

A Global Analysis of Agricultural Reform in WTO Member Countries

Xinshen Diao
Trade and Macroeconomic Division, IFPRI

Agapi Somwaru
Economic Research Service, USDA

Terry Roe
Department of Applied Economics, University of Minnesota

June 2001

Abstract

Removing trade barriers, subsidies, and other trade distortions forms of support will cause aggregate world prices of agricultural commodities to rise by over 11 percent relative to an index of all other prices. Agricultural support and protection in developed countries is the major cause of low agricultural prices, and implicitly, a tax on net agricultural exporters in developing countries. The reform of agricultural policies would likely increase livestock product prices more than any other commodity. Reform increases world trade in agricultural commodities, but leaves the level of total agricultural production almost unchanged. In the short to medium term, some net agricultural importing countries suffer a welfare loss due to an adverse change in their terms of trade that reform causes. In the longer-run, however, agricultural policy reform benefits almost all countries, and developing countries in particular, due to the change reform induces in the developing countries' investment pattern, growth in capital stock, and growth in their total factor productivity.

Introduction

The Uruguay Round Agreement on Agriculture (URAA) of the multilateral trade negotiations brought agriculture under the discipline of the General Agreement on Tariff and Trade (GATT) for the first time. The signatories to the URAA Final Act (1994) committed themselves to reducing agricultural support and protection over the six-year period 1995–2000 (and 1995–2004 for developing countries) under three disciplines: tariffs, domestic support, and export subsidies. Agricultural trade barriers and producer subsidies still distort global agriculture. The new negotiations on agriculture are an opportunity to further reduce policy distortions in global agricultural markets. The growth in the world economy since the previous round of negotiations necessitates an evaluation of the costs of current agricultural trade and domestic policy distortions and the potential benefits from their full elimination both in a global context, and in the context of a world economy with increased capital flows.

This study assesses the possible global impacts of further agricultural liberalization in some sector detail from both a static-snapshot perspective, and in far less detail from a dynamic long-run perspective. Short to medium-run effects of policy reform on well-being can differ from long-run effects due to reform-induced changes in the long-run pattern of investment and capital accumulation. A global analysis of profound policy reform (i.e., the elimination of agricultural support and trade protection throughout the world) provides insights into the costs of agricultural policy distortions and suggests the potentially greatest effects on countries, both positive and negative, of the new agricultural negotiations.

To understand the individual and complementary effects of the various policy reforms on the post-URAA global economy, this study focuses on three disciplines: market access (trade barriers), export subsidies, and domestic support. The study decomposes the global effects of a full reform by type of policy being used and by commodity¹⁻¹ and country¹⁻². Specifically, the study uses the following scenarios: (1) eliminating agricultural import barriers (tariff equivalents) throughout the world; (2) eliminating agricultural export subsidies throughout the world; (3) eliminating domestic support in the developed countries; and (4) combining each of these scenarios. Because real negotiations can vary from country to country this study identifies specific country-region effects. Moreover, as some countries are net exporters of agricultural goods and others are net importers, policies can affect countries differently. Also, the composition of agricultural exports from developed countries tends to vary from those of developing countries. Thus, to identify a country's/region's effects, the study further decomposes scenarios (1) through (4) by regional options. For example, the study addresses questions such as: what are the likely effects on world agricultural price and trade flows, and on the economy of other countries/regions if the EU were to eliminate its agricultural support and trade protection?

The study used four indicators to assess the effects of agricultural liberalization on the world economy, as well as on each country/region: (a) changes in world agricultural prices, (b) changes in world agricultural trade, and changes in country's exports and imports, (c) changes in the level of agricultural production, and (d) changes in a measure of social well-being, or welfare.

The analysis is based on current (1998) levels of applied agricultural tariffs, domestic support and export subsidies, and the tariff rate quotas (TRQs). When the applied tariff rates are not available, the bound tariff rates are used instead. Data on nontariff barriers, such as state trading agencies and effective TRQs, are also not available for many countries. For this reason, a calculated tariff equivalent rate is used to proxy the effects of all other import barriers based on ERS/USDA¹ estimates.

Other caveats need to be noted. First, tariff rates and tariff equivalent rates are based on 1998 data. Since many countries undertook tariff after 1998, and since the bound rates are much higher than the applied rates in many cases, the analysis may overestimate the extent of tariff reduction presumed to take effect after 2000 for some countries. Other countries and commodities still have various nontariff barriers in place, and hence, the tariff reduction cannot represent the full elimination of import barriers. Thus, the analysis may underestimate the extent of all import barriers.

Second, the analysis focusing on the effect of domestic support on world agricultural markets considers the elimination of support only in Australia, New Zealand, Japan, Korea, the United States, Canada, the European Union (EU), and the three countries in the European Free Trade Area (EFTA). The analysis does take into account that many countries have recently adopted less-distorting forms of farm support, and differences exist in the effects of coupled and decoupled government payments received by farmers on production and trade. For example, subsidizing intermediate inputs in grain production (coupled) would affect farmers' production decisions, and removing such subsidies would affect farmer's supply response. Eliminating such subsidies, gives farmers incentives to adjust their planting structure, possibly allocating more land to other crops. On the other hand, direct payments to the owners of all farmland with no crop targeting (decoupled) would have little effect on the use of the land and, hence, the planting structure. Removing these subsidies would mainly reduce farmer's income but have little effect on production.

¹ See appendices on agricultural policies in the appendix to this report.

Third, it is assumed that labor and capital are mobile between the agricultural and the nonagricultural sectors of an economy. Without factor mobility, the supply response from countries having a comparative advantage in world agricultural markets would slow, which may cause world agricultural prices to rise more than the predicted levels of this analysis. Moreover, the study assumes full employment. This assumption places upward pressures on price since, if rural unemployed labor is available (which is likely in developing countries), supply response can occur at lower cost.

Removing Trade Barriers, Subsidies, And Support Will Likely Cause Aggregate World Prices Of Agricultural Goods to Rise Significantly In The Short To Medium-run

World agricultural prices are sensitive to changes in tariff levels and domestic support. The study is based on GTAP database version 5 and calculates average tariff equivalent rates using the Agricultural Market Access Database (AMAD), while ERS provides the average rates of export subsidies and domestic support. The average world agricultural tariff equivalent rate is 22 percent. This rate, the trade weighted average tariff rate, is calculated as the ratio of the total revenues of all countries' agricultural tariff equivalents to the value of their total agricultural imports². The similarly computed average world export subsidy rate is 2.9 percent. The domestic support rate for the developed country group is 5.3 percent (table 1).

The elimination of all tariffs (and tariff equivalents) on agricultural imports, export subsidies, and domestic support worldwide, results in an increase in world agricultural price levels of 11.6 percent relative to the level of world nonagricultural prices. This result does not take into account further agricultural liberalization in China, which is not yet a participatory member of the WTO at this time. If China liberalizes agriculture, the level of world agricultural prices would rise by 12.2 percent an increase of about 0.6 percent over non-China predicted values. The following discussion assumes that China maintains current policies.

This study determines the global price effect of worldwide agricultural liberalization without accounting for investment response to price changes. Later, this assumption is relaxed. Under this consideration, eliminating tariffs, worldwide, accounts for more than 50 percent of the 11.6 percent increase in world agricultural prices, that is, when other policy variables remain constant and only agricultural import tariffs are eliminated, world agricultural prices rise by 6 percent (relative to world nonagricultural prices) (figure 1). This result occurs because import barriers protect domestic producers by restricting imports. In many *import*-protecting countries, import restrictions raise domestic food prices higher than world prices while at the same time induce these countries to employ too many resources in agriculture. Eliminating import tariffs, raises the demand for agricultural imported goods, while supply contracts, thus placing upward pressure on world agricultural prices. This pressure in turn induces agricultural exporting countries to increase production.

Eliminating domestic support in the developed countries, as mentioned earlier, contributes more than 30 percent to the rise in world agricultural prices. In other words, when other policy variables remain constant and only domestic support in the developed countries is eliminated, world agricultural prices rise by about 4 percent (figure 1). Farmers benefit from price support or, indirectly, from lowered production costs. Reducing or eliminating domestic support in the developed countries lowers farm income, or, more precisely, lowers returns to land, farm

² The simple average world agricultural tariff rate is 45 percent. High tariffs for a specific sector usually restrict trade in this sector, lowering the sector's share in the world trade. Thus, the weighted trade tariff rate is lower than the simple average tariff rate.

buildings and machinery, and owner-operator labor. Farmers in these countries respond to such policy changes by reducing production, thus an upward pressure is placed on world prices.

Eliminating total export subsidies worldwide has smaller direct effects than removing tariffs and domestic support. Eliminating these subsidies for sugar and livestock products, however, causes their prices to rise by more than 3 percent (figure 2). The main reason is that while world average export subsidies are much lower than the world import tariffs, they are relatively high for the cases of sugar and livestock (table 1). When other policy variables remain constant and only agricultural export subsidies worldwide are eliminated, the world agricultural price rises 1.5 percent relative to the price of nonagricultural goods.

Agricultural support and protection in developed countries is the major cause of low world agricultural prices

The decomposition of the increase in world prices by developed – developing country groups helps determine that agricultural liberalization in the developed countries accounts for about 80 percent of the rise in world agricultural prices. That is, eliminating agricultural support and trade protection only in the *developed* country group increases world agricultural prices 9 percent relative to non-agricultural prices (figure 1). Eliminating trade protection in the developing country group³ increases world agricultural prices 2.3 percent.

Three reasons help explain why liberalization in the developed countries causes world agricultural prices to rise. First, as a group, developed countries import more agricultural goods than developing countries. Discounting intra-regional trade among EU member countries and EFTA member countries, developed countries' imports account for about 57 percent of world agricultural trade. Moreover, the developed country group has an average agricultural tariff (equivalent) rate of 24 percent compared with a rate of 20 percent for the developing country group (table 1). This high rate is mainly due to the high rates for grain and livestock product imports by Japan, Korea, the EU, and EFTA (table 2). The tariff rates are low in other developed countries, such as in Australia, New Zealand, Canada, and the United States. Second, the average export subsidy rate for the developed country group is 4.8 percent, and only 0.13 percent for the developing country group (table 1). Finally, developed countries mainly employ domestic support policies.

Because agricultural support and protection rates in the developed countries are higher than those in the developing countries, and because the developed countries are major players in world agricultural markets, it follows that liberalizing developed countries' agricultural support and trade policy causes world agricultural prices to rise. More specifically, removing import tariffs, domestic support, and export subsidies in the EU alone, holding the policy of other countries unchanged, causes world prices to rise 4.4 percent (figure 1) or more than one-third of the world price increase that would result. When policy variables for the other countries remain constant and only the agricultural support and trade protection in the United States are eliminated, world agricultural prices rise 1.8 percent. Liberalization of Japan's plus Korea's agricultural trade policies causes world agricultural prices to rise about 1.5 percent (figure 1).

Livestock product prices rise the most in response to liberalization

The data indicate that, for the world as a whole, the livestock and livestock product (including dairy) trade faces the highest level of import protection and export subsidies in comparison to the

³ This group includes emerging markets, transition economies, and China.

other agricultural commodity categories (table 1). Moreover, the value of world livestock product trade is almost twice the value of world trade in grain products. Consequently, world livestock product prices rise more than other commodity prices after liberalization. If all forms of domestic support and border protection in agriculture are removed, world livestock product prices would rise about 22 percent, while grain and other crop prices rise 6 to 18 percent (figure 2). Again, the developed countries influence the rise in world livestock product prices due to the fact that developed countries dominate world trade in this sector, as well as protect their domestic sectors from import competition (table 2).

The resulting higher agricultural commodity prices that are likely to prevail in this case affects agricultural importing countries differently. Those developing countries that are importers of grain and livestock products, and in which tariff rates on imports are not prohibitively high, face increased import costs with the result that consumer's interests are adversely affected. For those developed countries that are also grain and livestock product importers but in which tariff rates on imports are almost prohibitively high, such as Japan and Korea, the prices faced by their domestic consumers may not rise. Thus, consumers in these countries are likely to benefit from agricultural liberalization while their producers may be hurt due to competition from lower-cost foreign producers.

Liberalization Enhances Trade, But Among Sectors, Affects Production Differently

In general, freer trade results in more trade. The model results indicate that world agricultural trade is likely to increase substantially after liberalization. Removing all agricultural support and protection worldwide results in an increase in the value of world agricultural trade by about 30 percent. The corresponding volume of world trade rises 15 percent (table 3).

Agricultural export value from *developed* countries rises by 32 percent, while exports from *developing* countries increase 27 percent. However, the corresponding increase in the volume of exports from the developing countries (16 percent) is larger than the increase from the developed countries (14 percent). This result implies that the prices for the agricultural goods exported by the developed countries rise *more* than the prices of the agricultural goods exported by the developing countries. The reason for this result is that the developed country group exports more livestock products, accounting for 76 percent of world livestock product trade, while the developing country group exports more vegetable, fruits, oilseeds, sugar, and other crop products. While, as mentioned earlier, world livestock product prices could rise by 22 percent, world prices for the nongrain crop product categories rise 6 to 11 percent (except for sugar of which the world prices rise 16 percent (figure 2)).

The removal of import protection is a dominant factor in the increase growth in world agricultural trade. When only agricultural tariffs worldwide are eliminated, world trade rises 26 percent in value and 17 percent in volume. Exports and imports both rise more in the developed country group than agricultural exports and imports of the developing country group. The relatively high protection rates in the developed country group cause this disparity. Moreover, developed country group exports rise more than the increase in its imports, both in value and volume, while the developing country group imports rise more than the increase in its exports. This important result indicates that the terms of trade improve in the *developed* country group relative to the *developing* country group (table 6)

Removing export subsidies or domestic support alone appears not to enhance world agricultural trade. When only agricultural export subsidies worldwide are eliminated, world agricultural trade falls 0.7 percent in value and 1.8 percent in volume. If only domestic support in the developed

countries is eliminated, world agricultural trade rises 2.8 percent in value but falls slightly (0.7 percent) in volume (table 3). These results are consistent with the prediction of trade theory, that is, subsidies increase exports, albeit at the possible cost of reducing the exports of the nonsubsidized commodities. Removing subsidies can decrease total trade depending upon how consumers allocate the savings from taxes used to finance the subsidies and the extent to which the other nonsubsidized sectors respond to the slight increase in resources that are released from the formerly subsidized sector.

Even though world trade does not change much when export subsidies are removed worldwide, as the subsidy policies are mainly applied by the developed countries, the results suggest that exports from the developing country group would rise, while exports of the developed country group fall. If the export subsidies were removed worldwide, the developing country group exports would rise 0.5 percent in value and 0.2 percent in volume, while the developed country group exports fall by 1.4 and 3 percent in value and volume, respectively. When the domestic subsidies are eliminated in the developed countries, the developing country group exports rise 5.5 percent in value and 3.4 percent in volume, while the developed country group exports rise 0.9 percent in value and fall 3.4 percent in volume. These results indicate that, by stimulating domestic production and enhancing exports, the developed countries' export subsidy or domestic support policies have lessened the market shares of some developing countries that are net exporters of the agricultural commodities on which the developed countries have applied supporting policies, but benefited other developing countries that are net importers of these commodities. The net importers benefit because the subsidy and support policies lower the prices these countries would otherwise face if world markets were undistorted.

Grains, sugar, and livestock products trade more after liberalization

As grains, sugar, and livestock products have the highest import protection rates, it is not surprising that world agricultural trade liberalization causes world trade in grains, especially wheat and rice, sugar, and livestock products to increase more than other agricultural products. Results suggest that trade liberalization would increase the value of world rice, wheat, sugar, and livestock product trade about 78, 38, 44, and 61 percent, respectively. This sharp rise stands out relative to the 14 to 24 percent rise for the other crop and processed food trade (table 4).

Again, the increase in both developed and developing regions' grain, sugar, and livestock product exports is mainly due to liberalization in the developed countries. Eliminating agricultural support and trade protection only in the developed countries increases world trade of rice, wheat, sugar, and livestock products by 70, 30, 35, and 50 percent, respectively. Conversely, when the developed country group is unchanged, the world trade in grains, other crops, and livestock products only rise 4 to 12 percent.

Production effects vary among the sectors

In contrast to the relatively large world trade effects of agricultural reform, the model results suggest that reform only slightly affects the level of world agricultural production, at least in the aggregate. For commodities such as wheat, however, the effect is relatively large. Moreover, the change in production does not always point in the same direction as the changes in trade. For example, the value of world rice trade increases almost 80 percent when all the agricultural support and trade protection are removed worldwide, while the worldwide production of rice falls 1.7 percent (table 5). In addition, rice production falls 8.4 percent in the developed country group, due to an almost 20-percent decline in Japan and Korea, while rice production rises 1 percent in the developing country group. Japan and Korea place severely restrict rice imports and

domestic rice in the two countries is three times more expensive than the rice in the world market. When the protection afforded rice producers is removed worldwide, so that all farmers in different countries face essentially the same world prices, the uncompetitiveness of rice production in Japan and Korea becomes obvious and production in those two countries falls.

Besides rice, the production of sugar (including sugar crops and raw sugar), other crops, livestock products and processed food (see table 5) also falls slightly in the world after reform, due to the decline in production in the developed country group (table 5). While production of these commodities rises in the developing country group, the effect is not sufficient to cover the fall in production in the developed countries. For example, sugar production falls 1 percent in the world and 10 percent in the developed country group when all agricultural support and trade protection are removed worldwide, while sugar production rises 3.2 percent in the developing country group. Some developed countries, such as Japan, the EU, EFTA, and the United States protect their domestic sugar sector through both high tariffs and export subsidies. Eliminating agricultural protection worldwide strongly suggests that some of these countries have less of a comparative advantage in either growing or processing, and, hence, sugar production falls in these countries. For example, sugar production falls more than 20 percent in Japan and Korea, more than 10 percent in the EU and the EFTA, and almost 10 percent in the United States.

Wheat production has the highest increase among agricultural commodities when all agricultural support and trade protection are removed worldwide. The world wheat production is likely to rise almost 2 percent, and more than 1 percent in the developed country group, mainly due to increased production in Australia and New Zealand, Canada, and the United States. These countries appear to hold a strong comparative advantage in wheat production. In the other developed countries, such as Japan plus Korea and the EU, wheat production falls considerably (30 and 18 percent, respectively). Under the same scenario, wheat production rises almost 3 percent in the developing countries.

Tariffs, export subsidies, and domestic support affect production levels differently among countries. Removing tariffs worldwide would stimulate production in most agricultural sectors (except for rice and sugar), though most sectors would experience only small gains. Other grains, which is mostly corn, is an exception, as production rises more than 2 percent in this aggregate sector. Under this scenario, wheat and corn and other grain production rises mainly in the developed country group (5 percent), while production falls slightly in the developing country group (1 percent). Sugar and other crops' production rises 2.3 and 1.2 percent, respectively, in the developing country group and falls 6.2 and 1.4 percent, respectively, in the developed country group (table 5). Under this scenario, U.S. wheat production and other grains (primarily corn) both rise 5 percent, while U.S. livestock production rises 7 percent.

In contrast to removing tariff, removing export subsidies only worldwide or removing domestic support only in the developed countries would have a negative, negligible effect on most agricultural production, particularly on the developed countries. Under the same scenario, production rises in most sectors in the developing country group (table 5). For example, removing domestic supports in the developed countries causes production of oilseeds and vegetable oil to fall 0.5 percent in the world, but almost 7 percent in the developed country group, and rise more than 4 percent in the developing country group. The EU would experience the largest drop in oilseed and vegetable oil production, 19 percent, due to that region's high levels of support. Under the same scenario, U.S. wheat production would fall 5 percent and other grain production (primarily corn) would fall 1.2 percent.

Welfare Effects Of Reforming Agricultural Policies Are Mixed

From a world perspective, more efficient allocation of resources yields higher global welfare. Typically, in a country with a high degree of agricultural support and trade protection, consumers pay relatively high prices for food and other agricultural goods, and/or their disposable income is taxed to cover the costs of agricultural policies. Removing support or trade protection is expected to benefit consumers, however, welfare effect across countries varies, from the global perspective, and particularly when the world price is affected by agricultural policies.

Consumers can be worse off if their country's terms of trade deteriorate following agricultural policy reform. That is, if the prices of the goods they export fall relative to the prices of goods they import, consumers can be made worse off because their expenditures on imported goods increase while their income from exported goods falls. Moreover, consumers in a country with a low tariff rate (e.g., Mexico) may not benefit by liberalization in high tariff countries (e.g., Japan), as trade diversion may result. In other words, a country (i.e., Japan) may import more, following reform, from those trade partners (i.e., the United States) for whom, prior to reform, the country imposed high tariff rates. Post reform, the country (i.e., Japan) may import less from trade partners (i.e., Mexico) for which, prior to reform, it imposed low tariff rates. In this case, consumers in countries like Mexico may experience negative effects from the worldwide trade reform.

Small one-time welfare gains

This analysis uses the widely accepted equivalent variation (i.e., consumers' willingness to pay) to measure the social welfare gains or losses due to agricultural policy reform. Measurements consider both one-time welfare effects and welfare effects over time. The one-time effect measurements use the status-quo (pre-reform) prices as the base and address the question: what income would be equivalent to the change brought about by agricultural policy liberalization (Varian, 1984). The welfare effects over time are measured by summing the discounted value of this measure over time.

The one-time effects of agricultural policy liberalization on a nation's social welfare appear relatively small among all countries/regions (table 7). Relative to nonagricultural sectors, agriculture accounts for a small share of Gross Domestic Product (GDP). Further, agricultural goods in consumer's consumption bundle in most countries, and particularly so in the developed economies of the EU, Canada, and the United States, are relatively small in proportion to their total expenditures. Agriculture (including processed food products) accounts for less than 5 percent and 15 percent of the GDP of developed and developing countries, respectively. Consumption expenditures on food account for 5 percent of total expenditures for the developed country group and 17 percent for the developing country group. Thus, at a national level, agricultural policy liberalization alone is unlikely to have a large, one-time welfare effect on the aggregate economy in the short to medium-term.

Nevertheless, these relatively small aggregate welfare effects for the case of developing countries can be misleading for two reasons. First, a majority of the poor in low-income countries reside in rural areas where primary agriculture is a major source of income, either directly or indirectly through rural labor markets and in value-added activities related to primary agriculture. Second, monetary returns to the market surplus from primary agriculture (i.e., farm production minus own consumption) are closely linked to foreign markets. Thus, the national level effects of reform are likely to be small in proportion to the benefits received by rural households and, in particular, rural households whose disposable income ranks in the bottom quantile of a country's distribution of income.

Thus, the welfare effects are positive for the world aggregate. The sum of countries' equivalent variation due to worldwide agricultural policy reform is about \$31 billion. This is equivalent to 0.1 percent of world aggregate GDP, and 1 percent of consumers expenditures on agricultural and agriculture-related goods (table 7). Such welfare gains, however, are not equally distributed among countries and regions in the world, and some countries experience negative welfare effect. Developed countries experience a \$28 billion welfare gain, which is equivalent to 0.16 percent and 2 percent of their GDP and consumer expenditures on agricultural goods, respectively. Moreover, all developed countries in the model gain, with the largest gains shown by the EU (\$9.3 billion), Japan and Korea (\$8.6 billion), and the United States (\$6.6 billion).

The welfare gain for the developing country group is much smaller, \$2.6 billion. This is equivalent to 0.05 percent of GDP and 0.2 percent of consumers expenditures on agricultural goods. Furthermore, some countries/regions experience negative welfare effects. Mexico would experience a \$160 million welfare loss, which is equivalent to less than 0.06 percent reduction of its GDP.

Most developing countries experience smaller total welfare gains than developed countries because agricultural production in developing countries is distorted by more than just agricultural policies. While the level of domestic support and trade protection in nonagricultural sectors is quite low among most developed countries, many developing countries still highly protect their import-competing manufacturing and service sectors. This protection tends to implicitly tax agricultural producers. In extreme cases, removing agricultural protection in such countries (such as Morocco) can actually lower social welfare because the implicit tax imposed on agriculture by policies in other sectors actually increases when protection is taken from agriculture. Thus, in these countries, agriculture is not only distorted by the agricultural protection policies in high-income countries, but also by domestic manufacturing policies and distortions in service sector markets.

The negative effect of world agricultural policy reform on some other countries is mainly caused by a post-reform deterioration in their terms of trade (table 6). For, example, Mexico depends on the U.S. economy for most of its agricultural imports and exports, while the United States is more dependent on Japan, Korea, and the EU as export markets. Japan, Korea, and the EU have highly levels of agricultural support relative to other countries. When world agriculture and agricultural trade are fully liberalized, increased import demand from Japan, Korea, and the EU on U.S. agricultural goods causes U.S. export prices to rise, in turn causing Mexico to pay higher prices for post-reform U.S. imports. On the other hand, the North America Free Trade Agreement (NAFTA) lowered trade barriers between the United States and Mexico. When world trade is fully liberalized, the level of U.S. imports from Mexico may not rise to the level that imports from non-NAFTA countries because pre-reform the United States imposed relatively higher barriers to the goods imported from non-NAFTA countries. Mexico, however, depends on U.S. imports, as trade with the United States accounts for more than 70 percent of Mexico's exports. This implies that the price Mexico receives for its exports cannot rise to the same degree as the rise in price it must pay for imports, which results in a deterioration in Mexico's terms of trade. Thus, some member countries of a trade bloc may experience a welfare loss because of post-reform declines in demand for goods they export to former member countries and rises in world demand for the goods they import.

These results also attest to the fact that policies that distort agriculture in developed countries increase world supplies of these goods and thus indirectly subsidize consumers in countries that are net agricultural importers. Agricultural policy reform increases world prices of most agricultural goods -some more than others. Nevertheless, even in those low-income and net

agricultural importing countries that experience a decline in their terms of trade, returns to their agricultural resources (land, labor, farm machinery, and buildings) are biased downward from what would otherwise prevail in a distortion-free economy. Consequently, their agricultural households, defined as those rural households that are net suppliers of agricultural goods, are likely to be made better off as the result of trade reform.

Removal of import protection leads to welfare gains, while lowering domestic support and export subsidies can lead to welfare losses

Among the three policy categories, removing tariffs generates positive welfare gains at the world level of aggregation and for most countries and regions, while removing domestic support and export subsidies has negative effects for most developing countries (table 7). Holding other policy variables constant, removing tariffs results in a \$25 billion welfare gain worldwide, \$19.6 billion of which accrues to the developed countries and \$5.7 billion to the developing countries. Removing domestic support or export subsidies results in a much smaller welfare gain worldwide, as export subsidy rates are much lower than the tariff rates in all countries/regions and the domestic support policies are mainly employed by the developed countries. The world aggregate welfare gain from the removals of domestic support is \$2.8 billion and is \$250 million from the removal of export subsidies. Developed countries gain \$4.7 billion from domestic support removal and \$2.5 billion from export subsidy removal. Developing countries, however, experience welfare loss of \$1.9 billion and \$2.3 billion in the two scenarios, respectively.

Most developing countries/regions in the model (except for the Latin American countries) experience a welfare loss when domestic subsidies are removed in the developed countries or export subsidies are removed in the world. This outcome is due to the resulting rise in the world prices for grain and livestock products of which most developing countries are net importers (except for the region of Latin American countries which is a net exporter for the livestock products as well as for the aggregation of the primary agricultural products). Thus, for most developing countries/regions, welfare measures tend to deteriorate due to the hike in world agricultural prices.

The region of Japan plus Korea experiences the largest welfare decline (\$3.7 billion) in the world when the developed countries remove their domestic support, even though the domestic support rate in Japan and Korea on average is much lower⁴ than that in Canada, the United States and the EU. This result occurs because Japan and Korea are net agricultural importers, and agricultural prices rise in the world because agricultural supply declines in the United States and the EU due to the removal of domestic support. If only the United States or the EU eliminates its domestic support to agriculture, the social welfare in Japan and Korea falls by \$2.1 and \$0.55 billion, respectively, while if Japan and Korea eliminate their domestic support only, their welfare falls by \$0.66 billion.

Relatively large dynamic welfare gains-A brief overview of method and assumptions

The analysis earlier ignored the effect of reform on savings, investment, and the pattern of growth in a country's capital stock. To analyze these effects requires assumptions regarding household's willingness to forgo consumption and invest, the functioning of capital markets and international capital flows, as well as the technological spillovers that seem to accompany growth in countries' trade. These assumptions may be closely approximated for developed countries, and only poorly

⁴ While market barriers are very high.

approximated for many developing countries. Nevertheless, for the most part, the analysis suggests direction of change in the long run that seems well within the realm of reason.

Numerous studies find empirically strong and positive linkages between growth and a country's total factor productivity (TFP) and the share of its economy involved in trade with more advanced nations (e.g., Coe and Helpman, 1995; Wang and Xu, 1997; and Coe et. al., 1997). Thus, a dynamic model to not only captures consumer saving and producer investment decisions but also the effects of trade liberalization on a country's growth in factor productivity. Such effects are modeled by increases in technological spillovers embodied in the trade between developing and developed countries. Specifically, if a developing country eliminates trade protection, it then tends to increase its rate of learning new skills, organizational methods, and the more advanced product and process technologies embodied in its imports of investment goods from developed countries. This process helps to increase labor productivity and returns to land and social capital (Grossman and Helpman, 1991; Romer, 1994). The spillovers of the advanced technology embodied in trade can also result from developed countries' reduction of agricultural protection. As developed countries increase imports of agricultural goods, their exports of capital goods may be enhanced. Thus, this longer-run type of analysis allows for agricultural trade reform to yield broader economy-wide benefits, which, as shown next, is found to be higher for developing countries.

This study calculates the change in the regional equivalent variation for three different years as well as the intertemporal welfare index which measures the welfare gains in this dynamic setting. Changes in equivalent variation for the three different years are compared with the base year, while the intertemporal welfare index is the sum of the welfare change over time where future gains and losses are discounted relative to current gains and losses. The over-time welfare effects of the liberalization vary, depending on whether technological spillover-growth considerations are included in the analysis. Thus, welfare changes are specified under the different assumptions and, hence, the technological spillovers and growth effect of the policy reform on welfare can be told from the differences in the two groups of results.

Relatively large dynamic welfare gains-Results

Without taking into account the technological spillover-growth effects of liberalization, (that is, by considering only the investment incentives created by reform) the over-time welfare effect is still modest, especially in a short run, for instance, in the first five years (table 8). As production and investment adjustments take time, the welfare effect in a longer time period, for example, in the 15th year or after, is relatively large. The world welfare gain in year-10 doubles the gain accrued in year-5. More simply stated, this result suggests that the payoff to agricultural trade policy reform takes time.

However, if the technological spillover-growth effect of policy reform is taken into account for developing countries, the over-time welfare gains increase significantly, especially in developing countries. The developing countries are beneficiaries of the technological spillovers embodied in trade with developed countries. Such benefits assumed to generate an additional annual growth rate of 0.02 percent in the developing countries. This annual growth rate further increases welfare gains among the developing countries. Moreover, all the developing countries/regions in the model are better off after agricultural support and trade protection are totally removed worldwide, and the greater the volume of trade between developed and developing countries, the larger the welfare gain.

The developed countries benefit indirectly from the growth in productivity in the developing countries, even though the developed countries are presumed not to experience technological spillovers from increase in trade and, hence, experience no additional growth generated from trade liberalization. This benefit results from the growth in the returns to increased capital flows from developed to developing countries, induced by the increased investment demand of the developing countries as most of the developing countries do not have sufficient domestic savings to fully finance their growth in investment demand. This growth in investment demand creates opportunities for the developed countries to invest abroad, either through international lending activities or foreign direct investment in the developing countries. These indirect effects generated from the growing demand for foreign capital inflows to the developing countries tend to be stronger if the economic adjustments in the developing countries due to agricultural trade policy reform in the world are expected to be larger.

Conclusions

This study focuses on the global perspectives of total reform in protection and subsidies, a process began by the URAA Final Act (1994) and analyzes the case of total reform under three disciplines: tariffs, domestic support, and export subsidies. The study finds that freer trade results in more trade (i.e., eliminating most agricultural support and trade protection increases world agricultural trade substantially. World agricultural production, however, increases only marginally, while the developed countries, as a group, experience the largest decrease in production. As agricultural support and protection rates are higher in most developed countries than in the developing countries, and as the developed countries are major players in world agricultural trade, developed countries appear to benefit more from agricultural trade policy reform than the developing countries.

Nevertheless, worldwide agricultural liberalization would cause world prices to rise almost 12 percent. Of the three categories,-- tariffs, domestic support, and export subsidies-- the results suggest that tariffs are the major cause of distortions in world agricultural prices. The elimination, worldwide, of import tariffs would cause world agricultural prices to rise about 6 percent.

Within the developed country group, the major contributors to distorted world agricultural prices are EU, the United States, and Japan plus Korea. Consequently, these countries experience the largest social payoff from reform relative to the rest of the world, especially compared to the developing countries. As the protection levels and trade patterns vary among countries, some developing countries experience larger increases in the prices for imported goods than the increases in the prices for exports. Such negative terms of trade effect may cause these developing countries to experience welfare losses. Furthermore, some member countries of a trade bloc may experience a welfare loss because they may suffer post-reform a decline in demand for the goods they export to former member countries, while world demand for the goods they import rises.

The study also finds that the payoff to reform takes time. Over time, worldwide agricultural liberalization generates larger gains than the short-time gains for most countries. For example, the discounted present value of world welfare gains in year-10 doubles the gain accrued in year-5. Moreover, if the technological spillover-growth effect of reform is taken into account, the welfare gains increase significantly for all countries in the world. While the developing countries are beneficiaries of the technological spillover embodied in trade with the developed countries, the results suggest that developed countries benefit indirectly from the growth in productivity in the developing countries. This benefit result from the growth in the returns to increased capital flows

from developed to developing countries, induced by the increased investment demand of the developing countries.

References

- Coe, D.T., and E. Helpman (1995). "International R&D Spillovers," *European Economic Review*. 39: 859-887.
- Coe, D.T., E. Helpman, and A.W. Hoffmaister (1997). "North-South R&D Spillovers," *The Economic Journal*. 107: 134-149.
- Grossman, G., and E. Helpman (1991). *Innovation and Growth in the Global Economy*: MIT Press.
- McDougall, R., A. Elbehri, and T. Truong (1998). *Global Trade, Assistance, and Protection: The GTAP 4 Data Base*. Center for Global Trade Analysis, Purdue University. West Lafayette, IN.
- Romer, P.M. (1994). "The Origins of Endogenous Growth," *Journal of Economic Perspectives*. 8(1): 3-22.
- Varian, Hal R. (1984). *Microeconomic Analysis*, Second Edition. W.W. Norton & Company.
- Wang, J., and B. Xu. (1997) "Trade, FDI, and R&D Spillovers in the OECD," University of Florida. Unpublished.

Table 1. Summary of agricultural supports and protection data in the base year (1997)

	Rate of tariffs ⁽¹⁾	Rate of export subsidies ⁽²⁾	Rate of domestic supports ⁽³⁾
		----Percentage----	
World average	22.09	2.87	
Developed country group	23.67	4.79	5.25
Developing country group	19.62	0.13	
World sectoral average			
Wheat	22.75	2.78	
Rice	45.08	2.23	
Other grains	8.68	0.69	
Vegetable and fruits	12.13	1.01	
Oil and oilseeds	12.57	0.00	
Sugar	33.95	6.97	
Other crops	11.57	0.05	
Livestock and products	48.79	7.03	
Processed foods	14.90	0.00	
Developed country group			
Wheat	68.18	2.99	31.55
Rice	73.34	3.79	2.05
Other grains	11.02	0.84	21.84
Vegetable and fruits	10.22	1.92	0.00
Oil and oilseeds	9.50	0.00	9.94
Sugar	59.14	21.27	2.19
Other crops	9.85	0.17	2.75
Livestock and products	68.45	8.78	3.31
Processed foods	9.11	0.00	0.00
Developing country group			
Wheat	8.60	0.00	
Rice	10.75	0.00	
Other grains	6.56	0.13	
Vegetable and fruits	16.71	0.11	
Oil and oilseeds	15.67	0.01	
Sugar	14.50	0.16	
Other crops	15.82	0.00	
Livestock and products	23.23	0.58	
Processed foods	26.51	0.00	
Regional average			
Australia and New Zealand	5.12	0.01	0.19
Japan and Korea	47.49		2.43
United States	10.65	1.77	2.56
Canada	6.09		2.99
European Union	16.68	12.29	8.19
European Free Trade Area	48.72	43.96	19.29
China	26.47		
Other Asian countries	20.71		
Mexico	18.93		
Latin America	14.67	0.04	
South African countries	21.65		
Rest of the world	17.63	0.70	

Source: Calculated by authors

⁽¹⁾ Rates of tariffs for sector, country, region, and the world are weighted average rates and the weights are values of sectoral or country's imports. Both tariff rates and import data are for 1997.

⁽²⁾ Rates of export subsidies for sector, country, region, and the world are weighted average rates and the weights are values of sectoral or country's exports. Both subsidy rates and export data are for 1997.

⁽³⁾ Rates of domestic supports for sector, country, region, and the world are weighted average rates and the weights are values of sectoral or country's outputs. The domestic support data are for 1998, while the output data are for 1997.

Table 2. Regional agricultural tariff rates by sector in the base year (1997)

	Wheat	Rice	Other grains	Vegetable and fruits	Oil and oilseeds
	--- Percentage ---				
Australia and New Zealand	0.00	0.89	0.98	2.15	2.58
Japan and Korea	87.57	336.57	6.81	9.51	10.41
United States	2.60	5.28	0.60	4.70	6.74
Canada	50.24	0.00	0.08	0.27	0.00
European Union	42.98	47.66	38.60	10.86	5.68
European Free Trade Area	119.45	0.00	114.23	69.77	186.09
China	13.46	13.11	14.36	12.56	17.26
Other Asian countries	6.23	19.71	3.96	26.45	19.55
Mexico	13.40	15.00	0.77	17.90	6.89
Latin America	5.53	25.57	10.31	13.73	11.10
South African countries	20.20	5.55	21.62	15.46	24.72
Rest of the world	8.49	4.47	6.49	12.13	
	Sugar	Other crops	Livestock and products	Processed food	
	--- Percentage ---				
Australia and New Zealand	10.27	2.83	4.43	7.11	
Japan and Korea	81.02	7.51	132.39	8.41	
United States	53.10	21.46	10.62	8.62	
Canada	5.36	0.48	22.63	5.06	
European Union	61.91	2.74	42.88	12.20	
European Free Trade Area	100.67	55.11	123.57	3.71	
China	22.22	25.62	33.28	35.22	
Other Asian Countries	26.69	21.72	16.38	28.17	
Mexico	4.25	7.43	35.72	19.95	
South American countries	18.68	8.34	17.89	17.29	
South African countries	11.24	14.63	21.23	30.23	
Rest of the world	12.10	9.67	21.59	24.93	

Source: Calculated by authors

Table 3. Decomposition of world agricultural trade effects of
global agricultural liberalization in the model (1)
-- Percentage change in total agricultural trade from the base year (1997)

	Value	Volume
Removing agricultural supports and protections by all regions		
World trade	29.71	14.66
Exports of developed country group	31.81	13.75
Imports of developed country group	35.93	19.03
Exports of developing country group	26.50	16.05
Imports of developing country group	20.02	7.85
Removing tariffs by all regions		
World trade	26.40	17.31
Exports of developed country group	31.28	20.79
Imports of developed country group	28.66	18.39
Exports of developing country group	18.93	11.97
Imports of developing country group	22.89	15.63
Removing domestic supports by developed regions		
World trade	2.70	-0.71
Exports of developed country group	0.85	-3.42
Imports of developed country group	5.43	1.82
Exports of developing country group	5.54	3.44
Imports of developing country group	-1.54	-4.70
Removing export subsidies by all regions		
World trade	-0.66	-1.76
Exports of developed country group	-1.43	-3.04
Imports of developed country group	-0.44	-1.25
Exports of developing country group	0.51	0.22
Imports of developing country group	-1.01	-2.54

Source: Estimated by authors.

Table 4. Decomposition of world agricultural trade effects of global agricultural liberalization in the model (2)

-- Percentage change in world agricultural trade by sector from the base year

	<i>EXP-1</i>		<i>EXP-2</i>		<i>EXP-3</i>		<i>EXP-4</i>	
	Value	Volume	Value	Volume	Value	Volume	Value	Volume
Wheat	37.64	13.41	17.71	12.62	7.40	-3.56	-0.69	-2.16
Rice	78.12	47.21	76.70	52.72	1.66	-0.69	-0.68	-2.02
Other grains	24.19	3.87	7.24	4.80	9.02	-3.02	0.17	-0.40
Vegetable and fruits	14.15	8.23	15.27	9.60	-0.62	-0.56	-0.37	-0.68
Oil and oilseeds	23.50	11.38	11.66	8.05	11.11	3.45	0.00	-0.05
Sugar	44.43	23.24	43.57	27.72	1.72	0.10	-1.50	-4.12
Other crops	14.08	7.59	13.26	8.25	0.87	0.29	-0.13	-0.20
Livestock and products	61.42	28.96	56.62	35.75	3.76	-1.45	-1.60	-4.35
Processed food	18.27	9.61	18.59	12.80	0.45	-1.25	-0.61	-1.55

Source: Estimated by authors.

Experiment-1 (EXP-1): Removing all agricultural supports and protections worldwide

Experiment-2 (EXP-2): Removing only tariffs worldwide

Experiment 3 (EXP-3): Removing only domestic supports in the developed countries

Experiment 4 (EXP-4): Removing only export subsidies worldwide

Table 5. Decomposition of agricultural production effects of global agricultural liberalization in the model

-- Percentage change in output of selected agricultural goods from the base year

	<i>EXP-1</i>			<i>EXP-2</i>			<i>EXP-3</i>			<i>EXP-4</i>		
	World	DCs	LDCs	World	DCs	LDCs	World	DCs	LDCs	World	DCs	LDCs
Wheat	2.12	1.23	2.70	1.20	5.02	-1.04	-0.04	-5.07	2.92	0.07	-1.03	0.71
Rice	-1.65	-8.42	0.91	-1.18	-6.05	0.59	-0.21	-1.19	0.15	-0.03	-0.34	0.09
Other grains	1.83	1.07	2.48	2.19	4.71	-0.27	-0.49	-3.18	2.13	-0.11	-0.43	0.20
Vegetable & fruits	0.25	0.60	0.10	0.39	0.56	0.28	-0.10	0.04	-0.20	0.02	-0.03	0.06
Oil and oilseeds	0.70	-5.28	4.84	1.04	2.02	0.32	-0.49	-6.99	4.28	-0.03	-0.03	-0.02
Sugar	-1.01	-10.09	3.21	-0.26	-6.18	2.32	-0.64	-2.72	0.27	-0.16	-1.68	0.50
Other crops	-0.28	-2.78	1.47	0.16	-1.37	1.22	-0.44	-1.44	0.27	-0.03	-0.04	-0.02
Livestock products	-1.04	-2.53	1.38	1.28	1.96	0.17	-1.90	-3.47	0.67	-0.24	-0.61	0.36
Processed food	-0.09	-0.33	0.46	1.00	1.46	-0.02	-0.96	-1.51	0.26	-0.11	-0.23	0.16

Source: Estimated by authors.

Experiment-1 (EXP-1): Removing all agricultural supports and protections worldwide

Experiment-2 (EXP-2): Removing only tariffs worldwide

Experiment 3 (EXP-3): Removing only domestic supports in the developed countries

Experiment 4 (EXP-4): Removing only export subsidies worldwide

Table 6. Decomposition of terms of trade effects of global agricultural liberalization in the model

-- Percentage change in terms of trade from the base year

	EXP-1	EXP-2	EXP-3	EXP-4
Developed country group	0.08	-0.02	0.03	0.06
Australia and New Zealand	1.82	1.40	0.37	0.03
Japan and Korea	-1.36	-0.84	-0.32	-0.14
United States	0.86	0.54	0.29	0.00
Canada	0.35	0.16	0.22	-0.02
European Union	0.24	0.02	0.01	0.16
EFTA	0.12	-0.27	-0.21	0.56
Developing country group	-0.15	0.03	-0.07	-0.11
China	0.26	0.36	-0.04	-0.06
Other Asian countries	0.00	-0.02	0.05	-0.04
Mexico	-0.43	-0.20	-0.15	-0.07
Latin America	1.41	1.10	0.32	-0.03
South African countries	-0.35	0.13	-0.20	-0.22
Rest of the world	-0.98	-0.43	-0.28	-0.23

Source: Estimated by authors.

Table 7. Decomposition of static welfare effects of global agricultural liberalization in the model

	EXP-1			EXP-2			EXP-3			EXP-4		
	U.S. billion (\$)	% of GDP	% of agr.	U.S. billion (\$)	% of GDP	% of agr.	U.S. billion (\$)	% of GDP	% of agr.	U.S. billion (\$)	% of GDP	% of agr.
World	31.06	0.13	1.21	25.22	0.11	0.98	2.80	0.01	0.11	0.25	0.00	0.01
Developed country group	28.48	0.16	2.04	19.56	0.11	1.40	4.74	0.03	0.34	2.53	0.01	0.18
Australia& New Zealand	1.57	0.44	4.46	1.17	0.33	3.33	0.24	0.07	0.69	0.01	0.00	0.03
Japan and Korea	8.59	0.27	2.41	13.81	0.43	3.87	-3.66	-0.11	-1.02	-1.34	-0.04	-0.38
U.S.	6.57	0.10	1.51	3.83	0.06	0.88	0.97	0.01	0.22	-0.09	0.00	-0.02
Canada	0.75	0.15	2.01	0.40	0.08	1.07	0.28	0.06	0.76	-0.09	-0.02	-0.25
European Union	9.28	0.14	1.81	0.14	0.00	0.03	6.06	0.09	1.18	3.72	0.06	0.73
EFTA	1.73	0.58	7.34	0.20	0.07	0.87	0.83	0.28	3.54	0.32	0.11	1.37
Developing country group	2.60	0.05	0.22	5.66	0.11	0.48	-1.94	-0.04	-0.16	-2.28	-0.04	-0.19
China	0.42	0.07	0.20	0.85	0.13	0.42	-0.28	-0.04	-0.14	-0.21	-0.03	-0.10
Other Asian countries	1.52	0.14	0.53	1.71	0.16	0.60	-0.09	-0.01	-0.03	-0.25	-0.02	-0.09
Mexico	-0.16	-0.06	-0.24	0.19	0.06	0.27	-0.27	-0.09	-0.41	-0.11	-0.04	-0.17
Latin America	3.65	0.28	1.64	2.71	0.21	1.22	0.68	0.05	0.31	-0.05	0.00	-0.03
South African countries	0.25	0.09	0.30	0.60	0.21	0.72	-0.22	-0.07	-0.26	-0.22	-0.08	-0.26
Rest of the world	-3.07	-0.18	-0.97	-0.39	-0.02	-0.12	-1.76	-0.10	-0.56	-1.43	-0.08	-0.45

Source: Estimated by authors.

Experiment-1 (EXP-1): Removing all agricultural supports and protections worldwide

Experiment-2 (EXP-2): Removing only tariffs worldwide

Experiment 3 (EXP-3): Removing only domestic supports in the developed countries

Experiment 4 (EXP-4): Removing only export subsidies worldwide

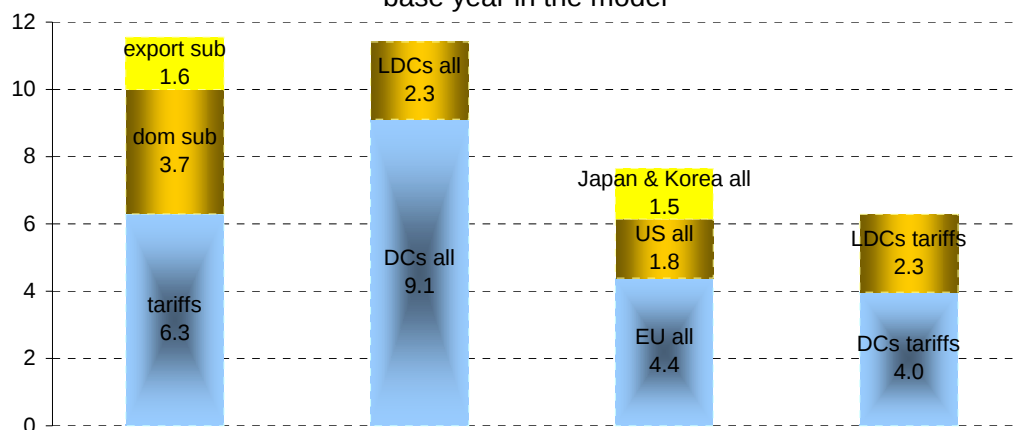
Table 8. Dynamic welfare effects of global agricultural liberalization in the model

	Without TFP growth							With TFP growth						
	Year 5		Year 10		Year 15		Intertemporal effect	Year 5		Year 10		Year 15		Intertemporal effect
	\$billion	%	\$billion	%	\$billion	%	%	\$billion	%	\$billion	%	\$billion	%	%
World	15.94	0.07	30.19	0.13	36.26	0.16		27.17	0.12	46.98	0.20	56.39	0.24	
Developed country group	14.69	0.08	25.66	0.14	29.74	0.17		17.00	0.10	29.59	0.17	35.14	0.20	
Australia and New Zealand	3.26	0.91	3.34	0.93	3.40	0.94	0.45	3.32	0.92	3.43	0.95	3.52	0.98	0.46
Japan and Korea	-1.40	-0.04	3.86	0.12	5.10	0.16	0.00	-0.85	-0.03	4.70	0.15	6.17	0.19	0.00
United States	8.72	0.13	10.60	0.16	11.76	0.18	0.11	9.18	0.14	11.59	0.17	13.30	0.20	0.12
Canada	1.05	0.21	1.17	0.24	1.24	0.25	0.07	1.13	0.23	1.27	0.26	1.37	0.28	0.07
European Union	3.35	0.05	6.68	0.10	8.15	0.12	0.03	4.41	0.07	8.48	0.13	10.58	0.16	0.04
EFTA	-0.27	-0.09	0.02	0.01	0.09	0.03	-0.03	-0.18	-0.06	0.12	0.04	0.21	0.07	0.00
Developing country group	1.25	0.02	4.52	0.09	6.52	0.12		10.16	0.19	17.39	0.33	21.25	0.40	
China	1.24	0.20	1.68	0.26	1.83	0.29	0.11	1.48	0.23	2.02	0.32	2.23	0.35	0.14
Other Asian countries	-0.70	-0.06	0.54	0.05	0.93	0.09	-0.02	2.10	0.19	4.47	0.41	5.11	0.47	0.13
Mexico	-0.40	-0.14	-0.22	-0.07	0.09	0.03	-0.04	0.53	0.18	0.99	0.33	1.60	0.54	0.14
Latin America	3.94	0.30	4.27	0.33	4.66	0.36	0.16	4.62	0.35	5.36	0.41	6.11	0.47	0.19
South African countries	0.16	0.06	0.33	0.11	0.50	0.17	0.05	0.35	0.12	0.59	0.20	0.81	0.28	0.08
Rest of the world	-3.00	-0.17	-2.07	-0.12	-1.49	-0.08	-0.18	1.07	0.06	3.97	0.26	5.39	0.32	0.00

Source: Estimated by authors.

Figure 1: Decomposition of price effects of global agricultural liberalization (1)

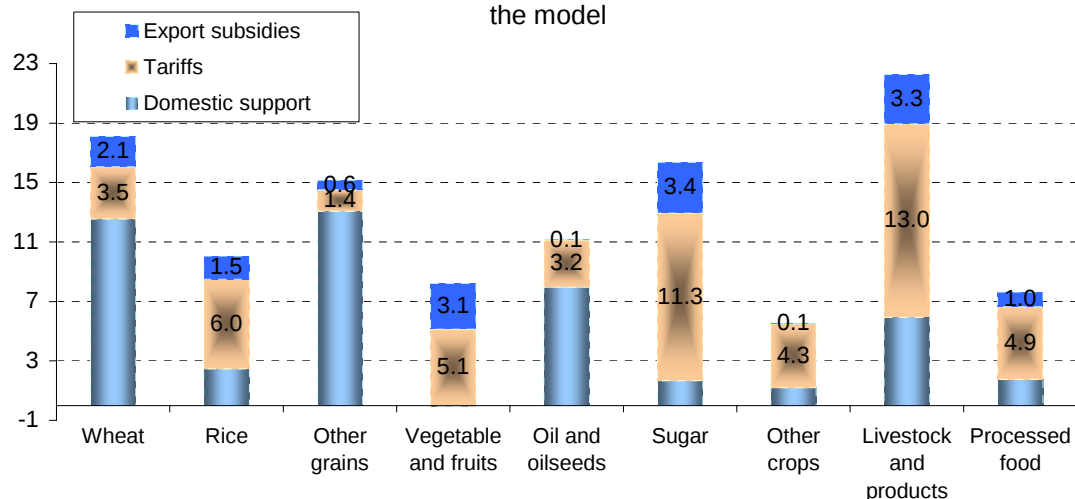
-- Percentage change in world agricultural price index from the base year in the model



Source: Estimated by authors.

Figure 2: Decomposition of price effects of global agricultural liberalization (2)

-- % change in selected world commodity prices from the base year in the model



Source: Estimated by authors.

I-1. Agricultural sectoral aggregation in the study

Sectors in the model	Sectors in GTAP data
Rice	Paddy rice, processed rice
Wheat	Wheat
Corn and other cereal grains	Corn and other cereal grains
Vegetable and fruits	Vegetable, fruits and nuts
Oil seeds and products	Oil seeds, vegetable oil
Sugar	Sugar cane and sugar beet, sugar
Other crops and products	Plant-based fibers, other crops
Livestock and products	Bovine cattle, sheep and goats and meats, other animal products, raw milk and dairy products, wool, and silk-worm cocoons
Other processed food sector	Beverages and tobacco products, and other processed food products

I-2. Countries and regions included in the study

1) Australia and New Zealand; 2) China, including Hong Kong; 3) Japan and Korea; 4) The other Asian countries; 5) Canada; 6) The United States; 7) Mexico; 8) Latin American countries; 9) the European Union; 10) the European Free Trade Area; 11) South African countries; 12) the rest of the world