

# Agricultural Tariffs or Subsidies: Which Are More Important for Developing Economies?

*Bernard Hoekman, Francis Ng, and Marcelo Olarreaga*

---

This article assesses the impact of the world price–depressing effect of agricultural subsidies and border protection in OECD countries on developing economies’ exports, imports, and welfare. Developing economy exporters are likely to benefit from reductions in such subsidies and trade barriers, whereas net importers may lose as world prices rise. A simple partial equilibrium model of global trade in commodities that benefit from domestic support or export subsidies is developed to estimate the relevant elasticities. Simulation results suggest that a 50 percent reduction in border protection will have a much larger positive impact on developing economies’ exports and welfare than a 50 percent reduction in agricultural subsidies. Although there is significant heterogeneity across developing economies, the results suggest that efforts in the Doha Round of WTO negotiations should be directed at substantially reducing border protection.

---

High tariffs and domestic support and export subsidies granted to farmers in high-income economies limit developing economy agricultural production and exports. Such policies boost production in high-income countries, depress world prices, exacerbate the volatility of world prices, and reduce the scope for import competition. High tariffs and domestic support policies may, however, benefit net importers of agricultural products by providing access to the subsidized commodities at lower prices.<sup>1</sup> Thus national interests regarding global reform

Bernard Hoekman is senior advisor in the Development Research Group at the World Bank and a research fellow at the Centre for Economic Policy Research, London; his e-mail address is [bhoekman@worldbank.org](mailto:bhoekman@worldbank.org). Francis Ng is an economist in the Development Research Group at the World Bank; his e-mail address is [fng@worldbank.org](mailto:fng@worldbank.org). Marcelo Olarreaga is a senior economist in the Development Research Group at the World Bank and a research affiliate at the Centre for Economic Policy Research, London; his e-mail address is [molarreaga@worldbank.org](mailto:molarreaga@worldbank.org). The authors are grateful to Ataman Aksoy, Morvarid Bagherzadeh, Bijit Bora, Gopi Gopinath, Harry de Gorter, Ashok Gulati, Tim Josling, Will Martin, Wojciech Stawowy, the editor, three anonymous referees, and participants at the conference “The Developing Countries, Agricultural Trade, and the World Trade Organization,” Whistler, June 16–17, 2002, for helpful comments and suggestions. They also thank Lili Tabada for assistance in constructing the database.

1. This potential national welfare benefit is offset by the higher price volatility created by support policies, as country-specific shocks may be transferred to world markets. Also, as noted by Falvey and Tyers (1989), even net importers of agricultural products can gain from world price increases in the presence of distortions that led them to become net importers. This article ignores both the impact of policies on world price volatility and the potential for trade-pattern reversals associated with distortions.

THE WORLD BANK ECONOMIC REVIEW, VOL. 18, NO. 2,

© The International Bank for Reconstruction and Development / THE WORLD BANK 2004; all rights reserved.  
doi:10.1093/wber/lhh037 18:175–204

of agricultural trade and support policies will differ. However, most analyses conclude that the overall gain to developing economies from reforming agricultural policies greatly outweighs the potential cost to countries that are significant net importers of subsidized agricultural products.

Negotiations were launched in 2000 in the World Trade Organization (WTO) to reduce trade-distorting interventions in agricultural markets, both subsidies (domestic support and export subsidies) and border protection (tariffs and tariff rate quotas). Developing economies need to determine which instruments of agricultural protection are most detrimental to their interests and therefore where to direct their negotiating efforts on agriculture in the Doha Round.<sup>2</sup> This article attempts to shed some light on the issue by assessing the relative impact of tariffs, domestic support policies, and export subsidies on exports, imports, and welfare in 144 countries, 120 of them developing. The article assesses the impact of a 50 percent global reduction in agricultural tariffs and compares this to a 50 percent cut in domestic support and export subsidies.<sup>3</sup>

In welfare terms, tariffs matter significantly more than subsidies in that tariff reductions generate greater welfare gains. In large part this is because of high tariff peaks in both Organisation for Economic Co-operation and Development (OECD) and developing economies in products subject to domestic support or export subsidies. More generally, domestic support tends to have a much smaller impact on world prices than tariffs.<sup>4</sup> The econometric analysis generates very small estimates of the elasticity of net imports with respect to domestic support. Although the estimated elasticity with respect to export subsidies is considerably larger, export subsidies are much smaller than domestic support, so that their overall impact on the trade and welfare of developing economies is relatively small. These findings support the analysis of Snape (1987), who emphasizes the importance of reductions in border barriers in cases where governments also use subsidies to support production. As border barriers are reduced, the cost to national treasuries of maintaining a constant level of agricultural support increases substantially. Thus, reducing border protection will discipline the ability of governments to employ subsidy programs.

A partial equilibrium framework is used to estimate the impact of policy changes for a sample of 144 countries on world prices of agricultural commodities that benefit from domestic support or export subsidies in at least one WTO member.

2. The policy simulation reflects a conservative interpretation of the Doha Ministerial Declaration: "We commit ourselves to comprehensive negotiations aimed at: substantial improvements in market access, reduction of, with a view to phasing out, all forms of export subsidies; and substantial reductions in trade-distorting domestic support" (WTO Doha Ministerial Declaration, para 13, November 2001).

3. Tariffs include the global ad valorem equivalent of specific tariffs and tariff rate quotas. Linear cuts in tariffs are assumed rather than a nonlinear tariff formula to facilitate comparison with cuts in domestic support and export subsidies. Francois and Martin (2003) discuss different nonlinear tariff reduction formulas that could be used in the Doha Round negotiations.

4. See, for example, Snape (1987), who argues that for a given amount of domestic production, tariffs lead to lower domestic consumption than do domestic subsidies and therefore to lower world prices.

The analysis focuses on 267 commodities, defined at the six-digit level of the Harmonized System (HS),<sup>5</sup> that benefit from domestic support or export subsidies. The analysis is restricted to this set of commodities so as not to bias the findings. Because most countries apply tariffs to all agricultural products, not just those that are subsidized, any comparison of the effect of reducing tariffs on all agricultural goods with a reduction in support policies is likely to conclude that tariffs are more important for developing economies.

The partial equilibrium approach allows assessment of the effects of policy changes on individual countries, including the low-income and least developed areas that are of particular concern to the development community. Most of these countries are generally subsumed in regional aggregates in applied general equilibrium models. The partial equilibrium approach also allows the use of disaggregated six-digit HS trade and protection data, and it allows estimation of trade elasticities directly from the data instead of using elasticities that have been estimated outside the data and the simulation model.<sup>6</sup>

#### I. AGRICULTURAL TARIFFS, DOMESTIC SUPPORT, AND EXPORT SUBSIDIES

There are 158 commodities at the HS six-digit level that benefit from direct domestic support in at least one WTO member. Total support reported to the WTO was some US\$227 billion a year on average during 1995–98 (appendix table A-1). Around \$108 billion of domestic support is in the so-called Green Box—support exempted from future reduction commitments because it is considered not to distort trade. Domestic support is used primarily by OECD countries, accounting for more than 88 percent of total domestic support payments notified to the WTO. The Quad group (Canada, European Union, Japan, and the United States) accounts for 84 percent. Their share of world support is greater than 99 percent in several products (milling products; animal and vegetable fats and oils; prepared fruit, vegetable, and nut products; beverages and spirits; silk; and certain vegetable textile fibers and yarn).

Developing economies also have become greater users of subsidies—they account for 12 percent of total domestic support reported to the WTO during 1995–98 (see appendix table A-1). Major subsidizers include Brazil, Thailand, and Venezuela. Not surprisingly, the least developed countries report no direct domestic support. Developing economies support many of the same commodities as high-income countries, but they also support activities that OECD members do not (live trees and flowers; coffee, tea, and spices; gums, resins, and other vegetable saps; cocoa; and miscellaneous edible preparations).

5. The Harmonized Commodity Description and Coding System (usually referred to as the Harmonized System or HS) is used for tariff classification. It is made up of 1,241 headings grouped into 96 chapters. It has 5,000 subheadings identified by a six-digit code.

6. For recent computable general equilibrium studies focusing on the same question, see Beghin and others (2002), Dimaranan and others (2002), Rae and Strutt (2002), and Tokarick (2003). These studies obtain qualitatively similar results (border barriers matter more than domestic support).

Meat, dairy products, cereals, and sugar account for the lion's share of domestic support, representing almost 82 percent of reported nonexempt domestic support. They represent 78 percent of the \$88 billion in domestic support provided by the Quad, 97 percent of the total for other OECD countries, and 93 percent for developing economies. This product concentration across regions is reflected in the high correlation across products of the domestic support provided by the Quad and by other groups. The correlation coefficient is 0.87 between domestic support in the Quad and in developing economies and 0.67 in the case of the Quad and other OECD countries.

Export subsidies are also concentrated in a limited number of commodities. There are 208 tariff lines at the HS six-digit level that are subject to export subsidies in at least one WTO member. Export subsidy commitments across WTO member totaled \$18 billion in 1995–98—some 10 percent of total direct domestic support.<sup>7</sup> The OECD accounts for 83 percent of all export subsidy commitments made in the WTO. Developing economies account for the remainder—with least developed economies not reporting any export subsidies (see appendix table A-1).

Export subsidies are concentrated in the same four products that benefit most from domestic support. Meat, dairy products, cereals, and sugar represent 80 percent of export subsidies granted by WTO members. The product correlation of export subsidies across the three country groups is lower than for domestic support, but still high and positive (and statistically different from zero). The correlation is 0.56 between export subsidies in the Quad and in other OECD countries and 0.51 between the Quad and developing economies.

The average most favored nation tariff applied to agricultural products varies substantially, but in the majority of OECD countries it is more than double the average for manufactures. Products that receive domestic support or export subsidies tend to have higher average tariffs. In the Quad the average tariff on imports of products that are subsidized by at least one WTO member is 26 percent, compared with the average tariff for all agriculture of some 17 percent (appendix table A-2). High tariffs and tariff peaks for subsidized products are also observed in other OECD countries and in developing areas.

The global pattern of protection of agriculture will have differential impacts on countries, depending on whether they are net producers or consumers of the affected commodities. A first cut at identifying the implications of global protection on individual countries is to calculate the relative importance to them of exports and imports of the products that are subsidized by at least one WTO member. This reveals that the least developed economies are potentially much more affected than other countries: Goods that are subject to domestic support in at least one WTO member constitute 18 percent of their exports on average, compared with 3–4 percent for other countries (appendix table A-3). Similarly, 17 percent of their exports are in categories that receive export subsidies by at least

7. Export subsidy commitments are used rather than actual subsidy disbursements because data are more reliable.

one WTO member, compared with 4 percent for developed areas and 5 percent for other developing economies. A similar pattern holds for imports—some 9–13 percent of imports of least developed economies involve products that are subsidized, compared with 3–4 percent for other countries.

For many least developed economies, the potential incidence of subsidies is therefore very high. For economies such as Benin, Burkina Faso, Burundi, Chad, Malawi, Mali, Rwanda, St. Kitts and Nevis, St. Lucia, Sudan, Tanzania, Uganda, and Zimbabwe, goods that are subsidized by one or more WTO members constitute 60–85 percent of total exports. But even among least developed economies there is important heterogeneity. For example, products that receive domestic support or export subsidies in other WTO members constitute less than 1 percent of Mauritania's exports.

## II. ANALYTICAL FRAMEWORK

A simple partial equilibrium model is used to estimate the impact on exports, imports, and welfare of a reduction in tariffs, domestic support, or export subsidies. World markets are assumed to be perfectly competitive and integrated, with no further scope for arbitrage across countries. Products traded in world markets under the same HS six-digit classification are considered to be perfectly homogeneous. Each six-digit HS product category represents only a small share of the economy, so that changes in a particular category have only a negligible effect on other product markets.<sup>8</sup>

Import demand for each HS six-digit product of country  $c$  is given by

$$(1) \quad m_c = \frac{a_c}{[p_w(1+t_c)(1+\tau_c)]^{\varepsilon^d} s_c^{\lambda^d}} = \frac{\alpha_c}{p_w^{\varepsilon^d}}$$

where  $a_c$  is a demand parameter in country  $c$  that captures size and all other factors influencing import demand,  $p_w$  is the price in the world market,  $t_c$  is the tariff in country  $c$ ,<sup>9</sup>  $\tau_c$  is the average transport cost from country  $c$  to the world market,<sup>10</sup>  $\varepsilon^d$  is the import demand elasticity,  $s_c$  is producer support in country  $c$ ,<sup>11</sup>  $\lambda^d$  is

8. The setup is similar to those in Zietz and Valdés (1986) and Hoekman and others (2002). Hoekman and others discuss some of the caveats associated with the use of this type of model. Note that no account is taken of such issues as the potential impact of exchange rate overvaluation, indirect taxes, and other factors that may result in an overall antiagriculture bias and thus offset the effect of tariff protection or subsidy policies. Schiff and Valdés (2002) suggest that in many developing economies, antiagriculture bias due to such policies has declined, implying that direct instruments, such as tariffs and subsidies, are the major determinants of the magnitude of protection.

9. Tariffs (or ad valorem equivalents of different border protection measures) are likely to vary by exporting country. For example, the ad valorem equivalent of a specific tariff is likely to vary by exporting country. Because information on bilateral protection levels is lacking, they are assumed to apply on a most-favored-nation basis.

10. This explains differences in import prices across countries as observed in the data. Note that transport costs are likely to vary across exporting countries.

11. Countries with no domestic support are assigned a \$1 value to ensure that the import demand function is not undetermined.

the elasticity of import demand to producer support, and  $\alpha_c$  is defined as a residual for notational simplicity, incorporating all terms other than price on the left side of the second equality.

Export supply for each HS six-digit product of country  $c$  is given by

$$(2) \quad x_c = b_c \left[ \frac{p_w}{(1 + \tau_c)} \right]^{\varepsilon^s} s_c^{\lambda^s} e_c^{\lambda^s} = \beta_c p_w^{\varepsilon^s}$$

where  $b_c$  is a supply parameter that captures size and other determinants of export supply,  $\varepsilon^s$  is the export supply elasticity,  $\lambda^s$  is the elasticity of export supply with respect to domestic support,<sup>12</sup>  $e_c$  is the export subsidy in country  $c$ ,  $\lambda^x$  is the elasticity of export supply with respect to export subsidies, and  $\beta_c$  is a residual used for notational purposes. Transport costs to world markets are the same for exporters and importers of the same HS six-digit good in the same country. The simultaneous presence of tariffs, domestic support measures, and export subsidies may lead to both imports and exports of a homogeneous product for a given country.

Because of data constraints, import demand and export supply elasticities for products and import and export elasticities with respect to domestic support and export subsidies are assumed to be identical for all countries. This has implications for the underlying domestic supply and demand elasticities of domestic support across the countries in the data set. For example, if the elasticities are relatively similar across countries and if consumption is only marginally affected by changes in domestic support, then import demand elasticities should vary across countries depending on the ratio of domestic production to exports. The underlying domestic demand and supply elasticities cannot be estimated, however, because production and consumption data are not available at the HS six-digit level. The empirical analysis tests whether elasticities for the two subsamples of developing and developed economies are statistically different (see note 18).

The equilibrium world price is obtained by solving for the world price in the world market clearing condition

$$(3) \quad p_w^e = \underset{p_w}{\text{argsol}} \left[ \sum_c m_c - \sum_c x_c = 0 \right] = \left[ \frac{\sum_c \alpha_c}{\sum_c \beta_c} \right]^{1/(\varepsilon^s + \varepsilon^d)}$$

The change in the world equilibrium price following a reduction in tariffs, domestic support, or export subsidies is obtained by taking the total differential of equation 3 with respect to  $t_c$ ,  $s_c$ , or  $e_c$ . The percentage changes in the world price after a common percentage change in each policy are given by

12. Again, countries with no domestic support (or export subsidies) are assigned a \$1 value to ensure that the export supply function is not undetermined.

$$\hat{p}_w^e = -\frac{\varepsilon^d}{\varepsilon^d + \varepsilon^s} \hat{t} \left[ \frac{\sum_c \frac{t_c}{(1+t_c)} \alpha_c}{\sum_c \alpha_c} \right] \text{ for changes in tariffs}$$

$$(4) \quad \hat{p}_w^e = -\frac{\hat{s}}{\varepsilon^d + \varepsilon^s} \left[ \lambda^d \frac{\sum_c \frac{s_c-1}{s_c} \alpha_c}{\sum_c \alpha_c} + \lambda^s \frac{\sum_c \frac{s_c-1}{s_c} \beta_c}{\sum_c \beta_c} \right] \text{ for changes in domestic support}$$

$$\text{and } \hat{p}_w^e = -\frac{\hat{e}}{\varepsilon^d + \varepsilon^s} \lambda^x \left[ \frac{\sum_c \frac{e_c-1}{e_c} \beta_c}{\sum_c \beta_c} \right] \text{ for changes in export subsidies,}$$

where  $\hat{\cdot}$  denotes the percentage change in the variable,  $t$  is the common percentage change in tariffs,  $s$  is the common percentage change in domestic support, and  $e$  is the common percentage change in export subsidies.

The change in export revenue and import revenue associated with a change in tariffs, domestic support, or export subsidies is given by

$$(5) \quad \begin{aligned} \hat{x}_c^r &= (1 + \varepsilon^s) \hat{p}_w + \lambda^s \hat{s}_c \frac{s_c - 1}{s_c} + \lambda^x \hat{e}_c \frac{e_c - 1}{e_c} \\ \hat{m}_c^r &= -(\varepsilon^d - 1) \hat{p}_w - \varepsilon^d \hat{t} \frac{t_c}{1 + t_c} - \lambda^d \hat{s}_c \frac{s_c - 1}{s_c} \end{aligned}$$

where  $x_c^r$  is the percentage change in export revenue in country  $c$ , and  $m_c^r$  is the percentage change in import revenue in country  $c$  (evaluated at world prices). Note that if there is no producer support, export subsidies, or tariffs in country  $c$ , there will be no changes in export revenue or import revenue in this country apart from that induced by the change in world price after other countries change their policies.

The change in welfare can be calculated by taking the integral of the import demand and export supply functions with respect to world prices and tariffs. Domestic support and export subsidies are assumed to be simple transfers from government revenue to producers.<sup>13</sup> The change in welfare for exporters and importers relative to initial export and import revenue is then given by

$$\hat{w}_c^x = \frac{1}{1 + \varepsilon^s} \left( (1 + \hat{p}_w)^{\varepsilon^s + 1} - 1 \right) \left( 1 + \hat{s} \frac{s_c - 1}{s_c} \right)^{\lambda^s} \left( 1 + \hat{e} \frac{e_c - 1}{e_c} \right)^{\lambda^x}$$

13. This implicitly assumes that the government revenue necessary for agriculture subsidies was collected on a lump sum basis (taxation is nondistortionary). Note that these welfare measures also assume that there are no other distortions in the relevant part of these economies.



$$(6) \quad \hat{w}_c^m = \frac{1}{(\varepsilon^d - 1)} \left( \frac{1}{\left(1 + \hat{p}_w + \hat{t} \frac{t_c}{1+t_c}\right)^{\varepsilon^d - 1}} - 1 \right) \frac{1}{(1+t_c)^{\varepsilon^d} \left(1 + \hat{s} \frac{s_c - 1}{s_c}\right)^{\lambda^d}} \\ + t_c \hat{m}_c^r + \hat{t} \frac{t_c}{1+t_c}$$

where  $w_c^x$  is the change in welfare in an exporting country relative to the initial export revenue, and  $w_c^m$  is the change in welfare in an importing country relative to the initial import revenue. The first term on the right side of the  $w_c$  in equation 6 is the change in import consumer surplus, and the last two terms provide the change in tariff revenue. Note that the changes in welfare in equation 6 take into account shifts of domestic import demand and export supply functions following changes in relevant policies. The overall change in welfare can be obtained by adding up the two expressions in equation 6 after normalizing the two terms to the same base (exports, imports, total trade, or per capita income).

### III. EMPIRICAL METHODOLOGY

The empirical methodology consists of three steps. First, import demand and export supply elasticities are estimated with respect to prices and subsidies ( $\varepsilon^d$ ,  $\varepsilon^s$ ,  $\lambda^d$ ,  $\lambda^s$ , and  $\lambda^x$ ). Next, the demand and supply parameters ( $a_c$  and  $b_c$ ) are calibrated for each country and product at the HS six-digit level. Finally, the elasticities and calibrated parameters are used to measure the changes in world prices, export revenue, import revenue, and welfare following a 50 percent reduction in agricultural tariffs, domestic support, or export subsidies in all countries.

The elasticities cannot be obtained simply by estimating the import demand and export supply functions in equations 1 and 2 because they are determined simultaneously in any country. Moreover, world prices are not observed, but only export and import unit values in each country, including transport costs. If traded quantities are measured with error (which is likely because customs revenue authorities are generally mostly concerned with the value of shipments), unit values will also be measured with error, which may bias the results.<sup>14</sup> To avoid these problems, units are chosen so that the average world price of each product during 1995–98 is equal to 1. The net import demand function is then estimated across countries and products as the log difference of import demand and export supply for each country (measured in value terms due to the choice

14. There is no obvious instrument for unit values at the HS six-digit level.



of units). Note that world price terms will then drop from the specification, as  $\log(p_w) = \log(1) = 0$ .

Equations 1 and 2 are used to obtain the following estimating equation:

$$(7) \log(m^r) - \log(x^r) = \log(a_c) - \log(b_c) - \varepsilon^d \log(1 + t_c) - (\varepsilon^d - \varepsilon^s) \log(1 + \tau_c) \\ - (\lambda^d + \lambda^s) \log(s_c) - \lambda^x \log(e^c).$$

GDP and population in each country are used as controls for  $a_c$  and  $b_c$ . Product and country dummy variables are also included to control for other demand and supply factors that are common within countries (such as endowments) or across HS six-digit categories (such as international market structure).<sup>15</sup>

There are two problems with the estimation of equation 7: Transport costs are not directly observable, and only the sum of the elasticity of import demand and export supply with respect to domestic support can be retrieved. Assuming that transport costs to the world market are equal for exporters and importers, transport costs can be proxied by the ratio of export and import unit values. As long as the measurement error in unit prices is identical for exports and imports, the problems are addressed. On the second issue elasticities of import demand and export supply with respect to domestic support are assumed to be equal.<sup>16</sup> Because of the unbalanced nature of the data set, a between estimator is used, based on four-year averages over the period for which domestic support and export subsidy data are available, rather than annual data (the sample is thus a cross-section of countries and products).<sup>17</sup>

#### IV. RESULTS

Table 1 reports the results of the estimation of equation 7, introducing different types of subsidies in a stepwise fashion. It reports results using notifications by WTO members of nonexempt types of domestic support only, denoted  $s_c^{DS4-9}$ . It also reports results using notifications on exempt (Green Box) types of domestic support, which are non-product specific. For purposes of estimation these categories are allocated across products using the distribution of domestic support commitments by product. This type of domestic support is denoted as  $s_c^{DS1-3}$ . The results of estimating equation 7 when the two types of domestic support are combined are also reported. Testing for the adding up of the two types of domestic support was done by running a nonlinear regression (but without country and product dummy variables because of programming constraints) that included the following

15. As world prices are normalized to 1 by choice of units, the export supply elasticity can be retrieved by using the information on transport cost and the estimate of the import demand elasticity in front of  $(1 + t)$ .

16. The simulations test for the robustness of results by varying the elasticities with respect to domestic support on the demand and supply side.

17. This is also due to the fact that ad valorem equivalents of specific tariffs have only been estimated for 1999 in the OECD (2000).

TABLE 1. Ordinary Least Squares Estimates of Price, Domestic Support, and Export Subsidy Elasticities

Variable	Notification of	Notification of	Notification		
	nonexempt domestic support <sup>a</sup>	exempt domestic support <sup>b</sup>	1 + 2 (3)	of export subsidies (4)	3 + 4 (5)
$\log(GDP)$	0.34 (0.09)**	0.33 (0.09)**	0.33 (0.09)**	0.33 (0.09)**	0.33 (0.09)**
$\log(Pop)$	-0.28 (0.11)**	-0.28 (0.11)**	-0.28 (0.11)**	-0.28 (0.11)**	-0.28 (0.11)**
$\log(1 + t) - (\varepsilon^d)$	-1.72 (0.17)**	-1.76 (0.18)**	-1.74 (0.18)**	-1.67 (0.18)**	-1.64 (0.18)**
$\log(1 + \tau) - (\varepsilon^d - \varepsilon^s)$	-0.88 (0.05)**	-0.88 (0.05)**	-0.88 (0.05)**	-0.87 (0.05)**	-0.87 (0.05)**
$\log(s^{DS4-9}) - (\lambda^d + \lambda^s)$	-0.09 (0.02)**				
$\log(s^{DS1-3}) - (\lambda^d + \lambda^s)$		-0.07 (0.02)**			
$\log(s^{DS1-3} + s^{DS4-9}) - (\lambda^d + \lambda^s)$			-0.07 (0.02)**		-0.04 (0.02)*
$\log(e) - \lambda^x$				-0.24 (0.02)**	-0.23 (0.03)**
Product dummy variables	Yes	Yes	Yes	Yes	Yes
Country dummy variables	Yes	Yes	Yes	Yes	Yes
Adjusted $R^2_{adj}$	0.23	0.23	0.23	0.23	0.23
Number of observations	14,661	14,661	14,661	14,526	14,526
Number of HS six-digit lines	267	267	267	267	267

\*Significant at the 5 percent level.

\*\*Significant at the 1 percent level.

*Note:* These results are from estimation of equation 7 in the text. The left side variable is the difference of the logs of import revenue and export revenue,  $\varepsilon^d$  is the price elasticity of import demand,  $\varepsilon^s$  is the price elasticity of export supply,  $\lambda^d + \lambda^s$  is the sum of elasticities of import demand and export supply with respect to domestic support,  $\lambda^x$  is the elasticity of export supply with respect to export subsidies,  $GDP$  is the value of GDP,  $Pop$  is population,  $t$  is tariff expressed in percentage points,  $\tau$  is transport cost,  $s^{DS4-9}$  is nonexempt domestic support,  $s^{DS1-3}$  is WTO-exempted domestic support (Green Box), and  $e$  is the export subsidy. Standard errors in parenthesis are White robust.

<sup>a</sup>Corresponds to WTO categories DS4-9; see data appendix.

<sup>b</sup>Corresponds to WTO categories DS1-3; see data appendix.

*Source:* Authors' calculations based on data from sources described in the appendix.

variable:  $\log(s_c^{DS1-3} + \phi s_c^{DS4-9})$ . The parameter  $\phi$  is statistically not different from 1. Results are also reported using export subsidies only and both export subsidies and the sum of the two types of domestic support.

Results across the five specifications generally yield an elasticity of import demand in the 1.64–1.72 range and an elasticity of export supply in the 0.77–0.88 range. The elasticities of domestic support are in the 0.04–0.09 range. The elasticity of net import demand with respect to export subsidies is estimated at 0.23 in the preferred specification (column 5 of table 1).<sup>18</sup>

These pooled regressions assume common elasticities across different products, which is not necessarily the case. Table 2 reports the results of the estimation of equation 7, but with elasticities allowed to vary across five product groups: animal products (HS 01–04); vegetables, fruits, and nuts (HS 06–09); cereals and grains (HS 10–14); processed food products (HS 15–24); and cotton and other textile fibers (HS 50–53). The product group-specific elasticities are used as the base estimates for the simulation exercises that follow. The overall estimates in column 5 of table 1 are used to test for the robustness of the results.<sup>19</sup> Note that the elasticities of net import demand with respect to domestic support are relatively small (around 0.05), suggesting that a reduction in domestic support across WTO members will have only a small impact on world prices.<sup>20</sup> The elasticities with respect to export subsidies tend to be much larger.

### *Simulation Results*

The baseline simulations use the estimated coefficients in table 2 to calibrate import demand and export supply in each country. Changes in export and import revenue and welfare following a 50 percent cut in tariffs, domestic support, and export subsidies are then calculated for each country using equations 5 and 6. Recall that the simulations are done for the 267 tariff lines at the HS six-digit level for which at least one country provides domestic support or export subsidies. (The overall agricultural universe includes more than 900 tariff lines at the HS six-digit level.)

The increase in trade and welfare across OECD countries, developing economies (excluding least developed economies), and least developed economies is much larger for the tariff cut than for the reduction in domestic support or export

18. Testing for the homogeneity of the parameters across groups of countries in the estimation of the regression reported in column 5 was done by splitting the sample into developed and developing economies. Results suggest that domestic support and export subsidy elasticities are not statistically different across these two subsamples, whereas price elasticities tend to be different.

19. For cereals and other grains, the coefficient capturing the import demand elasticity is insignificant and smaller than the coefficient on the difference of import demand and export supply price elasticities (which is significant). Thus the assumption that the export supply elasticity is zero cannot be rejected. The export supply elasticity is therefore set to zero in the simulations for these products, and the import demand elasticities are calibrated accordingly.

20. The implicit assumption here in moving along the export supply and import demand functions that domestic support affects only the variable cost of farmers receiving the subsidy. This approach does not permit measuring the (potential) impact that domestic support may have on fixed costs or on decisions to produce. Note that it is sometimes argued that domestic support that is decoupled from production may still have an impact on production levels because it may affect farmers' decisions to enter a market.

TABLE 2. Seemingly Unrelated Regression Estimates of Price and Domestic Support Elasticities by Group of Products

Variable	HS01-04 Animal products (1)	HS06-09 Vegetables, fruits, and nuts (2)	HS10-14 Cereals and other grains (3)	HS15-24 Food processed products (4)	HS50-53 Silk, cotton, and other textile fibers (5)
$\log(GDP)$	0.35 (0.21)	0.95 (0.09)**	0.18 (0.21)	-0.42 (0.23)	1.76 (0.20)**
$\log(Pop)$	-0.48 (0.29)	-0.98 (0.09)**	-0.11 (0.27)	0.38 (0.34)	-1.11 (0.19)**
$\log(1+t) - (\varepsilon^d)$	-1.14 (0.42)**	-1.19 (0.39)**	-0.39 (0.40)	-1.44 (0.30)**	-1.29 (2.00)
$\log(1+\tau) - (\varepsilon^d - \varepsilon^s)$	-0.36 (0.11)**	-0.76 (0.08)**	-0.74 (0.10)**	-1.36 (0.10)**	-0.50 (0.28)
$\log(s^{DS1-3} + s^{DS4-9})$	-0.00 (0.03)	-0.13 (0.03)**	-0.03 (0.03)	-0.05 (0.03)	-0.03 (0.09)
$\log(e) - \lambda^x$	-0.16 (0.04)**	-0.30 (0.07)**	-0.25 (0.06)**	-0.16 (0.04)**	-0.14 (0.13)
Product dummy variables	Yes	Yes	Yes	Yes	Yes
Country dummy variables	Yes	Yes	Yes	Yes	Yes
Adjusted $R^2_{adj}$	0.37	0.33	0.28	0.23	0.30
Number of observations	1,764	5,110	2,377	4,694	485
Number of HS six-digit lines	37	87	49	77	14

\*\*Significant at the 1 percent level.

Note: These results are from estimation of equation 7 in the text. The left side variable is difference of the logs of import revenue and export revenue,  $\varepsilon^d$  is the price elasticity of import demand,  $\varepsilon^s$  is the price elasticity of export supply,  $\lambda^d + \lambda^s$  is the sum of elasticities of import demand and export supply with respect to domestic support,  $\lambda^x$  is the elasticity of export supply with respect to export subsidies,  $GDP$  is the value of GDP,  $Pop$  is population,  $t$  is tariff expressed in percentage points,  $\tau$  is transport cost,  $s^{DS4-9}$  is nonexempt domestic support,  $s^{DS1-3}$  is WTO-exempted domestic support, and  $e$  is the export subsidy. Group-specific elasticities were estimated using the information in the whole sample, letting the elasticities vary by group of products. Standard errors in parenthesis are White robust.

Source: Authors' calculations based on data from sources described in the appendix.

subsidies (table 3).<sup>21</sup> Reductions in domestic support and export subsidies have little impact on the exports, imports, or welfare of developing economies. A 50 percent tariff cut by WTO members, however, boosts developing economy welfare by \$7.8 billion, exports by 9 percent, and imports by 6.8 percent. The effects for least developed economies are much lower, with a negative welfare effect and a 3.8 percent rise in exports and 3.4 percent rise in imports.

21. The increase in export revenue is not necessarily equal to the increase in import revenue because these are measured at different prices (due to the presence of transport costs).

TABLE 3. Impact of a 50 Percent Cut in Tariffs, Domestic Support, and Export Subsidies across All WTO Members (267 Products)

Country group	Change in exports		Change in imports		Change in welfare	
	Value (\$ millions)	%	Value (\$ millions)	%	Total (\$ millions)	Per capita (\$)
<i>Cut in tariffs</i>						
OECD countries	5,938	5.4	8,846	8.1	13,419	17.04
Developing countries	7,782	9.0	6,522	6.8	7,695	1.90
Least developed countries	130	3.8	125	3.4	-11	-0.03
<i>Cut in domestic support</i>						
OECD countries	-20	-0.0	232	0.2	53	0.07
Developing countries	96	0.1	75	0.1	167	0.04
Least developed countries	24	0.7	-2	-0.0	12	0.03
<i>Cut in export subsidies</i>						
OECD countries	-689	-0.6	-392	-0.4	206	0.26
Developing countries	41	0.0	-520	-0.5	-238	-0.06
Least developed countries	20	0.6	-18	-0.5	-14	-0.03

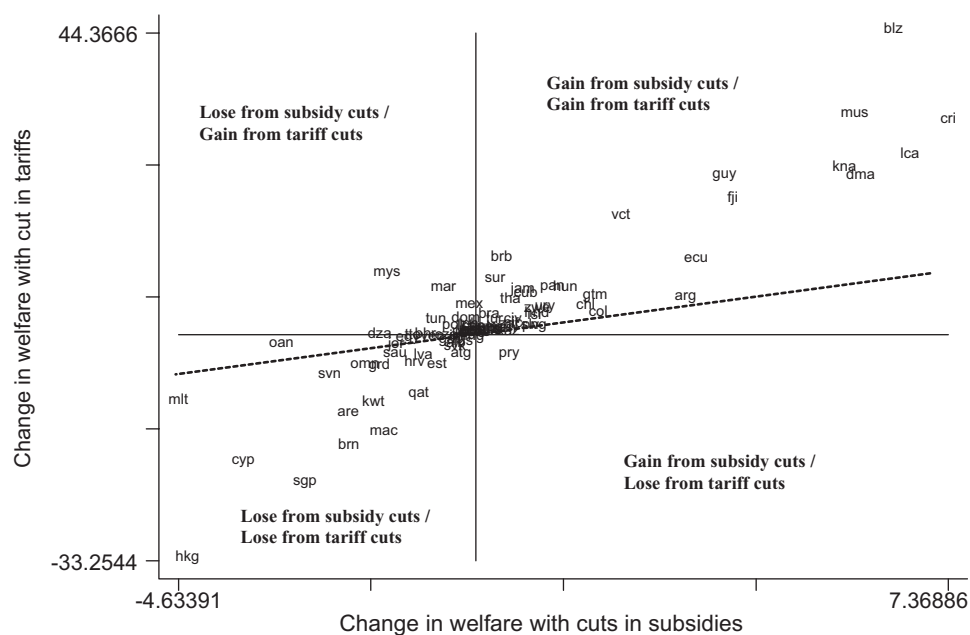
Source: Authors' calculations based on data from sources described in the appendix.

These average changes mask substantial heterogeneity across countries. For example, in Benin, Burundi, Guinea-Bissau, Paraguay, and Uganda the increase in export revenue associated with a 50 percent reduction in domestic support and export subsidies is two to three times larger than the increase associated with a 50 percent reduction in tariffs. The increase in welfare after a 50 percent cut in domestic support is also larger in these countries (figures 1 and 2). The highest percentage increases in exports following a 50 percent tariff reduction are found in Caribbean and Central American countries, reflecting their specialization in such commodities as edible fruits and vegetables, processed foods, and sugar—categories that see the largest expansion in demand in percentage terms (see appendix table A-1). With a few exceptions (such as the Republic of Congo, Malawi, and Mauritius), African countries tend to register only limited increases in exports and welfare.

Most developing economies will benefit (some significantly) from a 50 percent tariff reduction for the 267 products in the sample (see figure 1). The largest gainers include Caribbean and Central American countries and some Cairns group members, such as Argentina, Chile, Colombia, and Malaysia. Among the winners, welfare gains are generally much larger under a 50 percent tariff cut (most countries are above the 45° diagonal).

Some developing economies may lose from a 50 percent tariff cut—including net food importing countries, such as Algeria, Kuwait, Oman, Paraguay, Qatar, Saudi Arabia, and Singapore. These countries also tend to lose from a 50 percent reduction in subsidies, but to a much smaller extent because subsidy cuts lead to much smaller increases in world prices.

FIGURE 1. Changes in Welfare in Developing Economies with Cuts in Tariffs or Subsidies (\$ per capita)



Note: The dotted 45° diagonal line shows which of the two reforms provides the greater welfare gains. The country names corresponding to the country codes are in the first column of table A-3 in the appendix.

Source: Authors' calculations based on data from sources described in the appendix.

For least developed economies, the welfare impacts tend to be relatively small, and a large number of least developed economies would experience a (modest) decline in welfare after a global 50 percent reduction in tariffs. Malawi would be the largest beneficiary in gains per capita from both types of reform.<sup>22</sup>

With respect to specific products a global 50 percent cut in tariffs generates a relatively large increase in developing economy exports of edible vegetables, fruits, and nuts (HS 07–08), sugar (HS 17), prepared vegetables and fruits (HS 20–21), and tobacco (HS 24). For least developed economies, the largest increases occur in meat (HS 02), sugar (HS 17), and miscellaneous edible preparations (HS 21).<sup>23</sup>

22. This is driven by the composition of Malawi's export bundle. The largest increase occurs for tobacco and sugar exports. All these numbers should be interpreted with caution because import demand and export supply elasticities are assumed to be homogenous across countries. Splitting the sample into developing and developed economies yields smaller export supply elasticities for developing economies, suggesting an overestimate for exporters in developing areas.

23. The analysis does not include the trade restrictiveness associated with sanitary or phytosanitary barriers, as well as other nontariff barriers that may hinder trade and limit export expansion. For recent analysis of these issues see Wilson and Abiola (2003).





TABLE 4. Impact of a 50 Percent Cut in Tariffs, Domestic Support, and Export Subsidies in the OECD (267 Products)

Country group	Change in exports		Change in imports		Change in welfare	
	Value (\$ millions)	%	Value (\$ millions)	%	Total (\$ millions)	Per capita (\$)
<i>Cut in tariffs</i>						
OECD countries	2,388	2.1	9,478	8.6	12,784	16.24
Developing countries	4,379	5.0	-424	-0.4	705	0.17
Least developed countries	44	1.3	-15	-0.4	0	0.00
<i>Cut in domestic support</i>						
OECD countries	-130	-0.1	301	0.3	237	0.30
Developing countries	172	0.2	-55	-0.1	-88	-0.00
Least developed countries	7	0.2	-1	-0.0	2	0.01
<i>Cut in export subsidies</i>						
OECD countries	-957	-0.9	-252	-0.2	491	0.62
Developing countries	435	0.5	-451	-0.5	-488	-0.12
Least developed countries	3	0.1	-15	-0.4	-22	-0.05

Source: Authors' calculations based on data from sources described in the appendix.

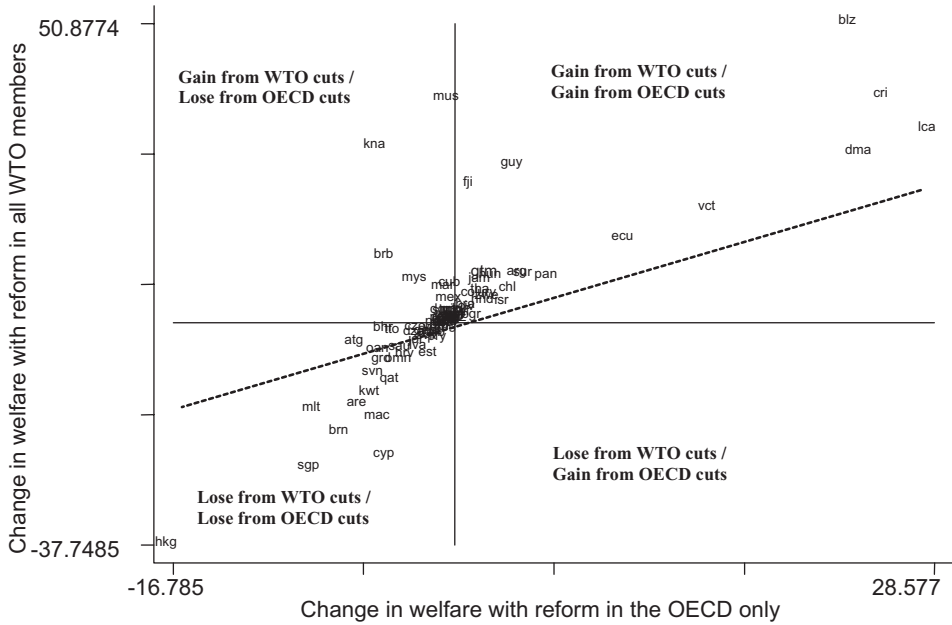
may be understated. Although the overall impact of ignoring preferences will be negligible because the countries that get deep preferences are small and have only a marginal impact on world trade, additional research and analysis are needed.

The potential problem of preference erosion is limited to a small number of countries. Few developing economies benefit significantly from trade preferences, especially in the product categories that are the subject of this analysis. As noted by Hoekman and others (2002), preference margins tend to be lowest for products for which tariffs are highest—because these are mostly “sensitive” categories. Recent research has also documented that utilization rates of preferences are often much below 100 percent. Even where there are benefits (rents), a significant share is captured by importers and retailers, not the intended beneficiary countries.<sup>24</sup>

Nonetheless, some countries, especially least developed economies that have recently been granted duty- and quota-free access to large OECD markets, stand to lose from preference erosion in certain markets. An obvious example is sugar. Although the predicted increases in the world price of sugar following global reform will benefit net exporters to some extent and offset the loss in preferential access to some extent, the existence of preferences implies that the losses to the least developed economies that currently benefit from preferences in such highly distorted markets may be greater (and the gains smaller) than suggested by the analysis here. This is not likely to be the case for other developing

24. See, for example, Brenton (2003), Inama (2003), Mattoo and others (2002), Tangermann (2002), and Ozden and Reinhardt (2003).

FIGURE 3. Changes in Welfare in Developing Economies Resulting from Reforms by All WTO Members or by OECD Countries Only (\$ per capita)



Note: The dotted 45° diagonal line shows which of the two reforms provides the greater welfare gains. The country names corresponding to the country codes are in the first column of table A-3 in the appendix.

Source: Authors’ calculations based on data from sources described in the appendix.

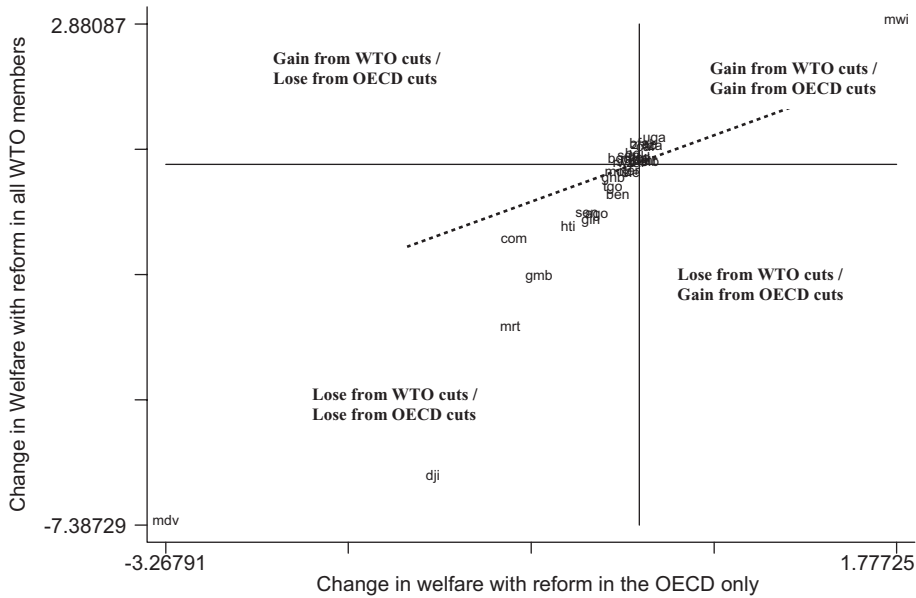
economies that are predicted to benefit from global reform, however, because these countries are not granted the type of deep preferences that have been offered to least developed countries.

### Sensitivity Analysis

Given the various assumptions made about elasticities, several sensitivity analyses were performed. First the results in table 3 were reestimated using the elasticity estimates provided for the whole sample in column 5 of table 1 (instead of the elasticity estimates by product reported in table 2). The results in table 3 were also reestimated using extreme values for the elasticities of domestic support on the import and export sides (either zero or the total value of the estimated coefficient instead of half the estimated coefficient in table 2).

When the elasticities estimated for the whole sample are used, a 50 percent tariff cut leads to a 20 percent smaller increase in exports for developing economies and a 15 percent smaller increase for least developed economies. A 50 percent cut in domestic support leads to a 25 percent greater increase in exports for developing economies and a 20 percent smaller increase for least

FIGURE 4. Changes in Welfare in Least Developed Economies Resulting from Reforms by All WTO Members or by OECD Countries Only (\$ per capita)



Note: The dotted 45° diagonal line shows which of the two reforms provides the greater welfare gains. The country names corresponding to the country codes are in the first column of table A-3 in the appendix.

Source: Authors' calculations based on data from sources described in the appendix.

developed economies. A 50 percent cut in export subsidies leads to a 22 percent greater increase in exports for developing economies and a 15 percent smaller increase for least developed economies.

The qualitative results remain: The increase in exports and welfare for developing economies is much larger under the 50 percent tariff cut than under the 50 percent reduction in domestic support or export subsidies. Similarly, for least developed economies the increase in exports is two times larger under the 50 percent tariff cut than under domestic support or export subsidy cuts. Developing economies experience welfare gains when tariffs are cut but welfare losses when domestic support or export subsidies are cut. For least developed economies the changes in welfare are almost negligible.

As noted earlier, the elasticity of domestic support on import demand and export supply cannot be empirically identified separately, only their sum. To test the sensitivity of the assumption that the two are equal, each in turn is assumed to be zero and the coefficient estimate is then assumed to identify the other. The estimated changes in export revenue, imports, and welfare are not affected by these modifications (with import demand and export supply recalibrated accordingly). For a 50 percent cut in domestic support the increase in

exports by developing economies is 20 percent greater, and the welfare loss is 22 percent smaller when the domestic support elasticity of export supply is assumed to be zero and the export increase is 60 percent smaller and the welfare loss is 25 percent greater. The qualitative results remain the same. For least developed economies the estimated change in exports is affected only marginally under both scenarios.

## VI. CONCLUSION

Tariffs matter much more than subsidies for an impact on world prices. Although there is some heterogeneity across countries, the positive welfare effect of reducing tariffs on products that are also affected by agricultural support is a multiple of what can be obtained from an equivalent cut in domestic support or export subsidies. This reflects not only the high tariff peaks in OECD countries but also developing economies' own use of tariffs to protect domestic production. Developing economies generally have low levels of domestic support and export subsidies, reflecting both budget constraints and a more neutral policy stance toward agriculture.

The analysis suggests that attention in the Doha Round should focus on reducing border protection in both OECD countries and developing economies. This does not mean that subsidies are unimportant. Decoupling domestic support from production and eliminating export subsidies are also both very important. Tariffs are often the only instrument of intervention that developing economies have to respond to the effects of OECD subsidy policies.

An important dimension of agricultural support policies that has been ignored here—the impact on price volatility—plays a major role (Valdés and Foster 2002). Tariff protection can shelter farmers from import surges in periods when world prices drop significantly. Whatever the source of the exogenous shock that drives prices down, the adjustment may fall disproportionately on residual (non-OECD) markets because support policies shelter OECD farmers from the shock. Unilateral liberalization of agricultural trade in countries such as India has been argued to have been politically unsustainable as farmers were subjected to large world price swings and import surges of commodities subsidized by OECD countries (Gulati and Narayanan 2002). Many developing economies oppose further agricultural trade liberalization as long as OECD countries continue to provide large-scale support for their farmers.

Substantial reductions in OECD agricultural support policies are therefore important not only because reductions generate direct benefits for the many developing economies that are net exporters but also because OECD reductions are critical for creating the political support to allow developing country governments to continue to pursue welfare-improving agricultural trade policy reforms. Reductions in production subsidies and elimination of export subsidies in OECD countries are necessary, although not sufficient, for developing economies to reap significant

gains from the current WTO negotiations on agriculture. At the same time, Anderson (2002) notes, if OECD members were to move seriously on subsidies, developing economies would also need to reduce protection. Without their own liberalization measures, the negative welfare effects for countries that experience terms of trade losses from subsidy removal would likely be greater.

Because the simulations suggest that a number of countries will lose from global agricultural policy reforms, compensation mechanisms should accompany liberalization and removal of domestic support. The same is true for countries for which preference erosion may be important. Compensation mechanisms could include additional aid for trade and support for adjustment. Such measures should include actions that improve the functioning of input, downstream, and factor markets to support efforts by farmers to expand output in response to the rise in prices. Also important are measures to reduce costs for farmers, such as actions to improve the efficiency of services—finance, insurance, transport, storage, packaging. The cost-increasing effect of inefficient services can be substantial—as illustrated in recent research on transport services (Fink and others 2002; Francois and Wooton 2001). If such accompanying measures are taken, the resulting supply response may transform some countries from net importers to net exporters, attenuating the negative effects estimated herein (Anderson 2002).

Finally, it is important to bear in mind that the analysis has been limited to subsidized commodities. The Doha Round negotiations span all trade, including nonsubsidized agricultural products and manufactures. The welfare findings generated by this analysis are therefore not particularly relevant, except to indicate that the countries that lose from reforms that affect subsidized agricultural products will need to identify other areas in which they can generate offsetting gains. In principle, this should be straightforward given the large negotiation set established in Doha.

#### APPENDIX: DATA SOURCES

All trade data are from UN Comtrade database (both value figures and unit prices). Data for countries that did not report trade data to Comtrade are mirrored using notifications by their trading partners.

Tariffs are drawn from the United Nations Conference on Trade and Development (UNCTAD) and WTO as provided in the UNCTAD/World Bank World Integrated Trade Solution (WITS) system. This database does not include the ad valorem equivalent of specific tariffs. For OECD countries this information comes from OECD (2000). The OECD ad valorem equivalents of specific tariffs use exclusively out-of-quota tariffs. Quota information is not available. This may bias some estimates because some import prices may be higher if exporters benefit from in-quota lower tariffs.

GDP (in U.S. dollars) and population data are drawn from the World Bank's World Development Indicators database.

The source of domestic support data is the WTO (document G/AG/NG/S/1). National currency data were converted to U.S. dollars using the period average exchange rate reported in the International Monetary Fund *International Financial Statistics*. The export subsidy data come from the WTO (document G/AG/NG/S/5/Rev.1). The product classification in each country's WTO notification is arbitrary, and therefore these classifications are mapped to the HS six-digit classification system. In most cases this can be done through a one-to-one mapping. When the domestic support and export subsidies reported cover several six-digit tariff lines, the subsidy was distributed across the relevant tariff lines using the share of the reporting country's exports as weights. The concordance file is available on request.

Only 30 WTO members have made domestic support reduction commitments under the Agreement on Agriculture, but all members are required to notify WTO of domestic support. Compliance is weak—in 1995 only 75 percent of WTO members that were required to notify did so. In 1996 and 1997 the coverage dropped to around 50 percent. For 1998 only 28 percent of WTO members had notified by March 2000. However, most countries that did not notify in 1997–98 had very little or no support in 1995–96, so coverage of the data spans the major users. The incomplete reporting problem was addressed by using the average aggregate measure of support (AMS) reported for whatever years are available. The empirical analysis therefore involves an unbalanced panel.

Domestic support notified to the WTO includes exempt and nonexempt measures. There are nine categories of support, designated DS1 through DS9. DS1 covers measures that WTO members have placed in the Green Box and are therefore exempt from reductions (the Green Box categories are defined in annex 2 of the Agreement on Agriculture). DS2 covers measures for developing economies that are exempt from reduction commitments under Article 6.2 of the Agreement on Agriculture relating to development programs. DS3 covers direct payments under production-limiting programs under Article 6.5. Categories DS4–DS9 cover measures that are not necessarily exempt from reduction commitments. DS4 refers to nonexempt support that is below the *de minimis* level (as set out in Article 6.4). The remaining categories included in the total AMS of WTO members include market price support (DS5), nonexempt direct payments (DS6), other product-specific support (DS7), and any support measured using the equivalent measurement of support methodology (DS8). Finally, where relevant, a total figure for non-product-specific support is also given (DS9).

Because exempt subsidies are not product specific, these were also mapped into product-specific subsidies using as weights the product-specific commitments that each country made in the Uruguay Round. Non-product-specific support and export subsidies are divided evenly into all products exported by the country concerned. All products shown in notifications to the WTO are included, whether or not the support is below the *de minimis* level for the member concerned. Thus, total AMS may exceed total WTO commitments for a country.

TABLE A-1. Domestic Support and Export Subsidies by Product in Selected Country Groups, 1995-98

HS-2 product	Domestic support <sup>a</sup>				Export subsidies <sup>b</sup>			
	All WTO members (\$ million) (90)	Quad (4) share (%)	Other OECD (5) share (%)	Developing country (81) share (%)	All WTO members (\$ million) (24)	Quad (3) share (%)	Other OECD (5) share (%)	Developing country (16) share (%)
01 Live animals	365	67	0	33	101	16	22	62
02 Meat and edible meat offal	19,505	88	10	2	2,972	87	2	11
04 Dairy products, eggs, honey	15,494	82	11	6	4,689	87	10	4
05 Products of animal origin NES	..	..	..	..	1	0	0	100
06 Live tree and other plant; flowers	15	0	0	100	27	0	0	100
07 Edible vegetables and roots	5,307	95	2	3	235	10	1	67
08 Edible fruit and nuts, melons	4,731	98	1	2	303	28	6	65
09 Coffee, tea, maté, and spices	101	0	0	100	15	0	0	100
10 Cereals	41,230	79	2	20	5,606	93	0	7
11 Milling products, malt, starches	191	99	0	1	599	0	0	100
12 Oil seed, oleagic fruit; miscellaneous grain	663	83	0	17	123	66	0	34
13 Lac, gums, resins, and other vegetable saps	0	0	0	100	0	0	0	100
14 Vegetable plating materials, vegetable products NES	..	..	..	..	0	0	0	100
15 Animal/vegetable fats and oils and products	2,159	100	0	0	191	69	0	31
16 Meat, fish, and seafood preparations NES	..	..	..	..	125	0	5	95
17 Sugars and sugar confectionery	8,530	79	1	21	1,013	79	0	26
18 Cocoa and cocoa preparations	0	0	0	100	36	0	0	100



19 Cereal, flour, starch, and milk preparations	..	..	..	..	..	34	0	0	100
20 Prep of vegetable, fruit, nut products	1,069	100	0	0	0	230	6	0	94
21 Miscellaneous edible preparations	3	0	0	100	0	129	0	91	9
22 Beverages, spirits, and vinegar	2,388	100	0	0	0	284	77	0	23
23 Residues and waste from food industry	486	80	0	21	5	84	84	0	16
24 Tobacco and manufactured tobacco products	968	92	1	7	139	70	0	0	30
33 Essential oils and resinoids, perfumes	..	..	..	..	0	0	0	0	100
35 Aluminoids, modified starches	..	..	..	..	11	0	0	0	100
41 Raw hides and skins	..	..	..	..	6	0	0	0	100
43 Furskins and artificial fur	..	..	..	..	0	0	0	0	100
50 Silk	20	99	0	1	0	0	0	0	100
51 Wool, animal hair, horsehair yarn	27	86	13	1	15	0	0	0	100
52 Cotton	991	96	0	5	74	0	0	0	100
53 Vegetable textile fibers NES	141	99	0	1	..	..	..	..	..
98 Other incorporated products	14,788	12	0	88	933	84	13	3	3
All above agricultural products	119,172	84	4	12	17,897	79	4	17	17
<b>Memo item</b>									
Domestic support in Green Box <sup>c</sup>	108,052	81	5	15					

*Note:* Numbers in parentheses are the number of countries in the group; the European Union is counted as one. NES is not elsewhere specified.

<sup>a</sup>Domestic support is defined as the sum of direct amount in WTO DS4–9 categories. See data appendix.

<sup>b</sup>Export subsidies are based on budgetary outlay commitments from 24 WTO member countries' notifications.

<sup>c</sup>The sum in WTO DS1–3 categories.

*Source:* Based on WTO documents G/AG/NG/S/1 and G/AG/NG/S/5/Rev.1.

TABLE A-2. Average (%) Most Favored Nation Tariff Equivalent and Maximum Rate on Subsidized Agricultural Products, 1995-98

HS-2 product	Quad countries (4)		Other OECD countries <sup>a</sup> (5)		Developing countries (76)	
	Average	Maximum <sup>b</sup>	Average	Maximum <sup>b</sup>	Average	Maximum <sup>b</sup>
01 Live animals	11	128	79	588	10	80
02 Meat and edible meat offal	27	157	59	480	25	362
04 Dairy products, eggs, honey	92	343	79	506	22	159
05 Products of animal origin NES	1	1			13	65
06 Live tree and other plant; flowers	4	17	19	186	19	71
07 Edible vegetables and roots	25	865	29	409	21	284
08 Edible fruit and nuts, melons	9	219	10	210	24	157
09 Coffee, tea, maté, and spices	4	17	2	11	21	213
10 Cereals	66	719	37	446	12	158
11 Milling products, malt, starches	95	1,403	72	553	18	171
12 Oil seed, oleagic fruit; miscellaneous grain	12	654	8	230	10	255
13 Lac, gums, resins, and other vegetable saps	4	30	1	5	14	75
14 Vegetable plaiting materials, vegetable products NES	0	1			12	66
15 Animal/vegetable fats and oils and products	10	81	16	179	18	188
16 Meat, fish, and seafood preparations NES	18	99	17	83	26	100
17 Sugars and sugar confectionery	44	209	19	55	25	135

18	Cocoa and cocoa preparations	9	65	29	530	19	102
19	Cereal, flour, starch, and milk preparations	7	24	16	100	23	100
20	Prep of vegetable, fruit, nut products	20	163	30	380	25	100
21	Miscellaneous edible preparations	41	302	44	609	22	185
22	Beverages, spirits, and vinegar	10	42	6	20	38	1,050
23	Residues and waste from food industry	5	87	35	364	12	55
24	Tobacco and manufactured tobacco products	29	111	10	42	34	907
33	Essential oils and resinoids, perfumes	0	1			15	75
35	Albuminoids, modified starches	4	8	4	4	14	68
41	Raw hides and skins	0	0			11	100
43	Furskins and artificial fur	3	6	5	5	15	43
50	Silk	59	236	0	1	10	80
51	Wool, animal hair, horsehair yarn	9	55	0	0	6	30
52	Cotton	5	21	0	0	6	37
53	Vegetable textile fibers NES	1	11	0	0	8	53
	All above agricultural products	26	1,403	28	609	21	1,050
	<b>Memo item</b>						
	Domestic support in Green Box <sup>c</sup>	17	1,403	27	609	17	1,750

*Note:* Numbers in parentheses are the number of countries in the group. The European Union is counted as one. NES is not elsewhere specified.

<sup>a</sup>High-income OECD countries excluding Quad countries.

<sup>b</sup>Highest applied tariff.

*Source:* Based on UNCTAD TRAINS data through WITS; OECD 2000.

TABLE A-3. Average (%) Trade Shares of Products Affected by WTO Members' Agricultural Subsidies, 1995-98

Economy (code)	Domestic support		Export subsidies	
	Exports	Imports	Exports	Imports
Albania (alb)	8.8	8.2	10.6	22.0
Algeria (dza)	0.0	20.0	0.1	23.8
Angola (ago)	0.3	7.2	0.1	16.2
Antigua (atg)	6.0	2.8	6.0	5.2
Argentina (arg)	25.6	2.3	29.3	3.0
Australia (aus)	17.0	1.4	16.3	1.7
Bahrain (bhr)	0.1	3.7	0.2	7.3
Bangladesh (bgd)	2.2	12.7	0.4	13.3
Barbados (brb)	21.9	5.9	20.9	8.1
Belize (blz)	46.6	5.9	47.5	7.3
Benin (ben)	84.7	5.9	78.2	12.8
Bolivia (bol)	11.3	5.2	19.9	7.4
Brazil (bra)	13.1	6.7	20.1	6.7
Brunei (brn)	0.0	1.8	0.0	3.7
Bulgaria (bgr)	6.9	5.4	9.5	6.3
Burkina Faso (bfa)	75.5	7.9	73.8	9.2
Burundi (bdi)	72.8	10.9	72.2	10.8
Cameroon (cmr)	24.7	8.6	27.4	8.5
Canada (can)	3.4	2.1	3.9	2.8
Central African Republic (caf)	24.8	4.4	24.8	12.2
Chad (tcd)	82.5	3.5	82.7	13.5
Chile (chl)	14.2	3.2	12.6	4.2
China (chn)	1.9	4.0	2.1	4.6
Colombia (col)	32.0	7.2	34.2	7.7
Congo, Dem. Rep (zar)	10.6	8.6	7.3	13.8
Congo, Rep. (cog)	1.1	3.9	1.0	7.2
Costa Rica (cri)	37.5	5.9	44.5	4.7
Côte d'Ivoire (civ)	48.7	11.0	57.2	13.0
Croatia (hrv)	2.2	5.0	2.8	6.2
Cuba (cub)	50.7	13.4	53.8	17.1
Cyprus (cyp)	24.5	4.2	20.0	8.8
Czech Republic (cze)	1.9	3.6	3.1	3.4
Djibouti (dji)	9.5	9.9	10.1	20.9
Dominica (dma)	57.7	7.1	32.4	8.6
Dominican Repub (dom)	10.2	7.4	12.0	9.3
EU-15 (eec)	31.2	5.7	38.3	6.6
Ecuador (ecu)	2.2	4.9	4.3	5.0
Egypt, Arab Rep (egy)	11.0	17.1	9.1	12.8
El Salvador (slv)	42.0	8.3	24.7	10.7
Estonia (est)	6.3	6.3	3.5	7.8
Fiji (fji)	37.9	6.5	36.1	7.7
Gabon (gab)	0.1	4.9	0.1	6.7
Gambia, The (gmb)	11.0	17.5	3.3	20.6
Ghana (gha)	32.4	4.7	39.0	7.1
Grenada (grd)	14.5	7.2	23.3	12.4
Guatemala (gtm)	48.6	7.2	42.0	9.0
Guinea (gin)	7.8	19.1	7.8	17.2

(Continued)

TABLE A-3. *Continued*

Economy (code)	Domestic support		Export subsidies	
	Exports	Imports	Exports	Imports
Guinea-Bissau (gnb)	39.8	4.2	39.6	12.7
Guyana (guy)	33.1	6.7	33.2	10.4
Haiti (hti)	12.2	14.9	17.9	22.7
Honduras (hnd)	43.9	9.0	26.7	6.2
Hong Kong, China (hkg)	0.1	1.5	0.6	2.3
Hungary (hun)	5.6	2.3	6.7	2.1
Iceland (isl)	7.9	2.6	0.7	4.3
India (ind)	8.4	2.4	9.9	2.5
Indonesia (idn)	2.8	8.9	4.0	7.9
Iran, Islamic Rep. (irn)	1.0	10.3	0.7	14.5
Israel (isr)	4.1	3.3	5.0	3.6
Jamaica (jam)	12.1	5.5	13.8	7.9
Japan (jpn)	0.1	4.9	0.2	6.2
Jordan (jor)	6.2	12.3	5.3	15.4
Kazakhstan (kaz)	0.0	0.0	12.3	5.9
Kenya (ken)	48.7	8.4	36.2	10.5
Korea, Rep. (kor)	0.3	3.6	0.6	4.1
Kuwait (kwt)	0.0	4.0	0.1	6.5
Kyrgyz Republic (kgz)	24.1	4.7	25.1	8.6
Latvia (lva)	2.0	5.7	3.8	7.2
Lithuania (ltu)	6.7	5.0	7.1	7.5
Macao (mac)	0.3	2.5	0.5	6.7
Madagascar (mdg)	26.6	7.8	25.8	6.2
Malawi (mwi)	75.7	4.4	77.0	9.6
Malaysia (mys)	0.5	3.4	1.4	3.2
Maldives (mdv)	2.1	8.3	0.2	10.8
Mali (mli)	84.5	5.8	84.3	10.6
Malta (mlt)	1.2	3.0	0.6	3.4
Mauritania (mrt)	0.7	13.8	0.1	28.9
Mauritius (mus)	24.6	8.5	25.4	7.5
Mexico (mex)	3.0	4.3	4.5	4.3
Mongolia (mng)	12.0	2.2	12.5	10.6
Morocco (mar)	9.0	13.8	9.7	11.0
Mozambique (moz)	0.0	0.0	36.5	18.2
Myanmar (mmr)	23.6	1.0	17.1	6.7
New Zealand (nzl)	24.1	3.0	25.3	3.3
Nicaragua (nic)	40.0	8.7	35.2	15.8
Niger (ner)	17.2	12.9	2.3	13.4
Nigeria (nga)	1.8	7.5	2.0	10.9
Norway (nor)	0.3	2.8	0.5	2.6
Oman (omn)	0.7	5.8	0.2	5.7
Pakistan (pak)	7.0	6.7	9.1	7.3
Panama (pan)	38.8	4.1	19.9	1.4
Papua New Guine (png)	15.1	2.6	12.0	3.0
Paraguay (pry)	55.1	3.5	27.0	11.9
Peru (per)	19.3	9.6	9.4	11.8
Philippines (phl)	5.6	4.5	3.6	6.6
Poland (pol)	2.7	4.9	3.9	4.4

*(Continued)*

TABLE A-3. *Continued*

Economy (code)	Domestic support		Export subsidies	
	Exports	Imports	Exports	Imports
Qatar (qat)	0.0	2.3	0.0	4.3
Romania (rom)	4.9	3.8	4.4	5.5
Russian Federation (rus)	1.4	6.9	1.5	12.4
Rwanda (rwa)	59.0	18.2	59.2	18.5
Saudi Arabia (sau)	0.1	6.3	0.2	9.0
Senegal (sen)	7.6	16.1	7.8	19.1
Sierra Leone (sle)	6.6	8.7	6.8	15.8
Singapore (sgp)	0.6	1.2	0.7	2.3
Slovak Republic (svk)	2.1	3.0	2.7	4.2
Slovenia (svn)	0.9	3.6	1.6	5.1
Solomon Islands (slb)	9.1	1.7	3.3	5.1
South Africa (zaf)	6.4	3.2	7.6	4.0
Sri Lanka (lka)	2.1	9.1	3.6	10.5
St. Kitts and N (kna)	77.5	5.6	31.2	6.8
St. Lucia (lca)	63.8	5.3	61.2	10.2
St. Vincent and (vct)	57.3	10.5	34.4	8.8
Sudan (sdn)	60.1	8.6	48.6	12.5
Suriname (sur)	11.6	5.5	9.6	6.8
Switzerland (che)	0.5	3.2	1.4	3.1
Taiwan, China (oan)	0.2	3.6	0.6	3.7
Tanzania (tza)	67.8	5.0	60.0	7.8
Thailand (tha)	7.0	2.8	8.0	2.5
Togo (tgo)	42.5	6.3	41.8	13.7
Trinidad and To (tto)	2.1	6.4	3.6	7.6
Tunisia (tun)	4.0	6.9	4.5	7.3
Turkey (tur)	10.5	5.0	8.1	4.8
Uganda (uga)	63.3	7.5	83.6	7.4
United Arab Emi (are)	1.0	3.1	1.8	4.9
United States (usa)	5.2	1.8	5.2	2.5
Uruguay (ury)	23.0	6.2	25.2	6.4
Venezuela (ven)	0.8	8.0	1.2	8.7
Zambia (zmb)	8.1	4.0	7.1	5.6
Zimbabwe (zwe)	59.3	3.0	48.8	3.7
All countries (143)	3.6	3.7	4.4	4.4
OECD countries (23)	3.1	3.3	4.0	3.9
Developing countries (90)	4.2	4.2	5.0	5.0
Least developed countries (30)	17.8	8.9	16.7	13.1

Note: Intra-EU trade is excluded.

Source: Based on partners' data from UN COMTRADE statistics.

A number of limitations are associated with the AMS data (see de Gorter 2002 for a careful discussion of problems associated with measurement of the AMS). Two problems are that the time period for which data are available is short and reporting is incomplete, especially for more recent years. Another problem is that the economic relevance of the AMS time series is limited given the use of the

fixed 1986–88 benchmark for calculating price supports. However, assuming that changes in world prices over time have a proportional effect on the AMS figures of all WTO members, the double log specification used to estimate the import demand and export supply and the focus on percentage changes in variables should not significantly affect our results.

## REFERENCES

- Anderson, Kym. 2002. "Trade Liberalization, Agriculture and Poverty in Low Income Countries." Paper presented at the Trade and Industrial Policy Strategies (TIPS) Annual Forum, September 9–11, Johannesburg. Available online at [www.tips.org.za](http://www.tips.org.za).
- Beghin, John, David Roland-Holst, and Dominique van der Mensbrugge. 2002. "How Will Agricultural Trade Reforms in High-Income Countries Affect the Trading Relationships of Developing Countries?" Working Paper, World Bank, Washington, D.C.
- Brenton, Paul. 2003. "Integrating the Least Developed Countries into the World Trading System: The Current Impact of EU Preferences under Everything but Arms." Policy Research Working Paper 3018. World Bank, Washington, D.C.
- de Gorter, Harry. 2002. "The AMS and Domestic Support in WTO Trade Negotiations on Agriculture: Issues and Suggestions for New Rules." Working Paper, World Bank, Washington, D.C.
- Dimaranan, Betina, Thomas Hertel, and Roman Keeney. 2002. "OECD Domestic Support and the Developing Countries." GTAP Working Paper 1161. Purdue University, Department of Agricultural Economics, Center for Global Trade Analysis, West Lafayette, Ind.
- Falvey, Rod, and Rod Tyers. 1989. "Border Price Changes and Domestic Welfare in the Presence of Subsidized Exports." *Oxford Economic Papers* 41(2):434–51.
- Fink, Carsten, Aaditya Mattoo, and Cristina Neagu. 2002. "Trade in International Maritime Services: How Does Policy Matter?" *World Bank Economic Review* 16(1):120–45.
- Francois, Joseph, and Will Martin. 2003. "Formula Approaches for Market Access Negotiations." *World Economy* 26(1):1–28.
- Francois, Joseph, and Ian Wooton. 2001. "Trade in International Transport Services: The Role of Competition." *Review of International Economics* 9(2):249–61.
- Gulati, Ashok, and Sudha Narayanan. 2002. "Managing Import Competition When Developing Countries Liberalize Trade: The Indian Experience." Working Paper, International Food Policy Research Institute, Washington, D.C.
- Hoekman, Bernard, Francis Ng, and Marcelo Olarreaga. 2002. "Eliminating Excessive Tariffs on Exports of Least Developed Countries." *World Bank Economic Review* 16(1):1–21.
- Inama, Stefano. 2003. "Trade Preferences and the WTO Negotiations on Market Access." Working Paper. United Nations Conference on Trade and Development, Geneva.
- Mattoo, Arvind, Devesh Roy, and Arvind Subramanian. 2002. "The Africa Growth and Opportunity Act and Its Rules of Origin: Generosity Undermined?" Policy Research Working Paper 2908. World Bank, Washington, D.C.
- OECD (Organisation for Economic Co-operation and Development). 2000. "Post Uruguay Rounds Tariff Regimes: Achievements and Outlook." OECD, Paris.
- Ozden, Caglar, and E. Reinhardt. 2003. "The Perversity of Preferences." Policy Research Working Paper 2955. World Bank, Washington, D.C.
- Rae, Allan, and Anna Strutt. 2002. "The Current Round of Agricultural Trade Negotiations: Why Bother about Domestic Support?" Paper presented at the 5th Annual Conference on Global Economic Analysis, Taipei, June 5–7.
- Schiff, Maurice, and Alberto Valdés. 2002. "Agriculture and the Macroeconomy." In Bruce Gardner and Gordon Rausser, eds., *Handbook of Agricultural Economics*, vol. 2B. Amsterdam: North Holland.



- Snape, Richard H. 1987. "The Importance of Frontier Barriers." In H. Kierzkowski, ed., *Protection and Competition in International Trade*. Oxford: Blackwell.
- Tangermann, S. 2002. "The Future of Preferential Trade Arrangements for Developing Countries and the Current Round of WTO Negotiations on Agriculture." Working Paper. Food and Agriculture Organization, Rome.
- Tokarick, Stephen. 2003. "Measuring the Impact of Distortions in Agricultural Trade in Partial and General Equilibrium." Working Paper. International Monetary Fund, Washington, D.C.
- Valdés, Alberto, and William Foster. 2002. "On the Management of Price Risk in the Context of Trade Reform in LDCs." Working Paper. World Bank, Washington, D.C.
- Wilson, John, and Victor Abiola. 2003. "Standards and Global Trade: A Voice for Africa." Working Paper. World Bank, Washington D.C.
- Zietz, Joachimlz, and Alberto Valdés. 1986. "The Potential Benefits to LDCs of Trade Liberalization in Beef and Sugar by Industrialized Countries." *Weltwirtschaftliches Archiv* 122(1):94–112.