the transition countries in Europe and Asia in the 1990s often required the borrowing governments to liberalize their policies and reduce price distortions. Some policy reforms were reversed after the loans were in place, but many appear to have stuck (Akiyama et al. 2001; Kherallah et al. 2002). In the transition countries of Europe and Central Asia, this shift has caused substantial reductions in farm subsidies (Anderson and Swinnen 2010). In Sub-Saharan Africa, the structural-adjustment programs are partly responsible for reductions of farm export taxes (Swinnen et al. 2011).

Several additional factors have played a role in the reversal of agricultural protection in high-income countries, including the GATT/WTO and European Union (EU)-specific effects. Agricultural policies became much more disciplined within the WTO after the Uruguay Round negotiations began in 1986 and concluded in 1994 with the Agreement on Agriculture (URAA) and the Agreement on Sanitary and Phytosanitary (SPS) Measures. The impacts of the URAA and SPS Agreement have been particularly strong on countries that joined the WTO after 1994,[3] but it also may have constrained the growth of agricultural protection (Anania et al. 2004; Swinnen 2008; Swinnen et al. 2012)—even if its impact on agricultural policy in, for example, the USA over the past two decades may have been more limited (Orden et al. 2010, 2011). Countries that joined the WTO after its creation, for example China and Russia, had much more stringent conditions placed on them than was the case for some of the older WTO members (Drabek and Bacchetta 2004; Evenett and Primo Braga 2006).

The URAA required countries to convert non-tariff barriers to tariffs on farm products, to set caps (bindings) on those tariffs, and to phase down and cap agricultural domestic and export subsidies. The caps were somewhat above applied rates in high-income countries, but the bindings were very much above applied tariffs in the case of middle- and especially low-income countries. Hence those bindings currently provide little discipline on the agricultural policies of most developing countries.

In the EU, new countries' accessions have required reforms of the EU's agricultural policy in order to avoid conflicts with WTO. While probably the most important aspect of the reforms has been a shift to less-trade-distorting instruments, these accessions have also contributed to a substantial decline in the EU's overall support for farmers. Since the 1980s, mostly poorer countries have joined the EU (e.g., Spain, Portugal, and Greece in the 1980s, and 10 East European countries in the 2000s), apart from the three rich but small ones that joined in 1995 (Austria, Finland, and Sweden). This reduced the pressure to increase farmer assistance. In addition, several of these countries were not part of the GATT, and their integration in the EU caused GATT constraints for the EU as a whole in the 2000s. These constraints generated pressure to reduce total agricultural support.

In short, the above suggests that high-income countries (including Eastern Europe's transition economies that are now part of the EU) are unlikely in the foreseeable future to raise their assistance to farmers via price-distorting measures, developing countries are unlikely to return to farm export taxation (apart from temporarily at times of price spikes, see the previous chapter), and all countries are unlikely to return to high levels of protection for the manufacturing sector.

## Why the Shift to Support Decoupled from Production in High-Income Countries?

Re-instrumentation of assistance has occurred in some high-income countries, involving a movement away from market-price support to domestic somewhat-decoupled measures (Figs. 5.11 and 5.12). The selection of policy instruments is influenced by several factors. First, different instruments imply different deadweight costs in redistribution. When exports are large, countries are more likely to use non- or less-distortionary instruments than border measures (Swinnen et al. 2012). Policy instruments differ also in implementation costs. Trade taxes are easiest and least costly to implement (Dixit 1996; Rodrik 1995). As economies develop, the system for administering and enforcing income taxes and/or subsidies becomes less costly, so governments will choose trade (and other market) interventions less often as their administrative capacity to tax and subsidize incomes improves. Accessions to WTO may have influenced the nature of the policy-instrument interventions too, with a bias against trade-distorting measures (Swinnen 2008; Orden et al. 2011).

The URAA (and later WTO Doha Round) negotiations have triggered an important change in farm policy instrument choice in the EU, including the shifts in the 1990s from price support to direct payments and then to decoupled payments in the 2003 Reform of the CAP. The URAA has had less impact on US agricultural policies, but the US administration has attempted to insure in its reforms that many US agricultural subsidies are classified as 'green box' (i.e., non-trade distorting) at the WTO (Orden et al. 2010, 2011). These EU and US developments may induce emerging countries such as China to choose non-distorting (or less-distorting) policy instruments as they attempt to support the incomes of their farm households in years to come.

## Why the Differences in Assistance Between Farm Commodities

Why is the intra-sectoral dispersion of nominal rates of assistance across farm commodities so large in so many countries, and why are some commodities (rice, dairy, sugar) assisted in virtually all countries (Fig. 5.8)? There are several reasons to expect such differences within a country. Two already mentioned are the loss-averting tendency for societies to want to assist industries undergoing long- or short-term declines in competitiveness, and for governments to intervene in a product's market the more it can raise tax revenue (hence the far greater use of trade taxes than subsidies to production, consumption, or trade). In the case of a country having a large share of global trade in a product, it is more likely to tax that trade so as to improve the country's terms of trade, and less likely to subsidize its production.

Demand and supply characteristics matter as well. Raising tariffs on commodities that are more important for consumers, such as staple foods, will be opposed more often than will raising tariffs on commodities that are less important as a consumption item. Demand and supply elasticities also affect the distortions and costs of policies (Gardner 1983, 1987; Rausser and de Gorter 1989; de Gorter et al. 1992). The distortions (deadweight costs) and budgetary costs of policy intervention typically increase with higher supply elasticities and with the commodity's trade balance (i.e., when its net exports increase). Because of the inherent changes in the distribution of costs and benefits of policies and the associated political incentives, sectors with higher supply elasticities will be subsidized less (or taxed more). These factors are likely to affect also the choice of policy instruments, as, for example, when governments restrain supply responses through such additional regulations as marketing quotas and/or land controls (Rausser 1992; Rausser et al. 1984).

Also, the costs of implementing (and enforcing) certain policies can be different because of differences in the way commodities are marketed. For example, commodities that are perishable and require processing, such as sugar and dairy products, are typically marketed through processing companies—a point at which governments can intervene at relatively low cost. By contrast, it can be more costly to intervene in the case of products that are easily storable and/or which farmers can market directly to consumers (or to other farmers, as with feedgrains).

Finally, governments treat perennial crops differently than annual crops, because once farmers have incurred the costs of establishing a perennial plantation, they will continue to produce it as long as the price they receive covers incremental or harvesting costs (McMillan 2001; Gawande and Hoekman 2010).

## Will Developing Countries Follow Richer Countries Down the Agricultural Protection Path?

In Chap. 5, it is noted that more than ten advanced developing and transition economies have reached the status of having an agricultural NRA at least half the current average for the OECD as a whole (Fig. 5.6). Most of those emerging economies have seen their NRAs and RRAs rising over the past quarter century. Moreover, they would have risen even more during the past decade had that not been a period of large increases in international food prices that were not fully passed onto domestic markets (for reasons explained in the previous chapter).

Whether those NRAs will continue on an upward trajectory as international food prices return to trend is a moot point. It depends whether the traditional domestic political economy forces that have driven such trajectories in more advanced economies in the past continue to play a dominant role in emerging economies. It is possible that international influences, such as the WTO's URAA and the international financial institutions' inducements to adopt more efficient instruments for achieving society's goals than trade policies, could offset those standard domestic political forces. It is also possible that becoming more democratic, and the lowering of information costs and the spread of commercial mass media, will at least help to remove any remaining anti-agricultural policy bias in developing countries—but those same influences may also lead to those economies 'overshooting' in the sense of going beyond a neutral policy position to a pro-agricultural bias. Nor will developing countries' commitments in the WTO be enough to stop that tendency, thanks to the large gap between their tariff and subsidy bindings and their actual applied rates. If the WTO's Doha Development Agenda were to be revived and brought to a successful conclusion, how much might that limit the growth of agricultural protection and farm subsidies in developing countries? That is the subject of the next chapter. However, if that Doha Round is abandoned, as seems likely as of early 2016, and current ceiling bindings remain at their present high levels, there will be little external constraint on farm policies in developing countries for the foreseeable future. Chapter 11 examines what that might mean for trade and policy development prospects through to 2030.

## Key Messages

It is now well understood as to why domestic political forces in the past have led countries gradually to transition from negative to positive agricultural nominal and relative rates of assistance as their per capita incomes grow and the agricultural sector's shares of GDP and employment shrink. So too are the political economy reasons as to why countries partially insulate their domestic food markets from spikes, both up and down, in international food prices.

Trade policies pervade as a means of altering the trend level and fluctuations in domestic food prices, even though they are far from being the most efficient or equitable instruments for achieving the objective of averting losses—both long term and short term—to significant groups in society. Fortunately, the standard reasons for that choice of instrument are altering, as democracy and commercial mass media spread and as costs of becoming informed about policies fall. While that will help to remove any remaining anti-agricultural policy bias in developing countries, those same influences may also lead emerging economies to go beyond a neutral policy position to a pro-agricultural bias as their incomes grow. Those countries' commitments in the WTO will not be enough to stop that tendency in the foreseeable future, thanks to the large gap between their tariff bindings and their actual applied rates (see Chap. 11 below). However, the cost of more-direct supports to selected.

## Notes

1. There is a literature also on the broader households is falling rapidly in developing countries. its implications for assistance vis trade measures are discussed in Chap. 12 aversion of society to income inequality. See, for example, Engelmann and Strobel (2004) and Bernard et al. (2007), and its application in the context of US farm-support programs in Lusk and Briggeman (2011).
2. Loss aversion has also been suggested as part of the reason for governments to support sectors, such as agriculture, in long-term decline (Swinnen 1994; Baldwin and Robert-Nicoud 2007; Tovar 2009).
3. On the role played by the SPS Agreement in freeing up some non-tariff barriers to food imports, see Anderson et al. (2001), Josling et al. (2004), and for a specific example adversely affecting tropical fruit exports, James and Anderson (1998).

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CHAPTER 10

# Prospective Effects of (or Requiem for?) WTO's Doha Development Agenda

Had this book been written a decade earlier, a large part of it would have focused on the opportunities for taking the next big step in liberalizing multilaterally the world's food markets. By then the decade-long implementation of the Uruguay Round agreements—including the historic agreement on agriculture—had been completed (at the end of 2004), and the WTO's membership had expanded to cover all but a small fraction of world trade, including most importantly China's. True, the 1999 Trade Ministerial in Seattle had to be abandoned because of anti-globalization protesters but, after the terrorist attacks of 11 September 2001 on the USA, the membership of the WTO convened two months later in the capital of Qatar to launch a new comprehensive round of multilateral trade negotiations, the so-called Doha Development Agenda (DDA). By the time trade ministers had their biennial meeting in December 2015, however, enthusiasm for continuing the Doha round had all but evaporated.

In the first few years of the DDA, there was a great deal of *ex ante* analysis of the prospective effects of a DDA agreement. Indeed the quality of that analysis was far higher and far more comprehensive than prior to any of the GATT's seven negotiation rounds that preceded it, including the Uruguay Round. Given the focus on development, many analyses gave special attention to the likely effects on developing countries in particular. And because distortions were still greatest in agriculture, that sector received more attention than any other.



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It now seems unlikely that the farm policy reform proposals tabled in the first few years of the DDA will ever become part of a single-undertaking agreement at the WTO. Nonetheless, analyses of them are worth examining because they give insights into what might have been, and why the package was insufficiently appealing to enough of the key members of the WTO. So after providing some background, this chapter summarizes the main questions that were addressed in the economic analyses that focused on the agricultural parts of the DDA, and explains what was learnt from a sample of those analyses.

## Background to the DDA

Agriculture has a habit of causing contention in international trade negotiations. It caused long delays to the Uruguay Round in the late 1980s and 1990s, and it is again proved to be the major stumbling block in the WTO's Doha round of multilateral trade negotiations (formally known as the Doha Development Agenda, or DDA). For example, it contributed substantially to the failure of the September 2003 Trade Ministerial Meeting in Cancún to reach agreement on how to proceed with the DDA, and it was the ostensible reason for the collapse of the negotiations in the summer of 2008. Very little progress was made between then and the Trade Ministerial Meeting in Nairobi in late 2015, apart from an agreement at that Nairobi meeting to phase out agricultural export subsidies.

Since policies affecting this declining sector are so politically sensitive, there are always self-interested groups suggesting it be sidelined in trade negotiations—as indeed it has in numerous sub-global preferential trading agreements, and was in the GATT prior to the Uruguay Round.[1] Today the groups with that inclination include not just farmers in the highly protecting countries and net food importing developing countries but also those food exporters receiving preferential access to those markets including holders of tariff rate quotas (TRQs), members of regional trading agreements, and parties to non-reciprocal preference agreements including all least-developed countries. However, because agricultural earnings are so important to a large number of developing countries, the highly protective farm policies of a few wealthy countries have been targeted by them in the DDA negotiations. Better access to rich countries' markets for their farm produce is a high priority for them.[2]

Some developing countries have been granted greater access to developed country markets for a selection of products under various preferential agreements. Examples are the European Union's (EU's) provisions for former colonies in the Africa, Caribbean and Pacific (ACP) program and for least-developed countries under the Everything-But-Arms (EBA) agreement. Likewise, the USA has its Africa Growth and Opportunity Act (AGOA) and Caribbean Basin Initiative (CBI). These schemes reduce demands for developed country farm policy reform from preference-receiving countries, but they exacerbate the concerns of other countries excluded from such programs and thereby made worse off through declining terms of trade—and they may even be worsening rather than improving aggregate global and even developing country welfare.

Apart from that, many in developing countries feel they did not get a good deal out of the Uruguay Round. From a mercantilistic view, the evidence seems to support that claim: Finger and Winters (2002) report that the average depth of tariff cut by developing countries was substantially greater than that agreed to by high-income countries. Also, developing countries had to take on costly commitments such as those embodied in the Sanitary and Phytosanitary (SPS) and Trade-related Aspects of Intellectual Property Rights (TRIPS) agreements (Finger and Schuler 2001). They therefore have been determined in the Doha round that they get significantly more market access commitments from developed countries before they contemplate opening their own markets further.

Greater market access for developing countries' exporters, and especially for poor producers in those countries, is to be found in agriculture (and to a lesser extent in textiles and clothing). This can be seen from a glance at Table 10.1. It shows that, at the time of the launch of the DDA in 2001, developing country exporters face an average tariff (even after taking account of preferences) of 16 % for agriculture and food, and 9 % for textiles and clothing, compared with just 2.5 % for other manufactures. The average tariff on agricultural goods is high not just in high-income countries but also in developing countries, suggesting even more reason for attention to be focused on that sector (along with textiles) in the multilateral reform process embodied in the DDA.

It was only with the establishment of the WTO, in 1995, that agricultural trade was brought under multilateral disciplines via the Uruguay Round Agreement on Agriculture (URAA). That agreement was ambitious in scope, converting all agricultural protection to tariffs and limiting increases in virtually all tariffs through tariff bindings. Unfortunately, the process of converting non-tariff barriers into tariffs (inelegantly termed 'tariffication') provided numerous opportunities for backsliding that greatly reduced the effectiveness of the agreed disciplines (Hathaway and

**Table 10.1** Average applied import tariffs, by sector and region, 2001 (%, *ad valorem* equivalent)

| | *Importing region* | | |
|---|---|---|---|
| *Exporting region* | *High-income countries*[a] | *Developing countries*[b] | *World* |
| *Agriculture and food* | | | |
| High-income countries[a] | 18 | 18 | 17.8 |
| Developing countries[b] | 14 | 18 | 15.6 |
| All countries | 16 | 18 | 16.7 |
| *Textiles and wearing apparel* | | | |
| High-income countries[a] | 8 | 15 | 12.0 |
| Developing countries[b] | 7 | 20 | 9.3 |
| All countries | 8 | 17 | 10.2 |
| *Other manufactures* | | | |
| High-income countries[a] | 2 | 9 | 4.1 |
| Developing countries[b] | 1 | 7 | 2.5 |
| All countries | 1 | 8 | 3.5 |
| *All merchandise* | | | |
| High-income countries[a] | 3 | 10 | 5.4 |
| Developing countries[b] | 3 | 10 | 4.9 |
| All countries | 3 | 10 | 5.2 |

Source: Compiled from the GTAP database Version 6.05 by Anderson and Martin (2006, Table 1.1)

[a]High-income countries include the newly industrialized East Asian customs territories of Hong Kong, Korea, Singapore, and Taiwan as well as Europe's transition economies that joined the EU in April 2004

[b]These import-weighted averages incorporate tariff preferences provided to developing countries, unlike earlier versions of the GTAP database. They assume that the EU is a single customs territory

Ingco 1996). In developing countries, the option for 'ceiling bindings' allowed countries to set their bindings at high levels, frequently unrelated to the previously prevailing levels of protection. Hence agricultural import tariffs were still very high in both rich and poor countries when the DDA was launched, with bound rates half as high again as MFN applied rates (Table 10.2).

Also, agricultural producers in some countries were being supported by export subsidies (still tolerated within the WTO only for agriculture) and by domestic support measures. Together with tariffs and other barriers to agricultural imports, these measures supported farm incomes and encouraged agricultural output to varying extents. The market price support component also typically raises domestic consumer prices of farm products. For OECD member countries as a group, the PSE was almost the same in 2001–03 as in 1986–88, at about $240 billion per year. However,

**Table 10.2** Agricultural weighted average import tariffs, by region, 2001 (%, *ad valorem* equivalent, weights based on imports)

| | *Bound tariff* | *MFN applied tariff* | *Actual applied tariff*[a] |
|---|---|---|---|
| Developed countries | 27 | 22 | 14 |
| Developing countries | 48 | 27 | 21 |
| *of which:* LDCs | *78* | *14* | *13* |
| World | 37 | 24 | 17 |

Source: Jean et al. (2006, Table 4.2)

[a]Includes preferences and in-quota TRQ rates where relevant, as well as the *ad valorem* equivalent of specific tariffs. Developed countries include Europe's transition economies that joined the EU in April 2004. The 'developing countries' definition used here is that adopted by the WTO and so includes East Asia's four newly industrialized tiger economies, which is why the 21 % shown in column 3 is above the 18 % and 14 % shown in the first column of Table 10.1

there has been a significant increase in the proportion of that support coming from programs that are somewhat 'decoupled' from current output, such as payments based on area cropped, number of livestock, or some historical reference period.

Nonetheless, the achievements of the URAA provided some scope for optimism about what might be achieved via the WTO as part of the DDA and beyond. The Doha round has the advantage over the Uruguay Round of beginning from the framework of rules and disciplines agreed in that previous round. In particular, it has the three clearly identified 'pillars' of market access, export subsidies, and domestic support on which to focus. True, it took more than three years to agree on a framework for the current negotiations, reached on at the end of July 2004 (WTO 2004), but that Framework Agreement has provided a strong basis for undertaking *ex ante* analysis of various options potentially available to WTO members from the Doha negotiations.

This chapter provides a summary mostly of one study (Anderson and Martin 2006), but that study built on numerous analyses of the DDA and agricultural trade, including five books that appeared in 2004. One edited by Aksoy and Beghin (2004) provides details of trends in global agricultural markets and policies, especially as they affect nine commodities of interest to developing countries. Another, edited by Ingco and Winters (2004), includes a wide range of analyses based on papers revised following a conference held just prior to the aborted WTO Trade Ministerial meeting in Seattle in 1999. The third, edited by Ingco and Nash (2004), provides a follow-up to the broad global perspective of the Ingco and Winters volume: it explores a wide range of key issues and options in agricultural trade reform from a developing country perspective. The fourth, edited by Anania et al. (2004), is a comprehensive tenth-anniversary retrospective on the URAA as well as a look ahead following also numerous unilateral trade and subsidy reforms in developed, transition, and developing economies. And the fifth focuses on implications for Latin America (Jank 2004).

All of those 2004 studies were completed well before the July Framework Agreement was reached in the early hours of 1 August 2004, and before the public release in December 2004 of Version 6 database of the Global Trade Analysis Project (GTAP) at Purdue University. That Version 6 database is a major improvement over the previous version for several reasons. One is that it includes global trade and protection data as of 2001 (previously 1997), the year the DDA was launched. Another is that protection data are available, for the first time, on bound as well as applied tariffs, non-reciprocal as well as reciprocal tariff preferences, the *ad valorem* equivalents of specific tariffs (which are plentiful in the agricultural tariff schedules of many high-income, high-protection countries), and the effects of agricultural TRQs. In addition, key trade policy changes to the start of 2005 have been added, namely, the commitments associated with accession to WTO by such economies as China and Taiwan, the implementation of the last of the Uruguay Round commitments (most notably the abolition of quotas on trade in textiles and clothing at the end of 2004), and the eastward enlargement of the EU from 15 to 25 members in April 2004.

Hence what distinguishes the Anderson and Martin (2006) collection of studies from the above 2004 studies and other books with similar titles is that (a) its *ex ante* analysis focuses on the core aspects of the July Framework Agreement from the viewpoint of agriculture and developing countries, taking account also of what might happen to non-agricultural market access and the other negotiating areas; (b) it does so in an integrated way by using the GTAP Version 6 database (amended to account for key protection changes to early 2005) and the World Bank's global, economy-wide Linkage model described in Chap. 6 and details of which are documented in van der Mensbrugghe (2005);[3] and (c) it involved an intense program of integrated research by a complementary set of well-informed economic researchers from four continents.

## What Questions Did Economic Analysts Focus on?

Among the core questions addressed in the multi-authored study that culminated in the book edited by Anderson and Martin (2006) are the following:

- What is at stake in this Doha round, in terms of efficiency gains foregone by the various regions of the world because of current tariffs and agricultural subsidies?
- How much are each of the three 'pillars' of agricultural distortions (market access, export subsidies, and domestic support) contributing to those welfare losses, compared with non-agricultural trade barriers?
- How might the demands for SDT for developing and least-developed countries be met without compromising the potential welfare gains from trade expansion for those economies?
- What are the consequences, in terms of opening up to imports, of alternative formulas for cutting bound agricultural tariffs?
- In the case of products whose imports are subject to TRQs, what are the trade-offs between reducing in-quota or out-of-quota tariffs versus expanding the size of those quotas or the in-quota tariffs?
- To what extent would the erosion of tariff preferences, that necessarily accompanies MFN trade liberalization by developed countries, reduce the developing countries' interest in agricultural and other trade reform?
- What should be done about agricultural export subsidies, including those implicit in export credits, food aid, and arrangements for state trading enterprises?
- Based on recent policy changes in key countries, how might domestic farm support measures be better disciplined in the WTO?
- What are the consequences of reducing the domestic support commitments made in the Uruguay Round, in terms of cuts to the actual domestic support levels currently provided to farmers?
- In particular, how might reductions in cotton subsidies help developing country farmers in West Africa and elsewhere?
- What difference does it make to expand market access for non-agricultural products at the same time as for farm goods under a Doha agreement?

- Which developing countries would have to reduce their farm output and employment as a result of such a Doha agreement?
- Taking a broad brush, and in the light of past experience and our understanding of the political economy of agricultural policies in rich and poor countries (see the previous chapter), how might reform of those policies best be progressed during the DDA negotiations?
- What would be the overall market and welfare consequences by 2015, for various countries and regions as well as globally, of the alternative Doha reform commitments considered in addressing each of the above questions?

## What Reform Scenarios Were Modeled?

So as to focus in this chapter on the agricultural component of the DDA in particular, scenarios are considered that make simplifying assumptions about non-agricultural components of the negotiations, namely no reform in services and no new trade facilitation measures. Also, agricultural export subsidies are assumed to be eliminated, and domestic support for agriculture is cut in just four economies: by an average of 28 % for the USA, 18 % for Norway, 16 % for the EU, and 10 % for Australia.

More difficult to determine were the likely nature and extent of reductions in market access barriers, so a number of scenarios are considered initially for agricultural and food products in isolation of non-agricultural tariff cuts, before incorporating (as in Scenarios 5 and 6 below) some non-agricultural market access. A total of six simulations are designed to evaluate the consequences of different approaches to liberalization, and particularly different degrees of tops-down progressivity in the tariff cuts, and different degrees of SDT. Throughout this study, the WTO usage of the term 'developing countries' applies when allocating SDT, which means Hong Kong, Korea, Singapore, and Taiwan are all able to enjoy SDT despite their high-income status.

The experiments begin for *Scenario 1* with a progressive or tiered reduction formula with marginal agricultural tariff rate reductions of 45 %, 70 %, and 75 % within each of the three bands defined by the Harbinson (WTO 2003) inflection points of tariff rates of 15 % and 90 % for developed countries (i.e., for low agricultural tariffs the marginal rate of reduction is 45 %, for medium-level tariffs it is 70 %, and for the highest tariffs it is 75 %), and for developing countries the reductions are 35 %, 40 %, 50 %, and 60 % within each of their four bands (and least-developed countries are not required to undertake any reduction commitments). These cuts are greater than those proposed in the Harbinson draft because its cuts were too light to have much impact (providing only two-thirds of the global welfare gain of Scenario 1, and leading to zero gain in Scenario 2).

*Scenario 2* considers the impact of a proportional cut formula that brings about the same reduction in average agricultural tariffs in developed countries as a group (44 %), and developing countries as a group (21 %), as the tiered formulas used in Scenario 1.

*Scenario 3* has the same proportional cut formula as Scenario 2 but adds 2 % Sensitive Products[4] in developed countries and 4 % Sensitive and Special Product (SSP) in developing countries, thereby reducing the average cut to 16 % for developed countries and 9 % for developing countries.

*Scenario 4* considers the effects of adding to Scenario 3 a tariff cap of 200 % such that any product with a bound tariff in excess of that limit will be subjected to a reduction down to that cap rate, which leads to average cuts in food and agricultural tariffs of 18 % for both developed and developing countries.

*Scenario 5* adds to Scenario 1 the cuts in non-agricultural tariff bindings of 50 % in developed countries, 33 % in developing countries, and zero in least-developed countries.

Finally, *Scenario 6* makes developing (including least-developed) countries full participants in the round, undertaking the same reductions in bound (but not necessarily applied) tariffs as the developed countries in Scenario 5.

## What Has Been Learned About the DDA Proposals?

It is not possible in this chapter to provide details of analysts' answers to all of those questions, but in this section a paragraph summarizes each of the main findings and provides a guide to the pertinent literature. The modeling results are based on the LINKAGE model of the global economy (van der Mensbrugghe 2005) and Version 6.05 of the GTAP database which is calibrated to 2001, but the model is projected to 2015 which is when implementation would have been completed had the DDA negotiations been concluded at the biennial Trade Ministerial Meeting in Hong Kong in late 2005. Details of the modeling features and scenarios are given in Anderson et al. (2006a). The first few lessons below come from a scenario involving full trade liberalization and farm subsidy removal, while the rest come from a series of partial liberalizations.

**The potential gains from further global trade reform are huge** Global gains from trade reform post-2004 are estimated to be large even if dynamic gains and gains from economies of scale and increased competition are ignored. Freeing all merchandise trade and agricultural subsidies is estimated to boost global welfare by nearly $300 billion per year by 2015 (Table 10.3), plus whatever productivity effects that reform would generate.[5]

**Developing countries could gain disproportionately from further global trade reform** The developing countries (as defined by the WTO) would enjoy 30 % of the global gain from complete liberalization of all merchandise trade, well above their one-fifth share of global GDP. Their welfare would increase by 0.8 %, compared with an increase of just 0.6 % for developed countries (Anderson et al. (2006b, 2006d). The developing countries' higher share is partly because they have relatively high tariffs themselves (so they would reap substantial efficiency gains from reforming their own protection), and partly because their exports are more concentrated in farm and textile products whose tariffs in developed country markets are exceptionally high (see Table 10.1)—notwithstanding nonreciprocal tariff preferences for many developing countries, which contribute to the losses associated with terms of trade deterioration shown in the middle column of Table 10.3.

**Benefits could be as much from South–South as from South–North trade reform** Trade reform by developing countries is just as important economically to those countries as is reform by developed countries, including from agricultural liberalization (Table 10.4b). Hence choosing to delay their own reforms or reforming less than developed countries, and thereby holding back South–South trade growth (detailed in Anderson et al. 2006e), could reduce substantially the potential gains to developing countries.

**Agriculture is where cuts are needed most** To realize that potential gain from opening up goods markets, it is in agriculture that by far the greatest cuts in bound tariffs and subsidies are required. This is because of the very high rates of assistance in that sector relative to other sectors. Food and agricultural policies are responsible for more than three-fifths of the global gain foregone because of merchandise trade distortions (column 1 of Table 10.4a)—despite the fact that agriculture and food account for less than 10 % of world trade and less than 4 % of global GDP. Agricultural reform is

**Table 10.3** Projected effects on real income from full liberalization of global merchandise trade, by country/region, 2015

| *(Impacts in 2015 relative to the baseline, in 2001 US dollars)* | *Real income gain ($billion)* | *Income changes due just to change in terms of trade ($billion)* | *As% of baseline income in 2015* |
|---|---|---|---|
| High-income countries | 201.6 | 30.3 | 0.6 |
| Developing countries—WTO defn.[a] | 141.5 | −21.4 | 1.2 |
| Developing countries | 85.7 | −29.7 | 0.8 |
| Middle-income countries | 69.5 | −16.7 | 0.8 |
| Low-income countries | 16.2 | −12.9 | 0.8 |
| East Asia and Pacific | 23.5 | −8.5 | 0.7 |
| South Asia | 4.5 | −11.2 | 0.4 |
| Europe and Central Asia | 7.0 | −4.0 | 0.7 |
| Middle East and North Africa | 14.0 | −6.4 | 1.2 |
| Sub-Saharan Africa | 4.8 | −1.8 | 1.1 |
| Latin America and the Caribbean | 28.7 | 2.2 | 1.0 |
| **World total** | **287.3** | **0.6** | **0.7** |

Source: Anderson et al. (2006b, Table 12.4)

[a]Includes Hong Kong, Korea, Singapore, and Taiwan

at least as important to the welfare of developing countries as it is for welfare in the rest of the world: the gains to developing countries from global agricultural liberalization represent almost two-thirds of their total potential gains, which compares with just one-quarter from textiles and clothing and one-ninth from other merchandise liberalization (Table 10.4b).

**Subsidy disciplines are important, but increased market access in agriculture is crucial** Extremely high applied tariffs on agricultural relative to nonfarm products are the major reason for food and agricultural policies contributing 63 % of the welfare cost of current merchandise trade distortions. Subsidies to farm production and exports are only minor additional contributors: 3 and 1 percentage points, respectively, compared with 59 points due to agricultural tariffs.[6] This is even truer for developing countries than for developed ones (compare columns 1 and 2 of

**Table 10.4** Projected effects on economic welfare of full trade liberalization from different groups of countries and products, 2015 (%)

| | *From full lib'n of:* | | | |
|---|---|---|---|---|
| *Percentage due to:* | *Agriculture and food* | *Textiles and clothing* | *Other manufactures* | *All goods* |
| (a) *Distribution of effects on* global *welfare* | | | | |
| Developed[a] countries' policies | 46 | 6 | 3 | 55 |
| Developing countries' policies | 17 | 8 | 20 | 45 |
| **All countries' policies** | **63** | **14** | **23** | **100** |
| (b) *Distribution of effects on* developing countries' *welfare* | | | | |
| Developed[a] countries' policies | 30 | 17 | 3 | 50 |
| Developing countries' policies | 33 | 10 | 7 | 50 |
| **All countries' policies** | **63** | **27** | **10** | **100** |

Source: Anderson et al. (2006b, Table 12.6)

[a]Developed countries include the transition economies of Eastern Europe and the former Soviet Union

**Table 10.5** Distribution of global welfare impacts of fully removing agricultural tariffs and subsidies, 2001 (%)

| *Agricultural liberalization component* | *Beneficiary region* | | |
|---|---|---|---|
| | *High-income[a] countries* | *Developing countries* | *World* |
| Import market access | 66 | 27 | 93 |
| Export subsidies | 5 | −3 | 2 |
| Domestic support | 4 | 1 | 5 |
| **All measures** | **75** | **25** | **100** |

Source: Summarized from Hertel and Keeney (2006, Table 2.7), as explained in Anderson et al. (2006a)

[a]High-income countries include the newly industrialized East Asian customs territories of Hong Kong, Korea, Singapore, and Taiwan as well as Europe's transition economies that joined the EU in April 2004

Table 10.5). A more detailed empirical analysis by Anderson et al. (2006a) includes estimates of implicit forms of farm export subsidization such as via food aid, export credits, or state trading enterprises, but even they conclude that 93 % of the global welfare cost of agricultural policies was due to market access barriers and only 2 % to export subsidies and 5 % to domestic support measures. Disciplining those domestic subsidies and phasing

**Table 10.6** Projected impacts of full global merchandise trade liberalization on real factor prices, 2015[a] (% change relative to the baseline in 2015)

| | *Unskilled wages* | *Skilled wages* | *Capital* | *Land owner rent* | *CPI* |
|---|---|---|---|---|---|
| Australia + New Zealand | 3.1 | 1.1 | −0.3 | 17.2 | 1.2 |
| EU 25 + EFTA[a] | 0.0 | 1.3 | 0.7 | −51.0 | −1.3 |
| USA | 0.1 | 0.3 | 0.0 | −9.2 | −0.4 |
| Canada | 0.7 | 0.7 | 0.4 | 26.9 | −0.9 |
| Japan | 1.3 | 2.2 | 1.1 | −67.2 | −0.1 |
| Korea and Taiwan | 6.5 | 7.1 | 3.8 | −45.0 | −0.7 |
| Hong Kong and Singapore | 3.2 | 1.6 | 0.3 | 4.4 | 1.1 |
| Argentina | 2.9 | 0.5 | −0.7 | 21.3 | 0.3 |
| Bangladesh | 1.8 | 1.7 | −0.2 | 1.8 | −7.2 |
| Brazil | 2.7 | 1.4 | 1.6 | 32.4 | 2.2 |
| China | 2.2 | 2.2 | 2.8 | −0.9 | −0.4 |
| India | 2.8 | 4.6 | 1.8 | −2.6 | −6.0 |
| Indonesia | 3.3 | 1.5 | 0.9 | 1.0 | 0.5 |
| Thailand | 13.2 | 6.7 | 4.2 | 11.4 | −0.6 |
| Vietnam | 25.3 | 17.6 | 11.0 | 6.8 | −2.3 |
| Russia | 2.0 | 2.8 | 3.5 | −2.2 | −3.3 |
| Mexico | 2.0 | 1.6 | 0.5 | 0.6 | −1.4 |
| South Africa | 2.8 | 2.5 | 1.8 | 5.7 | −1.6 |
| Turkey | 1.3 | 3.4 | 1.1 | −8.1 | −0.3 |
| Rest of South Asia | 3.7 | 3.2 | 0.1 | 0.1 | −2.7 |
| Rest of East Asia | 5.8 | 4.2 | 5.2 | −0.9 | −1.6 |
| Rest of Latin America | 5.7 | 1.4 | −0.4 | 17.8 | −1.2 |
| Rest of E Europe/C Asia | 2.3 | 4.2 | 2.1 | −0.3 | −2.6 |
| Middle East and N Africa | 4.1 | 4.1 | 2.6 | 2.4 | −3.1 |
| Other Southern Africa | 6.0 | 1.6 | 0.0 | 4.6 | 0.4 |
| Rest of Sub-Sah. Africa | 8.2 | 6.5 | 2.2 | 5.2 | −5.0 |
| Rest of the World | 4.4 | 2.7 | 1.1 | 6.3 | −1.4 |

Source: Anderson et al. (2006a, Table 12.10)
[a]EFTA is the European Free Trade Area (predominantly Norway and Switzerland)

out export subsidies remained very important agenda items though (Hart and Beghin 2006), not least to bring agriculture into line with nonfarm trade in terms of not using export subsidies and to reduce the risk of re-instrumentation of assistance from import tariffs to domestic subsidies.

**In developing countries the poor would gain disproportionately from multilateral trade reform** Full global merchandise trade liberalization would raise real factor returns for the poorest households most. This is implied in Table 10.6, where for developing countries the biggest factor price rise is for farm land, followed by unskilled labor. Since farmers[7] and other low-skilled workers constitute the vast majority of the poor in developing countries, such reform would be highly likely to reduce both inequity and poverty.

**Large cuts in domestic support commitments are needed to erase binding overhang** In turning from the potential gains from full liberalization to what might be achievable under a Doha partial reform package, the devil is in the proposed details. For example, commitments on domestic support for farmers were so much higher than actual support levels at the time that the 20 % cut in the total bound aggregate measure of support promised in the July Framework Agreement as an early installment would require no actual support reductions for any WTO member. Indeed a cut as huge as 75 % for those with most domestic support is needed to get some action, and even then it would only require cuts in 2001 levels of domestic support for four WTO actors: the USA (by 28 %), the EU (by 18 %), Norway (by 16 %), and Australia (by 10 %)—and the EU and Australia had already introduced reforms of that order between 2001 and 2005, so would have needed to do no further cutting under even that formula.

**Large cuts in bound rates are needed also to erase binding overhang in agricultural tariffs** Table 10.2 shows that there has been substantial binding overhang in agricultural tariffs: the average bound rate in developed countries was almost twice as high as the average applied rate in 2001, and in developing countries the ratio was even greater. Thus large reductions in bound rates are needed before it is possible to bring about *any* improvements in market access. To bring the global average actual agricultural tariff down by one-third, bound rates would have to be reduced for developed countries by at least 45 %, and up to 75 % for the highest tariffs, under a tiered formula.

**A complex tiered formula may be little better than a proportional tariff cut** It turns out that, because of the large binding overhang, a tiered formula for cutting agricultural tariffs would generate not much more global welfare—and no more welfare for developing countries as a group—than a proportional cut of the same average size (columns 1 and 2 of Tables 10.7, 10.8, and 10.9). This suggests that there may be little value in arguing over the finer details of a complex tiered formula just for the sake of reducing tar-

**Table 10.7** Projected welfare effects of possible Doha reform scenarios, 2015 (% difference from baseline, and Equivalent Variation in income in 2001 US$ billion)

| | *Agricultural subsidy cuts[a] plus:* | | | | | |
|---|---|---|---|---|---|---|
| | *Tiered agricultural tariff cuts[b]* | *Propn'l agricultural tariff cuts[b]* | *Scenario 2 plus 2 % SSP* | *Scenario 3 plus 200 % cap* | *Scenario 1 plus 50 % NAMA cut for HICs[c]* | *Scenario 1 plus 50% NAMA cut for HICs + DCs[d]* |
| | *Scenario 1* | *Scenario 2* | *Scenario 3* | *Scenario 4* | *Scenario 5* | *Scenario 6* |
| High-income[e] countries | 0.20 | 0.18 | 0.05 | 0.13 | 0.25 | 0.30 |
| Middle-income countries | 0.10 | 0.10 | 0.00 | 0.01 | 0.15 | 0.21 |
| *of which: China* | *−0.02* | *−0.01* | *−0.05* | *−0.04* | *0.07* | *0.06* |
| Low-income countries | 0.05 | 0.04 | 0.01 | 0.00 | 0.18 | 0.30 |
| **Total world** | **0.18** | **0.16** | **0.04** | **0.10** | **0.23** | **0.28** |
| *(and in $billion)* | *74.5* | *66.3* | *17.9* | *44.3* | *96.1* | *119.3* |

Source: Anderson et al. (2006b, Table 12.14)

[a]Elimination of agricultural export subsidies and cuts in actual domestic support as of 2001 of 28 % in the USA, 18 % in the EU, and 16 % in Norway

[b]In Scenarios 1 and 2 the applied global average tariff on agricultural products is cut by roughly one-third, with larger cuts in developed countries, smaller in developing countries, and zero in least-developed countries. In Scenario 1 there are three tiers for developed countries and four for developing countries, following Harbinson (WTO 2003) but 10 percentage points higher

[c]Non-agricultural market access (NAMA) is expanded by a 50 % tariff cut for developed countries, 33% for developing countries, and zero in least-developed countries

[d]Developing and least-developed countries cut all agricultural and non-agricultural tariffs as much as developed countries

[e]High-income countries (HICs) include the newly industrialized East Asian customs territories of Hong Kong, Korea, Singapore, and Taiwan as well as Europe's transition economies that joined the EU in April 2004

**Table 10.8** Projected dollar change in real income in alternative Doha scenarios, 2015 (change in real income in 2015 in 2001 $billion compared to baseline scenario)

| | *Scen. 1* | *Scen. 2* | *Scen. 3* | *Scen. 4* | *Scen. 5* | *Scen. 6* |
|---|---|---|---|---|---|---|
| Australia + New Zealand | 2.0 | 2.2 | 1.2 | 1.2 | 2.4 | 2.8 |
| EU 25 + EFTA | 29.5 | 28.2 | 10.7 | 10.9 | 31.4 | 35.7 |
| USA | 3.0 | 3.4 | 2.5 | 2.1 | 4.9 | 6.6 |
| Canada | 1.4 | 1.2 | 0.4 | 0.4 | 0.9 | 1.0 |
| Japan | 18.9 | 15.1 | 1.4 | 12.9 | 23.7 | 25.4 |
| Korea + Taiwan | 10.9 | 7.3 | 1.7 | 15.9 | 15.0 | 22.6 |
| Hong Kong + Singapore | −0.1 | −0.1 | −0.2 | −0.2 | 1.5 | 2.2 |
| Argentina | 1.3 | 1.4 | 1.1 | 1.0 | 1.3 | 1.6 |
| Bangladesh | 0.0 | 0.0 | 0.0 | 0.0 | −0.1 | −0.1 |
| Brazil | 3.3 | 3.2 | 1.1 | 1.1 | 3.6 | 3.9 |
| China | −0.5 | −0.4 | −1.4 | −1.1 | 1.7 | 1.6 |
| India | 0.2 | 0.1 | 0.2 | 0.2 | 2.2 | 3.5 |
| Indonesia | 0.1 | 0.2 | 0.2 | 0.0 | 1.0 | 1.2 |
| Thailand | 0.9 | 1.0 | 0.8 | 0.8 | 2.0 | 2.7 |
| Vietnam | −0.1 | −0.1 | −0.1 | −0.1 | −0.5 | −0.6 |
| Russia | −0.3 | −0.1 | −0.7 | −0.7 | 0.8 | 1.5 |
| Mexico | −0.2 | −0.2 | −0.3 | −0.3 | −0.9 | −0.2 |
| South Africa | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.7 |
| Turkey | 0.6 | 0.5 | 0.1 | 0.0 | 0.7 | 1.4 |
| **High-income countries** | **65.6** | **57.2** | **17.8** | **43.2** | **79.9** | **96.4** |
| **Developing countries** | **9.0** | **9.1** | **0.1** | **1.1** | **16.1** | **22.9** |
| Middle-income countries | 8.0 | 8.3 | 0.0 | 1.0 | 12.5 | 17.1 |
| Low-income countries | 1.0 | 0.8 | 0.2 | 0.0 | 3.6 | 5.9 |
| East Asia and Pacific | 0.5 | 0.9 | −0.4 | 0.6 | 4.5 | 5.5 |
| South Asia | 0.4 | 0.3 | 0.3 | 0.4 | 2.5 | 4.2 |
| E Europe + Central Asia | 0.1 | 0.2 | −0.9 | −0.9 | 0.8 | 2.1 |
| Middle East + N Africa | −0.8 | −0.9 | −1.2 | −1.2 | −0.6 | 0.1 |
| Sub-Saharan Africa | 0.3 | 0.3 | −0.2 | −0.1 | 0.4 | 1.2 |
| Latin America + Caribbean | 8.1 | 8.0 | 2.5 | 2.1 | 7.9 | 9.2 |
| **World total** | **74.5** | **66.3** | **17.9** | **44.3** | **96.1** | **119.3** |

Source: Anderson et al. (2006b, Table 12.14)

iff escalation. Instead, a simple tariff cap of, say, 100 % or even 200 % could achieve essentially the same outcome (Jean et al. 2006, 2011).

**Even large cuts in bound tariffs do little if 'Sensitive Products' are allowed, except if a cap applies** If members succumb to the political temp-

**Table 10.9** Projected change in real income in alternative Doha scenarios, 2015 (change in real income in 2015 in% compared to baseline scenario)

| | *Scen. 1* | *Scen. 2* | *Scen. 3* | *Scen. 4* | *Scen. 5* | *Scen. 6* |
|---|---|---|---|---|---|---|
| Australia + New Zealand | 0.35 | 0.38 | 0.22 | 0.20 | 0.42 | 0.48 |
| EU 25 + EFTA | 0.29 | 0.28 | 0.11 | 0.11 | 0.31 | 0.36 |
| USA | 0.02 | 0.02 | 0.02 | 0.01 | 0.03 | 0.05 |
| Canada | 0.15 | 0.13 | 0.05 | 0.05 | 0.10 | 0.11 |
| Japan | 0.38 | 0.30 | 0.03 | 0.26 | 0.48 | 0.51 |
| Korea + Taiwan | 0.86 | 0.58 | 0.14 | 1.26 | 1.19 | 1.79 |
| Hong Kong + Singapore | −0.02 | −0.02 | −0.04 | -0.04 | 0.35 | 0.52 |
| Argentina | 0.32 | 0.34 | 0.27 | 0.26 | 0.34 | 0.39 |
| Bangladesh | −0.06 | −0.06 | −0.03 | −0.04 | −0.10 | -0.09 |
| Brazil | 0.50 | 0.49 | 0.17 | 0.17 | 0.55 | 0.59 |
| China | −0.02 | −0.01 | −0.05 | −0.04 | 0.07 | 0.06 |
| India | 0.02 | 0.02 | 0.03 | 0.02 | 0.25 | 0.40 |
| Indonesia | 0.05 | 0.08 | 0.09 | 0.01 | 0.37 | 0.44 |
| Thailand | 0.43 | 0.49 | 0.38 | 0.38 | 0.99 | 1.33 |
| Vietnam | −0.20 | −0.22 | −0.11 | −0.16 | −0.83 | −0.97 |
| Russia | −0.06 | −0.03 | −0.15 | −0.15 | 0.16 | 0.31 |
| Mexico | −0.02 | −0.02 | −0.04 | −0.04 | −0.11 | −0.02 |
| South Africa | 0.06 | 0.09 | 0.11 | 0.17 | 0.25 | 0.49 |
| Turkey | 0.25 | 0.22 | 0.02 | 0.02 | 0.26 | 0.55 |
| **High-income countries** | **0.20** | **0.18** | **0.05** | **0.13** | **0.25** | **0.30** |
| **Developing countries** | **0.09** | **0.09** | **0.00** | **0.01** | **0.16** | **0.22** |
| Middle-income countries | 0.10 | 0.10 | 0.00 | 0.01 | 0.15 | 0.21 |
| Low-income countries | 0.05 | 0.04 | 0.01 | 0.00 | 0.18 | 0.30 |
| East Asia and Pacific | 0.01 | 0.03 | −0.01 | 0.02 | 0.13 | 0.16 |
| South Asia | 0.03 | 0.02 | 0.03 | 0.03 | 0.21 | 0.36 |
| E Europe + Central Asia | 0.01 | 0.02 | −0.09 | −0.09 | 0.08 | 0.21 |
| Middle East + North Africa | −0.07 | −0.07 | −0.10 | −0.10 | −0.05 | 0.01 |
| Sub-Saharan Africa | 0.06 | 0.06 | −0.04 | −0.02 | 0.10 | 0.27 |
| Latin America and Caribbean | 0.29 | 0.29 | 0.09 | 0.08 | 0.29 | 0.33 |
| **World total** | **0.18** | **0.16** | **0.04** | **0.10** | **0.23** | **0.28** |

Source: Anderson et al. (2006b, Table 12.14)

tation to put limits on tariff cuts for the most sensitive farm products, much of the prospective gain from Doha could evaporate. Even if only 2 % of HS6 agricultural tariff lines in developed countries are classified as sensitive (and 4 % in developing countries, to incorporate also their 'Special Products' request), and are thereby subject to just a 15 % tariff cut (as a substitute for the TRQ expansion mentioned in the Framework Agreement), the welfare gains from global agricultural reform would shrink by three-quarters. However, if at the same time any product with a bound tariff in excess of 200 % had to reduce it to that cap rate, the welfare gain would shrink by 'only' one-third (columns 3 and 4 of Tables 10.7, 10.8, and 10.9).

**TRQ expansion could provide additional market access** Only a small number of farm products are subject to TRQs, but they protect over half of all developed countries' production and 44 % of their agricultural imports (de Gorter and Kliauga 2006). Bringing down the (out-of-quota) MFN bound tariffs on those products could be supplemented by lowering their in-quota tariffs or expanding the size of the quotas. While this may increase the aggregate rent attached to those quotas and hence resistance to eventually removing them, the extent of binding overhang is such that quota expansion may be the only way to get increased market access for TRQ products in the Doha round—especially if they are among the ones designated as 'sensitive' and hence subject to lesser cuts in their bound tariffs.

**High binding overhang means most developing countries would have to make few cuts** Given the high binding overhang of developing countries, even with their high applied tariffs—and even if tiered formulae are used to cut highest bindings most—relatively few of them would have to cut their actual tariffs and subsidies at all (Jean et al. 2006). That is even truer if 'Special Products' are subjected to smaller cuts and developing countries exercise their right—as laid out in the July Framework Agreement—to undertake lesser cuts (zero in the case of LDCs) than developed countries. Politically this makes it easier for developing and least-developed countries to offer big cuts on bound rates—but it also means the benefits to them are smaller than if they had a smaller binding overhang.

**Cotton subsidy cuts would help cotton-exporting developing countries** The removal of cotton subsidies (which have raised producer prices by well over 50 % in the USA and EU—see Sumner 2006) would raise the export price of cotton (although not equally across all exporters because of product differentiation). If those subsidies were removed as part of freeing all merchandise trade, that price rise is estimated to be 8 % for Brazil but less for Sub-Saharan Africa on average. However, cotton exports from Sub-Saharan Africa would be a huge 75 % larger, and the share of all developing countries in global exports would be 85 % instead of 56 % in 2015, vindicating those countries' efforts to ensure that cotton subsidies receive specific attention in the Doha negotiations.[8]

**Expanding non-agricultural market access would add substantially to the gains from agricultural reform** Adding a 50 % cut to non-agricultural tariffs by developed countries (and 33 % by developing countries and zero by LDCs) to the tiered formula cut to agricultural tariffs would double the gain from Doha for developing countries (compare Scenarios 1 and 5 in Tables 10.7, 10.8, and 10.9). That would bring the global gain to $96 billion from Doha merchandise liberalization, which is a sizable one-third of the potential welfare gain from full liberalization of $287 billion. Adding services reform would of course boost that welfare gain even more.

**Adding non-agricultural tariff reform to agricultural reform helps to balance the exchange of 'concessions'** The agricultural reforms would boost the annual value of world trade in 2015 by less than one-quarter what would happen if non-agricultural tariffs were also reduced. The latter's inclusion also would help balance the exchange of 'concessions' in terms of increases in bilateral trade values: in that case developing countries' exports to high-income countries would then be $62 billion, which is close to the $55 billion increase in high-income countries' exports to developing countries. With only agricultural reform, the latter's bilateral trade growth would be little more than half the former's (Table 10.10).

**Most developing countries gain, and the rest could if they reform more** Even though much of the DC gains from that comprehensive Doha scenario go to numerous large developing countries, notably Brazil, Argentina, and other Latin America plus India, Thailand, and South Africa, the rest of Sub-Saharan Africa gains too. This is particularly so when developing countries participate as full partners in the negotiations. An important part of this result comes from the increases in market access—on a non-discriminatory basis—by other developing countries.

**Preference erosion may be less of an issue than commonly assumed** Some least-developed countries in Sub-Saharan Africa and elsewhere appear to be slight losers in our Doha simulations when developed

**Table 10.10** Projected effects on bilateral merchandise trade flows of adding non-agricultural tariff cuts to agricultural reform under Doha, 2015 (2001 $billion increase over the baseline in 2015)

| *Exports from:* | *Propn'l agric reform only*[a] | | | |
|---|---|---|---|---|
| | *Exports to:* | | *Agric plus non-agric reform*[b] | |
| | *High-income*[c] *countries* | *Developing countries* | *High-income*[c] *countries* | *Developing countries* |
| High-income[c] countries | 20 | 11 | 80 | 55 |
| Developing countries | 18 | 5 | 62 | 16 |
| **World Total** | **38** | **16** | **142** | **71** |

Source: Anderson et al. (2006b, Table 12.16)

[a]Scenario 2

[b]Scenario 5

[c]High-income countries include the newly industrialized East Asian customs territories of Hong Kong, Korea, Singapore, and Taiwan as well as Europe's transition economies that joined the EU in April 2004

countries cut their tariffs and those LDCs choose not to reform at all themselves. These simulations overstate the benefits of tariff preferences for LDCs, however, since they ignore the trade-dampening effect of complex rules of origin and the grabbing of much of the rents by developed country importers. Even if they lose after correcting for those realities, it remains true that preference-receiving countries could always be compensated for preference erosion via increased aid at relatively very small cost to current preference providers—and in the process other developing countries currently hurt by LDC preferences would enjoy greater access to the markets of reforming developed countries (Bouët et al. 2006; Hoekman et al. 2009).

**Farm output and employment would grow in developing countries under Doha** Despite a few low-income countries losing slightly under our Doha scenarios when they choose to reform little themselves, in all the developing countries and regions shown the levels of output and employment on farms expand. It is only in the most protected developed coun-

**Table 10.11** Projected effects of a comprehensive Doha reform on agricultural output and employment growth, by region, 2005–2015 (annual average growth rate,%)

| | *Output* | | *Employment* | |
|---|---|---|---|---|
| | *Baseline* | *Scenario 5* | *Baseline* | *Scenario 5* |
| Australia and New Zealand | 3.5 | 4.3 | 0.4 | 1.0 |
| Canada | 3.5 | 4.0 | 0.2 | 0.6 |
| USA | 2.2 | 1.9 | −0.8 | −1.4 |
| EU 25 + EFTA | 1.0 | −0.3 | −1.8 | −2.8 |
| Japan | 0.5 | −1.4 | −2.7 | −4.1 |
| Korea and Taiwan | 2.2 | 1.5 | −1.3 | −2.1 |
| Argentina | 2.9 | 3.5 | 0.9 | 1.5 |
| Bangladesh | 4.2 | 4.2 | 1.1 | 1.2 |
| Brazil | 3.3 | 4.4 | 1.1 | 2.2 |
| China | 4.3 | 4.3 | 0.8 | 0.8 |
| India | 4.3 | 4.4 | 1.0 | 1.0 |
| Indonesia | 3.0 | 3.0 | −0.7 | −0.6 |
| Thailand | −0.1 | 0.4 | −4.6 | −4.3 |
| Vietnam | 5.8 | 5.9 | 3.9 | 4.0 |
| Russia | 1.5 | 1.4 | −2.3 | −2.4 |
| Mexico | 3.9 | 4.0 | 2.0 | 2.3 |
| South Africa | 2.5 | 2.6 | 0.0 | 0.1 |
| Turkey | 3.0 | 3.0 | −0.5 | −0.5 |

Source: Anderson et al. (2006b, Table 12.17)

tries of Western Europe, Northeast Asia, and the USA that these levels would fall—and even there it is only by small amounts, contrary to the predictions of scaremongers who claim agriculture would be decimated in reforming countries (Table 10.11). Even if there was a move to completely free merchandise trade, the developed countries' share of the world's primary agricultural GDP by 2015 was projected to be only slightly lower at 25 % instead of 30 % (but their share of global agricultural exports would be diminished considerably more: from 53 % to 38 %).

**International prices for staple foods rise very little** Opening up global markets as proposed raises the prices of foods in international markets, but only slightly: it is the cotton price that rises most, followed by animal products consumed by the relatively affluent, followed by livestock feed-

**Table 10.12** Projected impact of Doha reform scenarios on average international product prices, 2015 (% relative to baseline)

| | *Scen. 1* | *Scen. 3* | *Scen. 4* | *Scen. 5* | *Scen. 6* |
|---|---|---|---|---|---|
| Rice | 0.9 | 1.4 | 1.3 | 1.7 | 1.1 |
| Wheat | 1.8 | 1.6 | 1.6 | 1.8 | 1.7 |
| Other grains | 3.7 | 3.5 | 3.5 | 3.7 | 3.5 |
| Oilseeds | 4.5 | 3.9 | 3.9 | 4.5 | 4.4 |
| Sugar | 2.8 | 2.4 | 2.4 | 2.9 | 2.7 |
| Cotton | 6.0 | 5.8 | 5.8 | 5.9 | 5.8 |
| Fruit and vegetables | 1.2 | 0.9 | 0.8 | 1.3 | 1.0 |
| Other crops | 0.9 | 0.5 | 0.5 | 1.2 | 0.8 |
| Vegetable oils and fats | 0.7 | 0.6 | 0.6 | 1.0 | 0.8 |
| Livestock | 0.8 | 0.7 | 0.7 | 0.9 | 0.6 |
| Processed meats | 3.5 | 3.3 | 3.3 | 3.5 | 3.4 |
| Dairy products | 11.8 | 11.8 | 11.8 | 11.7 | 11.8 |
| Other food, bev. and tobacco | 0.3 | 0.5 | 0.5 | 0.4 | 0.1 |
| **All agriculture and food** | **1.8** | **1.8** | **1.8** | **1.9** | **1.7** |
| All primary agriculture | 2.0 | 1.7 | 1.7 | 2.1 | 1.9 |
| All processed agriculture | 1.7 | 1.8 | 1.8 | 1.8 | 1.6 |
| Textile and wearing apparel | 0.2 | 0.2 | 0.2 | 0.2 | –0.1 |

Source: Anderson et al. (2006c, Table 5)

stuffs (Table 10.12). The expanded demand in the international market for staples such as wheat and rice is met by a sufficient supply response as to keep those rises to below 2 %. In domestic markets that would be protected less after such a DDA agreement, food prices would fall, thereby lowering the cost of living for consumers in those countries.

**Poverty could be reduced under Doha** Under the full merchandise trade liberalization scenario, extreme poverty in developing countries (those earning no more than $1/day) is projected to drop by 32 million in 2015 relative to the baseline level of 622 million, a reduction of 5 %. The majority of the poor by 2015 are projected to be in Sub-Saharan Africa, and there the reduction would be 6 %.[9] Under the Doha scenarios reported in Table 10.13, the projected poverty impacts are far more modest. The number of poor living on less than $1/day would fall by 2.5 million in the case of the core Doha Scenario 5 (of which 0.5 million are in SSA) and by 6.3 million in the case of Doha Scenario 6 (of which 2.2 million are in SSA). This corresponds to the relatively

**Table 10.13** Projected changes in poverty (those earning <$1/day) in alternative Doha scenarios compared with full liberalization, 2015

| | *Baseline share* | *Full liberalization share* | *Shares under Doha alternatives* | | |
|---|---|---|---|---|---|
| | | | *Doha scenario 1* | *Doha scenario 5* | *Doha scenario 6* |
| **2015 Headcount** (%) | | | | | |
| East Asia & Pacific | 0.9 | 0.8 | 0.9 | 0.9 | 0.9 |
| Latin America & Carib. | 6.9 | 6.6 | 6.9 | 6.9 | 6.8 |
| South Asia | 12.8 | 12.5 | 12.8 | 12.7 | 12.6 |
| Sub-Saharan Africa | 38.4 | 36.0 | 38.4 | 38.3 | 38.1 |
| **All developing countries** | **10.2** | **9.7** | **10.2** | **10.2** | **10.1** |
| | *2015 level* | *Decrease from baseline (in millions)* | *Decrease from baseline (in millions)* | | |
| **2015 Headcount** (mill.) | | | | | |
| East Asia & Pacific | 19 | 2.2 | 0.1 | 0.3 | 0.5 |
| Latin America & Carib. | 43 | 2.1 | 0.3 | 0.4 | 0.5 |
| South Asia | 216 | 5.6 | 0.2 | 1.4 | 3.0 |
| Sub-Saharan Africa | 340 | 21.1 | –0.1 | 0.5 | 2.2 |
| **All developing countries** | **622** | **31.9** | **0.5** | **2.5** | **6.3** |

Source: Anderson et al. (2006d, Table 17.7)

modest ambitions of the merchandise trade reforms as captured in these Doha scenarios. If only agriculture was reformed (Doha Scenario 1), there would be much less poverty alleviation globally and none at all in SSA (Anderson et al. 2006c). This shows the importance for poverty of including manufactured products in the Doha negotiations.

**Developing countries could trade off Special and Differential Treatment for more market access** If developing countries were to tone down their call for Special and Differential Treatment (see Josling 2006), in terms of wanting smaller cuts and longer phase-in periods, reciprocity means they could expect bigger tariff and subsidy cuts from developed countries. Similarly, if they were to forego their call for lesser cuts for 'Special Products', they could demand that developed countries forego their call for some 'Sensitive Products' to be subject to smaller tariff cuts. A comparison of Scenarios 5 and 6 in Tables 10.7, 10.8, and 10.9 shows that the economic payoffs for low-income countries even if high-income countries do not reciprocate with larger offers is considerable. Moreover, embracing those options to reform more in the context of the Doha round would have made it harder for high-income countries to resist the call to respond with larger reforms themselves.

**More recent economic modeling reinforces the above findings** With the stalling of the DDA since 2008, there have been few new studies of its prospective effects. An important exception is a new pair of papers by Laborde et al. (2011, 2012) that not only analyze what was still on the Doha negotiation table but also incorporate new and better ways of including estimates of the price distortions caused by trade and farm subsidy policies. They too use the World Bank's LINKAGE model (but version 7.1, see van der Mensbrugghe 2010), and they also provide estimates of gains from partial global liberalization of all merchandise trade and subsidies. Laborde et al. (2011) estimate that if the basic formula approach to reducing trade barriers and subsidies, as proposed, were to be adopted by all WTO member countries, then global GDP would be 0.36 % higher.

## What Policy Implications Followed from These DDA Analyses?

Among the numerous policy implications that can be drawn from the above findings, the following are worth highlighting.

**Prospective gains are large enough to deserve the attention of politicians** With gains of the order of $300 billion per year at stake from implementing the July Framework Agreement (even if no reforms are forthcoming in services and if the counterfactual would be the status quo rather than protectionist backsliding), the political will needs to be found to bring the round to a successful conclusion, whether as a single muti-issue undertaking or as a stand-alone deal. Multilateral cuts in MFN bindings are helpful also because (a) they can lock in previous unilateral trade liberalizations that otherwise would remain unbound and hence be vulnerable to backsliding, (b) they make it illegal to sharply increase protection when international food prices slump (Francois and Martin 2004), and (c) they can be used as an opportunity to multilateralize previously agreed preferential trade agreements and thereby reduce the risk of trade diversion from those bilateral or regional arrangements.

**Since developed countries would gain most, and have the most capacity and influence, they need to show leadership at the WTO** The large developed countries cannot generate a successful agreement on their own, nor can the Doha round succeed without a major push by those key traders. Their capacity to assist poorer economies could hardly manifest itself more clearly than in encouraging global economic integration via trade reform, and in particular in opening developed country markets to the items of greatest importance to poorer countries, namely farm (and textile) products. The more that is done by developed countries, the more developing countries will be encouraged to reciprocate by opening their own markets more—accelerating South–South trade in addition to South–North trade.

**Outlawing agricultural export subsidies is the obvious first step** That has been needed for decades (Hoekman and Messerlin 2006). It is needed to bring agriculture into line with the basic GATT rule against such measures, and in the process to help limit the extent to which governments encourage agricultural production by other means (since such a ban would raise the cost of surplus disposal). China has already committed not to use them, and other developing countries too can find more efficient ways of stabilizing their domestic food markets than by dumping surpluses abroad. Somewhat unexpectedly, it was agreed at the biennial Trade Ministerial Meeting in December 2015 to phase out farm export subsidies.

**Even more importantly, agricultural tariff and domestic support bindings must be cut hugely to remove binding overhang and provide some genuine market opening** Getting rid of the binding overhang that resulted from the Uruguay Round, particularly with 'dirty tariffication', remains a priority. The highest-subsidizing countries, namely the EU, USA, and Norway, need to reduce their domestic support not just for the sake of their own economies but also to encourage developing countries to reciprocate by opening their markets as a quid pro quo. But more than that is needed if market access is to expand. If a choice had to be made, reducing MFN bound tariffs in general would be preferable to raising TRQs, because the latter help only those lucky enough to obtain quotas and crowd out non-quota holders. (Being against the non-discrimination spirit of the GATT, they deserve the same fate as textile quotas: they were abolished at the end of 2004.) Exempting even just a few SSPs is undesirable as it would reduce hugely the gains from reform and would tend to divert resources into, instead of away from, enterprises in which countries have their least comparative advantage. If it turns out to be politically impossible not to designate some SSPs, it would be crucial to impose a cap such that any product with a bound tariff in excess of, say, 100 % had to reduce it to that cap rate.

**Expanding non-agricultural market access at the same time as reforming agriculture is essential for a balanced exchange of concessions** With other merchandise included, the trade expansion would be four times greater for both rich and poor countries—and poverty in low-income countries would be reduced considerably more.

**South–South 'concessions' also are needed, especially for developing countries, which means reconsidering the opportunity for developing countries to liberalize less** Since developing countries are trading so much more with each other now, they are the major beneficiaries of reforms within their own regions. Upper-middle-income countries might consider giving least-developed countries duty-free access to their markets (mirroring the initiatives of developed countries), but better than such discriminatory action would be MFN tariff reductions by them. Even least-developed countries should consider reducing their tariff binding overhang at least, since doing that in the context of Doha gives them more scope to demand 'concessions' (or compensation for preference erosion or other contributors to terms of trade deterioration) from richer countries—and yet would not require them to cut their own *applied* tariffs very much.[10]

## Key Messages

Careful empirical modeling of trade reform options make clear that there is a great deal to be gained from liberalizing merchandise—and especially agricultural—trade. If it were done multilaterally under the

WTO's Doha round, a disproportionately high share of that potential gain could go to developing countries (relative to their share of the global economy). Moreover, it is the poorest people who appear to be most likely to gain from global trade liberalization, namely farmers and unskilled laborers in developing countries. To realize that potential gain, the greatest cuts in bound tariffs and subsidies are required in agriculture. However, the political sensitivity of farm support programs, coupled with the complexities of the measures introduced in the Uruguay Round Agreement on Agriculture and of the modalities set out in the Doha Framework Agreement of July 2004, have made a Doha agreement elusive.

Even so, the *ex ante* empirical analysis of the sort provided in the past decade provides countries engaged in such negotiations a better sense of what's at stake with various options. The results make clear that while developing countries would not have had to reform very much under Doha proposals (because of the large gaps between their tariff bindings and applied rates), if they exercised their right to undertake lesser tariff cuts than developed countries, they would have gained little in terms of improved efficiency of national resource use.

To realize more of their potential gains from trade, developing and least-developed countries would need to forego some of the Special and Differential Treatment they have previously demanded at the WTO, and perhaps also commit to additional unilateral trade (and complementary domestic) reforms, and to invest more in trade facilitation. High-income countries could encourage them to do so by being willing to open up their own markets more to developing country exports,[11] and by providing more targeted aid.

There was never any guarantee that major gains would flow from the agricultural part of DDA. That's because the size depends on, among other things, the nature of the tariff-cutting formula, the size of the cuts, the extent to which exceptions for SSPs are allowed, whether a tariff cap is introduced, and the extent to which Special and Differential Treatment is invoked by developing countries in terms of their market access commitments. But what is clear is that major gains are possible if only the political will to reform protectionist policies could be mustered.

## Notes

1. The rules of the GATT are intended, in principle, to cover all trade in goods. However, in practice, trade in agricultural products was largely excluded from their remit as a consequence of a number of exceptions. Details are to be found in Josling et al. (1996) and in Anderson and Josling (2005).
2. Around half of the economically active population in developing countries is engaged in agriculture, which is several times larger than the sector's measured GDP share. While some of that difference in shares is due to underreporting of subsistence consumption and of the extent of part-time off-farm work by farm families, it nonetheless implies that these people on average are considerably less productive and hence poorer than those employed outside agriculture.
3. This analysis is vastly more sophisticated than the *ex ante* analyses undertaken for the Uruguay Round. At that time there were very few economy-wide global models, so primary reliance was on partial equilibrium models of world food markets (see, e.g., World Bank 1986; Goldin and Knudsen 1990; Tyers and Anderson 1992); estimates of protection rates were somewhat cruder and less complete; and analysts grossly overestimated the gains because they did not anticipate that tariffication would be so 'dirty' in the sense of creating large wedges between bound and MFN applied tariff rates, nor did they have reliable estimates of the tariff preferences enjoyed by developing countries or the *ad valorem* equivalent of specific tariffs. Some of these limitations also applied to *ex post* analyses of the Uruguay Round (see, e.g., Martin and Winters 1996).
4. As described in Jean et al. (2006), 'Sensitive Products' are chosen for each country by taking into account the importance of the product, the height of its existing tariff, and the gap between its bound and applied tariffs in that country.
5. There was already strong evidence by 2005 supporting the view that trade reform in general was also good for economic growth and, partly because of that, for poverty alleviation (Winters 2004; Dollar and Kraay 2004; Winters et al. 2004).
6. This result is very similar to that reported from a partial equilibrium study by Hoekman et al. (2004).
7. See also the GTAP modeling of the prospective impact of a DDA agreement on farmers and the agricultural sector in Anderson and Valenzuela (2007a).
8. See also the analysis of cotton policies by Anderson and Valenzuela (2007b).
9. The approach here has been to take the change in the average per capita consumption of the poor, apply an estimated income-to-poverty elastic-

ity, and assess the impacts on the poverty headcount index. We have done this by calculating the change in the real wage of unskilled workers, deflating it by a food/clothing consumer price index that is more relevant for the poor than the total price index. That real wage grows, over all developing countries, by 3.6 %, or more than four times greater than the overall average income increase. We are assuming that the change in unskilled wages is fully passed through to households. Also, while the model closure has the loss in tariff revenues replaced by a change in direct household taxation, the poverty calculation assumes—realistically for many developing countries—that these tax increases only affect skilled workers and high-income households. While these simple calculations are not a substitute for more detailed individual country case study analysis using detailed household surveys as in, for example, Hertel and Winters (2006), they are able to give a broad region-wide indication of the poverty impact.

10. Bown (2016) argues with newly compiled evidence that the scope for even just tariff reductions to boost South–South in goods is still very large among WTO members. Regional preferential trade agreements could also provide such trade growth. On the various motives for the rapid spread of FTAs and what it means for the WTO, see Bagwell and Staiger (2016), Grossman (2016), and Limão (2016). Some presume that the WTO is passé. A comprehensive theoretical analysis by Bagwell et al. (2016) makes clear, however, that the rules-based, non-discriminatory multilateral trading system still has far more to offer the world economy than a series of preferential trading agreements of the sort that have been signed in the past decade or so. This is supported by a recent survey of the empirical evidence on the contribution to global economic welfare of the GATT and WTO (Anderson 2016).
11. Limão and Olarreaga (2006) suggest that preference erosion could be addressed by replacing the current margin of preference with an equivalent import subsidy for products from preference-receiving countries, thereby retaining the preference status quo while taking away this reason not to undertake most-favored-nation tariff cuts.

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CHAPTER 11

# Projecting International Trade to 2030

The previous chapters provide a picture of how food trade and trade-related policies have evolved over the past six decades, and an understanding of why international trade is important for global food security—and why governments have intervened with trade measures to alter the trend level, and reduce fluctuations in, domestic food prices. Those strands of knowledge are drawn on in this chapter as it seeks to provide a picture of how international trade in food (and other products) may look by 2030, and to discern what that means for global food security. Necessarily only a small number of possible scenarios can be presented in one chapter, but those chosen will open up opportunities for the final chapter to draw out policy implications and discuss additional ways in which trade could enhance global food security in sustainable ways.

The evolution of agricultural trade patterns since the 1960s is shown in Chap. 4 to be consistent with the neoclassical theory of comparative advantage. The consistency is even stronger once account is taken of the pattern of policy interventions that had distorted farmer and consumer incentives and that were reduced from the mid-1980s, as revealed in the modeling results reported in Chap. 6 that draw directly on the price distortions summarized in Chap. 5. In seeking to project future developments in markets, that same global economy-wide modeling framework is to be used here. It requires making three sets of assumptions: about population and income growth rates and preference changes on the demand side of



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national markets; about factor productivity growth rates for agriculture *and other sectors* on the supply side in each country; and about changes to policies that distort relative prices affecting both demand and supply in each national market and hence also in the international food marketplace.

The chapter begins by laying out the assumptions underlying a baseline projection of the GTAP global computable general equilibrium (CGE) model to 2030 from a 2007 base (i.e., just before the global financial crisis and food and fuel price spikes threw markets off trend for a few years). Initially it is assumed that agricultural and trade policies do not change. The market outcomes from that baseline projection are summarized, before examining how those projections change when key assumptions are altered.

One assumption relates to Asian economic growth. Many commentators expect that the region's prolonged high GDP growth rate of the previous few decades is coming to an end, while others remain more optimistic. Baseline results are therefore compared with what they could look like with slightly higher economic growth in Asia (albeit still less than in the past two decades).

Another assumption of significance to global food security has to do with farm productivity growth. The baseline projection assumes that productivity growth rates in the various sectors of each economy continue as in the past. If more developing countries were to increase their investments in agricultural R&D, or to liberalize their policy to allow genetically modified food crop varieties to be grown, their shares of world food production and income would grow and they would contribute to keeping down the price of food and raising food security domestically and internationally.

If some food-importing developing countries sought to reduce the long-term decline in their food self-sufficiency by raising barriers to imports, that would raise food prices in those countries and reduce income-earning opportunities for food exporters in other countries, thereby reducing food security in both sets of countries.

An opposite and extreme change in trade policies would be to assume all (farm and nonfarm) goods markets moved to free trade by 2030. Unlikely though that is, modeling it provides a sense of how large the cost would be by 2030 not only if current policies were to continue but also if—perhaps because of not bringing the WTO's Doha round of multilateral trade negotiations to a successful conclusion—agricultural protection were to continue to grow in emerging economies for the political economy reasons outlined in the previous chapter.

As discussed in the previous chapter, the Doha round has been in a coma for several years and seems less likely to be revived than to be replaced by other approaches to opening markets. Meanwhile, preferential trading agreements have been proliferating, and several large mega-regionals are currently under negotiation. Their economic effects are likely to be smaller globally than what the WTO's Doha round might have delivered, but they may offer new liberalization pathways that the WTO can build on. Their boost to the trade and incomes of participating countries and regions may be at the expense of some other countries and regions, however.

Perhaps the biggest uncertainty in food markets over coming decades is what impact climate change and associated policy responses by different governments will have. While there are huge uncertainties about how agriculture will be affected by climate change, one thing is certain: trade openness will become even more important to the world, because it will assist adaptation both to changes in climate and to policy responses to that development.

## Global CGE Modeling Methodology and Database

The economy-wide model of the world's national markets used here to project future trends in primary product markets is the same GTAP model (Hertel 1997) that is used in Chap. 7, and it draws on Version 8.1 of the GTAP database which is calibrated to 2007 levels of production, consumption, trade, and protection (Narayanan et al. 2012). The standard GTAP model is the most widely used CGE model for economy-wide global market analysis, in part due to its robust and explicit assumptions. The Version 8.1 base-period of 2007 is better than the latest-available global (2011) database for projecting forward to 2030, because it immediately precedes the 2008–12 period of temporary spikes in food and fuel prices and the global financial crisis and subsequent recession in northern hemisphere rich countries.

In its simplest form as used here,[1] the model assumes perfect competition and constant returns to scale in production. The functional forms are nested constant elasticities of substitution (CES) production functions. Land and other natural resources, labor (skilled and unskilled), and produced physical capital substitute for one another in a value added aggregate, and composite intermediate inputs substitute for value added at the next

CES level in fixed proportions. Land is specific to agriculture in the GTAP database, and is mobile amongst alternative agricultural uses over this projection period, according to a constant elasticity of transformation which, through a revenue function, transforms land from one use to another. In the modified version of the GTAP model we use, natural resources, including coal, oil, gas, and other minerals, are specific to the sector in which they are mined. Aggregate national employment of each productive factor is fixed in the standard macro-economic closure, although we use exogenous projections to model changes in factor availability over time. In the model closure adopted here, labor and produced capital are assumed to be mobile across all uses within a country, but immobile internationally.

On the demand side there is a national representative household whose expenditure is governed by a Cobb–Douglas aggregate utility function which allocates net national expenditures across private, government, and saving activities. Government demand across composite goods is determined by a Cobb–Douglas assumption (fixed budget shares). Private household demand is represented by a constant difference of elasticities functional form, which has the virtue of capturing the non-homothetic nature of private household demands, calibrated to replicate a vector of own-price and income elasticities of demand (Hertel et al. 2008). In projecting to 2030 the theory point made by Markusen (2013) is acknowledged in that food demand elasticities are lowered in developing countries as their per capita incomes grow, following Yu et al. (2004). This is done by econometrically estimating the relationship between per capita incomes and income elasticities of demand for food crops (Anderson and Strutt 2014).

Bilateral international trade flows are handled through the Armington (1969) specification by which products are differentiated by country of origin. These Armington elasticities are the same across countries but are sector-specific, and the import-import elasticities have been estimated at the disaggregated GTAP commodity level (Hertel et al. 2007). For present purposes, the typical modeling practice for dealing with long-term changes, of doubling the short-to-medium term Armington elasticities, is adopted. The national balance of trade is determined by the relationship between national investment and savings and. Investment can be allocated in the GTAP model either in response to rates of return, with capital markets kept in equilibrium, or in fixed shares across countries so that it moves in line with global savings. For present purposes savings and investment are allowed to respond to changes in rates of return.[2]

The GTAP version 8.1 database divides the world into 134 countries/country groups, and each economy into 57 sectors. In the present study, these are aggregated to 35 countries and regions and to 34 sectors, but to aid digestion of model outputs, there is further aggregation of these regions and sectors when reporting results in the tables below.

## Projecting Markets to 2030 Assuming No Policy Changes

The recent slowdown in Western economies and the relatively rapid economic growth in emerging economies are shifting the global industrial center of gravity away from the north Atlantic and raising the importance of natural resource-poor Asian economies in world output and trade, especially of manufactures. That in turn is increasing Asia's demand for food, feed, fibers, and other primary products, and thus prices and quantities of exports from natural resource-rich economies. This is a continuation of a process begun in Japan in the 1950s, followed by Korea and Taiwan from the late 1960s and then by some Southeast Asian countries. Most recently it has involved far more populous China and India. The early Northeast Asian group represents just 3 % of the world's population; hence its rapid industrial growth was accommodated by the rest of the world without much difficulty, including in food and other primary product markets. China and India, by contrast, account for more than two-fifths of humanity. Their rapid and persistent growth therefore has been having far greater influence on primary product markets and such things as food and energy security and greenhouse gas emissions nationally, regionally, and globally. The modeling results below show how market and government responses to these concerns will have non-trivial effects in both the emerging economies and their trading partners, including for food.

The GTAP model's 2007 baseline data are projected for the world economy to provide an initial baseline for 2030 by assuming that the 2007 trade-related policies of each country do not change. However, over that 23-year period, national real GDP, population, unskilled and skilled labor, capital, agricultural land, and extractable mineral resources (oil, gas, coal, and other minerals) are assumed to grow at exogenously set rates.

The baseline reflects relatively conservative growth assumptions for China and India. GDP, capital, and population growth rates are based on estimates from the World Bank and Fouré et al. (2012), while the projections of skilled and unskilled labor growth rates draw on Chappuis and Walmsley (2011). Historic trends are estimated for agricultural land from the UN's FAO the (summarized in Deininger and Byerlee 2011) and for mineral and energy raw material reserves from BP (2012) and the US Geological Survey (2010). It is assumed that past annual rates of change in fossil fuel reserves since 1990 continue for each country over this and the next decade. For other minerals, in the absence of country-specific data, the unweighted average of the annual rate of growth of global reserves for iron ore, copper, lead, nickel, and zinc between 1995 and 2009 for all countries is used (from the US Geological Survey 2010). The rate of total factor productivity (TFP) growth for each country is assumed to be the same in each of its manufacturing industries, somewhat higher in most primary sectors and somewhat lower in services. For agriculture it is higher for North America than for Europe, for example, on the basis of recent experience reflected in Fig. 7.1 and on the assumption that Europe continues to reject applications to allow genetically modified crop production.

The growth rates for key exogenous variables in the core scenario are summarized in the Appendix (Table 11.15). This forms the baseline 2030 scenario against which others are compared below. The differences across regions in rates of growth of factor endowments and total factor productivity, and the fact that sectors differ in their relative factor intensities and their share of GDP, ensure that the structures of production, consumption, and trade across sectors within countries, and also between countries, are going to be very different in 2030 than in 2007. Real food prices in international markets in 2030 are only slightly higher than in 2007 though, and hence well below the historically high levels of 2008–12 and consistent with projections by OECD/FAO (2015, pp. 49–59).

In particular, developing economies (especially the faster-growing ones of Asia) will account for considerably larger shares of the projected global economy over the next two decades. Their aggregate share of world GDP (measured in 2007 US$, not Purchasing Power Parity (PPP) dollars in which developing country shares are much larger) is projected to rise from 27 % in 2007 to 40 % in 2030 even in the baseline scenario. Most of that rise is in Asia, but the shares of Latin America and Sub-Saharan Africa excluding South Africa (hereafter LA and SSA) also rise non-trivially. Europe's share, meanwhile, is projected to fall from 36 % to 29 %, and NAFTA's from 30 % to 26 %. Economically active population shares change less, with the developing countries' share

**Table 11.1** Regional shares of global value added by sector, 2007 and baseline projection to 2030 (%)

| | *Agric. and food* | *Other primary* | *Manufactures* | *Services* | *Total* |
|---|---|---|---|---|---|
| | | (a) 2007 | | | |
| China | 14.4 | 9.4 | 11.7 | 4.3 | 6.4 |
| Rest East Asia | 10.4 | 7.4 | 14.6 | 13.7 | 13.4 |
| South Asia | 8.5 | 2.6 | 2.1 | 2.4 | 2.7 |
| **HICs** | **50.2** | **34.4** | **68.7** | **78.2** | **73.1** |
| **All developing** | **49.8** | **65.6** | **31.3** | **21.8** | **26.9** |
| of which LA | 8.4 | 7.7 | 4.2 | 4.8 | 5.1 |
| and SSA | 5.0 | 6.1 | 0.5 | 0.6 | 1.1 |
| **World** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |
| | | (b) 2030 (baseline projection) | | | |
| China | 25.2 | 17.5 | 20.8 | 7.6 | 11.7 |
| Rest East Asia | 9.0 | 8.6 | 15.0 | 13.1 | 12.7 |
| South Asia | 14.1 | 4.5 | 3.4 | 4.3 | 5.0 |
| **HICs** | **33.5** | **26.5** | **52.4** | **68.0** | **59.9** |
| **Developing** | **66.5** | **73.5** | **47.6** | **32.0** | **40.1** |
| of which LA | 7.6 | 8.6 | 4.6 | 6.4 | 6.3 |
| and SSA | 6.6 | 11.6 | 0.9 | 1.4 | 2.5 |
| **World** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

**Table 11.2** Regional shares of global exports and imports in primary sectors, 2007 and baseline projection to 2030 (%)

| | *Share of global exports* | | *Share of global imports* | |
|---|---|---|---|---|
| | *Agric. and food* | *Other primary* | *Agric. and food* | *Other primary* |
| | | (a) 2007 | | |
| Asia | 14.5 | 6.5 | 20.3 | 40.3 |
| All HICs | 65.2 | 31.3 | 68.0 | 65.3 |
| All developing | 34.8 | 68.7 | 32.0 | 34.7 |
| of which LA | 12.9 | 7.9 | 4.1 | 2.5 |
| SSA | 2.3 | 10.1 | 2.6 | 0.3 |
| World | 100.0 | 100.0 | 100.0 | 100.0 |
| | | (b) 2030 (baseline projection) | | |
| Asia | 11.1 | 8.4 | 40.1 | 54.6 |
| All HICs | 64.6 | 34.9 | 44.0 | 44.4 |
| All developing | 35.4 | 65.1 | 56.0 | 55.6 |
| of which LA | 14.4 | 11.9 | 4.1 | 2.1 |
| SSA | 3.3 | 16.8 | 4.7 | 1.0 |
| World | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2015a, b) rising only from 79 % to 83 %. Thus incomes per capita for the economically active population converge considerably. For example, the average income in LA and SSA rises relative to the global average by one-sixth and one-third, respectively, between 2007 and 2030 (Appendix, Table 11.16).

When global value added (based on producer expenditure) is broken down by sector, the changes are more striking. China by 2030 is projected to return to its supremacy as the world's top producing country not only of primary products but also of manufactures. The global manufacturing share remains close to 4 % for LA and rises to just under 1 % for SSA, while the global share of overall GDP rises from 5.1 % to 6.3 % for LA and from 1.1 % to 2.5 % for SSA. This reflects the projected rise in importance of (especially non-agricultural) primary production in LA and SSA (Table 11.1). As a result, LA and SSA exports of nonfarm primary products increase their combined share of global exports from 18 % to 29 %, while their combined farm product exports' share of world trade rises from 15 % to 18 % (Table 11.2). Meanwhile, the Asia region doubles

**Table 11.3** Sectoral shares of national exports, 2007 and baseline projection to 2030 (%)

| | *Agric. and food* | *Other primary* | *Manufactures* | *Services* | *Total* |
|---|---|---|---|---|---|
| | | (a) 2007 | | | |
| China | 2.9 | 0.6 | 89.8 | 6.7 | 100.0 |
| Rest East Asia | 3.0 | 3.1 | 78.3 | 15.6 | 100.0 |
| South Asia | 7.9 | 4.2 | 60.0 | 27.8 | 100.0 |
| **All HICs** | **6.3** | **4.8** | **68.1** | **20.8** | **100.0** |
| **All developing** | **5.9** | **18.5** | **61.9** | **13.7** | **100.0** |
| of which LA | 20.6 | 20.3 | 44.3 | 14.8 | **100.0** |
| SSA | 9.4 | 65.4 | 15.3 | 9.9 | 100.0 |
| **World** | **6.1** | **9.8** | **65.8** | **18.2** | **100.0** |
| | | (b) 2030 (baseline projection) | | | |
| China | 0.2 | 0.9 | 89.6 | 9.3 | 100.0 |
| Rest East Asia | 3.9 | 4.3 | 77.3 | 14.5 | 100.0 |
| South Asia | 2.3 | 4.5 | 59.7 | 33.4 | 100.0 |
| **All HICs** | **10.1** | **9.5** | **59.3** | **21.1** | **100.0** |
| **All developing** | **5.0** | **16.1** | **65.3** | **13.6** | **100.0** |
| of which LA | 24.2 | 34.8 | 31.7 | 9.4 | **100.0** |
| SSA | 7.7 | 69.3 | 14.3 | 8.6 | 100.0 |
| **World** | **7.4** | **12.9** | **62.4** | **17.2** | **100.0** |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

**Table 11.4** Revealed comparative advantage indexes,[a] LA and SSA, 2007 and various projections to 2030

| | *Agric. and food* | *Other primary* | *Manufactures and services* |
|---|---|---|---|
| | | (a) 2007 | |
| LA | 3.4 | 2.1 | 0.7 |
| SSA | 1.5 | 6.7 | 0.3 |
| | | (b) 2030 (baseline projection) | |
| LA | 3.2 | 2.7 | 0.5 |
| SSA | 1.0 | 5.4 | 0.3 |
| | | (c) 2030 (projection with faster Asian growth) | |
| LA | 3.7 | 3.0 | 0.5 |
| SSA | 1.3 | 5.7 | 0.3 |
| | | (d) 2030 (projection with faster agricultural TFP growth in LA and SSA) | |
| LA | 4.3 | 2.5 | 0.4 |
| SSA | 1.8 | 5.1 | 0.3 |
| | | (e) 2030 (projection with increased agricultural protection in China and India) | |
| LA | 3.3 | 2.7 | 0.5 |
| SSA | 1.1 | 5.4 | 0.3 |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

[a]Defined as sectoral share of region's exports divided by sectoral share of global exports

its share of world agricultural and food imports, while increasing its share of other primary imports by more than a third by 2030 (Table 11.2).

As for the sectoral shares of national trade, the projected consequences for LA differ considerably from those for SSA. SSA is a net importer of farm products, and that dependence increases slightly over the projection period as low African incomes and thus food consumption levels rise, whereas LA is a large net exporter of agricultural goods whose share of total LA exports rises from 21 % to 24 % between 2007 and 2030. As for other primary goods, they account for two-thirds of SSA's 2007 exports and that becomes only slightly larger by 2030, while in LA their share was only one-fifth in 2007 but it is projected to rise above one-third by 2030 (Table 11.3).

These boosts to primary product exports in LA necessarily are at the relative expense of their exports of manufactures and services, which suffer the Dutch disease problem associated with a boom in primary sector exports, in this case resulting mainly from Asia's rapid industrialization. That is, while LA's very strong comparative advantage in farming is projected to be maintained and its moderately strong comparative advantage in mining increases, its comparative disadvantages in manufactures and services are projected to deepen. For SSA the changes in comparative advantage are more modest because its exports are already highly specialized in non-food primary products (Table 11.4).

The sectoral structure of imports changes relatively little for LA and SSA, but it changes very considerably for China and South Asia under the initial assumption that trade policies do not change over the projection period. In particular, the share of farm products in imports doubles for South Asia and trebles for China, and the shares of other primary products in imports also rise, nearly doubling in China (Table 11.5). Whether in fact China and India allow such an increase in food import dependence is a moot point, to be taken up below.

The consequences for bilateral trade shares of these changes in total trade are summarized in Fig. 11.1. The shares of farm exports going to Asian developing countries are projected to increase by more than one and a half times for LA and by two and a half times for SSA, almost all at the expense of exports to high-income countries rather than to other developing countries. The changes in importance of developing Asia for nonfarm primary products from SSA and LA are not quite as dramatic as for farm products, but by 2030 it will be the destination for more than one-third of LA's and two-fifths of SSA's exports of those products, having been around one-quarter in 2007. Clearly this represents a huge change in the direction of primary product trade in just one generation for both LA and SSA.

These changes also mean that food and agricultural self-sufficiency in South Asia and China is projected to fall 6–9 percentage points by 2030 if there are no changes in policies to alter these market forces (Table 11.6). Brazil is the main country in LA to see its self-sufficiency rise, and South Africa also is projected to become a significantly greater exporter of farm products (as are Europe and North America). For many developing countries though, their food self-sufficiency is projected to fall at least a little in the wake of Asia's economic growth.

Self-sufficiency is a poor indicator of food security, however. A more meaningful indicator is real per capita private consumption of agricultural and processed food products by households. Between 2007 and 2030 real per capita food consumption is projected to rise by 51 % for developing countries, and even more for China and South Asia (first column of Table 11.7). Even in relatively well-fed LA the increase over the projection period is more than

**Table 11.5** Sectoral shares of national imports, 2007 and baseline projection to 2030 (%)

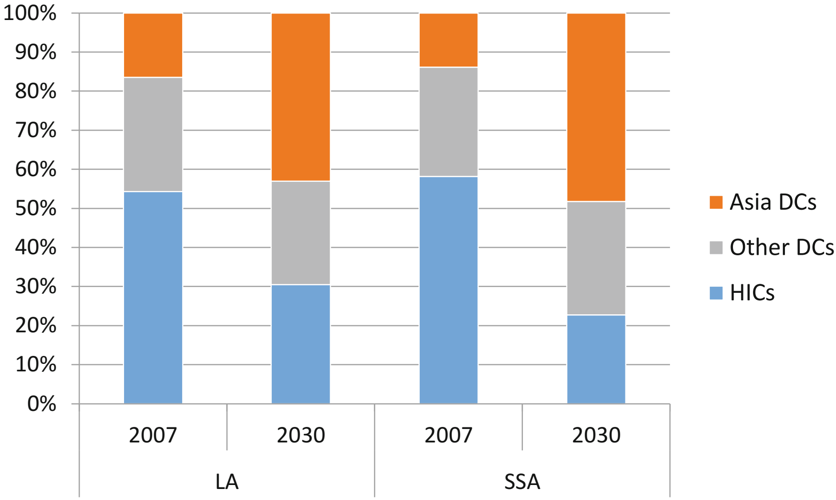
| | *Agric. and food* | *Other primary* | *Manufactures* | *Services* | *Total* |
|---|---|---|---|---|---|
| | | (a) 2007 | | | |
| China | 4.3 | 15.6 | 69.9 | 10.2 | 100.0 |
| Rest East Asia | 6.0 | 17.0 | 60.4 | 16.6 | 100.0 |
| South Asia | 5.6 | 25.8 | 52.3 | 16.3 | 100.0 |
| **All HICs** | **6.3** | **9.7** | **65.6** | **18.4** | **100.0** |
| **All developing** | **6.5** | **11.4** | **66.4** | **15.7** | **100.0** |
| of which LA | 7.6 | 7.3 | 68.6 | 16.4 | 100.0 |
| SSA | 12.0 | 2.5 | 62.2 | 23.2 | 100.0 |
| **World** | **6.4** | **10.2** | **65.9** | **17.6** | **100.0** |
| | | (b) 2030 (baseline projection) | | | |
| China | 13.0 | 28.3 | 52.0 | 6.6 | 100.0 |
| Rest East Asia | 6.3 | 16.2 | 61.8 | 15.7 | 100.0 |
| South Asia | 12.0 | 31.8 | 44.6 | 11.6 | 100.0 |
| **All HICs** | **6.0** | **10.6** | **64.5** | **18.8** | **100.0** |
| **All developing** | **9.7** | **16.8** | **60.1** | **13.5** | **100.0** |
| of which LA | 7.4 | 6.5 | 67.9 | 18.2 | 100.0 |
| SSA | 13.0 | 5.0 | 61.7 | 20.3 | 100.0 |
| **World** | **7.7** | **13.4** | **62.5** | **16.4** | **100.0** |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

one-third, and in SSA the rise is two-thirds. These are major improvements in food consumption per capita. Although not elaborated in that table, they also reflect an increase in dietary diversity as consumers in emerging countries move away from a reliance on starchy staples such as rice to more expensive but more nutrient-rich fruits, vegetables, and (mainly intensively fed) livestock products. Even if income distribution were to worsen in emerging economies over the next two decades, virtually all developing country regions could expect to be much better fed by 2030 according to this baseline scenario with relatively conservative Asian economic growth assumptions.

The rise in grain consumption is especially great in China because of their expanding demand for livestock products, most of which would continue to be produced domestically. So even though China's share of the world's direct grain consumption by households grows little, its share of grain consumed indirectly grows significantly, implying ongoing growth in the market for grain (and soybean) exports, particularly from North and South America.

(a) Agricultural and food products




(b) Non-agricultural primary products

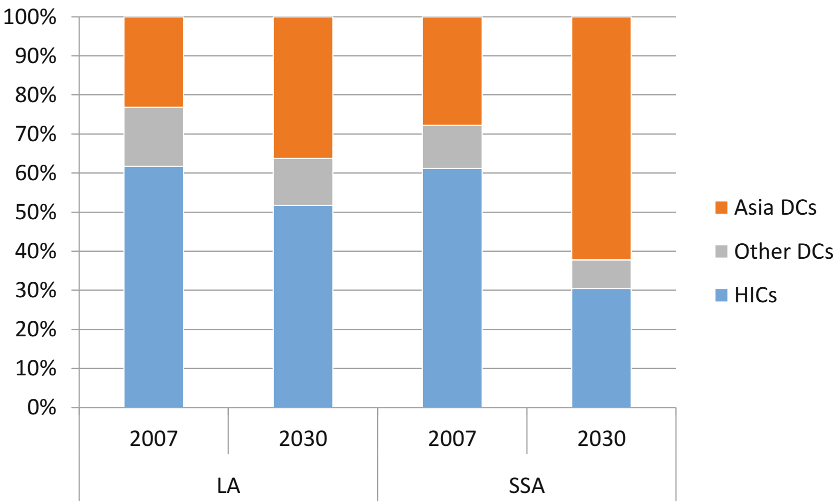



**Fig. 11.1** Bilateral trade shares, LA and SSA primary exports, 2007 and baseline projection to 2030 (%). (**a**) Agricultural and food products. (**b**) Non-agricultural primary products. Source: Anderson and Strutt (2016) (Color figure online)

**Table 11.6** Agricultural self-sufficiency ratio,[a] 2007, 2030 core and various other projections to 2030 (%)

| | *2007* | *2030 baseline* | *2030 faster Asian growth* | *2030, with faster LA and SSA agricultural productivity* | *2030, with increased agric. protection in China and India* |
|---|---|---|---|---|---|
| Argentina | 170 | 169 | 177 | 181 | 168 |
| Brazil | 119 | 135 | 141 | 151 | 133 |
| Chile | 117 | 113 | 115 | 128 | 112 |
| Peru | 100 | 94 | 97 | 102 | 93 |
| Rest LA | 104 | 101 | 105 | 112 | 101 |
| MENA | 84 | 86 | 88 | 83 | 86 |
| South Africa | 101 | 124 | 119 | 117 | 123 |
| Rest SSAfrica | 100 | 100 | 103 | 110 | 99 |
| Europe | 97 | 105 | 105 | 102 | 103 |
| NAFTA | 105 | 116 | 120 | 113 | 111 |
| ANZ | 131 | 132 | 138 | 129 | 130 |
| China | 97 | 88 | 87 | 87 | 94 |
| Rest E. Asia | 93 | 95 | 100 | 93 | 94 |
| South Asia | 100 | 94 | 95 | 93 | 94 |
| **HICs** | 100 | 109 | 111 | 106 | 106 |
| **Developing** | 100 | 96 | 96 | 97 | 97 |
| of which LA | 116 | 122 | 127 | 136 | 121 |
| **World** | 100 | 100 | 100 | 100 | 100 |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

[a]Agricultural self-sufficiency ratio excludes 'other (processed) food products'. MENA is middle East and North Africa, SSAfrica is Sub-Saharan Africa, ANZ is Australia and New Zealand.

The shares of global grain consumption by all developing countries rise from two-thirds to four-fifths between 2007 and 2030, and by just Asian developing countries from two-fifths to three-fifths. But of the grain directly consumed by households as distinct from livestock, the developing countries' share rises from 80 % to 88 % (Anderson and Strutt 2014, Table 7).

**Table 11.7** Increases in real household consumption per capita of agricultural and food products from 2007 to 2030 under various assumptions (%)

| | *2030 baseline* | *2030 faster Asian growth* | *2030, with faster LA and SSA agricultural productivity* | *2030, with increased agric. protection in China and India* |
|---|---|---|---|---|
| Argentina | 48 | 55 | 53 | 48 |
| Brazil | 43 | 50 | 48 | 43 |
| Chile | 33 | 42 | 36 | 33 |
| Peru | 45 | 56 | 52 | 45 |
| Rest LA | 30 | 36 | 34 | 30 |
| MENA | 31 | 41 | 33 | 32 |
| South Africa | 38 | 43 | 39 | 38 |
| Rest SSAfrica | 67 | 80 | 77 | 67 |
| Europe | 28 | 36 | 29 | 28 |
| NAFTA | 24 | 33 | 26 | 25 |
| ANZ | 17 | 27 | 18 | 18 |
| China | 76 | 150 | 78 | 75 |
| Rest East Asia | 25 | 34 | 26 | 25 |
| South Asia | 60 | 110 | 62 | 60 |
| **HICs** | **24** | **33** | **25** | **25** |
| **Developing** | **51** | **79** | **55** | **51** |
| of which LA | 37 | 45 | 42 | 37 |
| **World** | **28** | **45** | **30** | **28** |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

## Variations on the Baseline Projection: A Return to Faster Asian Growth

The above baseline projection is but one of myriad possibilities. An alternative baseline that seemed perhaps more likely in 2012 assumes one-third faster growth in GDP, in skilled labor, and in the capital stock in China and India—which are still well below their rates of growth during the decade prior to the global financial crisis. Taking into account those economies' actual growth rates during 2007–12, this faster-growth scenario implies GDP growth rates of around 7 % per year for China and 6 % for India for the remainder of the projection period (2013–30).

The purpose of presenting this alternative is to show how much greater would be the changes in the composition and direction of trade for other countries if something closer to Asia's growth rates of the past couple of

**Table 11.8** Regional shares of world trade in agricultural and food products, 2007 and 2030 under various assumptions (%)

| | *Exports* | | | | | *Imports* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *2007* | *2030 baseline* | *2030 faster Asian growth* | *2030, with faster LA and SSA agricultural productivity* | *2030, with increased agric. protection in China and India* | *2007* | *2030 baseline* | *2030 faster Asian growth* | *2030, with faster LA and SSA agricultural productivity* | *2030, with increased agric. protection in China and India* |
| Argentina | 3.1 | 3.4 | 3.6 | 4.3 | 3.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Brazil | 4.7 | 7.1 | 7.3 | 10.3 | 7.0 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 |
| Chile | 1.2 | 0.9 | 0.9 | 1.1 | 0.9 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Peru | 0.4 | 0.4 | 0.6 | 0.7 | 0.5 | 0.2 | 0.3 | 0.2 | 0.2 | 0.4 |
| Rest LA | 3.5 | 2.6 | 2.7 | 3.8 | 2.8 | 2.7 | 2.7 | 2.2 | 2.3 | 2.9 |
| MENA | 2.5 | 3.4 | 3.2 | 2.9 | 3.6 | 7.2 | 7.5 | 6.4 | 7.5 | 8.0 |
| South Africa | 0.7 | 1.3 | 1.0 | 1.1 | 1.4 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 |
| SSA | 2.3 | 3.3 | 3.7 | 5.9 | 3.4 | 2.6 | 4.7 | 3.7 | 4.2 | 5.0 |
| Europe | 47.8 | 42.2 | 38.9 | 38.4 | 43.4 | 49.8 | 31.3 | 29.1 | 31.5 | 33.3 |
| NAFTA | 15.4 | 21.2 | 21.5 | 18.6 | 18.7 | 14.4 | 11.0 | 10.0 | 10.9 | 11.4 |
| ANZ | 3.9 | 3.2 | 3.3 | 2.9 | 3.2 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| China | 3.9 | 0.4 | 0.4 | 0.3 | 0.3 | 4.3 | 20.2 | 28.6 | 20.8 | 15.2 |
| Rest East Asia | 8.2 | 9.5 | 11.3 | 8.7 | 10.4 | 13.9 | 13.7 | 11.9 | 13.5 | 14.8 |
| South Asia | 2.4 | 1.2 | 1.5 | 1.0 | 1.1 | 2.1 | 6.2 | 5.5 | 6.6 | 6.6 |
| **HICs** | **65.2** | **64.6** | **61.8** | **58.2** | **63.3** | **68.0** | **44.0** | **41.0** | **44.2** | **46.5** |
| **Developing** | **34.8** | **35.4** | **38.2** | **41.8** | **36.7** | **32.0** | **56.0** | **59.0** | **55.8** | **53.5** |
| of which LA | 12.9 | 14.4 | 15.1 | 20.0 | 14.7 | 4.1 | 4.1 | 3.4 | 3.5 | 4.3 |
| **World** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | 100.0 |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016) decades were to persist for the remainder of the present decade and the next. Also assumed in this alternative scenario is a one percentage point faster annual rate of TFP growth in primary sectors globally, in response to faster growth in demand for those sectors' output by China and India. These amendments to Asian GDP growth and global TFP growth lead to real global export prices in 2030 being only 3 % instead of 11 % above those in 2007 for farm products, and 5 % below instead of 9 % above 2007 levels for other primary products.

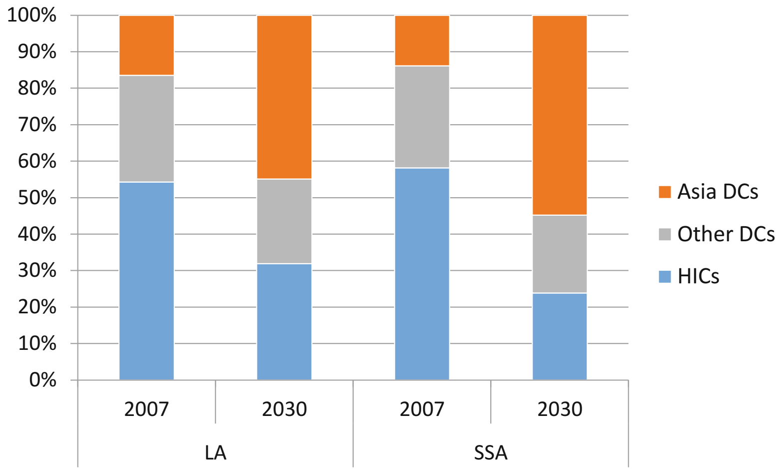
Not surprisingly, the faster Asian growth scenario leads to a substantial increase in the importance of this region to total exports of resource-rich economies, with the share of total LA exports in 2030 going to Asia increasing from 30 % to 38 %, while for SSA the increase is from 50 % to 57 % of its total 2030 exports. Although overall developing country agricultural self-sufficiency stays constant in this faster growth scenario, the agricultural self-sufficiency rates increase for the LA and SSA regions by 3–5 percentage points, as shown in Table 11.6. The share of developing Asia in world imports of food and agricultural products increases from 20 % to 40 %, as shown in Table 11.8, with both LA and SSA increasing their share of global exports of these products. Despite increasing their exports to the Asian region, LA and SSA are projected to have further increased levels of real household consumption of farm products (Table 11.7), in part due to the faster agricultural TFP growth in this scenario, but also due to their higher incomes as the Asian region grows more rapidly.

## Variations on the Baseline Projection: Increased Farm Productivity in LA and SSA

The next alternative scenario assumes that LA and SSA choose to invest more in public agricultural R&D in response to the growth in Asia's import demand for farm products. This is consistent with Asia recently taking a greater interest in farm productivity growth in SSA and LA.

In this scenario, the conservative growth baseline assumption is modified to reflect an increase in agricultural TFP in LA and SSA. It has been shown in general that the marginal returns from boosting such levels of public investment are extremely high (Hurley et al. 2014). The evidence from Brazil is particularly compelling: during the 1980s and 1990s Brazil

(a) and faster LA & SSA agricultural productivity




(b) and increased agricultural protection in China and India

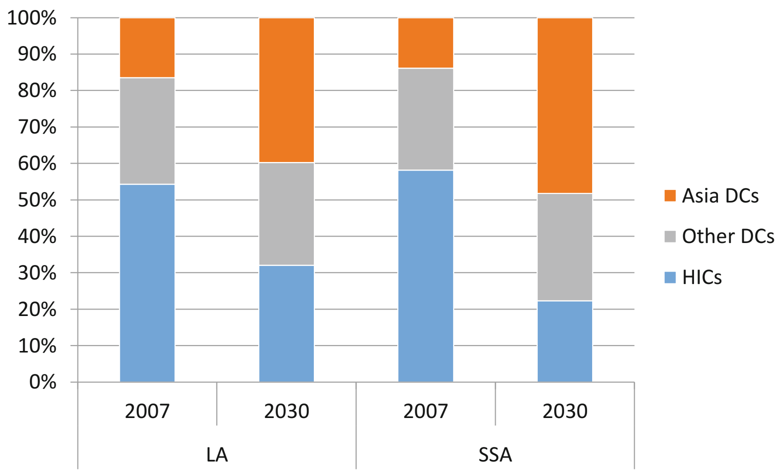



**Fig. 11.2** Bilateral trade shares, LA and SSA agricultural and food exports, 2007 and alternative assumptions to 2030 (%) (**a**) and faster LA and SSA agricultural productivity (**b**) and increased agricultural protection in China and India. Source: Anderson and Strutt (2016) (Color figure online)

invested more than four times as intensely as China in public agricultural R&D as a percent of national agricultural GDP. It is therefore not surprising that Brazil's output of both crop and livestock products has more than doubled since the early 1990s, and its food self-sufficiency has been boosted commensurately. And by biasing that research toward labor-saving technologies, that investment also helped farmers adjust to rising rural wages—something that is becoming more pressing also in China as the supply of under-employed labor in rural areas shrinks (Zhang et al. 2011). Here it is assumed that increased agricultural R&D in LA and SSA leads to agricultural TFP being 1 percentage point per annum higher in the LA and SSA regions over the projected period than in the core conservative growth scenario.

Such higher rates of agricultural productivity growth in LA and SSA would increase their comparative advantage in farm products (Table 11.4d), with the share of exports of these products going to Asia increasing from 43 % to 45 % for LA and from 48 % to 55 % for SSA (compare Figs. 11.1a and 11.2a). SSA almost doubles its share of world agricultural and food exports, relative to the conservative growth scenario, and LA increases its share of those exports from 14 % to 20 % (Table 11.8). The agricultural productivity boost significantly raises self-sufficiency rates in both regions, indeed substantially more than did the faster Asia growth scenario, as shown in Table 11.6; and it raises real household food consumption in Asia (Table 11.7).[3]

## Variations on the Baseline Projection:[4] Increased Agricultural Import Protection in China and India

The projected decline in self-sufficiency in farm products by 2030 for China from 97 % to 88 % and for South Asia from 100 % to 94 % in the baseline scenario (Table 11.6) may prompt a trade policy response. Specifically, it may well lead China and India to follow the earlier-industrializing Northeast Asian countries in imposing import restrictions on key food grains and, in the interest of boosting farm incomes to reduce the yawning urban–rural income gap, imposing import restrictions on meat and milk products (but not on coarse grains and oilseed products required for animal feedstuffs). Indeed there are signs already of such a rise in agricultural supports for farmers in these two countries (and in Indonesia, see Fig. 11.3).

If such restrictions were in the form of tariff equivalents severe enough to eliminate imports of those selected products in 2030, then according to the GTAP model such a trade policy response by China and India would raise substantially the share of imports of agricultural products that are not protected (Table 11.9). As resources move toward rice, wheat, and livestock production, self-sufficiency would fall further for crops that provide inputs into livestock feedstuffs, and also for other crops. The tariff equivalents of such import restrictions in our simulations range from 115 % for wheat to 255 % for red meats for China and between 136 % and 326 % for those products in India. These are well above bound out-of-quota tariffs in numerous cases (compare the last two columns for China and for India in Table 11.9) and so would be inconsistent with WTO commitments under international law. Moreover, such a policy response would impose a burden on Chinese and Indian households that are net buyers of those grain, meat, and milk products, because domestic consumer prices for those products would increase along with the producer price hikes.

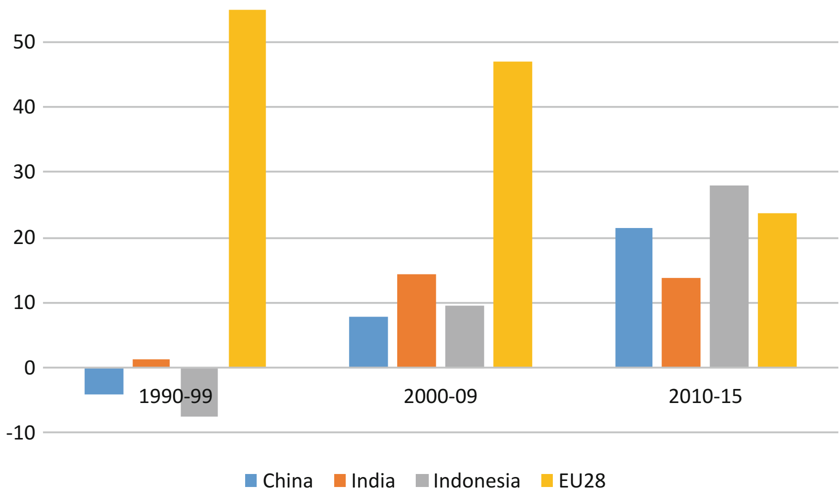



**Fig. 11.3** Agricultural nominal rates of assistance in China, India, Indonesia and EU28, 1990–2015 (%). Source: Compiled from estimates in Anderson and Nelgen (2013) and OECD (2016)
(The nominal rate of assistance (NRA) is the percentage by which gross returns to farmers have been raised by national farm policies (predominantly import restrictions and, in India's case, farm input subsidies). The final column for India is just 2010, as more-recent estimates are not yet available.)

**Table 11.9** Projected shares of agricultural imports under different tariffs for China and India, 2030 (%)

| | *China* | | | | | *India* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Share of agric. imports, 2030 baseline* | *Share of agric. imports, 2030 with selected food import bans* | *2030 tariff rates* | *2030 tariff rates, with selected import bans* | *China's out-of-quota bound tariffs at WTO* | *Share of agric. imports, 2030 baseline* | *Share of agric. imports, 2030 with selected food import bans* | *2030 tariff rates* | *2030 tariff rates, with selected import bans* | *India's out-of-quota bound tariffs at WTO* |
| Rice[a] | 1 | 0 | 2 | 196 | *65* | 0 | 0 | 43 | 256 | 80 |
| Wheat[a] | 0 | 0 | 2 | 115 | *65* | 7 | 0 | 100 | 326 | 80 |
| Coarse grains | 0 | 1 | 2 | 2 | *65* | 0 | 0 | 24 | 25 | 60–80 |
| Fruit and veg | 8 | 16 | 7 | 8 | *11* | 23 | 26 | 35 | 35 | 25–50 |
| Oilseeds | 11 | 15 | 2 | 2 | *3* | 1 | 1 | 41 | 41 | 75 |
| Vegetable oils | 18 | 30 | 2 | 2 | *3* | 28 | 30 | 82 | 81 | 75 |
| Sugar | 1 | 2 | 0 | 0 | *50* | 1 | 1 | 96 | 96 | *na* |
| Cotton | 3 | 4 | 4 | 4 | *40* | 7 | 8 | 10 | 10 | *na* |
| Other crops | 1 | 2 | 8 | 8 | *na* | 17 | 21 | 48 | 48 | *na* |
| Beef and sheepmeat[a] | 1 | 0 | 11 | 255 | *12* | 0 | 0 | 17 | 136 | *na* |
| Other meats[a] | 26 | 0 | 8 | 164 | *12* | 3 | 0 | 17 | 156 | *na* |
| Dairy products[a] | 4 | 0 | 8 | 159 | *11* | 1 | 0 | 31 | 153 | 60 |
| Other + processed food | 25 | 30 | | | | 13 | 13 | | | |
| TOTAL | 100 | 100 | | | | 100 | 100 | | | |
| *Prop'n of total imports* | *13* | *10* | | | | *9* | *8* | | | |

Source: Derived from GTAP Model results reported in Anderson and Strutt (2016)

[a]Indicates sectors subject to the self-sufficiency policy

This may substantially undermine national food security and nutrition in China and India by reducing households' economic access to food.

Turning to the implications of the increased Asian agricultural market protection for LA and SSA, Fig. 11.2b indicates that this reduces the share of agricultural exports from LA to Asia by 3 percentage points, relative to the baseline scenario. In fact, it would lower those regions' indexes of comparative advantage in farm products to below what they were in 2007 (Table 11.4a, e). However for SSA, that increased protection leads to little change in the relative importance of exports of farm products to Asia. For the South Asian region there is almost no impact on overall agricultural self-sufficiency, while for China its overall agricultural self-sufficiency would decline only about half as much from its 2007 rate as in the core scenario (Table 11.6). Not surprisingly, Asia's overall household consumption of food is reduced by the increased Asian protection (Table 11.7).

## Variations on the Baseline Projection: Broader Agricultural Protection Growth

Most major countries have liberalized most of their markets for industrial products. However, Chap. 5 showed that many agricultural policies remain highly distortive, and the pattern of those distortions has been evolving in fairly systematic ways, with some emerging countries raising their support for farmers (see Fig. 5.6), following the earlier example set by today's high-income countries. How different might farm policies be in 2030 if there were no further multilateral or major preferential trade agreements? Anderson et al. (2016a) address this question by making projections of agricultural price distortions to 2030, based on the political economy theory surveyed in Chap. 9 and knowledge of current WTO-bound tariffs. These provide a more formal and broader alternative to the previous two-country protection growth scenario, and to the common 'business-as-usual' approach to projection modeling which assumes policy *status quo*.

As explained in Chap. 9, political economy theory and institutional history suggests a simple set of econometric equations to help explain policy choices for the most important agricultural products. Once estimated, those equations can be used in conjunction with the GTAP model to project future agricultural distortions for any country in the absence of further trade reform.[5] We can then examine the differences in estimated welfare effects of trade-distorting policies consequent on these alternative price

**Table 11.10** Relationship between a food product's NRA and income, arable land endowment and trade status, developing countries, 2004 (endogenous variable: NRA)

| *Exogenous variables* | *Beef* | *Cotton* | *Maize* | *Milk* | *Pigmeat* | *Poultry* | *Rice* | *Soybean* | *Sugar* | *Wheat* |
|---|---|---|---|---|---|---|---|---|---|---|
| YPC | 0.378*** | 0.150** | 0.0222 | 0.198*** | 0.0895 | 0.197** | 0.396*** | 0.330* | 0.268*** | 0.0555* |
| | (0.0662) | (0.0655) | (0.0306) | (0.0594) | (0.0579) | (0.0928) | (0.0891) | (0.173) | (0.0542) | (0.0306) |
| LPC | –0.200** | –0.0477 | –0.0735 | –0.265*** | –0.135* | –0.265* | –0.725*** | –0.849** | –0.122 | –0.122* |
| | (0.0977) | (0.120) | (0.0717) | (0.0817) | (0.0776) | (0.145) | (0.173) | (0.311) | (0.112) | (0.0691) |
| $TSI_i$ | –0.169 | –0.00249 | –0.00486 | –0.0383 | –0.0795 | –0.354* | –0.369** | 0.115 | –0.176 | –0.114 |
| | (0.120) | (0.107) | (0.0747) | (0.101) | (0.0973) | (0.187) | (0.159) | (0.328) | (0.126) | (0.0733) |
| Constant | –2.978*** | –1.227** | –0.141 | –1.483*** | –0.693 | –1.439* | –3.701*** | –3.517** | –1.295*** | –0.481* |
| | (0.592) | (0.552) | (0.261) | (0.530) | (0.522) | (0.833) | (0.766) | (1.561) | (0.482) | (0.271) |
| Observations | 44 | 22 | 56 | 41 | 35 | 42 | 37 | 26 | 57 | 53 |
| *R*-squared | 0.554 | 0.241 | 0.031 | 0.410 | 0.214 | 0.268 | 0.527 | 0.309 | 0.336 | 0.265 |
| Adj. *R*-squared | 0.521 | 0.114 | –0.0248 | 0.362 | 0.138 | 0.210 | 0.484 | 0.215 | 0.298 | 0.220 |

Standard errors are shown in parentheses

Significance levels are $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Source: Anderson et al. (2016a), based on NRA estimates and other variable data compiled from the World Bank (World Development Indicators) and the United Nations (COMTRADE data) by Anderson and Valenzuela (2008) distortions. The expectation is that the contribution of farm policies to the estimated welfare cost of trade-distorting policies by 2030 is considerably higher—especially for developing countries—than if one assumes no change in farm policies over the next two decades.

To obtain this alternative counterfactual, Eq. (9.1) in Chap. 9 is estimated for ten key traded farm products as of 2004, and NRAs for each of those products are projected to 2030 for each developing country in the World Bank distortion database compiled by Anderson and Valenzuela (2008).

Those regression equations are reported in Table 11.10. The results are not highly significant but, apart from maize, at least one of the three explanatory variables is statistically significant in each equation. The insignificant result for maize is not surprising in view of the very small range of its NRAs in the panel data and their average of almost zero. For the other nine products, the $R^2$ values are between 0.21 and 0.55. All product equations have a positive coefficient for the log of real national income per capita (YPC) and a negative coefficient for the log of arable land per capita (LPC, an indicator of agricultural comparative advantage). For the trade specialization index for product $i$ ($TSI_i$, exports minus imports as a fraction of exports plus imports), as predicted by theory, virtually all have a negative coefficient, the only exception being soybean (soybean has an even smaller range of NRAs around its zero average than does maize). While the overall explanatory power for the cross-country pattern of NRAs in 2004 is not good, this is to be expected, since there are many other factors (not least, the particular state of supply and demand, and hence world prices, in this particular sample year of 2004). Nonetheless, these regressions capture the general trend of changes in protection as driven by changes in real per capita income, agricultural comparative advantage, and individual product trade specialization.

To use these equations to project NRAs, it is necessary to have projected values for the three exogenous variables. These are taken from a recent exercise that employs the GTAP economy-wide model to project the world economy to 2030 (Anderson and Strutt 2012). That projection assumes that the trade-related policies of each country do not change over the projection period but that national real GDP, population, unskilled and skilled labor, capital, agricultural land, and other natural resources (oil, gas, coal, and other minerals) grow at exogenously set rates.

In addition to taking the real GDP, land, and population values for 2030 from the Anderson and Strutt (2012) study, its estimated trade structure for 2030 also is extracted, so as to estimate a value for TSI for

**Table 11.11** Average projected 2030 tariffs without and with increases in developing country agricultural protection, aggregated regions (%) (trade-weighted averages)

| | *China* | *ASEAN* | *Rest E. Asia* | *India* | *Rest S. Asia* | *Central Asia* | *Latin America* | *M. East and Africa* | *All DCs* | *All HICs* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (a) With unchanged NRAs | | | | | | |
| Rice | 3.9 | 37.6 | 2.2 | 37.1 | 9.4 | 7.0 | 7.7 | 21.2 | **14.1** | **33.6** |
| Wheat | 2.1 | 2.4 | 3.3 | 99.7 | 6.7 | 3.0 | 3.0 | 10.5 | **15.8** | **11.7** |
| Coarse grains | 1.8 | 4.5 | 3.9 | 21.0 | 3.3 | 1.9 | 12.8 | 7.3 | **7.4** | **6.0** |
| Oilseeds | 2.5 | 6.5 | 22.4 | 42.7 | 4.2 | 3.4 | 0.6 | 4.7 | **4.0** | **0.9** |
| Sugar | 0.3 | 13.9 | 4.8 | 89.5 | 11.8 | 9.4 | 15.0 | 15.0 | **11.1** | **24.2** |
| Cotton | 5.0 | 0.1 | 0.0 | 9.8 | 3.2 | 0.2 | 2.9 | 2.5 | **4.0** | **0.3** |
| Beef and sheep meat | 24.0 | 6.5 | 18.2 | 15.1 | 6.2 | 10.0 | 3.5 | 7.3 | **16.1** | **8.5** |
| Pork and poultry | 8.3 | 10.3 | 8.9 | 10.2 | 7.7 | 15.7 | 6.4 | 9.2 | **8.4** | **6.9** |
| Dairy products | 8.6 | 4.6 | 19.5 | 30.6 | 17.4 | 11.4 | 13.1 | 11.1 | **10.3** | **6.3** |
| Average –above sectors | **7.9** | **7.9** | **10.0** | **37.5** | **5.9** | **8.3** | **6.6** | **11.0** | 9.3 | 7.9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (b) With increased NRAs | | | | | | | | | | |
| Rice | 4.2 | 99.4 | 6.8 | 47.0 | 23.4 | 8.4 | 15.7 | 32.9 | **20.3** | **34.6** |
| Wheat | 43.0 | 4.8 | 4.5 | 99.7 | 10.5 | 4.8 | 15.2 | 13.7 | **22.4** | **12.0** |
| Coarse grains | 19.2 | 8.0 | 156.6 | 21.3 | 11.6 | 7.5 | 20.1 | 11.1 | **36.9** | **6.0** |
| Oilseeds | 15.9 | 18.9 | 84.8 | 100.6 | 18.8 | 14.7 | 4.4 | 10.3 | **17.2** | **0.9** |
| Sugar | 26.7 | 46.5 | 8.9 | 118.2 | 30.5 | 14.4 | 29.9 | 15.6 | **21.9** | **24.3** |
| Cotton | 5.5 | 3.9 | 0.8 | 9.9 | 8.6 | 0.3 | 3.0 | 5.7 | **6.1** | **0.3** |
| Beef and sheep meat | 26.2 | 12.6 | 26.7 | 19.5 | 11.2 | 17.8 | 29.2 | 9.0 | **21.7** | **8.6** |
| Pork and poultry | 10.4 | 17.7 | 12.8 | 21.0 | 12.9 | 19.9 | 11.0 | 11.1 | **10.9** | **7.0** |
| Dairy products | 12.4 | 5.3 | 20.8 | 34.8 | 18.9 | 11.4 | 21.1 | 11.1 | **12.1** | **6.2** |
| Average—above sectors | **12.5** | **14.8** | **39.2** | **43.8** | **11.8** | **10.9** | **15.4** | **13.8** | **15.5** | **8.0** |

Source: Anderson et al. (2016a). See text for the methodology

**Table 11.12** Changes in economic welfare and component contributions from full trade liberalization, relative to 2030 baseline (equivalent variation, 2007 US$ million)

| | *Total welfare (EV)* | | | *Allocative efficiency contribution* | | | *Terms of trade contribution* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *(1) Policy status quo* | *(2) Increased DC protection* | *(3) Increment with increased DC protection (2)–(1)* | *(4) Policy status quo* | *(5) Increased DC protection* | *(6) Increment with increased DC protection (5)–(4)* | *(7) Policy status quo* | *(8) Increased DC protection* | *(9) Increment with increased DC protection (8)–(7)* |
| China | **173,294** | 175,376 | 2,082 | 145,823 | 148,912 | 3,090 | 28,592 | 27,736 | –856 |
| ASEAN | **45,925** | 47,512 | 1,587 | 32,534 | 35,970 | 3,436 | 10,706 | 8,666 | –2,040 |
| Rest East Asia | **58,412** | 63,447 | 5,035 | 38,256 | 44,599 | 6,343 | 25,107 | 24,057 | –1,050 |
| India | **92,167** | 93,271 | 1,104 | 129,353 | 130,217 | 865 | –34,470 | –34,208 | 263 |
| Rest South Asia | **–2,110** | –1,799 | 311 | 6,114 | 6,427 | 313 | –2,802 | –2,996 | –194 |
| Central Asia | **2,858** | 3,076 | 219 | 1,392 | 1,440 | 48 | 580 | 786 | 206 |
| Latin America | **19,227** | 20,687 | 1,460 | 31,996 | 33,681 | 1,685 | –13,023 | –13,288 | –266 |
| ME and Africa | **31,480** | 32,467 | 987 | 41,394 | 42,201 | 807 | –19,609 | –19,400 | 209 |
| All Developing | **421,252** | 434,037 | 12,785 | 426,861 | 443,448 | 16,587 | –4,919 | –8,647 | –3,728 |
| All High-income | **138,359** | 140,626 | 2,266 | 133,955 | 132,568 | –1,387 | 3,046 | 6,633 | 3,586 |
| World | **559,611** | **574,663** | **15,052** | **560,816** | **576,016** | **15,200** | **–1,873** | **–2,014** | **–141** |

Source: Anderson et al. (2016a). See text for the methodology

**Table 11.13** Allocative efficiency contributions of fully liberalizing from increased DC protection, relative to liberalization from 2030 baseline (equivalent variation, 2007 US$ million)

| | *China* | *ASEAN* | *Rest E. Asia* | *India* | *Rest S. Asia* | *Central Asia* | *C&L America* | *M. East & Africa* | *All DCs* | *All HICs* | *World* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 66 | 1,393 | 148 | 36 | 138 | 0 | 31 | 468 | 2,281 | –49 | 2,232 |
| Wheat | 238 | –15 | –39 | –202 | 68 | 5 | 239 | 63 | 357 | –376 | –19 |
| Coarse grains | 570 | –1 | 5,348 | 22 | 0 | 1 | 27 | 145 | 6,112 | –29 | 6,083 |
| Oilseeds | 263 | 502 | 2,405 | 563 | –14 | 1 | –92 | 90 | 3,717 | –219 | 3,498 |
| Sugar | 821 | 975 | 170 | 174 | 383 | 1 | 220 | 21 | 2,764 | –11 | 2,754 |
| Cotton | –290 | –13 | 0 | –15 | –275 | –13 | 6 | 9 | –590 | –95 | –685 |
| Beef and sheep meat | 46 | 87 | 259 | 88 | 9 | 9 | 668 | 122 | 1,288 | –17 | 1,272 |
| Pork and poultry | 1,701 | 148 | 88 | 129 | 5 | 39 | 168 | 46 | 2,324 | –171 | 2,153 |
| Dairy products | 545 | 28 | 6 | 49 | 34 | 0 | 403 | –16 | 1,048 | –163 | 885 |
| Total—sectors with increased DC protection | **3,959** | **3,103** | **8,385** | **844** | **349** | **44** | **1,670** | **948** | **19,302** | **–1,129** | **18,172** |
| All other sectors | –869 | 333 | –2,042 | 21 | –35 | 4 | 16 | –140 | –2,715 | –257 | –2,972 |
| All sectors | **3,090** | **3,436** | **6,343** | **865** | **313** | **48** | **1,685** | **808** | **16,587** | **–1,387** | **15,200** |

Source: Anderson et al. (2016a). See text for the methodology

each product and developing country. That provides all the exogenous variables needed to estimate a potential endogenous value for the NRA for each product and country. That estimated value is then subjected to the following two tests. First, if a farm product was and is projected still to be a net export product in 2030 (TSI > 0), then its 2030 NRA is assumed to be the lesser of its base-period NRA or zero. That is, we assume that all export taxes will be phased out by 2030, and that no new export subsidies will be introduced. And second, if it is projected to be an import-competing product in 2030 (TSI < 0), then its 2030 NRA is assumed to be the lesser of the equation's projected NRA or its WTO-bound tariff rate. That is, we assume that all developing country governments respect their commitment to WTO not to exceed their tariff bindings but otherwise that they feel free to respond to domestic political forces in determining the degree of protection provided to import-competing farm industries.

Using this methodology and set of selection criteria, projected NRA values are obtained for each of the ten products and for each of the 39 developing countries in the World Bank sample. Their averages across regions and products, applied within a GTAP model projection to 2030, are reported in Table 11.11.

What do those estimates reveal? For developing countries as a whole, the average NRA for these products is projected to rise from 9 % to 16 % by 2030. It happens that that is twice the average for high-income countries (including Europe's transition economies). The biggest tariff increases are in East Asia and Latin America. By product, the biggest rises are in grains, beef, oilseeds, and sugar, which is not surprising since they are also some of the most distorted products in high-income countries (see the final column of Table 11.11).

For farm products other than these ten major ones, and for highly processed food and other merchandise, we assume that developing country import protection rates in 2030 are the same as in the base period, and that any developing country agricultural export taxes in GTAP's protection database are eliminated by 2030 (while leaving high-income countries price distortions in place). A simulation involving full liberalization of this alternative set of NRAs for developing countries' agriculture in 2030 is then compared with a simulation that involves fully removing tariffs on all commodities and any export or output subsidies in the agriculture and food sectors as if the 2007 rates had stayed in place through to 2030.

The welfare results from these two simulations are summarized in Table 11.12, which shows the distribution of the welfare gains as equivalent variations, in 2007 US dollars, that would come from full global liberalization of all merchandise trade as of 2030 under the 'Policy status quo' and 'Increased DC protection' scenarios. The 'Increment' columns suggest, unsurprisingly, that the global welfare cost of trade policies would be somewhat higher with the agricultural protection growth in developing countries. In particular, the welfare cost to developing countries would be US$12.8 billion higher per year by 2030. It would be US$16.6 billion higher because of more inefficiently allocated resources, but the protection growth would improve the terms of trade for developing countries slightly and thereby reduce that loss by one-quarter—at the expense of high-income countries. Since income growth and declines in agricultural comparative advantage are projected to be faster in East Asia than any other developing economy region, it is not surprising that the projected losses that would be associated with endogenous farm protection growth are greatest for that region.

Table 11.13 decomposes column 6 of Table 11.12 (repeated in the final row of Table 11.13) to show the additional impact of allocative efficiency contributions by sector to welfare of liberalizing when there is increased developing country protection. As expected, we find that the additional welfare contributions are particularly significant in sectors where protection is projected to increase. For example, there are an additional US$6.1 billion of allocative efficiency gains contributed by liberalizing the coarse grain sector, where average developing country protection is projected to increase from 7 % to 37 % (see Table 11.12). This is especially driven by the Rest of East Asia region, where the endogenous increase in coarse grain protection is from 4 % to 157 %. Turning to other sectors, oilseeds are the next largest contributor to increased allocative efficiency: again this is a sector for which we modeled particularly large protection increases, including for India and the Rest of East Asia region. These two sectors alone account for almost half of the projected losses that would be associated with endogenous farm protection growth.

This analysis suggests that the common assumption in developing baseline projections for the world economy, namely that trade-related policies do not change over a projection period as long as a quarter century, may lead to underestimation of the gains from the phased implementation of prospective trade agreements. Had Japan and Korea been required to bind their agricultural tariffs at the rates in place when they signed onto the GATT in 1955 and 1967, respectively, estimates of the economic benefits of their membership of that club would have been much lower had it been assumed that their farm tariffs would remain unchanged over the following quarter century rather than rise—as indeed they did, and spectacularly so (Fig. 11.4).

At the time of China's accession to WTO in December 2001, its NRA was less than 5 % (see Fig. 11.4), or 7.3 % for just import-competing agriculture according to Anderson and Valenzuela (2008). Its average bound import tariff commitment was about twice that (16 % in 2005), but what matters most is out-of-quota bindings on the items whose imports are restricted by tariff rate quotas. The latter tariff bindings as of 2005 for China were 65 % for grains, 50 % for sugar, and 40 % for cotton (WTO, ITC, and UNCTAD 2007, p. 60). Hence China, too, has the scope to raise its agricultural protection substantially, making it not unreasonable to project a 58 % increase in their average NRA for key farm products in the present study (see Table 11.11).

A key finding is that the contribution of farm policies to the estimated welfare cost of all trade-distorting policies by 2030 is somewhat higher—

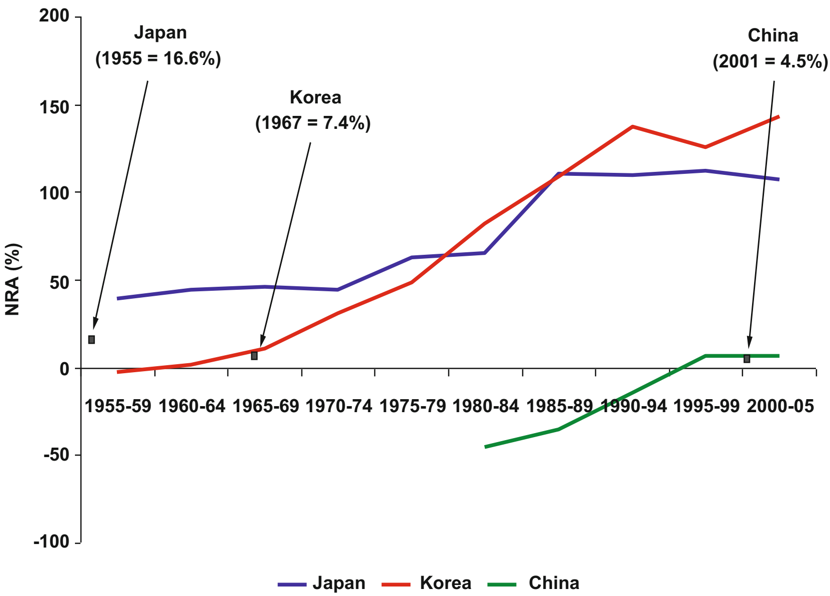



**Fig. 11.4** NRAs for Japan, Korea, and China and date of accession to GATT or WTO, 1955–2005 (%). Source: Anderson (2009b, Fig. 1.14), based on estimates in Anderson and Valenzuela (2008)

especially for developing countries—than if one assumes no change in farm policies over the next two decades.

While the estimated welfare difference between the two scenarios is only a fraction of 1 % of developing countries' GDP, we should remember that comparative static economy-wide modeling of this type always understates the true welfare costs (Francois and Martin 2010). Moreover, suppose the developing countries' policy response in place of raising farm import tariffs was to invest more in agricultural research. According to available evidence (Alston et al. 2000), this investment has a very high expected payoff for developing countries, a finding that is consistent with the welfare results from economy-wide modeling of boosts to farm productivity reported above. Increasing the productivity of farms also would boost food self-sufficiency in a way that increases accessibility to food for developing country consumers, in contrast to welfare-reducing agricultural protection, which shrinks their available quantity and diversity of food, raises the price of food, and thereby undermines their national food security and nutrition.

## Variations on the Baseline Projection: Mega-regional Trade Agreements

The most obvious opportunity available today for encouraging trade negotiations to stimulate significant market opening is a non-preferential, legally binding, partial liberalization of goods and services trade following the WTO's first round of multilateral trade negotiations, the Doha Development Agenda (DDA). As explained in the previous chapter, that round has yet to be able to be brought to a conclusion, notwithstanding the progress made at the Bali Trade Ministerial in December 2013 (including on trade facilitation—see Neufeld 2014).[6] Indeed after the Nairobi Trade Ministerial in December 2015, it appears that lots of WTO members have abandoned the DDA and will look to alternative opportunities.

Among the other opportunities are prospective sub-global regional integration agreements in the Asia-Pacific region, North Atlantic, and elsewhere. One recently agreed to, but yet to be ratified by national partnerships, is the Trans-Pacific Partnership (TPP) among a subset of 12 member countries of the Asia-Pacific Economic Cooperation (APEC) grouping.[7] China and Korea are not part of the TPP, however, so another negotiation involves extending the free-trade area among the ten-member

Association of South East Asian Nations to include China, Japan, and Korea (ASEAN+3). Yet another possibility is to embrace India, Australia, and New Zealand into ASEAN+3. It is called the Regional Comprehensive Economic Partnership (RCEP). APEC leaders have endorsed those regional integration tracks and see them as potential pathways for further integrating trade among all APEC members and extending that into South Asia (APEC 2010). A variant on that is another opportunity: a free-trade area among current APEC countries.[8] Meanwhile, another mega-regional focus is in the Atlantic Ocean region, the most important being the Transatlantic Trade and Investment Partnership (TTIP) being negotiated between the European Union (EU) and the USA.[9] Issues involved in estimating the possible trade and welfare effects of these regional opportunities are provided in the first sub-section, and the following two sub-sections review estimates for the Asia-Pacific and North Atlantic regions.

### *Estimating Benefits from Partial Sub-global Trade Reform*

Empirical comparative static model simulation studies of the potential economic welfare gains from prospective multilateral or large regional trade liberalization agreements typically generate positive gains for the world and for most participating countries (as do econometric studies of past trade reforms). In this section we review the latest economy-wide analyses of the above opportunities. All the studies reviewed here use CGE models of the global economy. As in Chap. 6, the CGE welfare gains refer to the equivalent variation in income (EV) as a result of each of the reforms described.[10] While not without their shortcomings (Francois and Martin 2010), CGE models are far superior for current purposes to partial equilibrium models, which fail to capture the economy-wide nature of the adjustments to reform whereby some sectors expand when others contract and release capital and labor. They are also superior to macro-econometric models which typically lack sufficient sectoral detail and are based on time-series analysis of the past which may no longer be relevant for the near future (Francois and Reinert 1997).

In the case of sub-global preferential trade reform studies, the estimated gains to the countries involved are almost always smaller than from multilateral reform involving similar tariff cuts, and some excluded countries—and even some participating ones—may lose. When increasing returns to scale and monopolistic competition are assumed instead of constant returns to scale and perfect competition, and firms are assumed to be heterogeneous rather than homogeneous, and when trade is liberalized not just in goods but also in services and investment flows, the estimates of potential gains can increase several fold. Virtually all such studies are in comparative static mode however, and so are unable to capture the crucially important growth-enhancing dynamic effects of trade reform described in Chap. 2. It is therefore not surprising that they generate results for gains from trade reform that are typically only a small fraction of GDP.

Such low estimated gains seem to fly in the face of casual empiricism. Irwin (2002), for example, notes that three different countries in three different regions chose to liberalize in three different decades (Korea from 1965, Chile from 1974, and India from 1991—see Irwin 2002, Figs. 2.3–2.5), and per capita GDP growth in each of those countries accelerated markedly thereafter by several percentage points per year. Admittedly those historical liberalization experiences also involved complementary reforms to other domestic policies and institutions that would have contributed significantly to the observed boosts in economic growth. Even so, they support the point that trade can generate not only static efficiency gains but also important dynamic gains.

Some CGE modelers have tried to proxy that dynamic effect by adding an additional one-off total factor productivity shock to their trade reform scenarios. But reform may also raise the rate of factor productivity growth and/or of capital accumulation. Such endogenous growth has yet to be satisfactorily introduced into CGE models, and in any case it is unclear how to interpret a model's estimated welfare effects if households are reducing current consumption in order to boost their or their descendants' future consumption by investing more.

The standard approach used in evaluating the consequences of international trade agreements is to compare the agreed tariff binding with the previously applied tariff rate, and to treat the post-agreement tariff rate as the lesser of the two rates. This essentially involves treating the current applied rate as a deterministic forecast of future protection rates in the absence of the agreement. As for services, new estimates of the extent to which policies inhibit their efficient provision (see Francois and Hoekman 2010; Borchert et al. 2014) suggest that reforms to those policies, particularly in developing countries, could generate far greater benefits than previous estimates have suggested. Moreover, those potential benefits are multiplying as the importance of global value chains grows with the fragmentation of production into ever more footloose processes. Modeling their economic consequences has proven difficult, however, and so is often ignored by CGE modelers.

### *Economic Consequences of Preferential Reforms in the Asia-Pacific Region*

The proposals and negotiations recently completed or currently under way within the Asia-Pacific region include the TPP among a subset of member countries of the APEC grouping, an extension of the free-trade area that is already in place among the ten members of ASEAN to include China, Japan, and Korea (ASEAN+3), and a free-trade area among all the APEC countries. Each of these trade liberalization initiatives is preferential, in the sense that trade is to be freed within the group but not between group members and the rest of the world.

Estimates of prospective gains from these three opportunities are provided by Petri et al. (2012). They use the GTAP database (version 8.1, with a 2007 baseline, see Narayanan et al. 2012), but their CGE model of the global economy is, in several respects, more sophisticated than the LINKAGE model used in Chap. 5 (see Zhai 2008). In particular, it is distinguished from the standard LINKAGE model in two important ways. First, it assumes economies of scale and monopolistic competition in the manufacturing and private services sectors instead of constant returns to scale and perfect competition. Second, following Melitz (2003), firms are assumed to be heterogeneous rather than homogeneous: each industry with monopolistic competition consists of a continuum of firms that are differentiated by the varieties of products they produce and their productivity. Furthermore, trade is liberalized by these authors not just by reducing applied bilateral tariffs on goods but also by raising utilization rates of tariff preferences, lowering non-tariff barriers to both goods and services, and reducing costs associated with meeting rules of origin (for details see the Appendixes in Petri et al. 2012, and also updated estimates in Burfisher et al. 2014 and Petri and Plummer 2016).

With these model refinements, the estimated gains from preferential liberalization of trade within this region are non-trivial. This is in part because the Asia-Pacific region is projected to become a much more important part of the global economy. Specifically, the TPP12 countries are projected by Petri, Plummer, and Zhai to account for one-quarter of the global economy, the ASEAN+3 economies for just over one-quarter, and the whole of APEC's 21 members for more than half of global GDP in 2025 (column 1 of Table 11.14).

The TPP, even if it involves just the current 12 members and excludes China and Korea, would get a 0.42 % boost to their GDP if they removed their bilateral barriers to trade in goods and services, and it would boost global GDP by 0.22 % (column 5 of Table 11.14). If instead the three large northeast Asian countries formed an FTA with the ASEAN members, global GDP growth would rise by a similar amount (0.21 %). But if all 21 APEC members were to form a free-trade area (FTAAP), the global gains would be four times greater than either of those other two (0.85 %). The corresponding gains for all developing countries would be 0.06 % of GDP from TPP, 0.33 % from ASEAN+3, and 1.17 % from FTAAP, and for all high-income and transition countries the gains would be 0.36 %, 0.10 %, and 0.56 % of GDP (Table 11.14). This progression in gains is due to several factors: greater trade complementarity as the mix of economies broadens, greater trade barriers (especially in agriculture) between the full set of APEC economies and the two smaller subsets prior to their removal, and greater scope for exploiting gains within the manufacturing sectors among the ASEAN+3 countries than among the TPP12 countries.

A region-wide free-trade area (FTAAP) is assumed by Petri et al. (2012) to involve completely freeing all trade, albeit preferentially within the Asia-Pacific region (including Russia and China), in contrast to the offers that were made for a Doha agreement which would only partially open up trade, albeit non-preferentially so that all WTO member countries are involved. Since the APEC members are projected to comprise nearly three-fifths of global GDP by 2025 (column 1 of Table 11.14), it is not surprising that an FTA among them could yield a benefit to the world that is three-quarters of what Doha is projected to offer, as discussed in the previous chapter. Furthermore, the FTAAP is projected to deliver a slightly greater benefit to developing countries as a group than is Doha. This is partly because, under Doha, developing countries are assumed to reform less than high-income countries, and partly because by 2025 the APEC grouping will account for around two-thirds of the GDP of all developing countries.

The two other opportunities analyzed involve sub-regional FTAs in the Asia-Pacific region, and so necessarily yield smaller benefits than an FTA for the entire APEC region: fewer countries are liberalizing, and only for their trade with a subset of APEC members. Of those two, the ASEAN+3 proposal would yield slightly more global and developing country benefits than the TPP.

How much impact these agreements have on agriculture is too speculative to guess, because sensitive foods tend to be less than fully liberalized for the same political reasons the GATT and WTO have had to contend with. To examine the potential difference agriculture can make to the overall gains from an FTA, Anderson and Strutt (2012) report results for freeing trade in the ASEAN+6 grouping called RCEP (i.e., ASEAN+3 plus India, Australia, and New Zealand).[11] They do so with and without agriculture included in the move to free trade within the region. The welfare gains to developing countries double when agriculture is also freed, and the projected gains to the world as a whole are four times greater if agriculture is not excluded. This again illustrates the point made in Chap. 6 that trade restrictions are so high for food compared with other products that they dominate the gains from freeing trade.

**Table 11.14** Change in economic welfare under three different prospective Asia-Pacific preferential free-trade agreements, 2025 (annual difference from baseline projection of 2025, 2007 US dollars and %)

| | *Baseline share of world GDP (%), 2025* | *US$ billion* | | | *Percent of GDP* | | |
|---|---|---|---|---|---|---|---|
| | | *TPP12* | *ASEAN+3* | *FTAAP* | *TPP12* | *ASEAN+3* | *FTAAP* |
| TPP12 countries | 26 | 112 | 26 | 172 | 0.42 | 0.11 | 0.73 |
| ASEAN+3 countries | 28 | 129 | 219 | 596 | 0.45 | 0.78 | 2.12 |
| FTAAP (all 21 APEC countries) | 57 | 239 | 216 | 912 | 0.41 | 0.37 | 1.57 |
| All non-APEC countries | 43 | –16 | –1 | –50 | –0.00 | –0.00 | –0.11 |
| World | 100 | 223 | 215 | 862 | 0.22 | 0.21 | 0.85 |

Source: Petri et al. (2012, Table 7)

### *Economic Consequences of Preferential Reforms in the North Atlantic*

Since July 2013 the USA and the EU have been negotiating a comprehensive agreement on facilitating trade and investment across the Atlantic. The proposed TTIP would be the largest free trade area in the world. Together, the two regions accounted in 2012 for more than 45 % of global value added and nearly one-third of the world's exports and imports of goods and services. Proponents of TTIP point to the potential economic gains while critics fear that the TTIP may lower health, safety, labor, and environmental standards and may undermine WTO. Knowing how large the gains might be could reduce the heat in the debate in those two regions, but it would also inform outsiders as to how they might be affected.

The agricultural consequences of TTIP are too difficult to forecast at this stage, because of the usual political sensitivity of food and hence reluctance to fully open the farm sector to trade. But a recent study by Felbermayr et al. (2015) uses a structurally estimated model to estimate the aggregate welfare benefits from such an arrangement based on historical FTA agreements. That study captures the net benefits from resource reallocations due to tariff cuts, but it also estimates the (usually far larger) benefits from lowering trade costs. Because the CGE studies summarized above do not include estimates of trade costs, the results in this sub-section are not directly comparable with those above. Felbermayr et al. (2015) find in their benchmark scenario that in the long run, real per capita income could be almost 4 % larger in the EU and 5 % larger in the USA. In the rest of the world, welfare is reduced by almost 1 %, however, so the global gain is just 1.6 %. Tariffs are already low in both regions, so removing them on bilateral trade flows contributes just under one-tenth of those estimated gains to the partners and the losses to non-TTIP countries.

Of additional interest in this study by Felbermayr et al. (2015) is a comparison of its model's estimates of the gains and losses from two Asian-focused mega-regionals: the TPP and RCEP (comprising the same members as ASEAN+3 plus Australia, New Zealand, and India). The USA, being part of TPP but not RCEP, is estimated to gain from TPP by 2.1 % but to lose from RCEP by 0.7 %. The EU, being uninvolved in either, is estimated to lose by 0.2 % from each of TPP and RCEP.

Despite this finding that preferential trade agreements tend to benefit the regions involved but sometimes at the expense of those excluded, countries continue to seek them out rather than get together to conclude the multilateral Doha round in which virtually all engaged regions would gain. The fear of losing by not engaging in preferential arrangements seems to be driving the demand for ever more sub-global deals. To date, agricultural trade seems to be just as politically sensitive in those smaller negotiations as it has been at the multilateral level. But perhaps they will provide deeper regional integration that gives their societies more confidence to embrace larger groupings and ultimately all WTO members in the future.[12]

## Variations on the Baseline Projection: Impacts of Climate Change

The above projections of the world economy have ‘business as usual’ baselines that have not necessarily incorporated allowance for climate change. This is understandable because the confidence bands around what those impacts might be are still very wide, and more so the further out in time one seeks to project (Tol 2014). What is clear, however, is that climate change is altering agricultural production not only in the long term but also year to year. In terms of the latter, many areas of the world are experiencing increased volatility of weather patterns and more intense or more frequent extreme weather events that can ruin a year’s production in minutes. Few models explicitly incorporate this uncertainty, and thus most underestimate worst-case scenarios (Burke et al. 2015). Openness to international (as well as intra-national) trade can be hugely important in mitigating the short-term effects of extreme weather that would otherwise drastically undermine food security (Burgess and Donaldson 2010). Hence this aspect of climate change underscores the importance of food trade openness.

As for the long-term effects of climate change, there are already signs that the optimal locations for producing the world’s various foods are altering (Donaldson et al. (2016). One response to date is rural workers migrating to urban areas of their country or to foreign countries, but this has proven less possible, for financial liquidity reasons, the poorer the country of the would-be migrant (Cattaneo and Peri 2015). Another response is breeding crop varieties for different climates. Agricultural research has been spectacularly successful in expanding the climate range for growing wheat (Olmstead and Rhode 2007, 2011).[13] However, R&D

takes decades. Faster options such as opening up more to trade in food therefore also need to be considered as possible policy responses to climate change.

Numerous global economic modeling studies have been undertaken to assess the role trade can play in the wake of long-run climate change. Their results vary greatly depending on the modelers' assumptions (von Lampe et al. 2014; Elbehri 2015, Chap. 10; Baldos and Hertel 2014),[14] but they all confirm the very positive role of trade openness. Just four sets of results are mentioned here to illustrate the types of conclusions being drawn.

First, Hertel et al. (2010a) find that the adverse poverty effects of climate change are most severe among nonfarm households in Africa and South Asia, but that farm households are likely to become less poor in regions such as Latin America. This difference results from lower yields outweighing any price rises for farm incomes in African and South Asia and the opposite for farmers in food-exporting countries of South America.

Second, while the average level of international food prices is expected to rise as a result of climate change, the extent is widely contested (Wiebe et al. 2015). For example, quite large rises are predicted by IFPRI's modeling of agricultural markets (Nelson et al. 2010), whereas others using global economy-wide models, such as Roson and van der Mensbrugghe (2012), are able to allow for intersectoral adjustment and tend to get smaller price rise projections. The range of projections is from zero to above 20 % for some crops by 2050. The aggregate real price rise by 2030 may be well under 5 % though.

Third, when economy-wide models are used, they can also incorporate effects of climate changes on other sectors (e.g., tourism in low-lying islands) and on factor productivity (e.g., the debilitating effect of higher temperatures and humidity on labor productivity in the tropics). Such spillover effects to the agricultural sector may be more important for some farmers or consumers than the direct effects of climate change on crop yields (Valenzuela and Anderson 2011).

And fourth, Baldos and Hertel (2014) show that standard drivers of food market developments such as growth in populations, incomes, and farm productivity are likely to have a much bigger impact on long-run trends in prices and food security than are changes in climate.

In addition to climate change itself impacting food markets, so too are policy responses to climate change. Biofuel subsidies and renewable fuel mandates have been mentioned in earlier chapters. Taxes on greenhouse gas emissions may harm agriculture more than manufacturing and services, while payments for $CO_2$ absorption may expand the demand for farmers and their land.

Clearly, the net effect of all of these developments on the future of any one farm product market remains highly uncertain, as do the net effects on poverty and food security in each nation. Openness to trade in food will ease the pain for those adversely affected though, and will allow those lucky enough to benefit to expand and so lessen the extent of food price rises.

## Key Messages

Under a range of assumptions about the world's economic growth and structural changes, it appears that the world will have enough to feed itself adequately in 2030. It will do so at international food prices that in real terms are not greatly different than those just before the global financial crisis and food price spike period of 2008–12—even when climate change is taken into account. Asia is projected to continue to become more important in the global economy and especially in markets for primary products. That opens opportunities for natural resource-rich economies to raise their own incomes by expanding their trade with Asia. Those trade growth prospects are greater, the faster Asia grows and the more those food-exporting countries invest in agricultural R&D to boost their farm productivity. But agricultural trade would grow less, as would global food security, the more agricultural protection rises in emerging economies in Asia and elsewhere.

Even if the WTO is unable to conclude its Doha round, regional trade agreements may continue to be signed. The extent to which they contribute to the integration of the world's food markets depends heavily, though, on the willingness of partners to liberalize agricultural trade alongside that for other goods and services. To date there has been a tendency to open markets for food less than for other products in regional agreements, just as in multilateral ones (or to assist all farmers within the bloc by protecting them from import competition from excluded countries, as with the EU's Common Agricultural Policy). Simulations of the welfare gains to developing countries from a prospective large Asian FTA suggest that they would double if agriculture is also freed, and the projected gains to the world as a whole are four times greater if agriculture is not excluded. This again illustrates the point that trade restrictions are so high for food compared with other products that they dominate the gains from freeing trade.

The finding that preferential trade agreements tend to benefit the regions involved but sometimes at the expense of those excluded helps us understand why countries continue to strive to form or join sub-global deals. Perhaps they will generate deeper regional integration to such an extent that their societies will be sufficiently confident to embrace larger (e.g., the RCEP) groupings and ultimately return to the WTO to multilateralize their regional liberalizations in the future.

## Notes

1. The following results draw from the most recent of several model projection studies of global markets by Anderson and Strutt (2012, 2014, b, 2015 and 2016). They update the estimates in Chapter 6 which reported global consequences of trade protection measures in place at the end of the Uruguay Round in 2004.
2. However, expected rates of return are relatively sensitive to investment which helps to ensure that model-generated projections of capital goods are consistent with the regional rates of growth in capital assumed in the projections.
3. For more on the importance of agricultural TFP growth assumptions on projections of global food consumption and dietary intake, see Baldos and Hertel (2014), Hertel (2015), Pardey et al. (2014), and Hertel and Baldos (2016).
4. On the many ways in which global economic models can differ in their long-term projections for agriculture, see von Lampe et al. (2014).
5. Bouët and Laborde (2010) also seek to assess the implications for the world economy of protection growth that might result if the WTO's Doha round fails to agree to liberalize trade multilaterally. However, their assumed alternative protection rates are more ad hoc than in this section.
6. If enough WTO member countries can agree to sign up to the Trade Facilitation Agreement negotiated in Bail to bring it into law, the gains could be very considerable. See Moïsé and Sorescu (2013) and Zaki (2014).
7. The TPP began in 2006 when just four small APEC members (Brunei, Chile, New Zealand, and Singapore) came together to begin negotiations for greater economic integration. Being already open liberal economies, their leaders saw this not as an end in itself but rather as a pathway for a more expansive club. In September 2008, the USA announced its interest in joining the TPP. By 2010, Australia, Malaysia, Peru, and Vietnam also

joined in, and since then Canada, Japan, and Mexico have joined the negotiations, to make a total of 12 of APEC's 21 members as of April 2014.

8. While all these initiatives are in the Asia-Pacific region, their importance to other regions is very considerable and continues to rise along with this region's share of the global economy. According to the World Bank's International Comparison Project (http://icp.worldbank.org), at current exchange rates this region represented almost 60 % of the global economy in 2011, compared with just 3 % for each of South Asia, Western Asia, Africa, the Commonwealth of Independent States, and the rest of Latin America plus Caribbean.
9. Whether such reciprocal preferential trade agreements are stepping stones or stumbling blocks to freer global trade is a much debated point among economists. For surveys of the impact of regionalism on the multilateral trading system, see Baldwin (2009) and Limão (2016).
10. EV is defined as the income that consumers would be willing to forego and still have the same level of well-being after as before the reform. For a discussion of the merits of EV versus other measures of change in economic welfare, see, for example, Just et al. (2004).
11. The RCEP agreement is Asia's response to the TPP. It is being driven by ASEAN, particularly Indonesia. The countries involved had a similar combined GDP to that of TPP members in 2007, but by 2030 the RCEP share has the potential to be twice as big as the TPP's.
12. On the various motives for the rapid spread of FTAs and what it means for the WTO, see Bagwell and Staiger (2016), Grossman (2016), and Limão (2016).
13. The case of maize is a little different: the varieties developed in the USA at least are more sensitive to drought than earlier varieties (Lobell et al. 2014).
14. To aid model transparency and convergence for this and general foresight work, the Agricultural Model Intercomparison and Improvement Project (AgMIP) has been established. See www.agmip.org.

# APPENDIX

**Table 11.15** Average annual GDP and endowment growth rates, % per year, 2007 to 2030 baseline projection

| | *GDP growth* | *Population growth* | *Unskilled labor* | *Skilled labor* | *Produced capital* | *Oil* | *Gas* | *Coal* | *Other minerals* | *Agric. land* |
|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 3.63 | 0.75 | 0.00 | 3.32 | 3.38 | 2.52 | –2.94 | 0.00 | 2.07 | 0.23 |
| Brazil | 3.40 | 0.58 | 0.44 | 2.85 | 3.18 | 5.66 | 6.29 | 0.50 | 2.07 | 0.50 |
| Chile | 2.98 | 0.76 | 0.69 | 2.96 | 3.37 | 0.00 | 0.00 | 0.00 | 2.07 | –0.06 |
| Peru | 4.19 | 1.02 | 0.86 | 3.45 | 4.96 | 1.64 | –0.35 | 0.00 | 2.07 | –0.10 |
| Rest LA | 3.12 | 1.11 | 0.99 | 3.75 | 2.95 | 5.53 | 2.36 | 5.54 | 2.07 | 0.28 |
| MENA | 3.65 | 1.37 | 0.58 | 3.86 | 3.78 | 0.71 | 3.73 | 0.96 | 2.07 | 0.00 |
| South Africa | 2.94 | 0.47 | –0.18 | 3.07 | 3.16 | 0.00 | 0.00 | 1.90 | 2.07 | 0.15 |
| SSA | 5.96 | 2.22 | 2.64 | 5.86 | 4.65 | 4.17 | 2.91 | 1.74 | 2.07 | 0.09 |
| Europe | 1.45 | 0.04 | –1.17 | 1.34 | 1.45 | 2.72 | 0.55 | –2.26 | 2.07 | –0.26 |
| NAFTA | 1.98 | 0.78 | 0.12 | 1.61 | 1.59 | 1.84 | –0.36 | 0.21 | 2.07 | –0.17 |
| ANZ | 2.19 | 1.08 | 0.32 | 1.89 | 2.18 | 1.41 | 6.26 | 3.55 | 2.07 | –0.56 |
| China | 5.66 | 0.42 | –0.06 | 2.07 | 5.49 | –0.40 | 4.85 | 5.62 | 2.07 | –0.36 |
| Rest East Asia | 2.35 | 0.70 | –0.86 | 1.51 | 2.55 | 1.94 | 1.61 | 2.92 | 2.07 | –0.12 |
| South Asia | 5.23 | 1.16 | 1.40 | 3.34 | 4.23 | 0.23 | –0.63 | 4.87 | 2.07 | –0.05 |
| **HICs** | **1.59** | **0.27** | **–0.53** | **1.41** | **1.34** | **2.53** | **0.74** | **0.17** | **2.07** | **–0.29** |
| **Developing** | **4.41** | **1.08** | **0.48** | **2.97** | **4.21** | **2.02** | **2.87** | **4.95** | **2.07** | **–0.13** |
| of which LA | 3.34 | 0.85 | 0.62 | 3.21 | 3.20 | 5.28 | 2.52 | 5.41 | 2.07 | 0.29 |
| **World** | **2.51** | **0.93** | **–0.18** | **1.79** | **2.50** | **2.18** | **1.99** | **3.30** | **2.07** | **–0.18** |

Source: See text for the details of assumptions

**Table 11.16** Regional shares of world real GDP, economically active population and GDP per economically active person, 2007 and the baseline projection for 2030[a] (%)

| | *World GDP share* | | *World econ. active population share* | | *GDP per econ. active person, relative to world average* | |
|---|---|---|---|---|---|---|
| | *2007* | *2030* | *2007* | *2030* | *2007* | *2030* |
| Argentina | 0.5 | 0.6 | 0.6 | 0.6 | 74 | 97 |
| Brazil | 2.4 | 3.0 | 3.3 | 3.2 | 75 | 94 |
| Chile | 0.3 | 0.3 | 0.2 | 0.2 | 121 | 136 |
| Peru | 0.2 | 0.3 | 0.4 | 0.5 | 44 | 58 |
| Rest LA | 1.7 | 1.9 | 2.0 | 2.3 | 84 | 82 |
| MENA | 3.4 | 4.3 | 3.9 | 4.6 | 87 | 95 |
| South Africa | 0.5 | 0.6 | 0.6 | 0.6 | 84 | 93 |
| SSA | 1.1 | 2.3 | 9.2 | 13.9 | 12 | 16 |
| Europe | 36.4 | 28.7 | 13.2 | 9.9 | 277 | 288 |
| NAFTA | 29.6 | 26.2 | 7.5 | 6.9 | 396 | 380 |
| ANZ | 1.8 | 1.7 | 0.4 | 0.4 | 397 | 384 |
| China | 6.3 | 12.5 | 26.0 | 20.9 | 24 | 60 |
| Rest East Asia | 13.2 | 12.7 | 12.3 | 12.1 | 108 | 105 |
| South Asia | 2.7 | 4.9 | 20.4 | 23.8 | 13 | 21 |
| **HICs** | **73.5** | **59.6** | **21.2** | **16.7** | **347** | **358** |
| **Developing** | **26.5** | **40.4** | **78.8** | **83.3** | **34** | **49** |
| of which LA | 5.1 | 6.1 | 6.6 | 6.8 | 77 | 89 |
| **World** | **100.0** | **100.0** | **100.0** | **100.0** | **100** | **100** |

Source: See text for the details of assumptions

[a]2007 prices

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CHAPTER 12

# Policy Implications and Prospects for Boosting Global Food Security

The strongest message to take from this study is that open markets maximize the benefit that trade can offer to boost global food security and use the world's agricultural resources most sustainably. Declining costs of trading internationally reinforce that message, thanks in particular to the information and communication technology revolution and to evolutionary innovations in transport and handling. And if global warming and extreme weather events are to become more damaging to food production as climate change proceeds, then all the more reason to open up food markets so as to lower the variance of international food prices and allow trade to buffer seasonal fluctuations in domestic production.

Yet the projected decline in food self-sufficiency in many industrializing countries may concern some groups in those countries enough to push for increased barriers to food imports. This chapter therefore begins by rehearsing why import protection is unlikely to boost most households' economic access to food, and hence is likely to undermine rather than enhance national food security. Indeed any policy that distorts markets tends to reduce national income and hence the aggregate capacity to afford food. By contrast, expanding public investments in areas where the marginal social rate of return is above the opportunity cost of funds not only raises the level of national income in the short run by enhancing the nation's aggregate stock of capital but also can raise the long-run rate of economic growth. If those public investments include agricultural



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R&D, rural infrastructure, and rural education and health, that incidentally would boost farm productivity growth and thus food self-sufficiency.

After contrasting these two alternative initiatives that lead to less dependence on imported food, the chapter examines the increasing efficacy of generic social protection measures as another way to assist the most food-insecure households that avoids using trade-restrictive measures. The chapter concludes by returning to what the WTO might be able to do in future, particularly in reducing the volatility of international food prices.

## Food Market-Distorting Measures

There are numerous market price-distorting measures used by governments in their attempts to ensure social stability through improving national food security and reducing farm–nonfarm income inequality and poverty. As reported in Chap. 5, the most common are trade measures such as an import tariff, which is the equivalent of a production subsidy plus a consumption tax at the same rate as the tariff (as is also an export subsidy). Similarly, an export tax (or an import subsidy) is the equivalent of a production tax plus a consumption subsidy at the same rate as the trade measure. All such price-distorting trade measures tend to reduce national income, the extent of which depends on, among other things, the price elasticities of domestic demand and supply.

In principle, a measure that distorts just the production or consumption side of the domestic market at the same rate as a trade measure would reduce national income less than that trade measure. That is not always true in practice though. A case in point is the rice policy of Thailand's government that was first introduced in October 2011. There the government buys rice from farmers at above the market price and stores it, pending a rise in the export price. However, because the international price did not rise, much of that stored rice was spoiled and the government has had to dispose of some of the rest at a loss. Such production subsidies, when combined with inefficiently managed public storage activities, therefore may involve an even greater national loss than a trade measure. Moreover, that government expenditure could have been used instead to invest in high-payoff rural public goods (see below).

India's government also buys grain from farmers at above market prices when the latter fall below a threshold level, and has similar wastage problems to Thailand. India subsidizes also the farmers' purchase of key inputs such as fertilizer, electricity, fuel, credit, and seeds. During the past decade, these input subsidies have amounted to around 10 % of the value of farm production (Pursell et al. 2009, p. 361; Hoda and Gulati 2013, p. 1). They are more wasteful than an equivalent transfer to farmers via an output subsidy, because in addition to over-encouraging output they also distort the mix of inputs used in production. Moreover, when many of those subsidized inputs are provided by inefficient government agencies, as is the case in India (Hoda and Gulati 2013, p. 2; Jha et al. 2013), this adds further to their wastefulness.

Similarly, food consumer subsidies can be much more wasteful in practice than in theory. India is again a case in point, as it is in the process of broadening its rice and wheat consumer subsidy scheme so as to extend discounts to two-thirds of India's households from 2013 (involving an annual payment of more than US$20 billion, see Kishore et al. 2014). Apart from the wasteful corruption and losses by the public procurement and distribution system associated with such schemes,[1] recent studies in both India and China demonstrate that such consumer subsidies do almost nothing to boost nutrition, as consumers tend to eat the same amount of nutrients but do so by switching, for example, from less-preferred coarse grains to subsidized rice and wheat (Jensen and Miller 2011; Kaushal and Muchomba 2015).

To avoid the budgetary outlays that producer or consumer subsidies involve, some other food-importing countries have imposed import restrictions on at least their key food grains (e.g., Japan, Korea, and Indonesia for rice—see Anderson 2009a, b). In the interest of boosting farm incomes to reduce the urban–rural income gap, Japan and Korea have imposed import restrictions also on meat and milk products—but not on coarse grains and oilseed products required for animal feedstuffs, which means that sub-sector would still not be self-reliant insofar as it continues to depend on imported ingredients for feed.

In the previous chapter, this option was examined for China and India. That modeling suggested that if they banned imports of grains, domestic resources would move toward rice, wheat, and livestock production but self-sufficiency would fall for crops that provide inputs into animal feedstuffs, and also for other crops (Table 11.9). In the case of China, the tariff equivalents of such import restrictions would range from 115 % for wheat to 160 % for non-ruminant meats and milk products to 255 % for red meats. These are well above China's WTO-bound out-of-quota tariffs and so would be inconsistent with China's WTO commitments under international law.

Moreover, such a policy response would impose a burden on households that are net buyers of those grain, meat and milk products, because domestic consumer prices for those products would increase along with the producer price rise. The extent of the consequent reductions in the volume of various foods consumed by households in China, as a result of that simulated policy response, ranges from 3 % to 6 % for livestock products, 0 % to 3 % for grains, and 2 % to 3 % even for vegetable oils and horticultural products. The fall for the latter goods is despite no change in their import restrictions. It is due to the fall in real national income resulting from this policy (estimated to be 0.9 % of China's GDP), as well as the rise in their prices due to productive resources being withdrawn from those industries to boost resources in the now-more-protected farm industries. In short, such a policy response to declining food self-sufficiency undermines national food security by reducing economic access to food for the vast majority of households.

## Growth-Enhancing Investment Measures

The price-distorting measures of the type discussed in the previous section re-distribute well-being between farmers, food consumers, and taxpayers but at the expense of overall national welfare. By contrast, investments in rural public goods can raise national income, boost economic growth, and enhance the food security of farm (and in some cases also nonfarm) households in the country (Fan and Hazell 2001). Three types of rural investments are considered in this section.

Public agricultural research and development (R&D) investments in developing countries have risen considerably in recent times. As a result, the developing countries' share of global public agricultural R&D has risen by half over the past three decades, from an average of 31 % in 1980–2000 to 45 % by 2011 (Pardey et al. 2016). Yet the marginal returns from boosting such levels of public investment in most developing countries are still extremely high (Hurley et al. 2014; FAO 2012), suggesting scope for high returns from more such expenditure.

The evidence from Brazil is particularly compelling: during the 1980s and 1990s, Brazil invested far more in public agricultural R&D as a percent of national agricultural GDP than most other countries. Not surprisingly, Brazil's outputs of both crop and livestock products have more than doubled since the early 1990s, and its food self-sufficiency has been boosted commensurately. By biasing that research toward labor-saving technologies, that investment also helped farmers adjust to rising rural wages—something that becomes more pressing as economic growth proceeds, including in China where the supply of under-employed labor in rural areas has shrunk (Zhang et al. 2011).

Raising agricultural R&D spending is clearly an option for countries to choose if they wish to slow their decline in food self-sufficiency. In addition to also boosting national income growth, such investments would tend to lower domestic consumer prices for some foods and so would benefit not only farmers but also net buyers of those foods, thereby contributing to both the availability and access dimensions of food security. This contrasts with food import restrictions, which raise domestic prices and thus benefit net sellers of food *but at the expense of net buyers of food*. More people will be harmed than helped by such a policy measure in countries where the majority of workers are (or will be in a few years) employed in nonfarm jobs. And in most developing countries, the poor (households below the US$1.25 international poverty line) are net buyers of food on average (Anderson et al. 2014, Table 1).

To illustrate this point, Anderson and Strutt (2014a) modeled increases in total factor productivity (TFP) that would be required in Chinese agriculture for the country (a) to achieve the same overall self-sufficiency rate in 2030 as with the grain and livestock product import bans describes in the previous section (94 %) and, even more ambitiously, (b) to return to the same overall agricultural self-sufficiency as in 2007, namely 97 %. In case (a), a cumulative 33 % improvement in agricultural TFP for China over the period to 2030 roughly achieved that target. In case (b), it takes a 59 % cumulative improvement in agricultural TFP over the period to 2030. This TFP increase generates higher incomes and so leads to higher volumes of various foods consumed, thus boosting national food security—in contrast to its deterioration in the import protection scenario. While the tightening of food import restrictions are estimated to reduce China's real GDP by 0.9 %, an increase in agricultural TFP of 33 % (or 59 %) raises estimated real GDP by 4.5 % (or 7 %).[2]

While these cumulative increases in agricultural TFP of 33 % or 59 % may seem high, recall that they are spread over a 23-year projection period. The annual rates required would be only 1 % or 2 % more than in the baseline scenario. These are not excessive by historical standards—see, for example, Alston et al. (2010) and Fuglie et al. (2012).

Turning to another investment area, poor infrastructure such as rural roads adds to the cost of procuring off-farm inputs, and also to the gap between the farm-gate and market prices of outputs. It thereby depresses farmer incentives and reduces consumers' economic access to food. So too do poor-quality telecommunications in rural areas, through raising the costs of such things as price information in distant markets and e-banking and farm credit.[3] Better rural infrastructure also improves the opportunities for farm household members to earn part-time incomes off the farm by lowering commuting costs (Fan and Zhang 2004). Experiences in many developing countries show that part-time off-farm earning opportunities for farm household members can reduce rural poverty and the farm–nonfarm income gap—and without reducing farm production greatly, thanks to the capacity to move to labor-saving techniques as rural wages rise (Otsuka et al. 2009).

China is one country that has been investing vast sums in infrastructure in recent decades, but whether there have been sufficient investments flowing into rural areas to ensure the marginal rate of return is driven down to that from further urban infrastructure investment is a moot point. Fan and Chan-Kang (2008), for example, examine returns from investments in local as compared with national roads in China. Their study suggests that the benefit-cost ratio for local roads is four times greater than for highways. That does not mean rural people would not benefit from major highway networks though: Roberts et al. (2012) estimate that such investments could boost Chinese real incomes by 6 % in the short run without increasing rural–urban income inequality. Even so, highway networks between pairs of major cities are found to benefit the larger city more (Faber 2012). The allocation of infrastructure investment funds even among rural areas may be less than optimal. Fan and Zhang (2004) found that the lower productivity in China's western regions could be explained by the lower levels there of rural infrastructure, education, and science and technology. They concluded that improving both the level and efficiency of public capital in the west would be key to narrowing the productivity difference between it and other regions of China.

As for education and health investments, they tend to be lower in quality as well as quantity in rural versus urban areas in many developing countries. This means the productivity of future farm workers and managers will be lower than is socially optimal, and farm production will be less. But it also means those wishing to work part- or full-time in nonfarm jobs will be less successful in finding and thriving in such positions and thus in repatriating earnings back to their relatives still working in the farm. Both outcomes lower national economic growth and contribute to the farm–nonfarm household income gap (Rozelle et al. 2005).

## Freeing Up Factor Markets

Factor markets are still far from free of restrictions in lots of developing countries, which means productive factors are used inefficiently. Making it easier for rural workers to access urban jobs would go a long way to reducing the rural–urban income gap. In the case of China, that would mean relaxing the *Hukou* household registration system (Zhao 1999; Lin et al. 2004; Hertel and Zhai 2006). A recent study of Russia, for the period 1995–2010, found that when barriers that hindered internal labor migration in the 1990s were eliminated, the economies of the poorer Russian regions grew out of their poverty trap and their income levels converged toward those in more affluent Russian regions in the first decade of this century (Guriev and Vakulenko 2015). Reducing such barriers to worker movements would increase the payoff from boosting the above-mentioned under-investments in rural education, health, and infrastructure too.

Current regulations that restrict or prohibit the sale of farm land are also a constraint. As wages rise, there is plenty of scope for mechanization to improve labor productivity, but far more so where economies of farm land size can be exploited. That is, farm land consolidation is required to allow more efficient use of farm machinery. True, land rental markets have developed to alter the operational size of some farms, but least so in areas where tenure security is weakest.

Markets in developing countries for water use in farming are even less developed than markets for land use. Whenever farmers are paying less than the true cost of irrigation water, they will be over-using it and thereby making less available for urban households and industries. Once water markets are developed with well-defined access, they provide greater certainty and hence more asset security for farmers (and other users).

The absence of tight land and water tenure rights makes it more difficult for farmers to access credit on reasonable terms requiring collateral. This adds to the cost of food production. Again farmers have found innovative ways around their credit constraints, such as renting rather than buying farm machinery (Christiaensen 2013), but freeing up capital markets so that more rural micro-credit institutions could develop would reduce this constraint on growth outside urban areas.

Improving the efficiency of markets for all key factors of agricultural production—capital, labor, land, and water—and for intermediate inputs such as fertilizer is an important way to improve not only current farm incomes but also the pathways for farm households to accumulate wealth. Without that security, farmers will be less inclined to support the government's other economic reform efforts (Morrow and Carter 2013).

## Reversing the Growth in Distortions to Farm Product Markets

The reforms to market-distorting policies that many developing countries undertook from the 1980s to reduce the discouragement of farm production (as reported in Chap. 5) have contributed to those countries' national economic growth and welfare in addition to boosting rural incomes. However, some countries have 'overshot' in the sense that they are now increasingly assisting farmers. Where that is being achieved by raising food import barriers it is also raising some food prices above levels at the country's border, is lowering national economic growth and welfare, and is reducing economic access to food for all but those farm households that are net sellers of foods that are protected from import competition. Indonesia, for example, introduced a new Food Law in late 2012 that broadens its food self-sufficiency beyond rice to several other key foods, the cost of which could be huge if it is fully implemented (Anderson and Strutt 2015).

True, higher-income countries in decades past followed a similar agricultural protection growth path (Anderson 2009b), but governments in those countries have since come to realize that this path is not very effective in closing the farm–nonfarm income gap. Moreover, reversing that process has proven to be very painful politically for them—which is all the more reason for developing countries not to follow that policy path in the first place. Yet policy reversals have happened, and some have been sustained. For the OECD membership as a whole, their average rate of assistance to farmers is now less than half what it was a generation ago, and it is now below the assistance rates in several developing countries (Fig. 5.6).[4]

A reluctance to abandon the use of trade-restricting measures sometimes stems from concerns about the reliability of import suppliers. China has already begun to address this by contracting foreign farmers to supply Chinese markets with specific products. Perhaps more such investments in land-abundant countries in Latin America, Africa, and elsewhere can further enhance the perceived security of supplies at lower cost than by protecting Chinese farmers from import competition for land- and water-intensive crops.

## Expanding the Role for Generic Social Protection Instruments

Fortunately, for many developing countries, there are politically feasible alternative policy instruments to market-distorting policies that are more efficient and effective in improving national food security, reducing the gap between farm and nonfarm household incomes, and reducing extreme poverty. The information and communication technology (ICT) revolution has recently made it far cheaper and easier than in the past to target income supplements, as and when needed, to the poorest and hence most food-insecure households, whether they be urban or rural. Such payments were unaffordable in developing countries in the past because of the fiscal outlay involved and the high cost of administering small handouts. However, the ICT revolution has made it possible for conditional cash transfers to be provided electronically as direct assistance to even remote households who have access to electronic banking. The extent to which households in developing countries now have a bank account or its equivalent is now very high (Fig. 12.1).

Evidence of the practical workability of such social safety net programs in developing countries is growing rapidly. Hoddinott and Wiesmann (2010) explore such programs in Mexico, Honduras, and Nicaragua, and conclude that exposure to these programs raised both the quantity

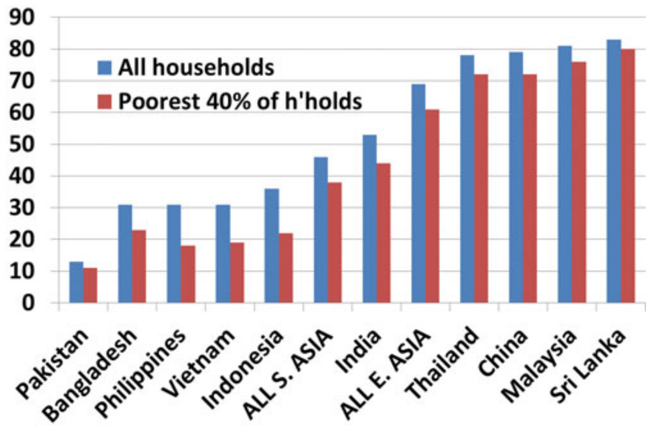


**Fig. 12.1** Share of adult population with bank account or equivalent, 2014 (%). *Source*: World Bank (2015)

of calories consumed and the quality of the recipients' diets—and the benefits were most pronounced among the poorest households. Adato and Bassett (2012) assess programs in six southern African countries, and they too find substantial improvements in the quantity and quality of food consumed by recipients in poor households there. They also note that the benefits could be even greater with complementary activities such as nutrition counseling and micro-nutrient supplements. Following a survey of results on consumption from a wide range of Latin American countries, Fiszbein and Schady (2009, Ch. 4) conclude that conditional cash transfers have had substantial positive impacts on consumption and on poverty alleviation.

Prospective offsetting effects that were a source of concern when such programs were created do not appear to have been sufficiently large as to offset the benefits of the transfer. For example, the schemes do not seem to reduce the labor supply of adults or to crowd out private transfers, and some programs increase productive investment, which boosts and sustains the impact on poverty. The latter is further supported by evidence from Mexico reported in Gertler et al. (2012), who find that one-quarter of cash transfers were invested in productive activities, thereby ensuring sustained higher living standards even after such programs end. While the political challenge of switching from market-distorting trade measures to domestic policy instruments for addressing non-trade domestic concerns is evidently non-trivial, this emergence in a wide range of developing countries of new, lower-cost social protection mechanisms involving conditional cash e-transfers is encouraging.

China is more capable than most developing countries in being able to effectively deliver social protection payments electronically to its rural households. Huang et al. (2013) point out that the government has set up a special account for each household in a local bank, and an annual allocation is made just prior to the planting season to each account from the Agricultural Financial Subsidy Fund. This provides China a way to avoid going any further down the agricultural protection growth path and thereby repeating the economically costly mistakes of higher-income countries, or going as far down the producer and consumer subsidy pathway that India has taken—and then having to reverse either of those processes, the political cost of which would be larger the longer such programs are in place. Moreover, such cash transfers would have an even more favorable national food security impact if combined with an increase in agricultural R&D investment.

This ICT revolution is making it more and more feasible for governments to provide social protection to any losers from any policy reforms who might otherwise fall into poverty (World Bank 2015). More than that, such social protection can even contribute to economic growth, thereby potentially also pulling more people out of poverty (Alderman and Yemtsov 2014). To the extent that the more widespread scope for providing social protection lowers the political resistance to trade policy reforms, there may be room for more optimism in the future than there has been in the past about prospects for both unilateral and plurilateral trade liberalization.

Even with new trade agreements, there will continue to be millions of poor and hungry people needing assistance to rise above extreme poverty, especially when consumer food prices spike up or farmer's product prices slump. The key point to conclude on is that policies to avert disastrous losses for such groups need not be as dependent on trade measures in the future as they have been in the past. Trade policy measures are very blunt instruments for dealing with either short-run price volatility or long-run concerns such as raising government revenue or reducing rural–urban income inequality. Myriad financial instruments are rapidly becoming available even in low-income countries for both farmers and food consumers to manage price risk (World Bank 2014). Also, instruments such as a value-added tax are becoming lower-cost ways to raise government revenue than trade taxes even in low-income countries. If complementary domestic measures are introduced or expanded as and when needed (including if need be to reach agreement to liberalize trade), the prospects for better food security outcomes globally will be greatly enhanced.

## What More Could the WTO Do to Reduce International Food Price Volatility?

The analysis in Chap. 8 showed that national trade restrictions add non-trivially to international food price volatility in at least two ways: through 'thinning' international food markets, and through 'insulating' domestic food markets from international price fluctuations. Both policy attributes magnify the effect on international prices of any shock to global food supply or demand.

The ideal solution to the first ('thinning') problem is simply for countries to open further their markets to food trade. The political difficulty and the adjustment costs associated with doing that are minimized if countries can agree to liberalize their food and agricultural markets multilaterally, and to do so at the same time as non-agricultural markets are liberalized. That was what happened in the Uruguay Round, and it is what has been aspired to by members of the WTO via their Doha Development Agenda (DDA).

The ideal solution to the second ('insulating') problem also involves the WTO. In a many-country world, it is clear from Chap. 8 that the trade policy actions of individual countries can be offset by those of other countries to the point that the interventions become ineffective in achieving their stated aim of reducing domestic food price volatility when international prices spike. This is a classic international public good problem that could be reduced by a multilateral agreement to restrain the variability of trade restrictions (e.g., by converting specific tariffs into *ad valorem* ones).

One of the original motivations for the Contracting Parties to sign the General Agreement on Tariffs and Trade (GATT, WTO's predecessor) was to bring stability and predictability to world trade. To that end the membership adopted rules to encourage the use of trade taxes in place of quantitative restrictions on trade (Article IX of the GATT), and managed to obtain binding commitments on import tariffs and on production and export subsidies as part of the GATT's Uruguay Round Agreement on Agriculture. However, those bindings continue to be set well above applied rates by most countries, leaving plenty of scope for varying import restrictions without dishonoring those legal commitments under WTO. Meanwhile, there are no effective disciplines on export taxes, let alone bindings.

In the Doha round of WTO negotiations, there were proposals to phase out agricultural export subsidies as well as to bring down import tariff bindings, both of which would contribute to more stable international food prices. Surprisingly, agreement was reached to phase out farm export subsidies at the biennial Trade Ministers Meeting in December 2015. However, proposals to broaden the Doha agenda to also introduce disciplines on export restraints have struggled to date to gain traction. A proposal by Japan in 2000, for example, involved disciplines similar to those on the import side, with export restrictions to be replaced by taxes and those export taxes to be bound and gradually phased down. A year later Jordan proposed even stronger rules: a ban on export restrictions and, as proposed for export subsidies, the binding of all export taxes at zero. However, strong opposition to the inclusion of this export item on the DDA has come from several food-exporting developing countries, led by Argentina (whose farm exports were highly taxed following its large currency devaluation at the end of 2001 until a new government in December 2015 removed them). This reflects the facts that traditionally the demandeurs in WTO negotiations have been dominated by interests seeking market access, and that upward price spikes are infrequent. Yet the above analysis reveals the need for symmetry of treatment of export and import disciplines in the WTO.

Such symmetry also would be helpful in times of downward price spikes. Some developing countries added to the WTO's Doha Agenda a proposal for a Special Safeguards Mechanism that would allow them to raise their agricultural import barriers above their bindings for a significant proportion of farm products in the event of a sudden international price fall or an import surge (Thennakoon and Anderson 2015). This is the exact opposite of what is needed to reduce the frequency and amplitude of downward food price spikes (Hertel et al. 2010b). Evidence provided in Chap. 8 for the mid-1980s suggests that if food-importing countries were to exercise that proposed freedom when international prices slump, food-surplus countries would respond by lowering their export restrictions—thereby weakening the efforts of the food-importing countries to insulate their domestic markets from the international price fall—*and* further depressing that price. If only WTO member countries were willing to bind their trade taxes on exports as well as imports at low or zero levels, there would be many fewer occasions when international food prices spiked.

## Key Messages

Open markets maximize the benefit that international trade can offer to boost global food security and ensure that the world's agricultural resources are used sustainably. The declining costs of trading internationally reinforce that message, as does climate change. If global warming and extreme weather events are to become more damaging to food production, then all the more reason to be open to international food markets and allow trade to buffer seasonal fluctuations in domestic production. The more countries that do so, the less volatile will be international food prices.

For those countries becoming more food import dependent as their comparative advantage moves away from agriculture, slowing that process by raising food import barriers worsens rather than improves their national food security, since it reduces economic access to food for the vast majority of households. By contrast, public investments to boost farm productivity—while achieving the same end of reducing import dependence—would enhance national economic growth and food security. Improving the efficiency of markets for all key factors of agricultural production (capital, labor, land, and water), and for inputs such as fertilizer, is another way to improve the sustainable use of the world's agricultural resources.[5]

Developing countries still concerned that poor households would be too vulnerable if food markets that were unrestricted have another option to consider. They can now invoke generic social safety net measures such as conditional targeted income supplements. Those measures can be made more affordable and more equitable if they are targeted at just the most vulnerable households. This option is far more practical now than just a few years ago, thanks to the information technology revolution that has reduced hugely the cost of administering such handouts, because they can be provided electronically as direct assistance to even remote households so long as they have access to electronic banking.

As for international efforts to reduce food price volatility, the most obvious option is for WTO member countries to agree collectively to desist from altering their food trade restrictions when prices spike. That would require binding not only import tariffs but also export taxes at zero or low levels. For that to happen, members will first need to find the political will to return to the WTO's multilateral negotiating table. Is it possible that once currently negotiated mega-regional free-trade deals are agreed to—or if they are not agreed to—there will be an appetite to again embrace multilateralism?

## Notes

1. Hoda and Gulati (2013, p. 3) suggest that two-fifths of those foodgrain stocks leak away.
2. In these faster TFP scenarios, we have ignored the cost of the research that might be required to boost farm productivity, but past experience suggests that cost would be small relative to the national gains.
3. Hoddinott et al. (2013) show that expenditures that improve access to market information through SMS messaging and interventions have a benefit/cost ratio between 4 and 8. This intervention is relatively cheap to provide, costing around $4 per capita currently, but scale economies will drive that cost down further.

4. On when and how Australia and New Zealand moved to farming with virtually no subsidies or protection, see Anderson et al. (2007) and (2009).
5. Of course if such things as chemical farm inputs are pollutive, they should be subject to optimal environmental taxes. Also, if farm activities contribute to greenhouse gas emissions (e.g., methane from cows), ideally those emissions should be taxed too—although it remains difficult to determine the optimal level of such taxes from a global viewpoint.

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[1] Note: Page number followed by 'n' refers to notes.



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