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**A GLOBAL ANALYSIS OF AGRICULTURAL  
TRADE REFORM IN WTO MEMBER COUNTRIES**

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# **A Global Analysis of Agricultural Trade Reform in WTO Member Countries**

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## **Abstract**

The effect on production, trade and well-being from the granting of market access, removing export subsidies, and eliminating trade-distorting forms of direct support to farmers in WTO member countries is analyzed from a world-wide general equilibrium perspective using the most recently available data. The results suggest that removing trade barriers, subsidies and 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 the developed countries is found to be the major cause of low agricultural prices, and implicitly, a tax on net agricultural exporters in developing countries. Livestock product prices are likely to increase the most from the reform of agricultural policies. Reform increase world trade in agricultural commodities, but the level of total agricultural production is left almost unchanged. In the short to medium term, some net agricultural importing countries are likely to suffer a welfare loss due to an adverse change in their terms of trade that reform causes. However, in the longer-run, reform of agricultural policies is found to benefit almost all countries and developing countries in particular due to the change reform induces in their pattern of investment, growth in capital stock, and to growth in their total factor productivity.

**J.E.L.** Classification: Q17, F13

**Key Words:** WTO, Agricultural Policy Reform, Trade Liberalization

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# **A Global Analysis of Agricultural Trade Reform in WTO Member Countries**

## **1. Introduction**

The Uruguay Round (UR) of the negotiations brought agriculture under the discipline of the GATT for the first time. The signatories to the UR 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: domestic support, border protection and export subsidies. The new negotiations on agriculture present an opportunity to achieve further reductions of policy distortions in global agriculture. Agricultural trade barriers and producer subsidies inflict policy distortions in global agriculture. With the growth in the globalization of the world economy since the previous round, more emphasis has been placed on the need to evaluate the costs of current trade and domestic policy distortions and the potential benefits from their full elimination in a global context, and in the context of a world economy with increased capital flows.

The general purpose of this study is to assess the possible global impacts of further agricultural liberalization in some sector detail from a static-snapshot perspective, and in far less detail from a long-run dynamic perspective. For this purposes we have chosen to analyze the case of profound policy reform, i.e., the elimination of most of agricultural support and trade protection throughout the world. A global analysis of this type provides insights into what is at stake in world agricultural negotiations, and suggests the likely greatest effects on countries, both positive and negative, of the new agricultural negotiations.

Following the Agreement on Agriculture in the Uruguay Round, we focus on the three disciplines: market access (trade barriers), export subsidies and domestic support. In general, trade barriers help keep inefficient domestic producers in operation, result in forgone opportunities for a more efficient allocation of national resources, and lower demand for trade partners' products. Domestic subsidies induce an oversupply of some agricultural products and help to retain resources in these agricultural sectors that can be used more profitably in other sectors. The oversupply of agricultural commodities leads to low prices and unfair competition for producers in other countries and can create the need for export subsidies to dispose of excess domestic production. Consumers are harmed not just by tariffs, which directly raise the cost of imports, but also by the negative effects that tariffs and subsidies have on the total return's to labor, capital and other resources that make up consumer income. Further, the short to medium-run effects

of policy reform on well-being can depart from the long-run effects due to changes in the longer-run pattern of investment and capital accumulation that reform induces.

## **1.1 The context of the analysis**

To understand the individual and complementary effects of the various policy reforms on the global economy, we decompose the global effects of a full reform by type of policy being used and by country and commodity. Specifically, we choose 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) the combination of (1) – (3). It is important to identify specific country-region effects as real negotiations are often on a country basis. Moreover, countries are affected differentially by different policies, as some are net exporters of agricultural goods, others are net importers. Also, the composition of agricultural exports from developed countries tends to vary from those of developing countries. Thus, to identify country's/region's effects, we further decompose the scenarios (1) – (4) by regional options. For example, we address 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?

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

## **1.2 Important assumptions**

The foundation for the analysis is an assessment of current levels of agricultural tariffs, domestic support and export subsidies, and the use of tariff rate quotas. As the applied tariff rates are not available for many countries, the bound rates of tariffs are used instead. Data about non-tariff barriers 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. Data on the gap between domestic prices and border prices are used to calculate the quota tariff equivalent rates. These estimates are taken from ERS/USDA (2000).

Other caveats need to be noted. First, tariff rates and tariff equivalent rates are based on the data in 1998. Since tariff reductions have been undertaken by many countries after 1998, and since the bound rates are much higher than the applied rates in many cases, our analysis may overestimate the extent of tariff reduction that are presumed to take effect after 2000 for the case of some countries. In the case of other countries and commodities, various non-tariff barriers are still in place, and hence, the tariff reduction cannot represent the full elimination of import barriers. Our analysis in this situation may underestimate the extent of all import barriers.

Second, the analysis focusing on the effect of domestic support on world agricultural markets considers only the elimination of support in Australia, New Zealand, Japan, Korea, the United States, Canada, the EU, and the three countries in the European Free Trade Area. The removal of support in other countries is not considered. However, the analysis does take into account that fact that many countries have recently adopted less distorting forms of farm support, and that there are differences in the effects of coupled and decoupled government payments received by farmers on production and trade. For example, if subsidies were implemented by subsidizing intermediate inputs in grain production (coupled), the policy would affect farmers' production decisions, and hence, removing such subsidies would affect farmer's supply response. When such subsidies are eliminated, farmers have incentives to adjust their planting structure, possibly allocating more land to other crops. On the other hand, if the government chose direct payments to the owners of all farmland and with no crop targeting (decoupled), the policy 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. For these reasons, we focus on the coupled farm subsidies and quantify the effects of eliminating such domestic support on production and trade.

Third, we assume that labor and capital are mobile between agriculture and the non-agricultural sectors of an economy. Relaxing this assumption would slow the supply response from countries having a comparative advantage in world agricultural markets, which may cause world agricultural prices to rise more than predicted by our analysis. Moreover, we assume that labor is fully employed. 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.

Several other key assumptions are also made. These are highlighted in the context of the specific analysis below.

## **2. 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 the levels of border protection and domestic support. The average rates of tariff equivalents are calculated using the data included in the GTAP Database version 5 for 1998, while the average rates of export subsidies and domestic support are provided by ERS (2000), as the GTAP database is inadequate in capturing the levels of export subsidies and domestic support. The average world agricultural tariff equivalent rate is 22 percent. This rate is calculated as the ratio of the total revenues of all countries' agricultural tariff equivalents to the value of their total agricultural imports. The average world export subsidy rate is 2.9 percent, and computed similarly. The domestic support rate for the developed country group is 5.3 percent (table A1 in the Appendix).

If we eliminate, world-wide, all tariffs (and tariff equivalents) on agricultural imports, export subsidies and domestic support, the results suggest that the index of

world agricultural prices would rise by 11.6 percent relative to the level of world non-agricultural prices. Since China is not a participatory member of the WTO at this time, this result is obtained without taking into account further agricultural liberalization in China. If agriculture were also liberalized in China, the index of world agricultural price would rise by 12.2 percent, instead of 11.6 percent. In other words, the effect of the equivalent level of reform in China's agricultural policies to that which is presumed for other WTO members would cause world agricultural prices to rise by about 0.6 percent. In the following discussion, we presume that China maintains her current policies.

Given these considerations, the results suggest that eliminating border protection alone, world-wide, accounts for more than 50 percent of 11.6 percent increase in world agricultural prices. That is, when we hold other policy variables constant and only eliminate agricultural import tariffs, world agricultural prices rise by 6 percent, again, relative to world non-agricultural prices (table 1). This result obtains because import barriers protect domestic producers by restricting imports. Restricting imports causes, in many *import*-protecting countries, domestic consumers to face food prices that are higher than world prices while at the same time induces these countries to employ too many resources in agriculture. When import tariffs are eliminated, the demand for agricultural imported goods can rise (table 3), while supply contracts thus placing upward pressures on world agricultural prices. These upward pressures in turn induce agricultural *exporting* countries to increase production.

Eliminating domestic support in the developed countries mentioned in Section 1.2 appears to contribute more than 30 percent to the rise in world agricultural prices. In other words, when we hold other policy variables constant and only eliminate domestic support in the developed countries, world agricultural prices rise by 3.6 percent. 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 buildings and owner-operator labor. In response to such a policy change, farmers in these countries are induced to reduce production, thus placing upward pressures on world prices.

Eliminating total export subsidies world-wide appears to be a minor factor contributing to a rise in world agricultural prices. However, for the cases of sugar and livestock products, the elimination of these subsidies causes their prices to rise by more than 3 percent (table 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 A1). When we hold other policy variables constant and only eliminate the agricultural export subsidies world-wide, the world agricultural price rises by 1.5 percent relative to the price of non-agricultural goods.

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

If we decompose the pressures on the rise in world prices by developed – developing country groups, we find that agricultural liberalization in the developed

**Table 1. Decomposition of World Agricultural Price Effects of Global Agricultural Liberalization**  
**-- Percentage Change in World Agricultural Price Index from the Base Year**

|  |              |
|--|--------------|
| Removing agricultural support and protection in all regions              | <b>11.55</b> |
| Removing agricultural support and protection in all developed countries  | 9.11         |
| Removing agricultural support and protection in the EU                   | 4.39         |
| Removing agricultural support and protection in Japan and Korea          | 1.51         |
| Removing agricultural support and protection in the US                   | 1.75         |
| Removing agricultural support and protection in all developing countries | 2.32         |
| Removing agricultural tariffs by all regions                             | <b>6.03</b>  |
| Removing tariffs in developed regions                                    | 3.77         |
| Removing tariffs in the EU   | 1.47         |
| Removing tariffs in Japan and Korea                                      | 1.37         |
| Removing tariffs in the US   | 0.66         |
| Removing tariffs in developing regions                                   | 2.30         |
| Removing agricultural support in developed regions                       | <b>3.55</b>  |
| Removing domestic support in the EU                                      | 1.96         |
| Removing domestic support in Japan and Korea                             | 0.15         |
| Removing domestic support in the US                                      | 0.93         |
| Removing agricultural export subsidies in all regions                    | <b>1.49</b>  |
| Removing export subsidies in developed regions                           | 1.47         |
| Removing export subsidies in developing regions                          | 0.02         |

**Table 2. Decomposition of World Agricultural Price Effects of Global Agricultural Liberalization**

**-- Percentage Change in World Agricultural Price by Sector from the Base**

|                        | <i>EXP-1</i> | <i>EXP-2</i> | <i>EXP-3</i> | <i>EXP-4</i> |
|------------------------|--------------|--------------|--------------|--------------|
| Wheat                  | 18.11        | 3.35         | 11.99        | 1.96         |
| Rice                   | 10.05        | 5.87         | 2.39         | 1.50         |
| Other grains           | 15.15        | 1.35         | 12.23        | 0.59         |
| Vegetable and fruits   | 8.16         | 4.94         | -0.06        | 2.96         |
| Oil & oilseeds         | 11.18        | 3.09         | 7.78         | 0.06         |
| Sugar                  | 16.36        | 10.88        | 1.61         | 3.31         |
| Other crops            | 5.57         | 4.22         | 1.17         | 0.07         |
| Livestock and products | 22.27        | 12.16        | 5.53         | 3.09         |
| Processed food         | 7.63         | 4.83         | 1.75         | 0.98         |

EXP-1: Removing all agricultural support and protection in the world

EXP-2: Removing tariffs in the world

EXP-3: Removing domestic support in the developed countries

EXP-4: Removing export subsidies in the world



**Table 3. Decomposition of World Agricultural Trade Effects of Global Agricultural Liberalization**  
**-- Percentage Change in Total Agricultural Trade from the Base Year**

|   | Value | Volume |
|---|-------|--------|
| Removing agricultural support and protection in 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  |

countries explains about 80 percent of the rise in world agricultural prices. That is, eliminating agricultural support and trade protection in the *developed* country group only, world agricultural prices are estimated to rise by 9 percent relative to non-agricultural prices (table 1). Eliminating trade protection in the *developing* country group, world agricultural prices only rise by 2.3 percent.

There are three reasons that help to explain why liberalization in the developed countries causes world agricultural prices to rise. First, as a group, developed countries import more agricultural goods than do developing countries. If we ignore intra-regional trade among the member countries of the EU and the European Free Trade Area member countries, developed countries' imports accounted for about 57 percent of world agricultural trade. Moreover, the developed country group has an average agricultural tariff (equivalent) rate of 24 percent compared to a rate of 20 percent for the developing country group (table A1). This high rate is mainly due to the high rates for grain and livestock product imports by Japan, Korea, the EU and the member countries of the European Free Trade Area (see table A2), while 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 A1). Finally, domestic support policies have been mainly employed by the developed countries.

Since agricultural support and protection rates in the developed countries are higher than those in the developing countries, and since the developed countries are major players in world agricultural markets, it is a logical result that liberalizing their 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 by 4.4 percent. In other words, more than one-third of the world price increase that would come about from total world liberalization is due to liberalization in the EU. Ranking second in this regard is the U.S., while Japan and Korea rank third. When we hold the policy variables constant for the other countries and only eliminate the agricultural support and trade protection in the U.S., world agricultural prices rise by 1.8 percent. Liberalization of Japan's and Korea's agriculture causes world agricultural prices to rise about 1.5 percent (table 1).

## **2.2. 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 trade faces the highest level of import protection and export subsidies in comparison to the other agricultural commodity categories (table A1). 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, the results suggest that world livestock product price would rise by about 22 percent, while grain and other crop prices rise by 6 - 18 percent (table 2). Again, the developed countries appear to be the major reason for the rise in world

livestock product prices. This result is due to the fact that developed countries dominate world trade in this sector, as well as highly protecting the sector from import competition (table A2).

The resulting high 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, end up facing 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.

### **3. Liberalization enhances trade, but among sectors, production is affected differently**

In general, freer trade is expected to result in more trade. Our model results indicate that world agricultural trade is likely to increase substantially after liberalization. Removing all agricultural support and protection world-wide results in an increase in the value of world agricultural trade by about 30 percent. By deflating to account for changing prices, the volume of world trade is calculated to rise by 15 percent (table 3).

Agricultural exports from *developed* countries raise by 32 percent, while exports from *developing* countries increase by 27 percent. Thus, the corresponding increase in the volume of exports from the developing countries is larger than the increase from the developed countries (16 vs. 14 percent, respectively). This interesting 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 above, world livestock product prices could rise by 22 percent, the world prices for the non-grain crop product categories rise by 6 - 11 percent (except for sugar of which the world price rises by 16 percent, table 2).

The removal of import protection is a dominant factor causing the increased growth in world agricultural trade. When we only eliminate agricultural tariffs in the world, world trade rises by 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. This disparity is due to the relatively high protection rates in the developed country group. Moreover, developed country group's exports rise more than the increase in its imports, both in the value and volume, while the developing country group's 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 we only eliminate the agricultural export subsidies world-wide, world agricultural trade falls by 0.7 percent in value and 1.8 percent in volume. If we only eliminate domestic support in the developed countries, world agricultural trade rises by 2.8 percent in value but falls slightly (by 0.7 percent) in the 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 non-subsidized sectors. Their removal can decrease total trade depending upon how consumers allocate the savings from the former taxes needed to finance the subsidies and the extent to which the other non-subsidized 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 subsidies are removed world-wide, 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 world-wide, the developing country group's exports would rise by 0.5 percent in value and 0.2 percent in volume, while the developed country group's exports fall by 1.4 and 3 percent in value and volume, respectively. When the domestic subsidies are eliminated in *developed* countries, the *developing* country group's exports rise by 5.5 and 3.4 percent in the value and volume, while the developed country group's exports rise 0.9 percent in value and fall by 3.4 percent in volume (table 3). 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 others 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.

### **3.1. Grains, sugar, and livestock product trade rises more after liberalization**

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

Once again, the increase in both developed and developing regions' grain, sugar, and livestock product exports is mainly due to liberalization in the developed countries. When we only eliminate agricultural support and trade protection in the developed countries, the world trade of rice, wheat, sugar, and livestock products rises by 70, 30, 35,

**Table 4. Decomposition of World Agricultural Trade Effects of Global Agricultural Liberalization**  
**-- 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 & 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  |

EXP-1: Removing all agricultural support and protection in the world

EXP-2: Removing tariffs in the world

EXP-3: Removing domestic support in the developed countries

EXP-4: Removing export subsidies in the world

**Table 5. Decomposition of Agricultural Production Effects of Global Agricultural Liberalization  
-- 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 and 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 & 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 and 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  |

EXP-1: Removing all agricultural support and protection in the world

EXP-2: Removing tariffs in the world

EXP-3: Removing domestic support in the developed countries

EXP-4: Removing export subsidies in the world

**Table 6. Decomposition of Terms of Trade Effects of Global Agricultural Liberalization**

**-- Percentage Change in Terms of Trade from the Base Year**

|                           | EXP-1        | EXP-2        | EXP-3        | EXP-4        |
|---------------------------|--------------|--------------|--------------|--------------|
| Developed country group   | <b>0.08</b>  | <b>-0.02</b> | <b>0.03</b>  | <b>0.06</b>  |
| Australia and New Zealand | 1.82         | 1.40         | 0.37         | 0.03         |
| Japan and Korea           | -1.36        | -0.84        | -0.32        | -0.14        |
| USA                       | 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         |
| EFT                       | 0.12         | -0.27        | -0.21        | 0.56         |
| Developing country group  | <b>-0.15</b> | <b>0.03</b>  | <b>-0.07</b> | <b>-0.11</b> |
| 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        |

EXP-1: Removing all agricultural support and protection in the world

EXP-2: Removing tariffs in the world

EXP-3: Removing domestic support in the developed countries

EXP-4: Removing export subsidies in the world

and 50 percent, respectively. Reversing the experiment, by holding the developed country group unchanged, we find that world trade in grains, other crops, and livestock products only rise by 4 – 12 percent (table 4).

### **3.2. 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. However, for some commodities, such as wheat, the effect is relatively large. Moreover, the change in production is not always in the same direction as is the change in net trade. For example, the value of world rice trade increases almost 80 percent when all the agricultural support and trade protection are removed world-wide, while the world-wide production of rice falls by 1.7 percent (table 5). In addition, rice production falls by 8.4 percent in the developed country group, due to almost 20 percent of decline in Japan and Korea, while rice production rises by 1 percent in the developing country group. It is well known that rice imports have been strictly restricted in Japan and Korea 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 world-wide, so that all farmers in different countries face essentially the same price, the disadvantage of rice production in Japan and Korea becomes obvious and hence their production falls.

Besides rice, the production of sugar (including sugar crops and raw sugar), other crops, and livestock products also falls slightly in the world after the reform (table 5). Such decline is due to the decline in production in the developed country group, while production of these commodities rises in the developing country group. The rise in production of these commodities in the developing countries however is not sufficient to cover the fall in production in the developed countries. For example, sugar production falls by 1 percent in the world and 10 percent in the developed country group when all the agricultural support and trade protection are removed world-wide, while sugar production rises by 3.2 percent in the developing country group. Some developed countries, such as Japan, member countries of EU, the European Free Trade Area, and the U.S. highly protect sugar sector by both high level of tariffs and export subsidies. Eliminating agricultural protection world-wide 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 European Free Trade Area, and almost 10 percent in the U.S.

Wheat production is observed to increase the most among agricultural commodities when all agricultural support and trade protection are removed world-wide. The results suggest that world wheat production is likely to rise by almost 2 percent, and rises more than 1 percent in the developed country groups, mainly due to the increases in Australia and New Zealand, Canada, and the U.S. These countries appear to hold a strong comparative advantage in wheat production. Wheat production rises almost 3 percent in the developing countries. For example, U.S. wheat production would rise by 9 percent,



mainly due to the tariff removal in other countries. In the other developed countries, such as Japan and EU, wheat production falls considerably (30 and 18 percent, respectively).

Tariffs, export subsidies and domestic support have quite different effects on production levels among different countries. Removing tariffs world-wide would stimulate production in most agricultural sectors (except for rice and sugar), though quite small for most sectors. Corn and other grains is an exception as production rises by more than 2 percent in this aggregate sector. Under this scenario, wheat and corn and other grain production mainly rises in the developed country group (about 5 percent), while their production falls slightly in the developing country group. However, sugar and other crops' production rise by 2.3 and 1.2 percent, respectively, in the developing country group and falls by 6.2 and 1.4 percent, respectively, in the developed country group (table 5). Under this scenario, besides a 5 percent of rise in U.S. wheat production, U.S. corn and other grain, and livestock production also rise by 5 and 7 percent, respectively.

In contrast to tariff liberalization, the results suggest that removing export subsidies only world-wide or only removing domestic support in the developed countries would have a negative, though almost negligible, effect on most agricultural production. The negative effect on the developed countries' agricultural production is much larger than that on the world production level, while production rises in most sectors in the developing country group (table 5). For example, removing domestic support in the developed countries causes production of oilseeds and vegetable oil to fall by 0.5 percent in the world, but fall almost 7 percent in the developed country group, and rise more than 4 percent in the developing country group. Oilseeds and vegetable oil production falls the most in the EU (fall by 19 percent) due to oilseed production is highly supported in the EU in the base data. Under this scenario, U.S. grain production would fall, for example, wheat would fall by 5 percent and corn by 1.2 percent.

#### **4. Welfare effects of reforming agricultural policies are mixed**

From a world perspective, the 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, from the global perspective, and especially when the world price is affected by agricultural liberalization, the welfare effect across countries varies.

The results of our analysis of the welfare effects of reform suggests that consumers can be made worse off if the country's terms of trade deteriorate following liberalization. That is, if the prices of the goods they export fall relative to the prices of goods they import, then consumers can be made worse since their expenditures on imported goods increase while their income from exported goods falls. Moreover, consumers in a small 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 may import more from those trade partners for whom, prior to reform, the country imposed high tariff rates. While, post reform, the country imports less from

trade partners for which prior to reform it imposed low tariff rates. In this case, consumers in this type of a country may experience negative effects from the world-wide trade reform.

#### 4.1 Small one-time welfare gains

We use the well-accepted equivalent variation (often referred to as the willingness to pay) to measure the social welfare gains or losses due to agricultural liberalization. We consider both one-time welfare effects and welfare effects over time. The one-time effects are measured by using 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 liberalization (Varian, 1984). The welfare effects over time are measured by summing the discounted value of this measure over time.

As table 7 shows, the one-time effects of agricultural liberalization on nation's social welfare appear relatively small among all countries/regions. The reason for this result is that, relative to non-agriculture, agriculture accounts for a small share of GDP. Further, agricultural goods in consumer's consumption bundle in most countries, and particularly so in the developed economies of Europe and North America, are relatively small in proportion to their total expenditures. Taking the developed and developing countries as two separate groups, agriculture (including processed food products) only accounts for less than 5 and 15 percent, respectively, of these two groups' GDP. 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 liberalization alone is unlikely to have a large one-time welfare effect on the aggregate economy in the short to medium-run.

Nevertheless, these relatively small *aggregate* welfare effects for the case of developing countries can be seriously misleading. The reason is two fold. First, it is well known that in low-income countries a majority of the poor 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 less own consumption) is closely linked to foreign markets. Thus, the national level effects of reform mentioned above are likely to be small in proportion to the benefits received by rural households, and in particular, rural households whose disposable income ranks them in the bottom quintile of a country's distribution of income.

Given these caveats, the welfare effects are positive for the world aggregate. The sum of countries' equivalent variation is about 30 billion U.S. dollars due the world-wide agricultural liberalization. This is equivalent to 0.1 percent of world aggregate GDP, and one percent of consumers' expenditure on agricultural and agriculture-related goods (table 7, *EXP-1*). Such welfare gains are not equally distributed among countries and regions in the world, and for some countries, the welfare effect is even negative. The developed countries are estimated to experience a 28 billion dollar welfare gain, which is equivalent to 0.16 and 2 percent of their GDP and consumers' expenditure on agricultural

**Table 7. Decomposition of Static Welfare Effects of Global Agricultural Liberalization**

|                           | <i>EXP-1</i> |                        |                       | <i>EXP-2</i> |                        |                       | <i>EXP-3</i> |                        |                       | <i>EXP-4</i> |                        |                       |
|---------------------------|--------------|------------------------|-----------------------|--------------|------------------------|-----------------------|--------------|------------------------|-----------------------|--------------|------------------------|-----------------------|
|                           | Billion (\$) | % in total expenditure | % to agr. consumption | Billion (\$) | % in total expenditure | % to agr. consumption | Billion (\$) | % in total expenditure | % to agr. consumption | Billion (\$) | % in total expenditure | % to agr. consumption |
| World                     | <b>31.06</b> | <b>0.13</b>            | <b>1.21</b>           | <b>25.22</b> | <b>0.11</b>            | <b>0.98</b>           | <b>2.80</b>  | <b>0.01</b>            | <b>0.11</b>           | <b>0.25</b>  | <b>0.00</b>            | <b>0.01</b>           |
| Developed country group   | <b>28.48</b> | <b>0.16</b>            | <b>2.04</b>           | <b>19.56</b> | <b>0.11</b>            | <b>1.40</b>           | <b>4.74</b>  | <b>0.03</b>            | <b>0.34</b>           | <b>2.53</b>  | <b>0.01</b>            | <b>0.18</b>           |
| Australia and 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                 |
| USA                       | 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                  |
| EFT                       | 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  | <b>2.60</b>  | <b>0.05</b>            | <b>0.22</b>           | <b>5.66</b>  | <b>0.11</b>            | <b>0.48</b>           | <b>-1.94</b> | <b>-0.04</b>           | <b>-0.16</b>          | <b>-2.28</b> | <b>-0.04</b>           | <b>-0.19</b>          |
| 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                 |

goods, respectively. Moreover, all developed countries in the model gain, with the largest gains of 9.3 billion dollars for the EU, 8.6 billion for Japan and Korea and 6.6 billion for the U.S.

The welfare gains for the developing country group is much smaller, 2.6 billion dollars. This is equivalent to 0.05 and 0.2 percent of their GDP and consumers' expenditure on agricultural goods. Furthermore, there are some countries/regions in which the welfare effect is negative. Mexico is estimated to experience a 160 million dollar welfare loss, which is equivalent to less than 0.06 percent of her GDP.

An import reason explaining why most developing countries experience smaller total welfare gains than do developed countries is that agriculture in developing countries is distorted by more than just agricultural policies. While the level of domestic support and trade protection in the nonagricultural sector 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 their countries' own manufacturing policies and distortions in service sector markets.

The negative effect of the world agricultural liberalization on Mexico and some other countries is mainly caused by, post reform, a deterioration in their terms of trade (table 6). To see this, consider Mexico. Mexico depends on the U.S. economy for both her agricultural imports and exports, while the U.S. is more dependent on Japan, Korea and the EU for agricultural exports. It is well known that Japan, Korea, and the EU highly protect agriculture relative to other countries. When world agriculture and agricultural trade are fully liberalized, increased import demand from Japan, Korea and EU on U.S. agricultural goods causes U.S. export prices to rise. This causes Mexico to pay high prices for imports from U.S., post-reform. On the other hand, there are much lower barriers to trade between U.S. and Mexico after the NAFTA. When world trade is fully liberalized, the U.S. imports from Mexico may not rise to the degree that imports rise from the non-NAFTA countries since, pre-reform, the U.S. imposed relatively high barriers to the goods imported from non-NAFTA countries. However, Mexico depends on U.S. imports, as her trade with U.S. accounts for more than 70 percent of Mexico's exports. This implies that the price Mexico receives for her exports cannot rise to the same degree as the rise in price it must pay for imports. The result is a deterioration in the country's terms of trade.

This interesting result implies that some member countries of a trade bloc may experience a welfare loss because, post reform, they suffer a decline in demand for the goods they export to former member countries, while world demand for the goods they import rise.

These results also attest to the fact that policies that distort agriculture in developed countries raise world supplies of the goods and thus indirectly subsidize consumers in countries that are net agricultural importers. Liberalization raises world prices of most agricultural goods, but 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 downwards 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.

#### **4.2 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 to most countries and regions, while removing domestic support and export subsidies has negative effects for most *developing* countries. Holding other policy variables constant, removing tariffs results in 25 billion U.S. dollar welfare gain world-wide, 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 world-wide, 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 removal of domestic support is 2.8 billion dollars and is 250 million from the removal of export subsidies. The gain for the developed countries as a group is 4.7 billion in the first case (domestic support removal) and 2.5 billion in the second (export subsidy removal). However, the developing countries as a group are observed to have 1.9 and 2.3 billion of welfare loss in the two cases, respectively.

Almost all developing countries/regions in the model (except for the Latin American countries) experience a welfare loss when the 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, we observe that for most developing countries/regions, their welfare measures tend to deteriorate due to the hike in the world agricultural prices.

The region of Japan and Korea is observed to have the largest decline (3.7 billion U.S. dollars) in welfare in the world when the developed countries remove their domestic support, even though the support rate in Japan and Korea on average is much lower than that in Canada, the U.S. and EU. This result occurs because these two countries are net agricultural importers, and agricultural prices rise in the world with agricultural supply declines in the U.S. and EU due to the removal of domestic support. If we presume that only the U.S. or the EU eliminates its domestic support to agriculture, the social welfare

in Japan and Korea falls by 2.1 and 0.55 billion dollars, respectively, while if Japan and Korea eliminate their domestic support only, their welfare falls by 0.66 billion dollars.

### **4.3 Relatively large dynamic welfare gains**

#### **4.3.1 A brief overview of method and assumptions**

The previous analysis ignored the affect 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 countries' trade. For developed countries, these assumptions may be closely approximated, and only poorly approximated for many developing countries. Nevertheless, for the most part, the analysis suggests direction of change in the long-run that seem well within the realm of reason.

Numerous studies have found 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 (for example, Coe and Helpman, 1995; Wang and Xu, 1997; and Coe, et. al., 1997). Thus, we use a dynamic model to not only capture consumer's saving and producer's 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 to adapt and adopt the more advanced product and process technologies that tend to be embodied in its imports from the developed countries. The result of this process is 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 happen by reducing agricultural protection in developed countries. In this case, 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 we show below, found to be higher for developing countries.

To measure the welfare gains in this dynamic setting, we calculate the change in the regional equivalent variation for three different years as well as the intertemporal welfare index. 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, as one would expect, depending on whether technological spillover-growth considerations are included in the analysis. Thus, we specify the welfare changes under the different assumptions, and hence the technological spillovers and growth effect of the liberalization on the welfare can be told from the differences in the two groups of results.

### **4.3.2 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 pay-off to reform takes time.

However, if the technological spillover-growth effect of liberalization is taken into account for the case of the 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 beneficiaries are assumed to generate an additional annual growth rate of 0.02 percent in the developing countries in average. With this 0.02 percent of more growth annually, welfare gains further increase 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 world-wide, and the greater the volume of trade between developed and developing countries, the larger is 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 there is no additional growth generated from trade liberalization. The main reason for this interesting and important result is that, with increased investment in the developing countries, developed countries gain from returns to capital flows, i.e., from financial support through the international financial capital market since 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 tends to be stronger if the economic adjustments in the developing countries due to agricultural liberalization in the world are expected to be larger. This win-win result is also consistent with the concluding comments of Summers (2000) in his Richard T. Ely Lecture at the year 2000's meetings of the Allied Social Science Association.

## **5. Conclusions**

This study focuses on the global perspectives of new agricultural negotiations under the WTO and, in the spirit of the commitments made by signatories to the UR Final Act (1994), analyzes the case of total reform under the three disciplines: domestic support, border protection and export subsidies. The study finds that freer trade results in more trade, i.e., eliminating most of agricultural support and trade protection increases world agricultural trade substantially. However, world agricultural production only

**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    | %           | %    | %                    |  |
| <b>World</b>                    | <b>15.94</b>       | <b>0.07</b> | <b>30.19</b> | <b>0.13</b> | <b>36.26</b> | <b>0.16</b> |                      | <b>27.17</b> | <b>0.12</b>     | <b>46.98</b> | <b>0.20</b> | <b>56.39</b> | <b>0.24</b> |      |                      |  |
| <b>Developed country group</b>  | <b>14.69</b>       | <b>0.08</b> | <b>25.66</b> | <b>0.14</b> | <b>29.74</b> | <b>0.17</b> |                      | <b>17.00</b> | <b>0.10</b>     | <b>29.59</b> | <b>0.17</b> | <b>35.14</b> | <b>0.20</b> |      |                      |  |
| 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 |                      |  |
| USA                             | 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 |                      |  |
| EFT                             | -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 |                      |  |
| <b>Developing country group</b> | <b>1.25</b>        | <b>0.02</b> | <b>4.52</b>  | <b>0.09</b> | <b>6.52</b>  | <b>0.12</b> |                      | <b>10.16</b> | <b>0.19</b>     | <b>17.39</b> | <b>0.33</b> | <b>21.25</b> | <b>0.40</b> |      |                      |  |
| 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 |                      |  |



increases marginally, with the largest decrease occurring in the developed countries. As agricultural support and protection rates are higher in some developed countries than those in the developing countries, and as the developed countries are major players in world agricultural trade, developed countries appear to benefit more from liberalization than do the developing countries.

Nevertheless, world-wide agricultural liberalization would cause world prices to rise. Of the three categories, domestic support, boarder protection, and export subsidies, the results suggest that boarder protection is the major cause of distortions in world agricultural prices. The elimination, world-wide, of import tariffs would cause world agricultural prices to rise by about 6 percent.

Within the developed country group, the major contributors to distorted world agricultural prices are EU, the U.S., and Japan and Korea. Consequently, these countries experience the largest social pay-off from reform relative to the rest of the world in general, and the developing countries in particular. As the protection levels and trade patterns vary among countries, some developing countries experience larger increase in the prices for importing 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, post reform, they may suffer a decline in demand for the goods they export to former member countries, while world demand for the goods they import rise.

The study also finds that the pay-off to the liberalization takes time. Over time, world-wide agricultural liberalization generates larger gains than the short-time gains for most countries. For example, the study suggests that 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 liberalization 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 is caused by the growth in the returns to increased capital flows from developed to developing countries, induced by the increased investment demand of the developing countries.

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## Appendix

### 1. Agricultural sectoral aggregation in the study

| <i>Sectors in the model</i>  | <i>Sectors in GTAP data</i>   |
|------------------------------|---|
| 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   |

### 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

**Table A1. Summary of Agricultural Support and Protection Data in the Base Year (1997)**

|                                 | Rate of Tariffs (1) | Rate of export subsidies (2) | Rate of domestic supports (3) |
|---------------------------------|---------------------|------------------------------|-------------------------------|
|                                 | ----Percentage ---  |                              |                               |
| <b>World average</b>            | 22.09               | 2.87                         |                               |
| Developed country group         | 23.67               | 4.79                         | 5.25                          |
| Developing country group        | 19.62               | 0.13                         |                               |
| <b>World sectoral average</b>   |                     |                              |                               |
| 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                         |                               |
| <b>Developed country group</b>  |                     |                              |                               |
| 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                          |
| <b>Developing Country group</b> |                     |                              |                               |
| 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                         |                               |
| <b>Regional average</b>         |                     |                              |                               |
| Australia and New Zeland        | 5.12                | 0.01                         | 0.19                          |
| Japan and Korea                 | 47.49               |                              | 2.43                          |
| USA                             | 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               |                              |                               |

**Table A2. Regional Agricultural Tariff Rates by Sector in the Base Year (1997)**

|                           | Wheat              | Rice        | Other grains       | Vegetable&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            |
| USA                       | 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&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             |                  |
| USA                       | 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            |                  |

**Table A3. Sensitivity Test: Effects of Removing Domestic Supports in the Developed Countries  
With and Without Land Based Payments Removal**

--- Percentage change from the base year

|                                  | <i>Without land based payment removal</i>            |      |       |       |        |        |        |
|----------------------------------|--|------|-------|-------|--------|--------|--------|
|                                  | World  | ANZ  | JPK   | USA   | Canada | EU     | EFT    |
| World Agricultural Price         | 3.55   |      |       |       |        |        |        |
| Wheat                            | 11.99  |      |       |       |        |        |        |
| Corn and other grains            | 12.23  |      |       |       |        |        |        |
| Oilseeds abd vegetable oil       | 7.78   |      |       |       |        |        |        |
| Returns to Farmland              |  | 4.11 | -1.28 | -1.38 | 1.93   | -7.26  | -21.43 |
| Total social welfare (\$billion) |  | 0.24 | -3.66 | 0.97  | 0.28   | 6.06   | 0.82   |
|                                  |  |      |       |       |        |        |        |
|                                  | <i>With land based payment removal but decoupled</i> |      |       |       |        |        |        |
| World Agricultural Price         | 3.6  |      |       |       |        |        |        |
| Wheat                            | 13.04  |      |       |       |        |        |        |
| Corn and other grains            | 13.5   |      |       |       |        |        |        |
| Oilseeds abd vegetable oil       | 7.7  |      |       |       |        |        |        |
| Returns to Farmland              |  | 3.65 | -1.3  | -8.71 | -1.52  | -14.49 | -32.58 |
| Total social welfare (\$billion) |  | 0.25 | -3.89 | 1.04  | 0.31   | 5.92   | 0.83   |
|                                  |  |      |       |       |        |        |        |
|                                  | <i>With land based payment removal and coupled</i>   |      |       |       |        |        |        |
| World Agricultural Price         | 4.78   |      |       |       |        |        |        |
| Wheat                            | 22.09  |      |       |       |        |        |        |
| Corn and other grains            | 20.95  |      |       |       |        |        |        |
| Oilseeds abd vegetable oil       | 8.17   |      |       |       |        |        |        |
| Returns to Farmland              |  | 5.09 | -0.63 | -4.31 | 6.43   | -7.2   | -22    |
| Total social welfare (\$billion) |  | 0.37 | -6.5  | 1.23  | 0.34   | 5.52   | 0.81   |

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