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**DEVELOPING COUNTRY INTERESTS IN
AGRICULTURAL REFORMS UNDER THE WORLD
TRADE ORGANIZATION**

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DEVELOPING COUNTRY INTERESTS IN AGRICULTURAL REFORMS UNDER THE WORLD TRADE ORGANIZATION

Xinshen Diao, Terry Roe, and Agapi Somwaru *

Abstract

The gains to developing countries from agricultural reform in developed countries is found to benefit most, even the net food importers, although the gains vary depending on a country's trade pattern. This results because the agricultural policy of a small number of developed countries cause the major distortions in world markets, and developing countries whose major share of agricultural trade is with the E.U. are impacted quite differently than those trading with the U.S. Even though Japan and Korea maintain high trade barriers, these barriers are found to have small effects on developing countries. The long-run benefits of reform are found to greatly exceed the short-run gains.

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Introduction

Growth in the number of countries engaged in international trade and the share of world GDP traded show that the new era of globalization is far-reaching. It is shown that the integration of the developing countries into the multilateral trade system has been especially impressive for a group of middle and higher income developing countries in Latin America and Asia (Michalopoulos, 1999). This process was stimulated by lowering barriers to trade in goods, services, and ideas causing many of these countries to benefit, with some doubling their per capita income in a period of less than ten years (Baldwin and Martin, 1999). However, for many others, this process has been much more protracted. This is due to both the slow processes of liberalization of their trade regimes and to the slow relaxation of conditions affecting access to the major markets of their export products. Protection in agriculture by countries in the North is still quite high, remaining a constraint to trade to many countries in the South. Since most developing countries have a disproportionate share of their resources in agriculture, a more open world agricultural market should afford them greater opportunities to increase exports and to participate more actively in the new globalization era. This study focuses on these linkages with emphasis on the cost of agricultural protection in the North to developing countries.

Global negotiations on agriculture were initiated in March 2000. These negotiations are expected to press for the continuation of the reforms initiated during the Uruguay Round, namely reduction of producer export subsidies, increase in import market access, and cuts in domestic farm support. There tend to be diverse and even divergent interests in the new round of World Trade Organization (WTO) negotiations among some countries of the South. These differences arise in part from the concern that liberalization may lead to a rise in food prices with negative consequences for net food importing countries.

This concern may not be well founded, however, because the type of agricultural products that developing countries tend to export (e.g., fruits, vegetables, sugar) are not

the products that dominate commodity exports from countries of the North; yet it is these categories of commodities for which the North tends to erect trade barriers. Moreover, the pattern of world agricultural trade is such that most countries in Africa tend to trade with Europe while many countries of Latin America and Asia tend to trade with the U.S. The barriers imposed by the U.S. are different from those of the European Union (EU), and consequently trade reform is likely to have quite different impacts on countries in Africa relative to those in Latin America or in Asia. While liberalization may lead to a rise in the price of grains, access to the developed country markets for commodities such as fruits, vegetables, and sugar by countries of the South may more than compensate them for the increase in cost of imported grains. However, the level of compensation is likely to vary by region in the world.

Thus, identifying and measuring the extent of developing countries' gains and losses by region from liberalizing world agricultural markets are important to understanding the nature of their interest in trade reform, as well as to facilitate possible policies to minimize the losses of the adjustment process. For this purpose, we first focus on the data pertaining to North - South and regional agricultural trade. This analysis suggests how reform in the North is likely to have differential impacts on developing countries in different regions. Then, we report the results from a global general equilibrium model in which developed and developing countries are categorized into various subgroups. Based on a global database (the Global Trade Analysis Project [GTAP] database version 5, 2001), we discuss the interests of different developing country subgroups and quantify the potential impacts of a global agricultural liberalization process.

Developing Countries' Agricultural Export Markets Are in the North

Forty developing country groups are identified in the database. Many countries are themselves "groups." According to the 1998 trade database, among these groups, there are seven for which agricultural exports accounted for more than 40% of their total exports; nine for which it accounted for 20 to 40%, and seven for which it accounted for 10 to 20% (figure 1). Most developing countries' agricultural export markets are in the

North. On average, 65% of developing countries' total agricultural exports are imported by Northern countries. Figure 2 shows the importance of three of the largest markets in the world – East Asia, represented by Japan and Korea, North America, the U.S. and Canada, and the EU – to the developing countries' agriculture.

There are 20 agricultural and processed food commodity groups in the database. Except for rice, for which a few Asian countries' exports account for 70% of world rice trade, the North, especially the U.S. and Canada, dominates world grain exports. Exports of non-grain crops, such as vegetables and fruits, cotton, sugar, and vegetable oil, are largely the domain of developing countries (table 1). Excluding intra-EU trade, developing countries account for 60 to 80% of world exports of these commodities, most of which are exported to the North (table 2). Hence, the agricultural exports of most developing countries do not compete directly with the exports of developed countries. In this case, if most developed countries eliminated their protection of agriculture, exports of developing countries should rise.

Agriculture is still highly protected in many developed countries, especially in Japan and member countries of the EU and the European Free Trade Association (EFTA). The average tariff rate, one indicator of agricultural protection, for bulk agricultural commodities is more than 50% in Japan, more than 23% in the EU, and around 100% for the three members of the EFTA - Norway, Switzerland, and Iceland (ERS/USDA, 2001). Figure 3 presents the developing countries' market shares in the total agricultural imports of Japan and Korea, North America, and the EU. Compared to the other two groups, the developing countries' export shares are consistently small for most commodities in the EU (except for cotton). The high protection level provides a partial explanation. For example, the tariff rate on vegetables and fruits in the EU market is twice the level as that in Japan and Korea, and seven times higher than that in the North America (ERS/USDA, 2001). At the same time, developing countries' exports accounted for fewer than 30% of EU's imports of vegetables and fruits, but accounted for 45% and 68% in the East Asian (Japan and Korea), and North American markets, respectively.

The low share of developing countries' agricultural exports in the EU market suggests that barriers to trade are the cause. Theory suggests that the broad patterns of trade among "North" countries can be mainly attributed to product differentiation, while trade between "North" and "South" can be attributed to differences in factor composition. Most developed countries are at an almost equivalent stage of development, share a similar composition of factor endowments, and consequently trade with each other mainly in differentiated products (see Helpman, 1998, for detailed analysis of trading patterns). On the other hand, in contrast to countries of the "North," most developing countries are relatively capital-scarce. Their exports are more likely to embody the services of labor or other natural endowments, and their imports are more likely to embody capital from the "North." Thus, we should expect to observe more intra-North trade in manufacturing and services, and more North-South trade in agriculture. We observe that intra-EU trade accounted for 59% of EU total non-agricultural exports. However, we also observe that the ratio of intra-EU trade in agriculture over EU total agricultural imports is higher than the ratio in non-agriculture, accounting for 72% of EU agricultural imports.

Thus agricultural protection policies in the EU appear to block developing countries' opportunities for entering the EU. The EU is the largest market in world agricultural trade, so its agricultural policies have important effects on developing countries. If 10% of intra-EU trade in agriculture were replaced by trade with the South, then the South's total agricultural exports would rise by 9%.

Distortions in World Agricultural Markets Are Mainly Due to A Few Countries in the North

As measured by the world price effects, we find, not surprisingly, that policies pursued by a small number of countries in the North cause most of the distortions in world agricultural markets. Using the Agricultural Market Access Database (ERS/USDA, 2001), together with the GTAP database version 5, our model results suggest that eliminating agricultural tariff equivalents, domestic support, and export subsidies worldwide would cause agricultural prices to rise by about 12%. This result is

obtained from a static analysis, without accounting for investment responses to price changes or the adoption and development of new technologies that increased price incentives would likely stimulate. The decomposition of the increase in world prices by developed – developing country-groups shows that agricultural liberalization in the developed countries accounts for about 80% of the rise in world agricultural prices. Of this 80%, the EU and EFTA account for 50% of world price distortions, while Japan and Korea, and the North America together account for almost the remaining half.

Three reasons help explain why a small member of countries in the North contribute most to the distortion in world agricultural prices. First, as importers, all of these countries are major players in world agricultural markets. In 1998, Japan and Korea imported 12% of all agricultural goods traded in the world; the U.S. and Canada imported another 12%, and 42% for EU and EFTA. Second, most of these countries either impose high import tariffs on a few agricultural commodities, such as the U.S. on sugar, or protect many of their agricultural sectors, as in the case of Japan and Korea, and the EU and EFTA. Eliminating import tariffs should increase import demand while domestic supply would contract in these developed countries. Third, most of the developed countries employ, in various forms, domestic support policies, some of which encourage increased production. In the case of the EU and EFTA, exports of major agricultural goods are also subsidized. Reducing domestic support in these countries should further decrease farm income, or more precisely, lower the returns to agriculture's sector-specific resources such as land, farm structures, machinery, and owner-operator labor. Together, these forces should place considerable upward pressures on world agricultural prices.

An Open EU Market is in the Common Interest of Most Developing Countries

Since world agricultural markets are dominated by a small group of developed countries, agricultural liberalization among these countries will create export opportunities for a relatively large number of developing countries. However, this generalization hides important regional linkages. For many of the developing countries, export markets are actually concentrated in a few countries in the North. This is due both

to geographic proximity and historical linkages, and to regional integration arrangements. For developing countries located in Eastern Europe, the Middle East, Africa, and some in South America, the EU is the largest agricultural export market. The U.S. and Canada are the largest markets for countries in Central and South America, as well as for some countries in Asia. Japan and Korea are the largest markets for neighboring countries in Asia (figure 2). Thus, for many developing countries, the benefits of a liberalized world agricultural market are likely to be regionally differentiated.

We use the change in developing countries' total agricultural exports to illustrate this linkage. Figure 4 presents the possible increase in agricultural exports of developing country groups after fully liberalizing world agriculture. Overall, the results suggest that among the 40 developing countries or groups included in the database (with the exception of only five countries--Malaysia, Viet Nam, Bangladesh, Sri Lanka, and Zimbabwe) the major increase in their agricultural exports is a result of agricultural liberalization in Japan and Korea, the North America, and the EU and EFTA. For 27 of 35 country groups, 50% or more of the increase in their agricultural exports is due to liberalizing EU agriculture. For two Asian countries (China and Thailand), 50% of their increase in agricultural exports is due to liberalizing Japanese and Korean agriculture. For the case of two Latin American countries (Mexico and Colombia) more than 50% of their increase in agricultural exports is due to liberalizing U.S. and Canadian agriculture. These results imply that some countries in the North are far more important to some groups of developing countries than are other Northern countries. In sum, the results suggest that the majority of developing countries share a common interest in calling for a more open EU agricultural market, while a more open Japanese, Korean and U.S. market is in the interest of a smaller group of countries located in Asia and in the Western Hemisphere.

While Japan and Korea are well known for their high agricultural import barriers, a closer look suggests that liberalization in these two countries does not generate large export opportunities for many developing countries. The scale of the Japanese and Korean markets is simply small relative to the U.S. and EU's agricultural markets (figure 2). More importantly, many of this region's import-restricted goods, such as grain and

livestock products, are goods for which many developing countries do not hold a decisive comparative advantage. Developing countries in total only accounted for 15% of world wheat exports (and more than half of that share is taken by Argentina). Even though Japan and Korea account for about 11% of world wheat imports, only 3% of wheat imports by Japan and Korea originate from developing countries. Similarly, Japan and Korea import more than 27% of the world's trade in meat and meat products, and only 17% of these imports originate from developing countries. The developing countries' largest export market share is in vegetables, fruits, and other cash crops (figure 3), commodities for which Japan and Korea's tariff barriers are relatively low. Thus, with the exception of rice, for which only a few Asian countries hold a decisive comparative advantage, gains to the developing countries from trade liberalization in this region are small. However, we should point out that trade in vegetables and fruits is also blocked by many non-tariff barriers, such as phytosanitary barriers, quotas, and voluntary export restraint agreements. Such barriers do not show up in the database we use for the study. Developing country exports are almost surely affected disproportionately by these barriers. If all trade barriers were represented and were removed in the model, developing countries' exports to the North would increase even more.

We also notice that for some developing countries, such as Uganda or Malawi, the increase in total agricultural exports after global agricultural reforms is quite small. One major reason for this outcome is that in the database many non-grain crops are placed in broad categories (called, e.g., vegetables and fruits, or the aggregate "other crops") in which individual developing countries are often net exporters for a narrow subgroup of these commodities. World trade for a specific commodity may not rise or even decline if the current trade barriers imposed by importing countries on this commodity are low. For this reason, some developing countries that specialize in the export of one or a few products in this category, such as tobacco leaf or coffee beans, may not benefit from liberalizing world agricultural markets. If trade liberalization causes these countries' terms of trade to deteriorate, it is possible for their exports to decline while import costs rise, thus lowering their total welfare.

Effects of Reform on Food Security Are Mixed

A more open world agricultural market would surely increase export opportunities among developing countries, but as importers of food grains and meats, some of these countries would more likely experience a rise in food prices. Many of the net food importing countries are poor and among the less developed, so that food expenditures account for a large share of household budgets. Consequently, high priced food imports caused by agricultural liberalization may hinder food security. For these reasons, some developing countries have expressed concern that agricultural trade liberalization may worsen their prospects for food security.

Among the 40 developing country groups included in the database, 30 countries are net grain importers. There are only four developing countries that are net exporters of wheat and other grain products (excluding rice). For most developing countries, grains and/or meats account for more than 20% of their total agricultural imports. While there is no universally acceptable definition of food security, using the cluster method, Diaz-Bonilla et al. (2000) identify more than 70 developing countries that can be categorized as food insecure. They used five indicators to gauge a country's food security standing: (1) food production per capita, an indicator of the ability of a country to feed itself, (2) the ratio of total exports to food imports, an indicator of the ability of a country to finance its food imports out of its total export revenues, (3) the ratio of the non-agricultural population to total population, (4) calories per capita, and (5) protein per capita. For food insecure countries, either all or most of these indicators are far below the world average level. Using the Diaz-Bonilla measure, we identify 13 food insecure countries in the GTAP database. Four major indicators used in Diaz-Bonilla et al. for these countries are displayed in table 3, while the shares of grain and meat imports in these countries' total agricultural imports are presented in figure 5.

Grain and meat account for a large portion of imports to food insecure countries. Grain and livestock are also highly protected in Japan, Korea, the EU and EFTA, so that trade in these products faces the highest level of import barriers in comparison to other

agricultural commodities. Consequently, liberalization will likely cause the world prices of these commodities to rise more than the prices of other commodities, such as vegetables and fruits. Our model's results show that if all forms of domestic support and border protection in agriculture were removed, world grain and livestock product prices would rise more than 10% and 25%, respectively, implying a significant rise in the cost of imported food for many developing countries.

Using both the data analysis and the results from the model simulations, we calculate (1) the ratios of imports over consumption for grains, meats, and total agricultural goods, (2) the ratios of the value of total exports over the values of imports of grains, meats, and total agricultural goods, and (3) the change in grain, meat, and agricultural production for all the 40 developing country groups in the database. These composite indicators show 35 countries for which the ratios of grain, meat, or total agricultural imports over consumption *rise* after agriculture is fully liberalized worldwide. Hence, most developing countries are likely to become more dependent on international markets for food.

Among these countries, the ratios of the value of total exports over the values of grain, meat, and total agricultural imports – indicators that capture the ability of a country to finance its food or agricultural imports out of total export revenues – decline post worldwide agricultural liberalization. However, the results show that more than 50% of these countries also increase their grain, meat, and total agricultural production post reform, indicating that their ability to feed themselves from domestic production actually increases. Change in the first two groups of indicators may indicate a negative effect of world agricultural liberalization on food security, while the last indicator definitely shows a positive effect.

We select some of the indicators for the 13 food insecure countries in the database to gain further insights into the food security issue. The rise in the ratio of grain imports over grain consumption and the decline in the ratio of total exports over agricultural imports are modest for most of the 13 countries (table 4). However, the results show that

for five countries whose grain imports accounted for more than 10% of grain consumption, their grain consumption becomes more dependent on imports while in four of them, grain production declines. We also notice that most of these countries are among the poorest countries in the database. It is, thus, possible that the high import costs could cause their food insecurity to increase.

Welfare Gains for Developing Countries Are Higher In the Long-run

The earlier analysis ignored the effect of reform on saving, investment, and the pattern of growth in a country's capital stock. The analysis of these effects requires assumptions regarding households' willingness to forgo consumption and invest, the functioning of capital markets and international capital flows, as well as the technological spillovers and improvement in total factor productivity that seem to accompany growth in countries' trade. This kind of analysis captures the direction of change in the long run that seems well within the realm of reason.

In addition to the typical growth model specification, a growth factor related to trade is also added, although the effects of this factor are reported separately. This factor is added because numerous studies find an empirically strong and positive linkage either between a country's growth rate and its openness to international trade (Easterly and Levine, 2000; Frankel and Romer, 1999), specifically between growth and trade with more advanced nations (Coe et al., 1997), or between the improvement in a country's total factor productivity and reduction in its barriers to the openness (Parente and Prescott, 2000). In our study, the effect of openness on economic growth is modeled by adding a technological spillover variable to a country's total factor productivity function. This spillover variable is the share of a country's trade over its GDP, i.e., virtually the same variable used in most of the econometric analysis cited above.¹ The presumption is that following worldwide agricultural trade reforms, trade volumes of developing countries should grow. Growth in trade volume should increase the rate of learning new skills, and improve organizational methods as more advanced product and process

¹ Detailed description about the dynamic model used for the study can be found in Diao and Somwaru (2001).

technologies are often embodied in the imports of investment goods from developed countries. This process should increase labor productivity and returns to capital and land, and it should be particularly strong for developing countries in the process of catching up with technologies already in use in more advanced countries. The elasticity in the TFP function is chosen between 0.05% - 0.8% for the first four years in the model. That is, if the share of trade over GDP rises by 1% in a developing country, then the TFP would grow by 0.05% - 0.8% in the first four years for this country. After the fourth year, the TFP level becomes constant. With such model setup, the longer-run type of analysis allows for agricultural trade reform to yield broader economy-wide benefits.

First, considering only the investment incentives created by reform (i.e., not taking into account the trade-technological spillover-growth effects), the short-run intertemporal welfare effects are found to be modest, with values almost identical to the static analysis. However, as production and investment adjustments take time, the welfare effect becomes relatively large over time, and the gain is greater for developing countries. While the worldwide measure of welfare gain in the tenth year doubles the gain accrued in the fifth year, the welfare gain for all developing countries, as a group, triples (table 5). Simply stated, the results suggest that the payoff to agricultural trade policy reform takes time, and the increase in benefits for developing countries exceeds that for developed countries.

Next, we factor in the trade-technological spillover-growth effect of policy reform. In this case, the intertemporal welfare gains increase significantly. Given the limits the large model imposes on computational capacity, we only include a few selected developing countries in the dynamic model while all other developing countries are aggregated into large groups. The results suggest that all developing country groups are better off after worldwide agricultural reform. Further, as the volume of trade between developed and developing countries grows, so do the welfare gains experienced by even the poorest of the developing countries (table 5).

These long-run results may be “optimistic” for the case of some countries.

Observation suggests that technological spillovers are uneven, and there are areas untouched by the global changes that have taken place. In particular, countries in South Asia and Sub-Saharan Africa have a far lower share of the world’s trade and capital inflows and they remain among the poorest in the world. In the case of these countries, it is possible for the poor people living in remote rural areas to be more marginalized by the process of trade liberalization. To spread the benefit of globalization to them is a major challenge.

Conclusions

Developing countries have increased their integration into the world economy in the last two decades. This trend has been especially impressive in a group of countries in Latin America and Asia. Most of these countries have doubled their per capita income in a period of less than ten years. However, for many others, especially countries in South Asia and Africa, this process has been much more abstracted and there were only marginal gains from globalization. As most developing countries have a disproportionate share of their resources in agriculture, and the major markets of their exports goods are in the North, a more open world agricultural market should afford them greater opportunities to increase exports and to participate more actively in the new globalization era.

By focusing on the cost of agricultural protection in the North to developing countries, we find that distortions in the world agricultural markets are mainly due to a few countries in the North. Our model results suggest that the current level of world prices for agriculture is about 8% to 10% below that if all agricultural tariffs, export subsidies and domestic supports were removed in the North. We also find that an open EU market is in the common interest of most developing countries. This follows because the EU is the largest market for many developing countries’ agricultural exports, and the EU agriculture is still highly protected which causes intra-EU agricultural trade to be disproportional high. If 10% of intra-EU agricultural trade were replaced by imports

from developing countries, it would create export opportunities equivalent to 9% of all developing countries' agricultural exports in 1998.

Many developing countries have a comparative advantage in fruits, vegetables, sugar, or other non-grain crops. 60% to 80% of South's exports of these goods went to the North markets. Trade in these commodities are not only restricted by tariff barriers, but also by a series of non-tariff barriers, such as phytosanitary, quotas, and voluntary exports restraint agreements. Developing countries' exports are disproportionately affected by these barriers. Unfortunately, such barriers do not show up in the database, and hence, we may underestimate the potential export opportunities for many developing countries if all trade barriers were removed.

We also notice that for some African countries who highly depend on the exports of a narrow group of commodities, such as tobacco leaf and coffee bean, a more liberalized world market may not be able to create more export opportunity for them. For these countries, in order to take advantage of a liberalized world market, it is necessary to diversify their trade structure and build up production and export capacity in non-traditional commodity markets. To achieve this, they will almost surely need help from wealthy countries and international organization as many of them are among the poorest countries in the world.

Many developing countries are net food importing countries. A rise in the prices for grain and meat products due to agricultural liberalization may hinder food security for them. Our model results show that ratio of food imports over domestic total consumption would rise, while the ratio of total exports over food imports – an indicator to capture the ability of a country to finance its food imports out of total export revenues – also decline for many developing countries. Such results suggest that liberalization will have a negative effect on food security. However, the results also show that more than half of these countries also increase food production post reform, implying that their ability to feed themselves from domestic production actually improves.

World agricultural trade is also distorted by the trade barriers imposed by developing countries. Moreover, one study shows that protection appears to be greater in low-income than in middle- and higher- income developing countries (Michalopoulos, 1999). This suggests a considerable range in the type of challenges and opportunities different developing countries will face in the context of future WTO negotiations. However, by taking into account the possible gains to growth due to increase in investment and technological spillovers embodied in trade, our study finds that liberalizing both developing and developed countries' agricultural trade is in the long-run interest of all developing countries.

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Appendix: Country and Commodity Groups in the Model

Country groups

ANZ	Australia and New Zealand
JPK	Japan and Korea
ADC	Other Asian developed countries
USA	U.S. and Canada
E_U	European Union and European Free Trade Association
CHN	China
IDN	Indonesia
MYS	Malaysia
PHL	Philippines
THA	Thailand
VNM	Viet Nam
BGD	Bangladesh
IND	India
LKA	Sri Lanka
XSA	Rest of South Asia
MEX	Mexico
XCM	Central America and Caribbean
COL	Colombia
PER	Peru
VEN	Venezuela
XAP	Rest of Andean Pact
ARG	Argentina
BRA	Brazil
CHL	Chile
URY	Uruguay
XSM	Rest of South America
HUN	Hungary
POL	Poland
XCE	Rest of Central Europe
XSU	Former Soviet Union
TUR	Turkey
XME	Rest of Middle East
MAR	Morocco
XNF	Rest of North Africa
BWA	Botswana
XSC	Rest of South Africa Custom Union
MWI	Malawi
MOZ	Mozambique
TZA	Tanzania
ZMB	Zambia
ZWE	Zimbabwe
XSF	Rest of Southern Africa

UGA Uganda
XSS Rest of Sub-Saharan Africa
XRW Rest of World

Commodity groups

PDR rice
WHT wheat
GRO other grains
V_F vegetable and fruits
OSD oilseeds
PFB plant based fibers
OCR other crops
CTL bovine cattle, sheep and goats, horses
OAP other animal products
WOL wool and silk-worm cocoons
CMT bovine cattle, sheep and goat meat products
OMT other meat products
VOL vegetable oils and fats
MIL dairy products
SGR sugar
OFD other food products
B_T beverages and tobacco products
NAG all non-agriculture

Tables and Figures.

Table 1. Share of country's exports in world total exports by commodity, 1998

	PDR	WH1	GRO	V_F	OSD	PFB	OCR	CTL	OAP	WOL	CMT	OMT	VOL	MIL	SGR	OFD	B_T	All-Ag
USA	15	46	50	14	58	28	9	26	21	0	23	18	13	4	2	13	16	17
ANZ	2	13	2	3	1	10	1	10	6	79	22	1	0	13	6	2	2	5
JPk	1	0	0	0	0	0	1	0	1	0	0	1	0	0	1	3	2	1
ADC	0	0	0	0	0	0	1	0	2	0	0	1	2	0	0	2	1	1
E_U*	14	26	23	41	10	5	23	47	40	6	40	58	31	75	29	46	65	42
DCS	32	85	75	58	69	44	35	83	70	86	86	79	46	92	37	65	86	66
MEX	0	0	0	5	0	1	3	3	0	0	0	1	0	0	1	1	2	1
XCM	2	0	0	5	1	0	7	0	0	0	1	0	0	0	14	1	1	2
COL	0	0	0	1	0	0	7	0	0	0	0	0	0	0	2	0	0	1
PER	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
VEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
XAP	1	0	0	3	0	1	1	0	0	0	0	0	1	0	0	1	0	1
ARG	3	9	10	2	2	3	1	1	1	2	4	1	13	1	1	1	0	3
BRA	0	0	0	1	12	0	10	0	1	0	1	5	8	0	15	1	1	3
CHL	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	1	1
URY	4	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0
XSM	1	0	0	0	3	1	0	0	0	0	0	0	0	0	1	0	0	0
CHN	6	0	7	3	2	0	3	1	10	2	0	4	2	0	1	4	2	3
IDN	1	0	0	0	0	0	4	0	1	0	0	0	5	0	0	2	0	1
MYS	0	0	0	0	0	0	1	0	2	0	0	0	13	0	0	1	0	1
PHL	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0
THA	18	0	0	1	0	0	1	0	0	0	0	2	0	0	8	4	0	2
VNM	5	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0
BGD	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
IND	17	0	0	2	2	4	3	0	1	0	1	0	3	0	2	2	0	2
LKA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
XSA	6	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
HUN	0	1	1	0	1	0	0	2	1	0	0	3	1	0	0	0	0	1
POL	0	0	0	0	0	0	0	2	1	0	0	2	0	1	2	1	0	1
XCE	1	0	0	0	1	0	0	2	1	0	0	1	1	1	1	1	1	1
XSU	0	2	2	1	4	21	0	0	4	2	2	1	1	2	2	2	2	2
TUR	0	0	0	4	0	1	2	0	1	0	0	0	1	0	0	1	0	1
XME	0	1	0	2	0	4	1	2	2	1	0	0	0	0	0	1	0	1
MAR	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
XNF	1	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0
BWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
XSC	0	0	1	2	0	0	0	1	1	2	0	0	0	0	3	1	0	1
MWI	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MOZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TZA	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
ZMB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZWE	0	0	1	0	0	1	2	0	0	0	0	0	0	0	1	0	0	0
XSF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
UGA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
XSS	0	0	0	2	1	12	10	0	1	0	0	0	1	0	1	1	0	2
XRW	0	0	0	1	1	0	1	0	1	0	0	0	1	0	1	1	1	1
LDC	68	15	25	42	31	56	65	17	30	14	14	21	54	8	63	35	14	34

* Including intra-EU trade

Source: GTAP data.

Table 2. Share of exports to developed countries in developing countries' total exports by commodity (1)

	Rice				Wheat				Corn and others				Vegetable and fruit			
	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS
MEX	1	25	2	28	0	0	86	86	5	18	13	38	2	89	4	96
XCM	3	3	69	77	3	3	6	12	1	2	3	6	0	49	45	94
COL	15	17	38	75	15	17	40	78	12	15	31	62	0	32	58	91
PER	4	5	10	20	3	2	4	9	22	15	58	96	1	55	35	91
VEN	0	0	0	0	15	16	39	75	1	2	3	7	1	35	38	74
XAP	0	0	0	1	15	16	36	72	1	0	3	4	6	26	33	66
ARG	0	1	0	1	2	0	1	3	12	1	10	25	0	5	43	49
BRA	6	7	20	53	0	0	0	0	0	4	1	5	0	47	41	89
CHL	10	11	25	49	14	28	34	79	0	75	21	96	3	34	25	69
URY	1	0	1	1	5	0	7	12	0	0	1	1	0	6	66	73
XSM	0	0	60	60	0	0	0	0	0	0	0	0	0	0	96	97
CHN	12	6	14	36	17	19	41	81	55	0	2	58	31	7	11	66
IDN	17	19	41	81	15	17	40	75	25	10	21	61	5	7	23	45
MYS	17	19	41	81	0	0	0	0	6	0	0	77	0	1	12	75
PHL	16	19	41	81	5	6	43	55	5	2	5	12	51	11	5	77
THA	5	15	12	58	0	0	10	10	4	12	10	29	6	6	9	69
VNM	0	7	1	11	19	27	30	79	10	6	1	90	4	30	16	83
BGD	12	15	35	72	0	0	44	44	8	10	24	50	1	1	76	79
IND	1	5	13	20	10	10	24	47	14	12	28	58	5	27	27	63
LKA	14	20	41	82	0	0	0	0	0	0	0	0	2	2	36	43
XSA	1	3	4	9	16	18	39	78	14	17	36	72	1	9	19	36
HUN	16	18	43	80	0	0	23	23	0	0	21	21	1	1	67	69
POL	2	3	4	9	0	0	0	0	0	33	7	40	1	1	49	51
XCE	13	15	32	63	18	1	6	25	0	0	19	20	5	5	53	65
XSU	6	6	13	27	0	0	1	1	0	0	5	6	0	0	11	12
TUR	0	1	70	71	12	21	37	72	0	0	5	6	1	4	66	72
XME	6	9	13	30	0	0	3	4	6	8	13	28	5	4	58	68
MAR	16	18	38	75	17	19	41	81	17	19	41	80	2	4	78	84
XNF	0	0	0	1	18	21	39	81	17	20	40	81	4	5	62	73
BWA	0	1	1	2	19	27	31	80	8	11	13	33	19	27	31	80
XSC	1	1	2	3	1	1	2	4	20	0	2	22	4	8	74	90
MWI	1	1	1	3	19	27	30	79	15	21	24	62	1	41	20	66
MOZ	19	27	31	80	19	27	30	79	2	3	3	8	0	46	6	53
TZA	17	19	41	81	13	14	31	61	17	19	41	81	1	2	9	12
ZMB	13	18	21	54	0	0	0	0	19	27	31	79	1	3	94	99
ZWE	19	27	30	79	0	0	0	0	0	0	2	2	0	1	85	88
XSF	18	21	39	81	18	21	39	81	15	18	34	71	15	18	48	84
UGA	5	6	12	25	17	18	40	79	2	2	4	7	13	14	48	78
XSS	17	22	38	80	3	4	5	12	6	5	17	29	1	1	79	81
XRW	14	17	29	69	3	4	34	42	1	2	17	25	9	2	23	38
All																
LDCs	4	8	13	32	2	1	6	9	21	2	8	33	6	25	38	73

Source: GTAP data.

Table 2. Share of exports to developed countries in developing countries' total exports by commodity (2)

	Oilseeds				Cotton				Other crops				Cattle and sheep			
	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS
MEX	6	61	8	87	19	1	5	31	5	70	23	99	0	100	0	100
XCM	30	30	14	75	14	5	11	31	7	37	51	96	6	10	15	33
COL	0	1	1	3	0	1	1	3	10	41	46	97	0	2	0	2
PER	21	23	45	90	23	0	21	54	13	48	35	96	9	41	23	75
VEN	3	14	14	36	10	31	26	70	12	37	49	98	12	15	28	58
XAP	11	0	27	37	4	6	14	25	2	57	29	88	2	6	4	13
ARG	3	13	60	80	1	0	5	7	1	32	35	70	0	19	8	27
BRA	12	3	63	81	0	0	67	67	9	18	57	85	1	30	13	46
CHL	4	58	6	69	0	0	0	0	13	39	27	81	1	32	5	39
URY	0	1	49	51	0	0	0	0	0	9	28	39	0	0	1	2
XSM	20	0	24	44	0	1	0	1	0	17	54	71	0	0	1	1
CHN	48	1	25	79	83	0	2	94	30	9	13	72	11	11	25	84
IDN	6	6	19	33	12	11	24	49	12	31	27	77	11	12	53	78
MYS	0	0	11	36	11	0	0	11	17	7	19	76	13	14	42	81
PHL	7	0	79	86	28	28	42	97	8	14	37	66	13	22	44	82
THA	11	3	6	24	3	0	1	5	29	31	18	82	0	1	1	2
VNM	7	0	1	25	0	3	2	94	7	19	39	85	8	12	70	91
BGD	0	0	44	45	0	1	4	6	1	1	7	9	12	15	35	72
IND	5	6	25	43	9	1	11	46	5	18	36	64	14	15	35	69
LKA	0	0	1	1	12	13	48	73	11	6	35	56	16	18	40	80
XSA	25	22	11	60	8	1	13	47	3	10	18	32	10	12	27	54
HUN	0	0	74	74	0	1	66	67	0	3	72	76	0	0	64	65
POL	0	0	70	70	0	0	65	65	0	2	69	71	0	1	91	92
XCE	0	0	67	67	0	0	39	40	3	7	48	59	0	0	51	52
XSU	0	0	67	67	10	0	28	38	0	2	11	13	3	4	36	44
TUR	4	6	46	56	0	0	65	66	5	44	35	84	10	11	66	89
XME	0	5	68	74	1	0	42	48	2	11	57	71	2	1	55	58
MAR	15	17	44	79	19	18	42	82	10	8	72	91	17	19	42	81
XNF	3	4	59	66	23	3	44	71	2	19	49	72	17	20	40	81
BWA	1	2	2	5	1	1	1	2	19	27	31	80	0	0	0	0
XSC	23	7	40	70	0	0	9	15	4	6	44	65	1	1	2	5
MWI	0	0	8	8	0	0	9	9	8	19	48	75	14	20	23	60
MOZ	0	0	83	83	0	0	89	89	2	3	41	46	18	25	35	82
TZA	83	3	7	93	1	0	17	35	15	3	60	80	7	8	22	39
ZMB	0	0	0	0	0	0	2	14	3	2	78	86	9	13	68	91
ZWE	0	0	11	11	4	0	45	57	6	3	53	68	4	6	7	17
XSF	17	20	40	81	18	21	39	81	18	6	64	96	8	9	73	91
UGA	64	1	5	71	6	0	64	70	0	10	73	83	17	18	40	80
XSS	39	1	33	74	3	1	31	37	3	10	65	80	6	8	14	30
XRW	21	5	24	64	5	6	24	41	11	13	45	84	6	8	61	76
All LDCs	13	4	50	70	7	1	27	38	9	24	46	83	2	22	38	65

Source: GTAP data.

Table 2. Share of exports to developed countries in developing countries' total exports by commodity (3)

	Other animal products				Wool				Cattle and sheep meat				Other meat			
	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS
MEX	6	44	44	94	6	32	14	94	11	38	40	90	81	8	5	94
XCM	8	7	30	45	16	18	36	74	8	57	6	70	5	11	19	38
COL	8	34	13	68	17	18	40	80	16	18	39	78	16	17	36	73
PER	13	21	56	90	0	0	0	0	12	13	29	57	18	4	56	79
VEN	1	1	41	44	17	18	40	80	11	12	28	55	1	0	0	2
XAP	6	64	13	82	19	10	52	81	41	11	26	81	2	2	20	24
ARG	4	50	33	88	0	0	85	85	1	2	53	58	8	36	37	85
BRA	15	17	40	73	30	0	3	33	0	0	74	88	13	5	25	55
CHL	2	5	38	45	0	2	48	51	3	3	47	55	7	1	33	50
URY	1	4	61	67	1	11	38	51	0	12	34	48	21	23	38	83
XSM	1	3	56	60	19	27	31	80	0	0	14	14	0	15	1	17
CHN	15	11	27	87	26	7	18	77	7	1	2	42	50	1	7	78
IDN	5	5	16	88	17	19	41	81	4	4	9	17	13	7	15	57
MYS	2	1	2	98	1	1	2	3	0	0	1	1	6	6	12	61
PHL	19	15	31	76	16	19	41	81	15	18	40	77	16	19	40	80
THA	18	40	7	81	73	0	0	73	17	18	39	78	62	0	26	96
VNM	11	6	8	87	0	0	0	55	16	22	25	66	16	1	1	77
BGD	20	3	6	30	0	0	0	0	1	1	44	46	0	0	0	0
IND	47	7	24	80	10	12	51	76	0	0	0	0	13	9	1	23
LKA	18	1	61	80	85	0	15	100	16	19	40	80	21	13	33	75
XSA	19	4	59	83	2	1	91	95	0	52	3	56	81	0	1	88
HUN	7	5	56	72	0	0	70	71	1	1	56	59	1	1	61	63
POL	11	5	77	93	1	1	98	99	4	1	31	36	1	5	23	29
XCE	1	1	61	63	3	3	33	39	6	6	58	71	3	3	27	33
XSU	2	1	55	59	0	0	16	16	1	1	2	3	2	1	4	7
TUR	1	1	89	92	2	2	81	85	3	3	7	13	2	2	10	74
XME	0	1	62	63	7	9	38	57	12	15	25	54	5	3	30	40
MAR	5	7	81	94	17	19	41	81	13	15	53	84	0	0	100	100
XNF	8	10	63	83	16	19	42	80	1	2	56	59	0	0	6	6
BWA	0	0	59	59	0	0	0	0	0	0	88	88	3	5	25	33
XSC	3	4	72	81	1	2	94	96	4	4	85	94	3	3	46	60
MWI	10	0	80	89	0	0	0	0	19	27	31	80	19	27	31	80
MOZ	7	10	14	32	0	0	0	0	0	0	1	1	19	27	31	80
TZA	8	8	27	60	0	0	0	0	17	19	41	80	17	18	40	78
ZMB	9	12	32	83	19	27	31	80	10	14	15	40	15	21	37	76
ZWE	13	10	24	82	19	27	31	80	0	0	99	100	0	1	67	68
XSF	13	15	38	68	18	21	39	81	18	21	39	81	3	4	89	96
UGA	2	1	30	63	0	0	100	100	7	8	74	91	17	18	40	80
XSS	5	6	49	67	10	13	47	73	5	6	67	80	11	11	36	61
XRW	8	2	47	59	3	2	19	24	9	6	27	43	5	11	22	41
All LDCs	9	9	39	78	8	5	47	65	2	6	37	49	23	5	26	62

Source: GTAP data.

Table 2. Share of exports to developed countries in developing countries' total exports by commodity (4)

	Vegetable oils				Dairy products				Sugar				Other processed food			
	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS	JPK	USA	E_U	DCS
MEX	4	66	10	79	3	17	34	56	0	21	5	27	6	69	9	86
XCM	1	5	5	11	3	7	8	19	4	31	17	52	13	37	22	73
COL	2	5	43	50	8	11	19	40	0	20	1	21	8	37	32	77
PER	2	2	5	9	11	12	31	57	1	86	1	88	8	8	22	46
VEN	4	4	5	13	3	4	8	16	1	84	2	88	2	41	20	64
XAP	0	0	0	0	4	5	11	22	4	36	2	42	6	52	24	86
ARG	1	0	26	29	0	4	1	5	0	43	1	44	12	18	18	56
BRA	6	1	38	47	8	5	16	35	0	9	2	11	15	26	31	76
CHL	29	2	8	43	2	2	3	7	5	5	11	21	33	18	15	74
URY	0	0	20	20	1	2	2	5	16	18	43	82	5	7	15	30
XSM	0	1	1	3	8	11	55	76	0	9	82	91	31	37	11	80
CHN	16	2	7	85	4	3	13	69	4	3	5	21	54	13	9	90
IDN	4	9	37	51	2	2	8	14	80	5	10	95	49	20	10	84
MYS	9	2	7	27	2	1	2	71	1	0	0	51	13	12	16	78
PHL	9	63	15	89	15	14	30	78	9	83	1	97	29	31	17	88
THA	15	4	9	33	4	5	10	60	43	1	1	47	32	34	16	91
VNM	7	0	0	9	0	0	0	8	18	21	9	49	56	10	10	92
BGD	9	12	29	58	8	10	25	49	9	11	33	61	15	42	35	95
IND	15	3	7	36	13	28	30	75	3	5	31	40	32	17	12	64
LKA	0	1	43	44	4	5	11	41	0	1	95	99	26	6	16	59
XSA	12	3	28	43	11	13	30	58	2	2	73	78	17	11	43	76
HUN	0	0	5	5	14	6	13	33	0	0	10	11	1	9	28	38
POL	1	1	54	56	3	5	27	34	0	3	21	25	3	2	44	49
XCE	0	0	14	15	3	6	23	34	0	0	12	12	3	4	26	34
XSU	0	1	16	17	10	8	37	55	1	0	3	5	35	11	21	68
TUR	0	9	19	28	12	14	35	64	11	12	37	62	2	2	37	42
XME	9	14	19	48	4	8	7	20	4	5	8	32	7	9	43	67
MAR	0	14	82	97	6	6	13	26	13	14	48	78	32	4	50	87
XNF	0	2	94	96	16	19	39	77	13	14	46	75	7	9	46	65
BWA	0	0	0	0	12	17	19	51	0	0	0	0	1	1	1	2
XSC	2	3	16	28	3	4	8	17	15	11	35	61	13	13	41	76
MWI	1	2	1	5	19	27	31	80	0	24	76	99	8	16	36	61
MOZ	2	3	3	8	0	0	0	0	0	96	3	99	23	0	71	95
TZA	2	2	22	27	17	19	41	81	6	7	79	93	17	10	44	82
ZMB	14	22	32	71	8	11	12	32	0	0	97	97	22	22	27	73
ZWE	1	1	3	5	0	0	1	1	0	11	19	30	1	4	3	11
XSF	17	20	37	77	17	20	38	78	0	4	96	100	16	13	64	96
UGA	0	0	0	0	17	18	40	80	16	18	42	80	5	10	48	92
XSS	1	0	96	97	17	8	12	39	2	20	54	77	13	5	70	91
XRW	1	2	72	77	5	8	27	42	8	9	69	86	10	6	49	72
All LDCs	5	4	23	39	5	7	20	37	8	15	18	42	24	21	24	75

Source: GTAP data.

Table 3. Indicator value used for food security analysis

	CALCAP ⁽¹⁾	PROTCAP ⁽²⁾	PRODCAP ⁽³⁾	IMPEXPOT ⁽⁴⁾
	(Calories)	(Grams)	(US\$)	(%)
India	2,400	57.4	112.5	4.8
Philippines	2,367	56.4	131.3	7.9
Viet Nam	2,427	56.2	124.0	5.9
Bangladesh	2,047	43.9	67.1	20.4
Sri Lanka	2,264	50.4	73.0	12.2
Peru	2,300	58.0	120.6	14.0
Botswana	2,208	70.6	112.7	10.0
Malawi	2,034	54.2	67.3	2.1
Mozambique	1,727	33.1	49.5	23.0
Tanzania	2,013	48.8	91.9	21.2
Zambia	1,964	51.3	67.3	2.1
Zimbabwe	2,078	50.6	67.0	6.6
Uganda	2,206	50.1	118.8	6.9
World average	2,739	73.5	194.3	

⁽¹⁾ Calories per capita per day

⁽²⁾ Protein consumption per capita per day

⁽³⁾ Food production per capita each year

⁽⁴⁾ Ratio of food imports over total exports

Data in (1) – (3) are five-year average between 1993 and 1997 from FAO, while data in (4) are 1998 from GTAP v5.

Source: Diaz-Bonilla et al (2000).

Table 4. Effects on Food Security for Selected Developing Countries

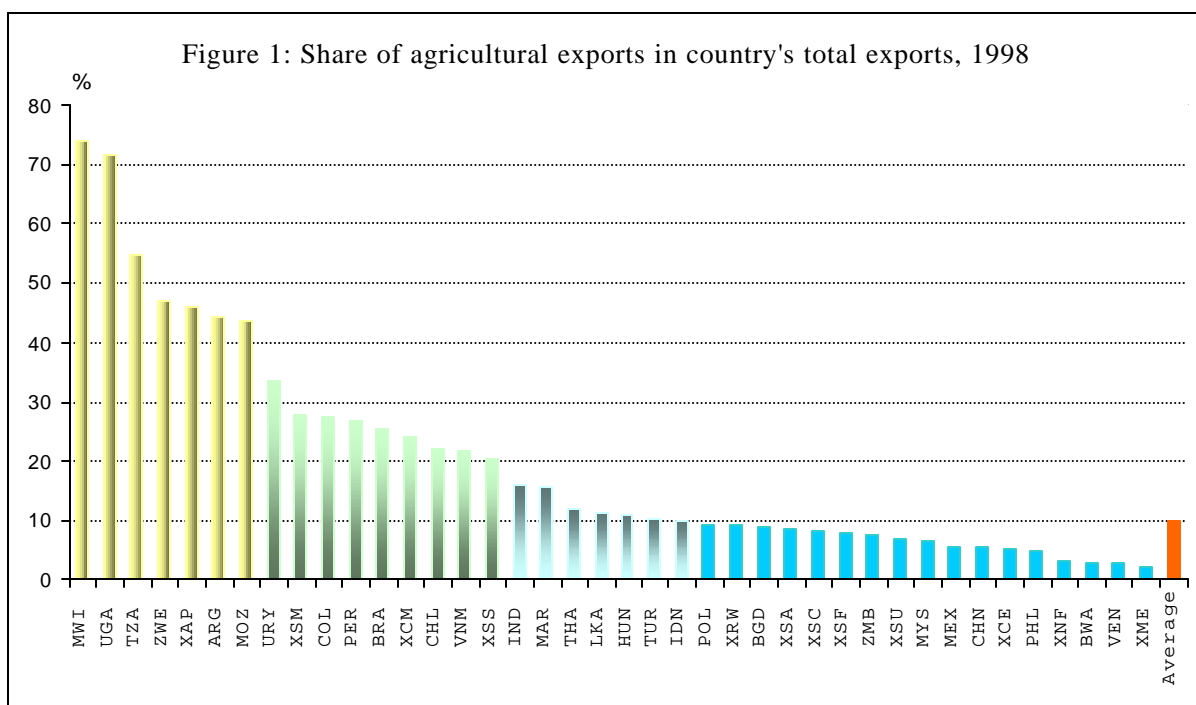
	Grain imports/consumption		Total exports/agr. Imports		Change in grain
	Base	Liberalization	Base	Liberalization	production
	----- % -----				base=100
India	3.07	3.13	13.50	12.76	0.20
Philippines	6.91	8.34	12.69	11.40	-3.17
Viet Nam	0.31	0.29	17.09	14.23	8.22
Bangladesh	2.17	2.17	4.90	4.40	-0.03
Sri Lanka	11.74	13.74	8.23	7.05	-2.42
Peru	20.99	23.14	7.12	6.56	-0.08
Botswana	49.94	51.42	12.52	12.13	-4.17
Malawi	0.53	0.51	48.71	48.70	0.07
Mozambique	11.97	12.15	4.35	4.14	0.43
Tanzania	4.06	4.10	4.71	4.28	1.28
Zambia	3.29	3.20	48.32	47.66	0.33
Zimbabwe	17.75	17.91	15.19	16.35	-0.11
Uganda	2.67	3.30	14.55	13.63	-0.88

Source: GTAP data and model results.

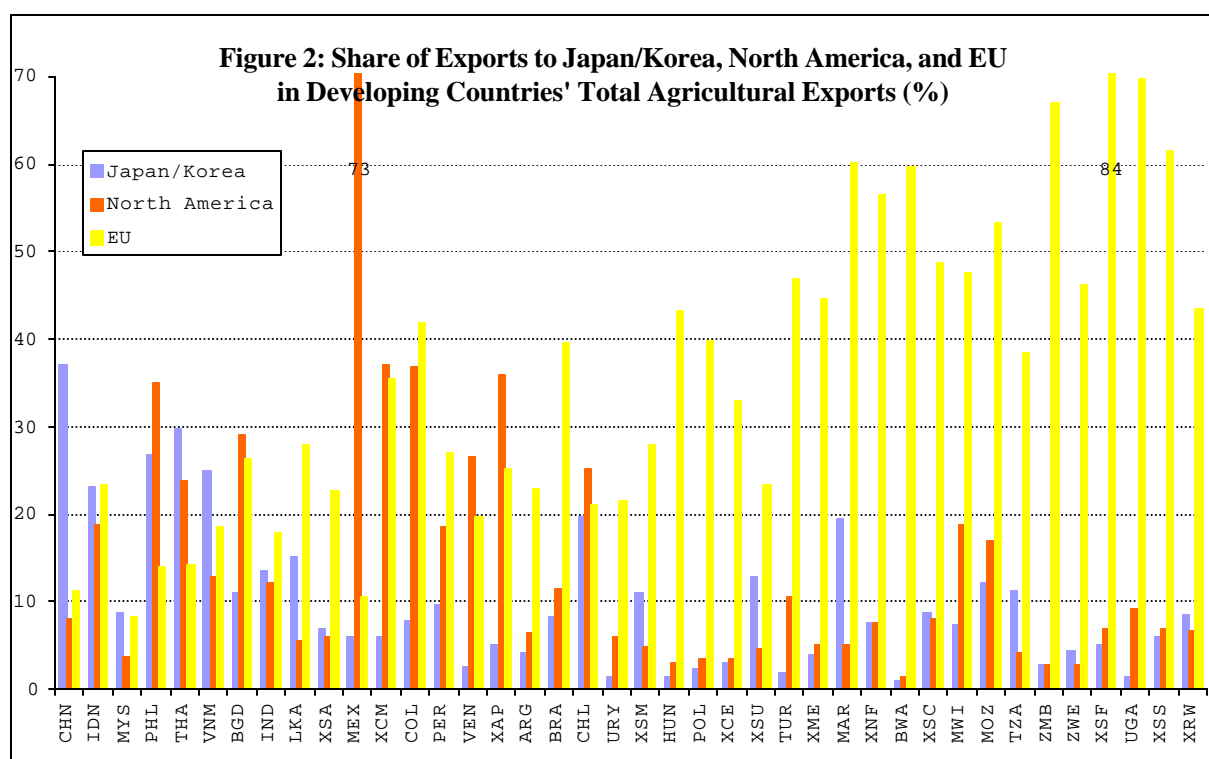
Table 5. Dynamic Welfare Effects in the Model (comparing with the base)

	<i>Without TFP growth</i>								<i>With TFP growth</i>							
	Year 5				Year 10				Year 15				Intertemporal			
	\$billion	%	\$billion	%	\$billion	%	\$billion	%	\$billion	%	\$billion	%	\$billion	%	\$billion	%
World	15.9	0.1	30.2	0.1	36.3	0.2			27.2	0.1	47.0	0.2	56.4	0.2		
Developed country group	14.7	0.1	25.7	0.1	29.7	0.2			17.0	0.1	29.6	0.2	35.1	0.2		
Japan and Korea	-1.4	0.0	3.9	0.1	5.1	0.2	0.0		-0.9	0.0	4.7	0.2	6.2	0.2	0.0	
North America	9.8	0.1	11.8	0.2	13.0	0.2	0.1		10.3	0.2	12.9	0.2	14.7	0.2	0.1	
European Union and EEFT	3.1	0.1	6.7	0.1	8.2	0.1	0.0		4.2	0.1	8.6	0.1	10.8	0.2	0.0	
Developing country group	1.3	0.0	4.5	0.1	6.5	0.1			10.2	0.2	17.4	0.3	21.3	0.4		
China	1.2	0.2	1.7	0.3	1.8	0.3	0.1		1.5	0.2	2.0	0.3	2.2	0.4	0.1	
Other Asian countries	-0.7	-0.1	0.5	0.1	0.9	0.1	0.0		2.1	0.2	4.5	0.4	5.1	0.5	0.1	
Mexico	-0.4	-0.1	-0.2	-0.1	0.1	0.0	0.0		0.5	0.2	1.0	0.3	1.6	0.5	0.1	
Latin America	3.9	0.3	4.3	0.3	4.7	0.4	0.2		4.6	0.4	5.4	0.4	6.1	0.5	0.2	
South African countries	0.2	0.1	0.3	0.1	0.5	0.2	0.1		0.4	0.1	0.6	0.2	0.8	0.3	0.1	
Rest of the world	-3.0	-0.2	-2.1	-0.1	-1.5	-0.1	-0.2		1.1	0.1	4.0	0.3	5.4	0.3	0.0	

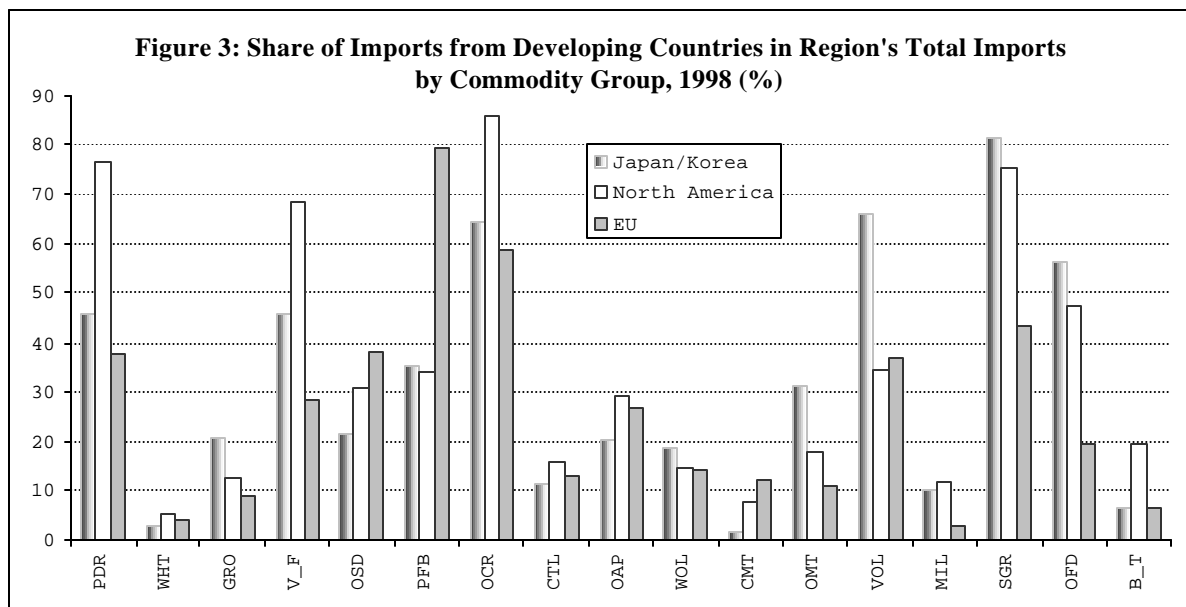
Source: Model results.



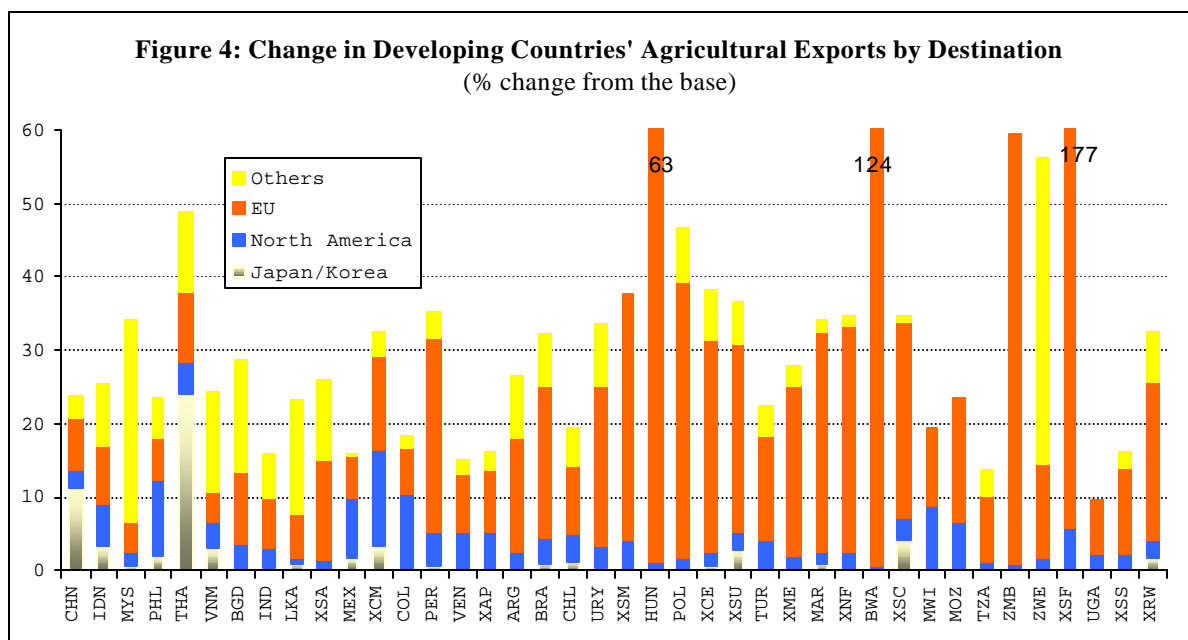
Source: GTAP data.



Source: GTAP data.

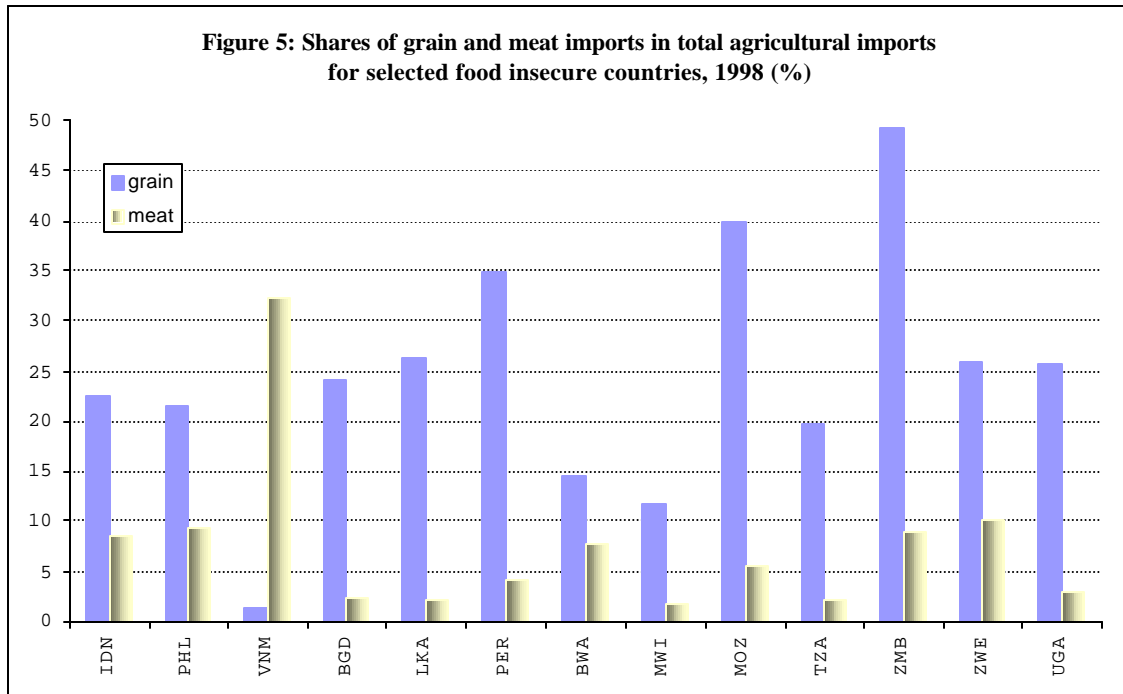


Source: GTAP data.



The height of bar indicates the change in total agricultural exports.

Source: Model results.



Source: GTAP data.

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