Welfare- and trade-based indicators of national distortions to agricultural incentives

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Abstract

Despite reforms over the past quarter-century, world agricultural markets remain highly distorted by government policies. Traditional indicators of those price distortions such as the nominal rate of assistance and consumer tax equivalent provide measures of the degree of intervention, but they can be misleading as indicators of the true effects of those policies. By drawing on recent theoretical literature that provides indicators of the trade- and welfare-reducing effects of price and trade policies, this paper develops more-satisfactory indexes for capturing distortions to agricultural incentives. It then exploits the Agricultural Distortion database recently compiled by the World Bank to generate estimates of them for both developing and high-income countries over the past half century, based on a sample of 75 countries that together account for all but one-tenth of the world's population, GDP and agricultural production. While they are still only partial equilibrium measures, they provide a much better approximation of the true trade and welfare effects of sectoral policies without needing a formal model of global markets or even price elasticity estimates.

Keywords: Distorted incentives, agricultural and trade policies, trade restrictiveness index

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Peter J. Lloyd, Johanna L. Croser and Kym Anderson[1]

The methodology outlined in Anderson et al. (2008) provides a number of ways to indicate the extent of distortions within the agricultural sector of a country (as distinct from between agriculture and other sectors, for which the relative rate of assistance indicator is used). They include the unweighted or weighted mean NRA of covered products, the standard deviation of covered product NRAs, the weighted mean NRA for exportable versus import-competing covered products, and the trade bias index defined as $[(1+NRAag_x/100)/(1+NRAag_m/100) - 1]$ where $NRAag_x$ and $NRAag_m$ are the weighted average percentage NRAs for the exportable and import-competing parts, respectively, of the agricultural sectors' covered plus non-covered products. The reason for reporting the latter indicators of dispersion in addition to the means – apart from them being informative in their own right – is that theory suggests the national economic welfare cost of government policy distortions to incentives in terms of resource misallocation tends to be greater the greater the degree of substitution in production (Lloyd 1974). In the case of agriculture which involves the use of farm land that is sector-specific but very transferable among farm activities, the greater the variation of NRAs across industries within the sector then the higher will be the welfare cost of those market interventions.

While those various indicators of dispersion are useful, it would also be helpful to have a single indicator to capture the overall welfare or trade effect of each country's regime of agricultural price distortions in place at any time. To that end, a theoretical literature has developed in recent years. This literature seeks to overcome aggregation problems across different intervention measures and across the product range by using a theoretically sound aggregation procedure that answers precise questions regarding the welfare and trade distortions imposed by each country's price and trade policies. The literature has developed

[1] The authors are grateful for the NRA estimates provided by country authors and for invaluable help with data compilation and manipulation by Esteban Jara, Marianne Kurzweil, Signe Nelgen and Ernesto Valenzuela. This chapter draws heavily on Lloyd, Croser and Anderson (2009).

considerably over the past two decades, particularly with the theoretical advances by Anderson and Neary (summarized in and extended beyond their 2005 book) and the theoretical simplifications by Feenstra (1995).

Notwithstanding these advances, few series of consistently estimated indexes have yet been estimated across time and even fewer across countries. A prominent exception is the work of Kee, Nicita and Olarreaga (2008, 2009), who estimate a series for developing and high-income countries, but they provide estimates only for a snapshot in time (the early-2000s). Other studies that have been country specific include an application to Mexican agriculture in the late 1980s (Anderson and Bannister 1992) and a long time series for US trade policy (Irwin 2009).

The purpose of this chapter is to provide estimates of indexes that are comparable across the focus countries and over the time period of the present study of global distortions to agricultural incentives. The estimates presented below make a significant contribution to the empirical literature on welfare and trade reduction indexes, as they provide the first panel set of consistent indexes for the agricultural sector for both developing and high-income countries. It is a global panel dataset that contains comparable estimates of annual nominal rates of assistance (NRAs) and consumer tax equivalents (CTEs)[2] for a wide range of agricultural products (around a dozen per country) over the past half century for 75 countries that together account for all but one-tenth of the world's population and agricultural production and 95 percent of global GDP.[3]

The indexes we estimate are well grounded in theory: they belong to the family of indexes first developed by Anderson and Neary (2005) under the catch-all name of trade restrictiveness indexes. To date, members of that family of indexes sometimes have been distinguished by using various adjectives; but at the same time others have used the trade restrictiveness index term for measures that have a different theoretical backing (for example the one used by the IMF – see Allen 2005). To avoid confusion, we coin terms that are more precise descriptors. Specifically, to capture distortions imposed by each country's border and

[2] The NRA and CTE measures are related to the well-known producer and consumer subsidy equivalent (PSE and CSE) measures estimated by the OECD (2008). Their main conceptual difference is that the NRA and CTE are expressed as a percentage of the undistorted price, whereas the PSE and CSE are expressed as a percentage of the distorted price. The NRA and CTE values are identical if the only government interventions are at a country's border (such as a tariff on imports). In the case of agriculture, however, there are typically domestic production or consumption taxes or subsidies also in place, so the NRAs and CTEs differ.

[3] Anderson and Valenzuela (2008). Within each region the shares of agricultural value added that the studied countries represented in 1990-2004 at distorted prices are 90 percent for high-income countries, 92 percent for Europe's transition economies (including Turkey and Central Asia), and 86 percent of developing countries (76 percent in Africa, 94 percent in Asia, 81 percent in Latin America and the Caribbean, and 0 percent in the Middle East), hence 88 percent globally.

domestic policies on its economic welfare and its trade volume, we define measures we call the Trade Reduction Index (TRI) and the Welfare Reduction Index (WRI). The WRI is computed from sub-indexes which we call the Producer Distortion Index (PDI) and the Consumer Distortion Index (CDI). The PDI and CDI are needed if any product's NRA and CTE differ, that is, whenever there are domestic subsidies or taxes on production or consumption in addition to border measures – as so often there are for staple foods and other farm products.

Thus the indexes we estimate capture the welfare and trade reducing effects of all policies directly affecting consumer and producer prices of farm products from all agricultural and food policy measures in place.[4] On the production side, by calculating the percentages by which domestic prices exceed border prices, the NRA estimates include assistance provided by all tariff and non-tariff trade measures, plus any domestic price support measures, plus an adjustment for the output-price equivalent of direct interventions on farm inputs. Where multiple exchange rates operate, an estimate of the import or export tax equivalents of that distortion are included as well (see Anderson et al. 2008a,b or Appendix A). On the consumption side, CTE measures — also expressed as ad valorem rates — estimate the extent to which consumers are taxed or subsidized by various agricultural, social welfare, trade and exchange rate policy measures. Like NRAs, the range of measures included in the CTE estimates is wide, including both domestic consumer and border taxes/subsidies/quantitative measures, so as to fully capture the wedge between the price that consumers pay for each commodity and the international price at the border adjusted to account for marketing margins, quality differences and the like.

The TRI (or WRI) has the advantage of providing a theoretically sound partial equilibrium indicator of the trade (or welfare) effect in a single sectoral measure that is comparable across time and place. In this way the TRI and WRI go somewhat closer to what a computable general equilibrium (CGE) can provide in the way of estimates of the trade and welfare (and other) effects of the price distortions captured by the product NRA and CTE estimates – and have the advantage of being able to indicate trends over time,

[4] Throughout this chapter we ignore indirect effects of sectoral and trade policy measures directed at non-agricultural sectors. We also adopt the standard assumptions in basic trade theory that there are no divergences between private and social marginal costs and benefits that might arise from externalities, market failures, and any other behind-the-border policies not represented in our analysis, including such things as underinvestment in public goods.

which a comparative static CGE model can do only if it is calibrated to a series of past years rather than to just one particular year.[5]

The TRI (or WRI) is defined as the ad valorem trade tax rate which, if applied uniformly across all tradable agricultural commodities in a country would generate the same reduction in trade (or economic welfare loss) as the actual cross-product structure of NRAs and CTEs for that country.[6]

The WRI measure reflects better than the NRA or CTE the true partial equilibrium welfare cost of agricultural price-distorting policies because it is a mean of order two. In particular, it captures the disproportionately higher welfare costs of peak levels of assistance or taxation. Also, the WRI and TRI measures overcome aggregation problems when there are different NRAs for sub-sectors within agriculture. For example, if policies affecting the import-competing and exporting sub-sectors had offsetting effects on farmer incentives, the aggregate NRA estimate may be close to zero even though the welfare- and trade-restricting consequences are considerable. Anderson et al. (2008a,b) deal with that by estimating separate NRAs and CTEs for each product and then for the import-competing and exporting (and nontradables) product sub-groups, and by using those sub-sector means to calculate their trade bias index. The WRI and TRI provide more succinct and more accurate ways of summarizing that information.

The remainder of the chapter is structured as follows. The next section presents the theory for estimating trade and welfare reduction index numbers in the import-competing sub-sector. This is extended to cover the exportables sub-sector in the following section. The World Bank's Agricultural Distortions database is then discussed as it is to be used here, followed by presentation of the trade and welfare reduction indexes for all countries studied in the Agricultural Distortions project. Some concluding observations are presented in the final section.

Defining the Welfare and Trade Reduction Indexes

[5] For a set of CGE estimates of the welfare, trade and various other economic effects of the policies captured in the Agricultural Distortions database, see Valenzuela, van der Mensbrugghe and Anderson (2009).

[6] In addition, another two indexes can be defined as the ad valorem trade tax rate which, if applied uniformly across countries for a particular product would generate the same global reduction in trade in that product (or global economic welfare loss) as the actual cross-country structure of NRAs and CTEs for that tradable commodity. See Anderson et al. (2009).

The initial theoretical work by Anderson and Neary, leading to their 2005 book, sought to derive a general equilibrium measure of the welfare-reducing effects of trade restrictions in a country's import-competing sector. They called this a Trade Restrictiveness Index. The work was important in that it solved the problem of how to aggregate assistance across commodities in a theoretically meaningful way. Anderson and Neary solved the problem for a small, open economy in which imports are restricted by tariffs and non-tariff measures (NTMs). Anderson and Neary then provided variants of the Trade Restrictiveness Index, including one based not on a welfare criterion but instead on an import volume criterion (the Mercantilist Trade Restrictiveness Index). In what follows, a more-general version of each of the Anderson and Neary indexes is developed for situations where, in addition to import measures, there are also export measures and possibly also direct domestic producer and consumer price distortions.[7] Our two indexes are first developed for agriculture's import-competing sub-sector and then for its exporting sub-sector.

The import-competing sub-sector

We take a particular country and assume it has a small open economy in which all markets are competitive. However, the market for an import good may be distorted by a tariff and/or other non-tariff border measures and/or behind-the-border measures such as domestic subsidies and price controls.

We turn first to the measure of the effect of a country's distortions on its import volume, the TRI. This is defined as the uniform tariff rate which, if applied to all goods in the place of all actual tariffs and NTMs and other price distortions, would result in the same reduction in the volume of imports as the actual distortions.

Consider the market for one good, good i, which is distorted by a combination of measures that distort the consumer and producer prices. For the producers of the good, the distorted domestic producer price, p_i^P, is related to the world price, p_i^*, by the relation, $p_i^P = p_i^*(1 + s_i)$ where s_i is the rate of distortion of the producer price in percentage terms. For the consumers of the good, the distorted domestic consumer price, p_i^C, is related to the world price by the relation, $p_i^C = p_i^*(1 + r_i)$ where r_i is the rate of distortion of the

[7] We build from Chapter 12 of Anderson and Neary (2005) which is devoted to a consideration of how to deal with domestic price distortions.

consumer price in percentage terms. In general, $r_i \neq s_i$. Using these relations, the change in imports in the market for good i is sum of the areas of two rectangles

$$\Delta M_i = p_i^* dx_i - p_i^* dy_i$$

$$= p_i^{*2} dx_i / d\, p_i^C r_i - p_i^{*2} dy_i / d\, p_i^P s_i \qquad (1)$$

where the demand and the supply for good i, x_i and y_i, are functions of own domestic price alone: $x_i = x_i(p_i^C)$ and $y_i = y_i(p_i^P)$ respectively. The neglect of cross-price effects makes the analysis partial equilibrium.

Strictly speaking, this result holds only for small distortions. In reality rates of distortion are not small. If, however, we assume that the demand and supply functions are linear, the effect on imports is:

$$\Delta M_i = p_i^{*2} dx_i / d\, p_i^C r_i - p_i^{*2} dy_i / d\, p_i^P s_i \qquad (2)$$

$$\text{with } \mathrm{d}x_i / \mathrm{d}\, p_i^C = cons\,\mathrm{t}. \text{ and } \mathrm{d}y_i / \mathrm{d}\, p_i^P = cons\,\mathrm{t}.$$

If the functions are not linear, this expression provides an approximation to the loss.

With n importable goods subject to different levels of distortions, the aggregate reduction in imports, in the absence of cross-price effects in all markets, is given by:

$$\Delta M = \sum_{i=1}^{n} p_i^{*2} dx_i / d\, p_i^C r_i - \sum_{i=1}^{n} p_i^{*2} dy_i / d\, p_i^P s_i \qquad (3)$$

Setting the result equal to the reduction in imports from a uniform tariff, we have

$$\sum_{i=1}^{n} p_i^{*2} dx_i / d\, p_i^C r_i - \sum_{i=1}^{n} p_i^{*2} dy_i / d\, p_i^P s_i = \sum_{i=1}^{n} p_i^{*2} dm_i / dp_i T$$

Solving for T, we get

$$T = \{Ra + Sb\} \qquad (4a)$$

where $R = \left[\sum_{i=1}^{n} r_i u_i \right]$ with $u_i = p_i^{*2} \mathrm{d}x_i / \mathrm{d}\, p_i^C / \sum_i p_i^{*2} \mathrm{d}x_i / \mathrm{d}\, p_i^C$ (4b)

$$S = \left[\sum_{i=1}^{n} s_i v_i \right] \text{ with } v_i = p_i^{*2} \mathrm{d}y_i / \mathrm{d}\, p_i^P / \sum_i p_i^{*2} \mathrm{d}y_i / \mathrm{d}\, p_i^P \,. \qquad (4c)$$

and $a = \sum_i p_i^{*2} \mathrm{d}\, x_i / \mathrm{d}\, p_i^C / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i$

$$b = -\sum_i p_i^{*2} \mathrm{d}\, y_i / \mathrm{d}\, p_i^P / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i \qquad (4d)$$

The TRI is best regarded as a true index of average distortion rates. More precisely, what is held constant is the value of imports in constant prices. R and S are indices of average consumer and producer price distortions. They are arithmetic means. In the empirical section of the paper these are referred to as the Nominal Rate of Assistance (NRA) and the Consumer Tax Equivalents (CTE).

Evidently, T can be written as a weighted average of the level of distortions of consumer and producer prices. An important advantage of using this decomposition of the index into producer and consumer effects is that it treats correctly the effects of NTMs and domestic distortions. We can deal with, and analyse, the production and consumption sides of the economy separately.[8]

In equations (4b) and (4c), the weights for each commodity are proportional to the marginal response of domestic production (or consumption) to changes in international free-trade prices. These weights can be written as functions of the domestic price elasticities of supply (demand) and the value of domestic production (consumption) at undistorted prices:

$$u_i = \rho_i^*(p_i^* x_i^*) / \sum_i^n \rho_i^*(p_i^* x_i^*) \qquad (5)$$

$$v_i = -\sigma_i^*(p_i^* y_i^*) / \sum_i^n \sigma_i^*(p_i^* y_i^*)$$

If, further, we assume domestic price elasticities of supply (demand) are equal across commodities, the elasticities in the numerator and denominator cancel. Thus we can find R (S) by aggregating the change in consumer (producer) prices across commodities, using as weights the share of each commodity's domestic value of consumption (production) at undistorted prices.

Estimating T in equation (4) also requires an assumption about the weights a and b (equation (4d)). The weight a (b) is proportional to the ratio of the marginal response of domestic demand (supply) to a price change relative to the marginal response of imports to a price change. If the domestic demand and supply curves have the same slope, then a=b=0.5.

As a special case, if $r_i = s_i$ for all i, that is, if tariff rates are the only distortion, equation (4) reduces to a much simpler form:

[8] MacLaren and Lloyd (2008) analyse the production side of the Australian agricultural sector with a Production Distortion Index, PDI (although they use the word Assistance rather than Distortion). This is the uniform production subsidy that gives the same deadweight production loss as the actual differentiated structure of assistance, and so is exactly equal to the production component we derive above. Here we add a similar uniform consumption tax component (call it a Consumption Distortion Index, CDI) and seek a TRI that gives the same trade-reducing effect as the sum of the actual trade effects on the two sides of the market. Likewise below we generate the WRI that gives the same deadweight welfare loss as the sum of the actual welfare losses on both sides of the market.

$$T = \sum_{i=1}^{n} t_i w_i \qquad w_i = \varepsilon_i (p_i^* m_i^*) / \sum_{i}^{n} \varepsilon_i (p_i^* m_i^*) \qquad (6)$$

Here t_i is the ad valorem tariff rate, which is equal to the rate of distortion of both consumer and producer prices, and ε_i is the elasticity of import demand. T is the mean of the tariff rates. This case can be used to obtain an alternative expression for the general case. But one must be careful, as this alternative form requires computing an import-equivalent tariff rate for each tariff item when there is some distortion other than an ad valorem tariff. (The Appendix derives the import-equivalent tariff and the alternative expression.)

Now we turn to the measure of the effect of a country's distortions on its welfare, the WRI. The derivation follows the same steps as in the derivation of the TRI. This leads to a simple comparison of the two indexes.

The distortions in the market for good i create a welfare loss, L_i. This loss is given by the sum of the change in producer plus consumer surplus net of the tariff revenue. This loss of producer and consumer surplus is given simply by the areas of the two triangles

$$L_i = \tfrac{1}{2}\{(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^P - (p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^C\} \qquad (7)$$

where the demand and the supply for good i are again functions of own domestic price alone.

Strictly speaking, this result too holds only for small distortions. With non-small rates of distortion, the welfare losses are defined by the triangular-shaped areas under the demand and supply curves for the good. These areas can be obtained by integration. On the assumption that the demand and supply functions are linear, the welfare loss is again the sum of two triangles:

$$L_i = \tfrac{1}{2}\{(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^P - (p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^C\} \qquad (8)$$

$$\text{with} \quad \mathrm{d}y_i / \mathrm{d}p_i = const. \text{ and } \mathrm{d}x_i / \mathrm{d}p_i = const.$$

If the functions are not linear, this expression provides an approximation to the loss.

In the special case where $r_i = s_i = t_i$, the expression reduces to

$$L_i = -\tfrac{1}{2}(p_i^* t_i)^2 \mathrm{d}x_i / \mathrm{d}p_i \qquad (9)$$

Equation (9) yields the fundamental result that the loss from a tariff is proportional to the square of the tariff rate. This holds because the tariff rate determines both the price adjustment and the quantity response to this adjustment.[9] If $r_i \neq s_i$, as is frequently true in

[9] This insight is usually attributed to Harberger (1959). In fact, it was discovered by Dupuit (1844), more than 100 years before Harberger, while analysing the welfare loss resulting from commodity taxation. In his words, "the loss of utility increases as the square of the tax" (Dupuit 1844, p. 281). Dupuit's contribution to consumer surplus and welfare analysis is considered in Humphrey (1992).

agricultural markets, the expression in equation (8) yields the result that the consumer and the producer losses are each proportional to the square of the rate of distortion of the consumer or producer price, respectively.

With n importable goods subject to different levels of distortions, the aggregate welfare loss, in the absence of cross-price effects in all markets, is given by:

$$L = \tfrac{1}{2}\{\sum_{i=1}^{n}(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^{\mathrm{P}} - \sum_{i=1}^{n}(p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^{\mathrm{C}}\} \qquad (10)$$

The uniform tariff rate that generates an aggregate deadweight loss identical with that of the differentiated set of tariffs is determined by the following equation:

$$\sum_{i=1}^{n}(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^P - \sum_{i=1}^{n}(p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^C = -\sum_{i=1}^{n}(p_i^* W)^2 \mathrm{d}m_i / \mathrm{d}p_i \qquad (11)$$

W is the uniform tariff which, if applied to all goods in the place of all actual tariffs and NTMs and other distortions, would result in the same aggregate loss of welfare as the actual distortions. Solving for W, we have:

$$W = \{R'^2 a + S'^2 b\}^{1/2} \qquad (12a)$$

where $R' = [\sum_{i=1}^{n} r_i^2 u_i]^{\frac{1}{2}}$ with $u_i = p_i^{*2}\mathrm{d}x_i / \mathrm{d}p_i^C / \sum_i p_i^{*2}\mathrm{d}x_i / \mathrm{d}p_i^C$ (12b)

$$S' = [\sum_{i=1}^{n} s_i^2 v_i]^{\frac{1}{2}} \quad \text{with } v_i = -p_i^{*2}\mathrm{d}y_i / \mathrm{d}p_i^P / \sum_i p_i^{*2}\mathrm{d}y_i / \mathrm{d}p_i^P \qquad (12c)$$

and

$$a = \sum_i p_i^{*2}\mathrm{d}x_i / \mathrm{d}p_i^C / \sum_i p_i^{*2}\mathrm{d}m_i / \mathrm{d}p_i$$

$$b = -\sum_i p_i^{*2}\mathrm{d}y_i / \mathrm{d}p_i^P / \sum_i p_i^{*2}\mathrm{d}m_i / \mathrm{d}p_i \qquad (12d)$$

W is the desired Welfare Reduction Index. R' and S' are measures of the average levels of consumer and producer price distortions, respectively. They are means of order two. In the empirical section, R' and S' are referred to as the Producer Distortion Index (PDI) and the Consumer Distortion Index (CDI) to distinguish them from the arithmetic mean forms, the NRA and CTE.

Evidently, W can be written as an appropriately weighted average of the level of distortions of consumer and producer prices. It too is a mean of order two. As with the index T, we can deal with, and analyse, the production and consumption sides of the economy separately.

Comparing the expression for the WRI in equation (12) with that for the TRI in equation (4), we see that the weights in the construction of the R', S' and W are the same as

the weights for R, S and T. The only difference in the expressions for R', S' and W is that, in the case of the TRI, one constructs arithmetic means (which are the means of order one) whereas in the case of the WRI one constructs means of order two.[10] This difference is all due to the fact that the losses of import volume in each market are all proportional to the distortion rate whereas the losses of welfare are proportional to the squares of the distortions rates (compare equation (1) with equation (8)). The tariff rate enters only once in the determination of the import loss, in the base of the rectangle, whereas the tariff rate enters twice in the determination of the welfare loss, once in the base of the triangle and once in its height.

In the special case where $r_i = s_i = t_i$ for all i, equation (12) reduces to a much simpler form:

$$W = [\sum_{i=n}^{n} (t_i)^2 w_i]^{1/2} \qquad w_i = \varepsilon_i (p_i^* m_i^*) / \sum_{i}^{n} \varepsilon_i (p_i^* m_i^*) \qquad (13)$$

Further, if we assume that the elasticities of import demand are all equal, the weights are the share of imports of each good in total imports. This case can be used to obtain an alternative expression of the general case of the WRI. This is done in the Appendix to Lloyd, Croser and Anderson (2009).

Adding the exportables sub-sector

The indexes can each be extended to include the exportables sub-sector. In the exportable sector an export subsidy reduces welfare in the same way as an import tax in the import-competing sector, but it increases trade whereas the tariff reduces trade. It is necessary to keep track of import and export price distortions separately, for both producers and consumers, for the purpose of estimating the full welfare and trade reduction indexes. In essence, this extension is done by extending the commodity set and keeping separate track of the subsets of import-competing and exportable goods.

As one example, the WRI for the whole tradables sector can be written as an expansion of equation (12):

$$W = \{(R_M'^2 \omega_{PM} + R_X'^2 \omega_{PX})a + (S_M'^2 \omega_{CM} + S_X'^2 \omega_{CX})b\}^{1/2} \qquad (14a)$$

[10] Anderson and Neary (2005, p.21) note that the expressions for their measures of trade restriction and welfare reduction use the same weights.

where $\omega_{PX} = \frac{\sum_{i=n+1}^{z} y_i p_i}{\sum_{i=1}^{z} y_i p_i}$, $\omega_{PM} = \frac{\sum_{i=1}^{n} y_i p_i}{\sum_{i=1}^{z} y_i p_i}$, $\omega_{CX} = \frac{\sum_{i=n+1}^{z} x_i p_i}{\sum_{i=1}^{z} x_i p_i}$, $\omega_{CM} = \frac{\sum_{i=1}^{n} x_i p_i}{\sum_{i=1}^{z} x_i p_i}$ (14b)

It can be seen that when including both import-competing and exportable sub-sectors, we continue to first aggregate for producers and consumers separately, where the weights for each sub-sector are the share of the sub-sectors' value of production (consumption) in the total value of production (consumption). Producer and consumer distortions are aggregated in the last step with the usual assumption that the aggregate demand and supply curves have the same slope (that is, $a = b = 0.5$). The resulting measure can be regarded as the import tax/export subsidy which, if applied uniformly, would give the same loss of welfare as the combinations of measures distorting consumer and producer prices in the import-competing and exportable sub-sectors.

The TRI can be similarly decomposed as follows:

$$T = (R_M \omega_{PM} + R_X \omega_{PX})a + (S_M \omega_{CM} + S_X \omega_{CX})b \quad (15)$$

where ω, a and b are as already defined, R_M and S_M are R and S from equation (4b and c), and

$$R_X = [\sum_{i=1+n}^{z} -r_i \; u_i \;]; \;\; S_X = [\sum_{i=1+n}^{z} -s_i v_i \;]. \quad (16)$$

The aggregates in equation (16) are the weighted average levels of distortions to consumer and producer prices in the exportables sub-sector, respectively, with weights u_i and v_i given in equation (4b and c). Importantly, distortions to the exportables sub-sector enter equation (16) as negative values. This is because whilst a lowering of r_i (the distortion of the consumer price of good *i)* or s_i (the distortion of the producer price of good *i)* in the import-competing sub-sector reduces the reduction index, a lowering of r_i or s_i in the exportables sub-sector increases it.

These extensions of the TRI and the WRI have precisely the same properties as the indices for the import-competing sector.

The World Bank's Agricultural Distortions Project Database

The database generated by the World Bank's Agricultural Distortions project (Anderson and Valenzuela 2008) contains around 30,000 consistent estimates of annual nominal rates of assistance (NRAs) to the agricultural sector and the same number of consumer tax equivalents (CTEs) for a total of 75 countries over a time period between 1955 and 2007. The country coverage in the 1950s is much less than from 1960 though, so we begin our series of index estimates in that year; and NRA and CTE estimates are available for 2005-07 only for high-income and European transition economies (tables 1 and 2). The series contains data at the commodity level, for a sub-set of agricultural products (called covered products) that account for around 70 percent of total agricultural production of each studied country. Aggregate NRAs and CTEs for various sectors and sub-sectors (including import-competing and exporting sub-sectors) are estimated, using as weights the values of production and consumption, respectively, at undistorted prices.[11]

The range of policy measures included in the Agricultural Distortions database NRA estimates is wide. By calculating domestic-to-border price ratios the estimates include assistance provided by all tariff and non-tariff trade measures, plus any domestic price support measures (positive or negative), plus an adjustment for the output-price equivalent of direct interventions on inputs. Where multiple exchange rates operate, an estimate of the import or export tax equivalents of that distortion are included as well. The range of measures included in the CTE estimates include both domestic consumer taxes/subsidies plus trade and exchange rate policies, all of which drive a wedge between the price that consumers pay for each commodity and the international price at the border.

The most aggregated summaries of NRA and CTE estimates for covered products for developing and high income countries are provided in figures 1 and 2. Figure 1 supports the widely held views that developing country governments had in place agricultural policies that effectively taxed their farmers through to the 1980s, and that the extent of those disincentives has lessened since then. The extent of taxation was of the order of 15+ percent from the early 1960s to the mid-1980s. Since then it has not only diminished but, on average, has become slightly positive. Figure 1 also supports the view that the growth of agricultural protection in high-income countries has been going on since the 1950s, and began to reverse only after the 1980s (at which time there was a re-instrumentation toward

[11] Estimates of the NRA for total agricultural production in studied countries are obtained by making 'guesstimates' of the rates of assistance for the remaining 30 percent of agricultural production. Those guesstimates are not used in the present study, but their impact can be seen by comparing the third and fourth sets of rows of NRAs in Table1.

forms of support – not included here – that are somewhat decoupled from production). It is clear from figure 2 that consumers have experienced changes similar to producers in recent years. In developing countries, taxation was negative (i.e. consumer subsidization was positive) for most of the last 50 years, but this has lessened since the 1990s. In high-income countries, the implicit taxation of consumers from agricultural support rose until the early 1990s but has fallen since then.

Figures 3 and 4 show the trends in NRAs and CTEs, respectively, for Europe's transition economies and the three developing country regions of Africa, Asia, Latin America. On the production side, Africa is where there has been least tendency to reduce the taxing of farmers and subsidizing of consumers of covered farm products. Indeed its average NRA has been negative in all 5-year periods except in the mid-1980s when international prices of farm products reached an all-time low in real terms. By contrast, for both Asia and Latin America their NRAs crossed over from negative to positive after the 1980s. And in Europe's transition economies, the nominal assistance to farmers has trended upward following their initial shock in the early 1990s. For consumers in all four regions, agricultural policies have almost always involved consumer subsidization. Since the 1980s, however, food consumer subsidization in Asia, Latin America and Europe's transition economies has gradually disappeared and been replaced by a small degree of taxation.

Within the farm sector of all regions, the assistance to the import-competing sub-sector is typically well above that for the export sector (Lloyd, Croser and Anderson 2008, Appendix Tables A.1 to A.4), meaning there is an anti-trade bias in the structure of distortions. In the case of developing countries where the former NRA is positive and the latter negative, the two tend to offset each other such that the overall sectoral NRA is close to zero. Such a sectoral average can thus be misleading as an indication of the aggregate extent of price distortion within the sector. It can also be misleading when compared across countries that have varying degrees of dispersion in their NRAs for different farm products (see Anderson et al. 2009).

Measuring the Welfare and Trade Reduction Indexes

Table 3 reports the WRIs for agricultural import-competing products, exportables, and all covered tradable products from 1960 to 2007 for the five main studied regions and for the

world as a whole.[12] The WRI results for covered products show a similar pattern over the five regions: there is constant or increasing tendency for policies to reduce welfare from the 1960s to the mid-1980s, but thereafter the opposite occurs in almost all regions, as can be seen from figure 5. This pattern is generated by different policy regimes in different regions. In high-income countries, agriculture was assisted throughout the period, although it peaked in the 1980s (at around 60 percent) and thereafter fell. By contrast, in developing countries, agriculture was disprotected until the mid-1980s, and only thereafter did taxation of developing country farmers decline to the point that they received positive assistance by the turn of the century. The first point to note, then, is that the WRI has the desirable property of correctly reflecting the welfare consequences that result from both positive and negative assistance regimes for the sector.

A second point to note is that the WRI provides a better indicator of the welfare cost of distortions than the average level of assistance or taxation in the Agricultural Distortions database (NRA and CTE). Although the latter are a significant contribution in their own right (for example, as inputs into global commodity or economy-wide models), they can be misleading as a pair of indicators of the extent of the welfare costs of assistance. This is due to the inclusion in the WRI of the 'power of two'. That is, a weighted arithmetic mean does not fully reflect the welfare effects of agricultural distortions because the dispersion of that support or taxation across products has been ignored. By contrast, the WRI captures the higher welfare costs of high and peak levels of assistance or taxation. A good example of this is the WRI for high-income countries. In figure 1, the NRA series for high-income countries is everywhere positive, but in figure 5 the WRI series is higher than the NRA series, owing to its capturing of the dispersion of the NRA. That is, the WRI reflects the so-called 'disparity' issue discussed in Lloyd (2007): the larger the variance in assistance levels, the greater the potential for resources to be used in activities which do not maximize economic welfare.

A third point to note is that the WRI and its two components (PDI and CDI, reported in tables 5 nd 6) — unlike the arithmetic mean measures of assistance, the NRA and CTE —reflect the true welfare cost of agricultural policies when they have offsetting components. This can be seen most clearly for the case of Africa where, in the latter half of 1980s, it was still taxing exportables but had moved (temporarily) from low to very high

[12] National WRIs are aggregated across countries using as weights an average of the value of consumption and production at undistorted prices. National TRIs are aggregated across countries using the absolute difference between the value of production and the value of consumption at undistorted prices. National and regional WRIs and TRIs for the 5-year periods are unweighted averages of the annual indexes.

positive levels of protection for import-competing farm products (table 1). Figure 3 indicates that in 1985-89 the weighted average NRA for African import-competing and exporting farmers was close to zero. However, figure 5 shows that the WRI for Africa peaks in this time period. Thus, while at the aggregate level African farmers received almost no government assistance then, the welfare cost of the mixture of agricultural programs as a whole was at its highest.

For developing countries as a group, the trade restrictiveness of agricultural policy was roughly constant until the early 1990s and thereafter it declined, especially for Asia and Latin America, according to the TRI estimates for the five main regions and for different sub-sectors (figure 6 and table 4). For high-income countries the TRI time path was similar but the decline began a few years later. The aggregate results for developing countries are being driven by the exportables sub-sector which is being taxed and the import-competing sub-sector which is being protected (albeit by less than in high-income countries – see tables 1 and 4). For high-income countries, policies support both exporting and import-competing agricultural products and, even though they favour the latter much more heavily (figure 1), the assistance to exporters offsets somewhat the anti-trade bias from the protection of import-competing producers in terms of their impacts on those countries' aggregate volume of trade in farm products. This is reflected in much smaller TRI for high-income countries in the third as compared with the first row for high-income countries in table 4.

Like the WRI, the TRI correctly aggregates the restrictiveness of sub-sector policies that are masked in aggregate NRA and CTE measures, because they offset one another. Using again the example of Africa in 1985-89 when the NRA was closest to zero, the TRI peaks at this time in a way that correctly identifies the trade-reducing effect of positive protection to the import-competing sub-sector and disprotection to the exportables sub-sector.

The TRI generally shows greater variance than the WRI series. This is because the TRI measure is sensitive to switches from negative to positive rates of assistance. For example, a move from -30 to +30 percent rates of assistance would have little or no effect on the partial equilibrium welfare consequences of the policy, but it could have a significant effect on trade restrictiveness: net imports of farm products would be greater when the NRA is negative than when it is positive, ceteris paribus. The greater variability of the TRI is most clearly demonstrated for Asia in the period from 1965-69 to 1985-89:

the WRI measure barely changed throughout that period whereas the TRI dipped down and then spiked upwards in the 1980s (c.f. figures 5 and 6).

For completeness, we also include the PDI and CDI estimates (tables 5 and 6) and the national WRI and TRI estimates (tables 7 and 8). The PDI and CDI estimates are not identical, but their similarity reflects the fact that most of the distortions to agricultural incentives, as compiled in Anderson and Valenzuela (2008), are due to price distortions at national borders with domestic measures contributing relatively little. Even so, it is important to keep the PDI and CDI separate because they can be very different for some products. Likewise, the country detail in tables 7 and 8 reveals considerable differences within each region that are concealed in the regional aggregates reported in earlier tables and figures. Those differences are illustrated clearly for 2000-04 in figure 7, where individual country TRIs and WRIs are shown. That figure reveals the extremely high indexes for the most agricultural-protecting countries in the world, namely the three European Free Trade Area members (Iceland, Norway and Switzerland) and the three advanced economies of Northeast Asia (Japan, Korea and Taiwan). Notice also from Figure 7 that while the WRI is always positive, the TRI can be negative – and is slightly for a few countries, because of export or import subsidies.

A useful way of summarizing the regional estimates is provided in figure 8, which shows their movement since most of the indexes peaked in the late 1980s. The indexes would suggest agricultural policies were not reducing either trade or welfare of a region if the region were located at the zero point of both axes, that is, in the bottom left corner of the diagram (the 'sweet spot'). While almost no region is near that point, virtually all regions have moved towards it since 1985-89, and very substantially so for the outliers, namely Africa and EFTA+Japan but considerably also for the largest developing country region (Asia) and the European Union.

The biggest contributors to the global reduction in trade from farm policies are (in order) Japan, Korea, India, France and Germany, while the biggest contributors to the global reduction in welfare from farm policies are (again in order) Japan, the United States, Korea, China and France (figure 9).

Over the entire period since 1961, the WRI has tended to be higher the higher is a country's real GDP per capita (figure 10). We also found a negative correlation between the TRI and a trade specialisation index defined as the ratio of net exports to the total value of exports plus imports of agriculture and food – and an even stronger negative correlation between the WRI and that trade specialisation index. That is, agricultural-exporting countries

tend to have both lower measures of the TRI and WRI, while import-competing countries tend to have more welfare- and trade-reducing policies in place.

What can be said about agricultural distortions in the world as a whole? The fact that NRAs for high-income and developing countries diverged (in opposite ways) away from zero in the first half of the period under study, and then converged toward zero in the most recent quarter-century, meant that their weighted average NRA traced out a fairly flat trend. By contrast, figure 11 shows the WRI and TRI for the world as a whole each tracing out a hill-shaped path and thus providing less misleading indicators of the evolving disarray in world agricultural markets. Figure 11 also suggests that the global welfare cost of distortions was much higher than the NRA indicates but more so in earlier decades than in the current one, whereas the trade restrictiveness of farm policies globally was less than the NRA implied at the beginning and end of the period studied but was much more than the global average NRA implied in the 1970s and 1980s.

Finally, how do our estimates of these partial equilibrium indicators of trade and welfare reduction compare with those generated by a global general equilibrium model? Even though there are numerous reasons for not expecting them to be the same, such a comparison can be a check on the orders of magnitude at least. Valenzuela, van der Mensbrugghe and Anderson (2009) provides one such set of modeling results. It uses the economy wide Linkage Model and the present project's NRAs and CTEs to examine what the trade, welfare and other effects would be of removing all distortions to goods markets globally as of 2004. According to that model, global trade in all primary and lightly processed agricultural products would be $154 billion higher, and global welfare would be $168 billion higher, or $101 billion if just agricultural and food policies were liberalized (Valenzuela, van der Mensbrugghe and Anderson 2009, tables 13.14 and 13.16). This compares with the global TRI and WRI of $138 billion and $282 billion for 2000-04 for just our 75 focus countries and for just farm products. The welfare result from the Linkage Model is smaller than the WRI number – despite the model's broader coverage of products and countries – because it takes into account the general equilibrium effects of other (including non-agricultural) distortions at home and also distortions abroad insofar as they affect international prices, whereas the global WRI is obtained simply by summing the WRIs of each country. A better comparison would have been with a set of model scenarios where just farm policies were liberalized in just one of the 75 countries at a time, but that would require 75 simulations and remains an area for further research.

Conclusion

This chapter provides a panel set of index estimates that is well-grounded in trade theory and that takes into account the various forms of agricultural price and trade taxes/subsidies. The panel set covers 75 countries over the past half-century. It provides a very useful supplement to the various indicators of the mean and variance of aggregate NRAs and CTEs and the trade bias index used in previous chapters, especially from the viewpoint of the likely economic welfare or trade impacts of a country's structure of assistance to/taxation of agricultural industries and food consumers. These indexes can thus serve as inputs into cross-county studies of the impact over time of agricultural distortions on growth, poverty, unemployment and so forth. They also are important supplements to the NRA and CTE in improving our understanding of the long history of food and agricultural price and trade policies. That is especially true in seeking an index of global distortions when developing and high-income countries' NRAs or CTEs tend to offset each other. Our new indexes suggest the world was not very much less distorted by 2004 than it was in the 1960 (although it certainly was compared with the latter 1980s), and that the level of distortion is far higher than that suggested by the global average NRA or CTE.

There would be high returns to further research in this area. The above estimates are based on the assumption that the domestic price elasticities of supply (demand) are equal across commodities within a country. They could thus be refined by relaxing the assumption. This would entail a move to 'marginal welfare weights', instead of production and consumption share weights when estimating the PDI and CDI, respectively. Kee, Nicita and Olarreaga (2009) provide a methodology for estimating elasticities that could be adapted to the Agricultural Distortions project database.

Finally, the above equations can also be developed so that estimates of the distortions of consumer and producer prices for a particular commodity in individual countries can be aggregated across countries to obtain partial equilibrium indexes of the reduction in world trade and economic welfare for any chosen global commodity market. The first attempt to do that is presented in the next chapter (Anderson et al. 2009).

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Appendix: Alternative expressions for the TRI and the WRI using Import-equivalent and Welfare-equivalent Tariff Rates

This Appendix derives alternative expressions for the TRI and the WRI which are simpler and can be related to other measures in the existing literature. First, we require the concepts of the import-equivalent tariff rate and the welfare-equivalent tariff rate.

When the market is distorted by a measure or measures other than a tariff, the usual practice is to take the producer price distortion as the equivalent rate (for example, Kee, Nicita and Olarreaga 2008, 2009). We can call this rate the *producer-price equivalent* rate. But this procedure is not, in general, correct because this producer-price equivalent rate does not replicate the effect on trade or welfare of the measure(s). The computation of the equivalent rates requires the rates of both the producer price and the consumer price distortions.[13]

Import-equivalent tariff rates

The import-equivalent tariff rate is the tariff rate that results in the same restriction of imports as the combination of measures applied to good i.

When the market is distorted by a combination of measures that distort the consumer and producer prices differentially, the change in imports is (from equation (2) above)

$$\Delta M_i = p_i^{*2} dx_i / d\, p_i^C r_i - p_i^{*2} dy_i / d\, p_i^P s_i \qquad \text{(A.1)}$$

The import-equivalent tariff is defined by the equality

$$p_i^{*2} dx_i / d\, p_i^C r_i - p_i^{*2} dy_i / d\, p_i^P s_i = p_i^{*2} dm_i / dp_i t_i^I$$

Hence,

$$t_i^I = a_i r_i + b_i s_i \text{ where } \quad a_i = (\mathrm{d}x_i / \mathrm{d}\, p_i^C) / (\mathrm{d}m_i / \mathrm{d}p_i) > 0$$

$$b_i = -(\mathrm{d}y_i / \mathrm{d}\, p_i^P) / (\mathrm{d}m_i / \mathrm{d}p_i) > 0 \qquad \text{(A.2)}$$

[13] One must be careful in calculating these rates. In some cases, the effects of two (or more) measures on the distortions of producer and consumer prices are not additive. For example, suppose that the producers are assisted by a 10 per cent tariff and a quota that, if applied alone, would raise producer and consumer prices by 20 per cent. The combined effect of these two measures on producer and consumer prices is only 20 per cent. In other cases, one or a combination of measures may prohibit trade. In such a case, the relevant rate is the prohibitive tariff rate.

In general, $r_i \neq s_i$. The import-equivalent tariff rate is a weighted arithmetic mean of the rates of distortion of consumer and producer prices, the weights being their share of the import response to the change in price. If $r_i > 0$ and $s_i > 0$ then $t_i^I > 0$.

Welfare-equivalent tariff rates

The welfare-equivalent tariff rate, t_i^W , is the tariff rate that results in the same loss of welfare as the combination of measures applied to a good. As in the case of tariffs, we take the welfare triangles as the measure of welfare loss.

When the market for a good is distorted by a combination of measures that distort the consumer and a producer prices differentially, the welfare loss is (from equation (7))

$$L_i = \tfrac{1}{2}\{(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^P - (p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^C\} \qquad \text{(A.3)}$$

This is the sum of two triangles. The two effects of the changes in consumer and producer prices capture all of the welfare effects when markets are competitive. The welfare-equivalent tariff is defined by the equality

$$\tfrac{1}{2}\{(p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i - (p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i\} = -\tfrac{1}{2}(p_i^* t_i^W)^2 \mathrm{d}m_i / \mathrm{d}p_i$$

Hence,

$$t_i^W = \{a_i r_i^2 + b_i s_i^2\}^{\frac{1}{2}} \qquad a_i = (\mathrm{d}x_i / \mathrm{d}p_i^C)/(\mathrm{d}m_i / \mathrm{d}p_i) > 0$$

$$b_i = -(\mathrm{d}y_i / \mathrm{d}p_i^P)/(\mathrm{d}m_i / \mathrm{d}p_i) > 0 \qquad \text{(A.4)}$$

The welfare-equivalent tariff rate is also a weighted average of the rates of distortion of consumer and producer prices, the weights again being their share of the import response to the change in price. However, the welfare-equivalent tariff rate is the mean of order 2, not the arithmetic mean (which is the mean of order 1). If $r_i > 0$ and $s_i > 0$ then $t_i^W > 0$.

Because both the import-equivalent and the welfare-equivalent tariff rates are means of the rates of producer and consumer distortions, they lie between these two rates, provided the weights are positive. For the same reason, both rates are different than the producer-price equivalent rate. They are greater or less than this rate depending on whether the producer price distortion rate is less than or greater than the consumer price distortion rate.

Importantly, the welfare-equivalent tariff rate is not equal to the import-equivalent tariff rate when the rate of distortion of the producer price is not equal to the rate of

distortion of the consumer price. In fact, the welfare-equivalent tariff rate must be greater than the import-equivalent rate.[14] The difference between these two equivalent rates increases with the difference between the producer and the consumer distortion rate.

With some non-tariff measures, the rates of distortion of the producer price and the consumer price are equal. In these cases, the import-equivalent and the welfare-equivalent tariff rate are equal, and both are equal to the producer-price equivalent. This holds for variable levies. Quotas also fall into this category if the conditions required for equivalence are satisfied and if the quota is auctioned or one treats the quota rents accruing to private quota-holders in the same way as revenues accruing to the government under a regime of tariffs only.

As one example, consider an industry that is assisted by an output-based subsidy alone. For the sake of illustration, we make the assumption that the slopes of the demand and supply functions are equal (ignoring signs). Then

$(dm_i / dp_i) = (dx_i / d\,p_i^C) - (dy_i / d\,p_i^P) = -2\ dy_i(/ d\,p_i^P)$ and $t_i^I = ½s_i$.

Hence, as required, the import-equivalent tariff rate is not equal to the producer-price equivalent tariff rate (s_i). In fact, it is exactly one half of this rate, because the import tariff affects both the domestic demand and the domestic supply whereas the subsidy affects on the supply side of the market. On the other hand, the welfare-equivalent tariff rate is $0.71\,s_i$ ($=\{0.5(s_i)^2\}^{1/2}$). This rate too is less than the producer-price equivalent tariff rate, and it is greater than the import-equivalent tariff rate.

As a second example, suppose a good is assisted by a combination of a 20 per cent tariff and a subsidy of 20 per cent in ad valorem terms. The consumer price increases by 20 per cent and the producer price by 40 per cent. If, again, the domestic demand and supply curves have the same slope, the import-equivalent rate is 30 ($= 0.5(0.2) + 0.5(0.4)$) per cent. The welfare-equivalent tariff rate for this combination is 31.2 ($=\{0.5(0.2)^2+0.5(0.4)^2\}^{1/2}$) per cent. Again $t_i^W \neq s_i$ and $t_i^I \neq s_i$, and $t_i^W > t_i^I$.

Now define the TRI as

$$T = \sum_{i=1}^{n} t_i^I w_i \qquad\qquad w_i = \varepsilon_i(p_i^* m_i^*) / \sum_i^n \varepsilon_i(p_i^* m_i^*) \qquad\qquad \text{(A.5)}$$

[14] From the Theorem of the Mean, the mean of order 2 is strictly greater than the mean of order 1 if $r_i \neq s_i$.

where ε_i (< 0) are the elasticities of the import demand function in the free-trade situation and $(p_i^* m_i^*)$ are the values of imports in the free-trade situation. If the definitions of t_i^I in equation (A.2) are inserted into equation (A.5), it is easily seen that the form in equation (A.5) is identical that in equation (4).

Similarly, define the WRI as

$$W = [\sum_{i=n}^{n} (t_i^W)^2 w_i]^{1/2} \qquad w_i = \varepsilon_i (p_i^* m_i^*) / \sum_{i}^{n} \varepsilon_i (p_i^* m_i^*) \qquad \text{(A.6)}$$

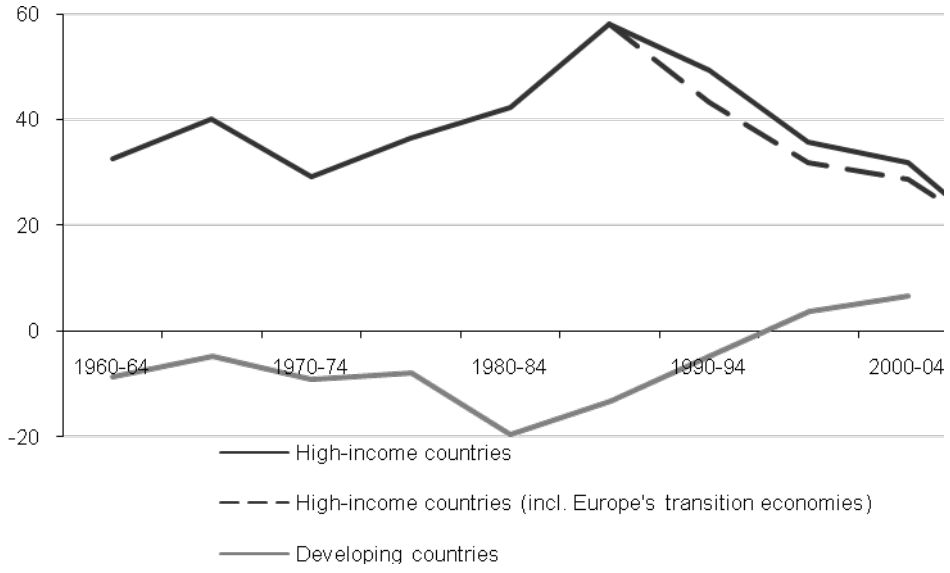
If the definitions of t_i^W in equation (A.4) are inserted into equation (A.6), it is easily seen that the form in equation (A.6) is identical that in equation (12).

In effect, the indexes in equations (A.5) and (A.6) are calculated in two stages.[15] First, we calculate the import-equivalent (welfare- equivalent) tariff rate of distortions to both producer and consumer prices in each market and then we average these tariff rates across all goods. These forms of the indexes are particularly useful if we are interested in the contributions which the distortions in the market for each good make to the aggregate loss of trade or welfare for the country.

[15] Kee, Nicita and Olarreaga (2009) use the expression in Equation (A.6) but again they wrongly use the producer price distortion in place of the welfare-equivalent tariff rate.

Figure 1: Nominal rate of assistance to farmers in high-income and developing countries, for all covered farm products, 1960 to 2007

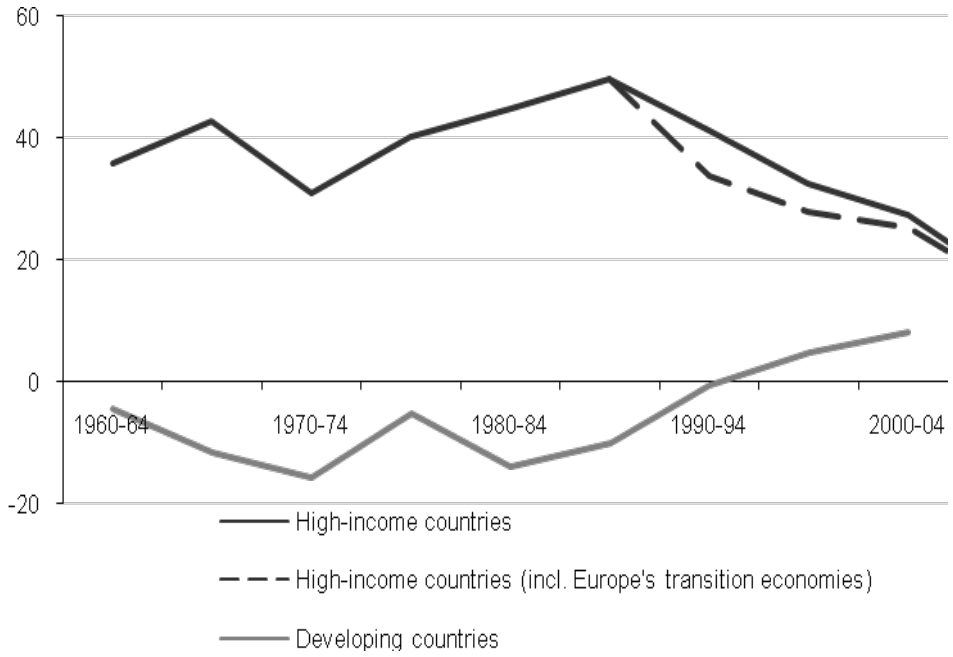
(percent, averaged using weights based on the gross value of agricultural production at undistorted prices)



Source: Anderson and Valenzuela (2008)

Figure 2: Consumer tax equivalents affecting covered farm products in high-income and developing countries, 1960 to 2007

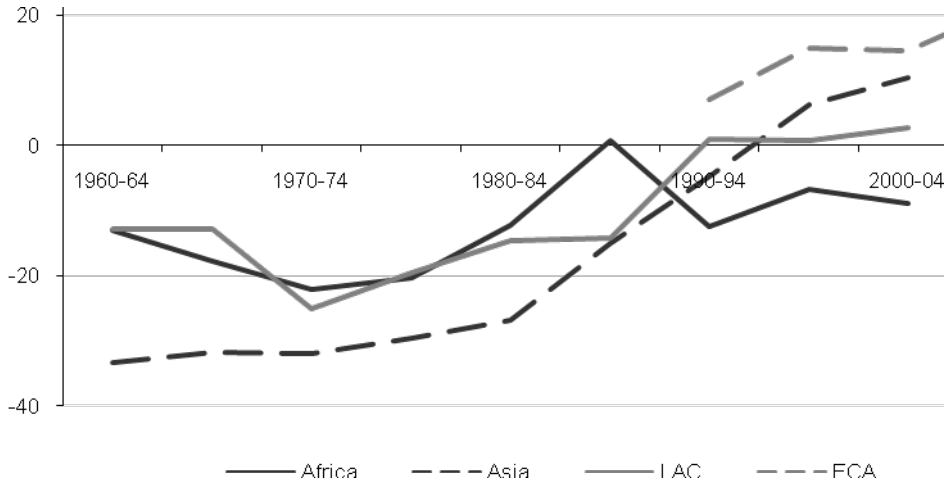
(percent, averaged using weights based on the value of agricultural consumption at undistorted prices)



Source: Anderson and Valenzuela (2008)

Figure 3: Nominal rate of assistance to farmers in developing countries of Africa, Asia, Latin America and in Europe's transition economies (ECA) for covered farm products, 1960 to 2007

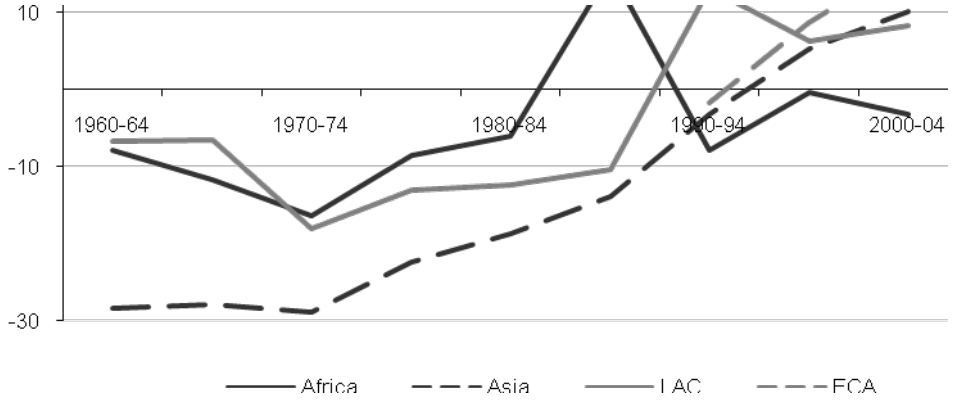
(percent, averaged using weights based on the gross value of agricultural production at undistorted prices)



Source: Anderson and Valenzuela (2008)

Figure 4: Consumer tax equivalents affecting covered farm products in developing countries of Africa, Asia, Latin America and in Europe's transition economies (ECA), 1960 to 2007

(percent, averaged using weights based on the gross value of agricultural consumption at undistorted prices)



Source: Anderson and Valenzuela (2008)

Figure 5: Welfare Reduction Indexes for covered tradable farm products, by region, 1960 to 2007

(percent)

(a) Africa, Asia and Latin America

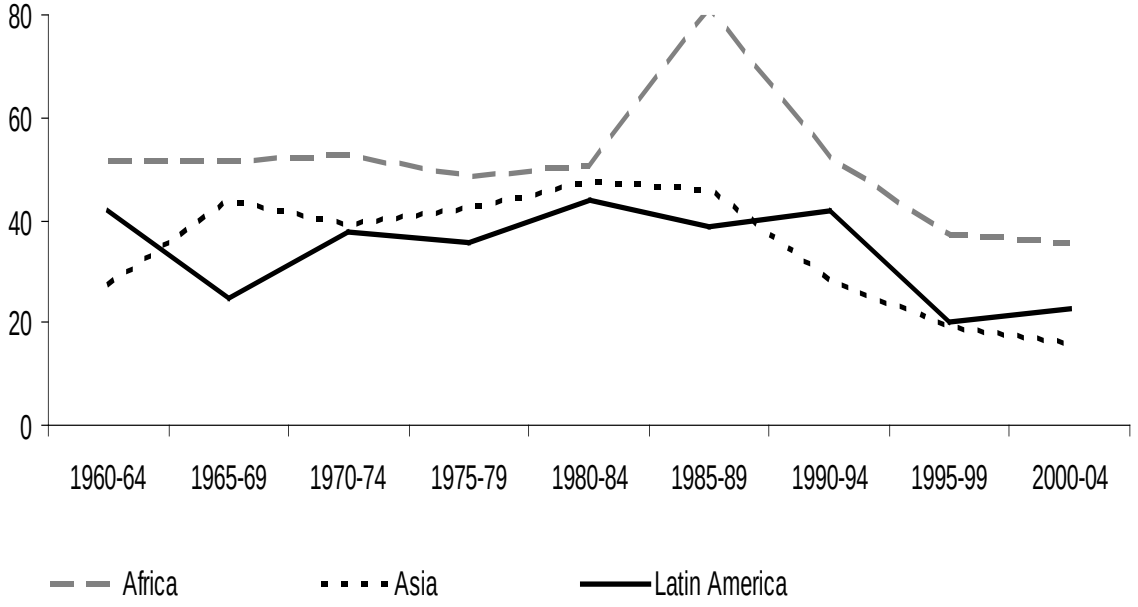
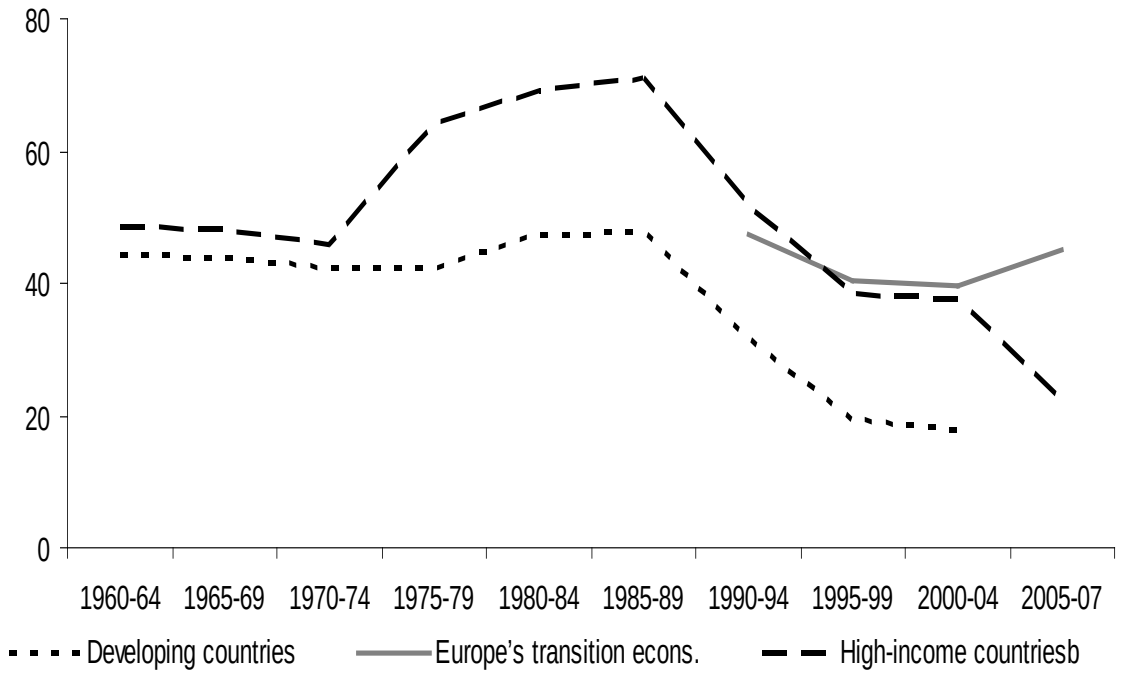


Figure 5 (continued): Welfare Reduction Indexes for covered tradable farm products, by region, 1960 to 2007

(percent)

(b) Developing countries, high-income countries and Europe's transition economies



Source: Authors' calculations based on NRAs and CTEs in Anderson and Valenzuela (2008).

Figure 6: Trade Reduction Indexes for covered tradable farm products, by region, 1960 to 2007

(percent)

(a) Africa, Asia and Latin America

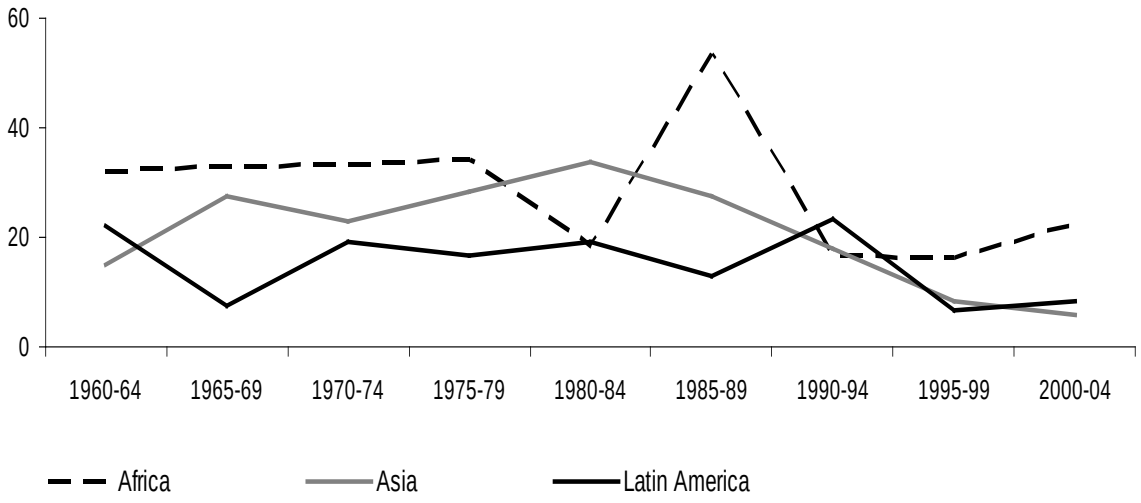
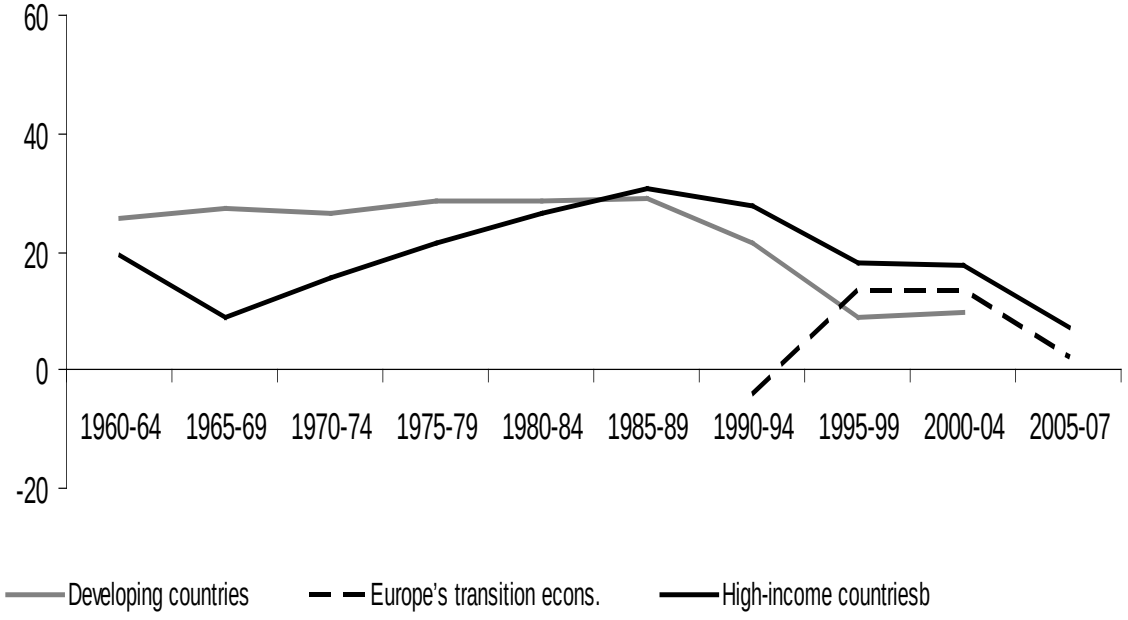


Figure 6 (continued): Trade Reduction Indexes for covered tradable farm products, by region, 1960 to 2007

(percent)

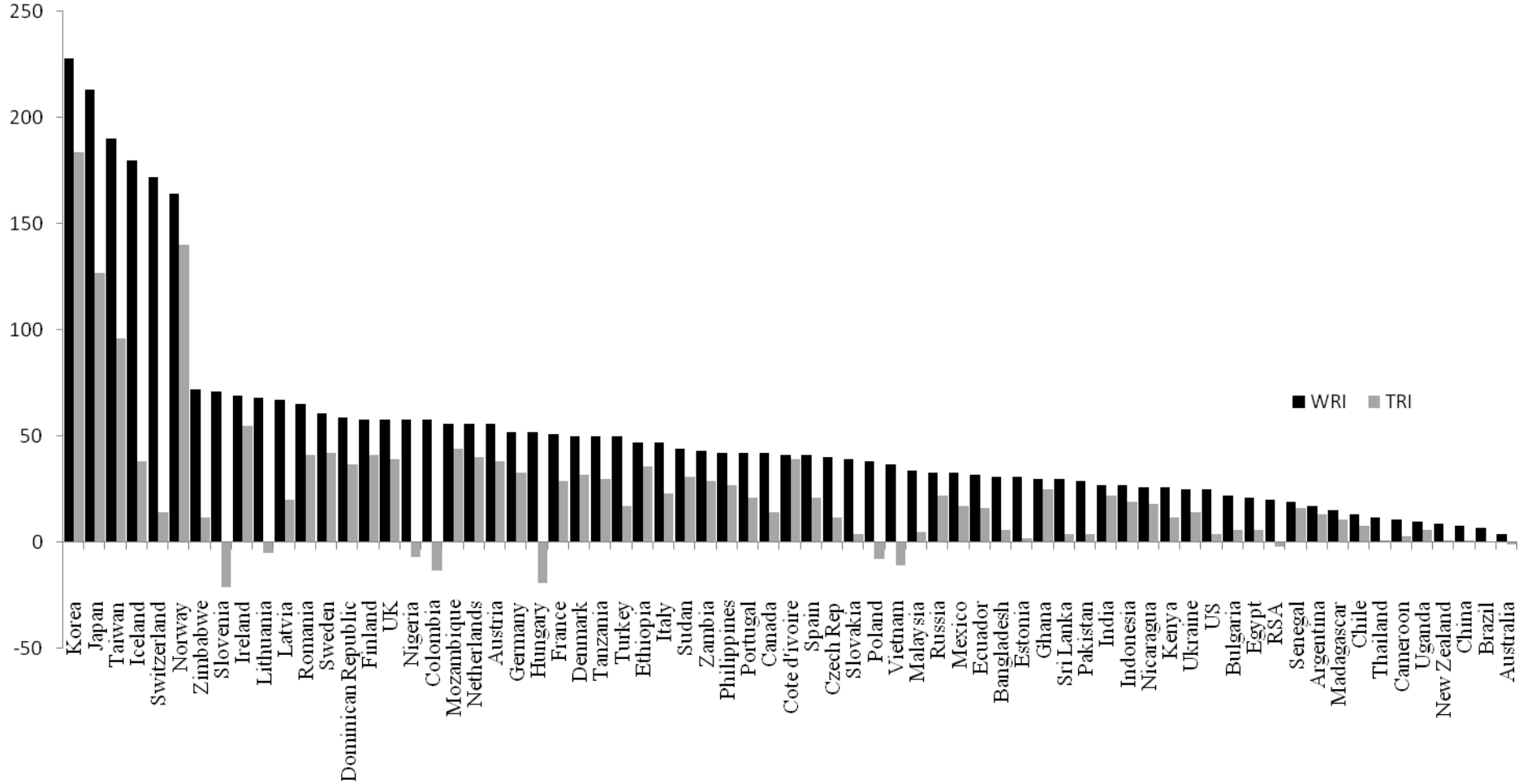
(b) Developing countries, high-income countries and Europe's transition economies



Source: Authors' calculations based on NRAs and CTEs in Anderson and Valenzuela (2008).

Figure 7: Welfare and Trade Reduction Indexes for covered tradable farm products, by country, 2000-04

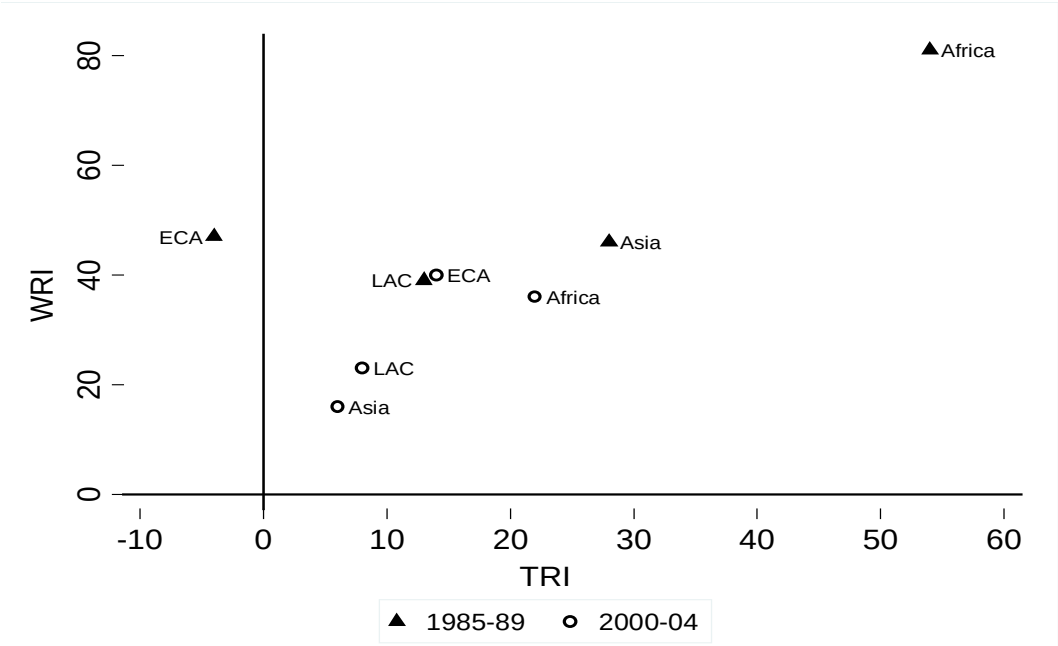
(percent)



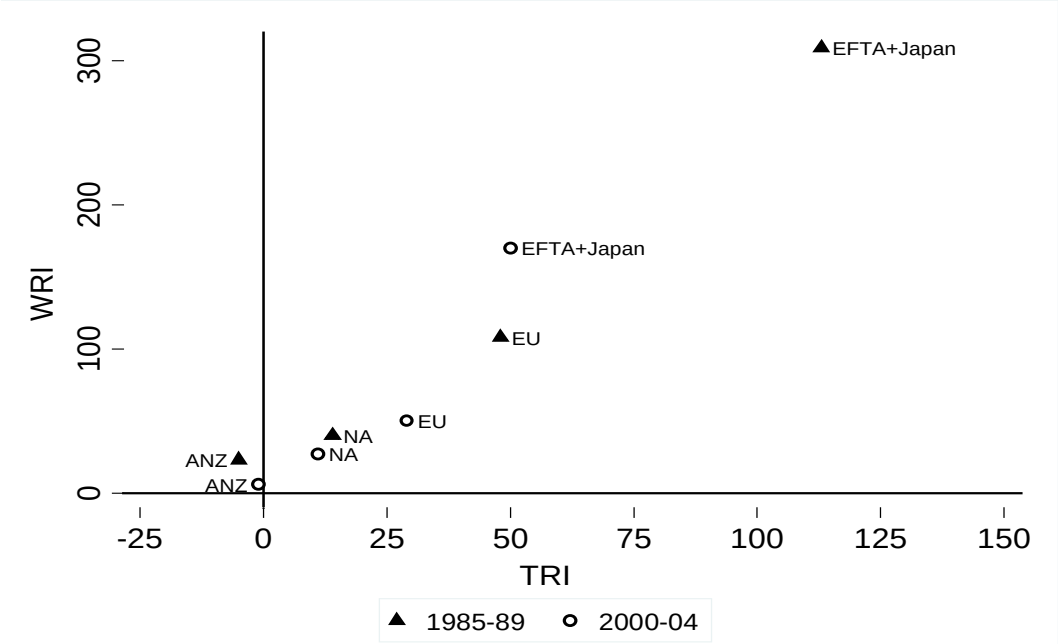
Source: Authors' calculations based on NRAs and CTEs in Anderson and Valenzuela (2008).

Figure 8: Trade and Welfare Reduction Indexes for covered tradable farm products, by region, 1985-89[a] and 2000-04 (percent)

(a) Developing and transition economies



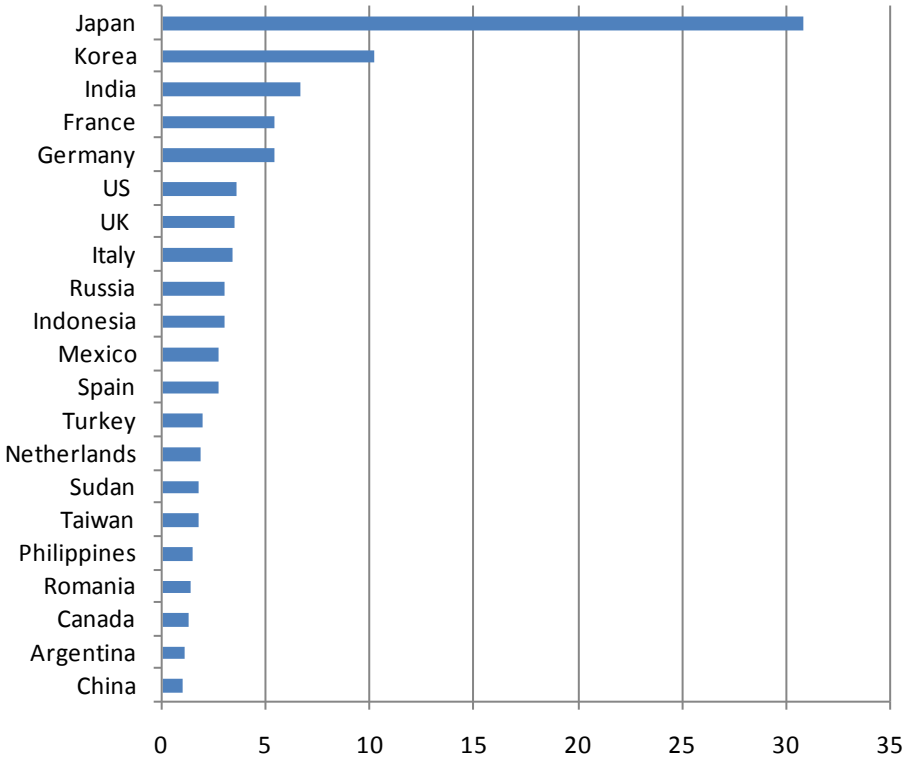
(b) High-income countries



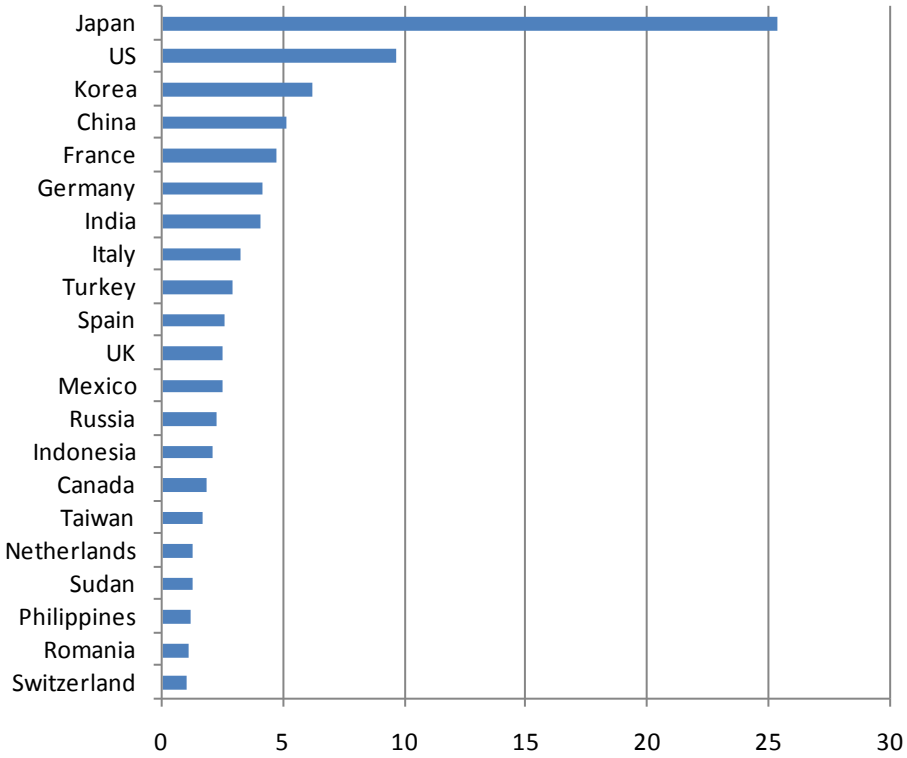
[a] The early years for ECA are 1992-94. CA is Europe's transition economies, LAC is Latin america nad the Caribbean, NA is North America, EU is the 15 members of the European Union as of the start of 2004, EFTA is Iceland, Norway and Switzerland.
Source: Derived by the authors using data from Anderson and Croser (2009)

Figure 9: Country contributions to the global TRI and WRI,[a] 2000–04
(percent shares, based on US dollar values at undistorted prices)[b]

(a) TRI


Japan
Korea
India
France
Germany
US
UK
Italy
Russia
Indonesia
Mexico
Spain
Turkey
Netherlands
Sudan
Taiwan
Philippines
Romania
Canada
Argentina
China
0
5
10
15
20
25
30
35

(b) WRI



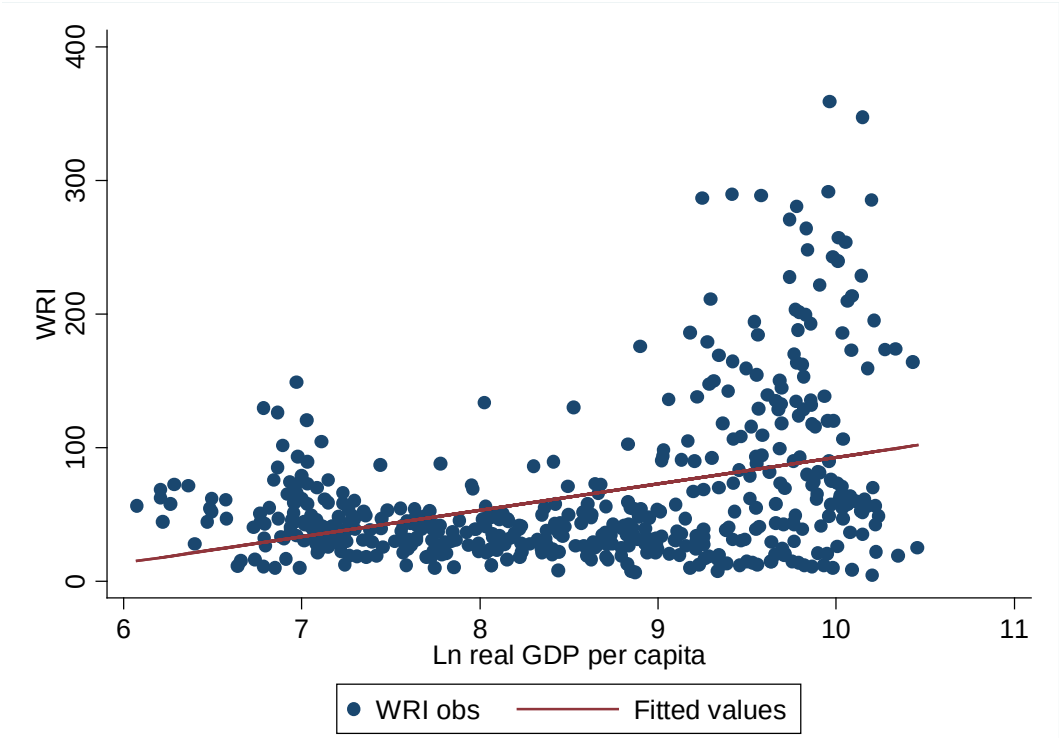
Source: Derived from data in Anderson and Croser (2009).

a. The global TRI in current US dollars is multiplied by the absolute value of trade (calculated as the absolute value of the value of production minus the value of consumption). Each country contribution is computed as the country-level TRI multiplied by the country-level value of trade at undistorted prices, as a share of the global aggregate TRI multiplied by the global value of trade at undistorted prices. The global WRI in current US dollars is multiplied by the average of the value of global production and consumption at undistorted prices. Each country contribution is computed as the country-level WRI multiplied by the country-level average of the value of production and consumption at

undistorted prices, as a share of the global aggregate WRI multiplied by the global average value of production and consumption at undistorted prices.
b. The sum of all country contributions (which are necessarily all positive for the WRI) is 100. Country contributions of less than 1 percent are omitted from the figures.

Figure 10: Welfare Reduction Index and real per capita GDP, all 75 countries, 1961 to 2004[a]

(WRI in percent, five-year averages)

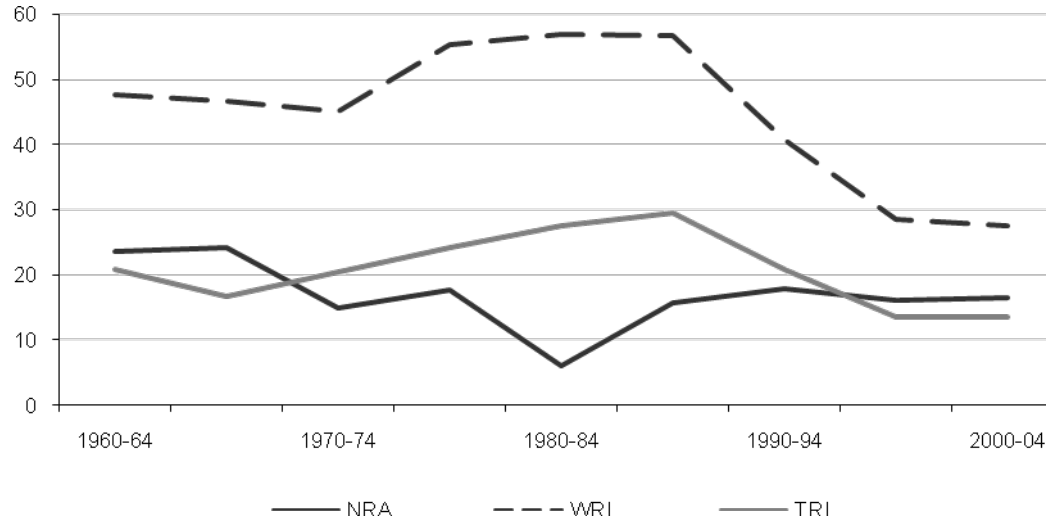


[a] The fitted regression line is WRI = -105 + 19.8 lnGDPPC, Adj R^2 = 0.14, n = 498
(-5.6) (9.1)

Source: Derived by the authors using data from Anderson and Croser (2009)

Figure 11: Nominal Rate of Assistance and Trade and Welfare Reduction Indexes for covered tradable farm products, world, 1960 to 2007

(percent)



Source: Authors' calculations based on NRAs and CTEs in Anderson and Valenzuela (2008).

Table 1: Nominal rates of assistance,[a] Africa, Asia, Latin America, European transition economies and high-income country regions, all farm products, 1960 to 2007 (percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Covered import-competing products										
Africa	12	4	-7	8	8	65	2	7	3	na
Asia	4	34	26	31	21	45	28	28	35	na
Latin America	20	3	-4	2	10	4	17	9	19	na

All developing countries	11	26	17	23	17	39	22	22	28	na
Europe's transition economies	na	na	na	na	na	na	31	34	34	30
High-income countries	54	59	42	56	70	84	73	64	60	31
World	48	50	37	46	46	66	51	43	44	na
Covered exportables										
Africa	-31	-39	-44	-45	-36	-36	-39	-26	-28	na
Asia	-13	-26	-20	-25	-44	-39	-19	-4	0	na
Latin America	-23	-17	-30	-26	-27	-24	-9	-3	-4	na
All developing countries	-25	-29	-29	-30	-40	-37	-19	-5	-3	na
Europe's transition economies	na	na	na	na	na	na	-4	-1	0	15
High-income countries	4	10	8	7	8	17	13	6	5	3
World	-2	-4	-7	-11	-24	-21	-8	-1	0	na
All covered farm products[b]										
Africa	-13	-18	-22	-20	-12	1	-12	-7	-9	na
Asia	-3	3	0	0	-21	-15	-5	6	10	na
Latin America	-13	-13	-25	-20	-15	-14	1	1	3	na
All developing countries	-9	-5	-9	-8	-20	-13	-5	4	7	na
Europe's transition economies	na	na	na	na	na	na	7	15	15	21
High-income countries	32	39	29	36	43	58	49	36	32	16
World	24	24	15	18	6	16	18	16	16	na
All agriculture[c]										
Africa	-8	-11	-15	-13	-8	-1	-9	-6	-7	na
Asia[d]	-27	-25	-25	-24	-21	-9	-2	8	12	na
Latin America	-8	-7	-21	-18	-13	-11	4	5	5	na
All developing countries	-23	-22	-24	-22	-18	-8	-2	6	9	na
Europe's transition economies	na	na	na	na	na	na	10	18	18	25
High-income countries	29	35	25	32	41	53	46	35	32	17
World	22	21	13	15	8	17	18	17	18	na

Source: Anderson and Valenzuela (2008)

[a] Weighted using the value of production at undistorted prices.

[b] Includes nontradables.

[c] Covered and non-covered products.

[d] Estimates for China pre-1981 and India pre-1965 are based on the assumption that the nominal rates of assistance to agriculture in those years were the same as the average NRA estimates for those economies for 1981-84 and 1965-69, and that the gross value of production in those missing years is that which gives the same average share of value of production in total world production in 1981-84 and 1965-69, respectively. This NRA assumption is conservative in the sense that for both countries the average NRA was probably even lower in earlier years.

Table 2: Consumer tax equivalents[a], Africa, Asia, Latin America, European transition economies and high-income regions, all covered farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	7	0	-8	7	3	76	5	9	5	na
Asia	1	14	8	24	24	44	32	27	35	na
Latin America	23	11	0	8	4	1	28	11	18	na
All developing countries	6	11	4	18	17	39	29	22	27	na
Europe's transition economies	na	na	na	na	na	na	12	21	31	30
High-income countries	53	56	41	54	65	66	57	55	50	30
World	46	44	32	43	43	55	41	38	39	na
Exportable products										
Africa	-29	-36	-42	-34	-28	-31	-38	-20	-24	na
Asia	-3	-38	-29	-32	-42	-40	-20	-5	0	na
Latin America	-25	-14	-25	-24	-27	-21	-12	1	0	na
All developing countries	-23	-36	-33	-30	-38	-37	-20	-5	-1	na
Europe's transition economies	na	na	na	na	na	na	-6	-4	2	-1
High-income countries	4	11	9	9	6	11	8	-2	-3	0
World	0	-8	-9	-11	-24	-24	-11	-4	-2	na
All covered farm products[b]										
Africa	-8	-12	-16	-9	-6	16	-8	0	-3	na
Asia	0	-12	-15	-2	-15	-14	-3	5	10	na
Latin America	-7	-7	-18	-13	-12	-10	13	6	8	na
All developing countries	-5	-12	-16	-5	-14	-10	0	5	8	na
Europe's transition economies	na	na	na	na	na	na	-2	9	17	11
High-income countries	35	42	30	40	45	49	41	32	27	16
World	28	23	14	21	10	15	16	15	16	na

[a] Weighted using the value of consumption at undistorted prices. [b] Includes nontradables.

Source: Anderson and Valenzuela (2008)

Table 3: Welfare Reduction Indexes, Asian, African, Latin American, Europe's transition economies and high-income regions[a], all covered tradable farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	59	52	53	47	51	98	43	32	30	na
Asia	36	45	46	50	48	62	48	44	48	na
Latin America	54	34	27	37	47	40	46	26	32	na
All developing countries	49	46	43	44	44	54	36	28	30	na
Europe's transition economies	na	na	na	na	na	na	60	44	45	43
High-income countries	79	87	71	100	106	123	102	91	87	50
World	74	76	65	85	81	100	78	65	65	na
Exportable products										
Africa	37	44	48	49	48	55	58	41	40	na
Asia	24	43	34	34	48	45	24	10	7	na
Latin America	28	22	36	32	36	33	29	12	15	na
All developing countries	31	38	38	36	46	44	26	11	10	na
Europe's transition economies	na	na	na	na	na	na	37	33	31	42
High-income countries	12	20	16	12	12	25	22	11	11	10
World	16	27	26	24	34	39	26	13	12	na
All covered farm tradables										
Africa	52	52	52	49	51	82	52	37	36	na
Asia	27	43	39	42	47	45	28	19	16	na
Latin America	43	25	38	36	44	39	42	20	22	na
All developing countries	44	44	42	42	47	47	31	19	18	na
Europe's transition economies	na	na	na	na	na	na	47	40	40	44
High-income countries	49	48	46	64	69	70	51	38	37	22
World	48	47	45	55	57	57	41	28	27	na

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

[a] Regional aggregates are weighted using the average of the value of production and the value of consumption at undistorted prices.

Table 4: Trade Reduction Indexes, Asian, African, Latin American, Europe's transition economies and high-income regions[a], all covered tradable farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	-28	-23	-19	3	0	112	7	10	4	na
Asia	11	25	19	26	38	70	68	63	76	na
Latin America	28	27	11	2	6	1	32	11	20	na
All developing countries	-1	20	10	11	7	48	26	10	16	na
Europe's transition economies	na	na	na	na	na	na	13	23	26	29
High-income countries	79	80	52	72	88	89	83	84	81	63
World	64	55	42	56	58	80	59	60	62	na
Exportable products										
Africa	29	39	43	47	41	36	38	24	30	na
Asia	14	27	26	23	35	20	17	8	0	na
Latin America	20	15	28	22	23	21	5	2	3	na
All developing countries	22	29	32	30	34	25	17	9	6	na
Europe's transition economies	na	na	na	na	na	na	0	2	-2	-9
High-income countries	-8	-12	-9	-5	-8	-21	-13	-4	-2	-2
World	3	7	11	12	17	8	4	4	3	na
All covered farm tradables										
Africa	32	33	33	34	18	54	17	16	23	na
Asia	15	28	23	28	34	28	18	8	6	na
Latin America	22	8	19	17	19	13	23	7	8	na
All developing countries	26	28	26	28	28	29	22	9	10	na
Europe's transition economies	na	na	na	na	na	na	-4	13	14	2
High-income countries	19	9	16	21	27	30	28	18	18	7
World	21	17	20	24	28	30	21	14	14	na

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

[a] Regional aggregates are weighted using the absolute value of net imports (computed as the difference between the value of consumption and the value of production) at undistorted prices.

Table 5: Producer Distortion Indexes (CDIs), Asian, African, Latin American, Europe's transition economies and high-income regions[a], all covered farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	60	54	53	48	52	93	43	32	31	na
Asia	39	53	52	52	48	60	46	43	46	na
Latin America	53	32	26	34	50	44	43	25	37	na
All developing countries	51	52	48	45	45	53	33	28	31	na
Europe's transition economies	na	na	na	na	na	na	58	49	48	43
High-income countries	79	86	72	102	108	130	106	90	87	47
Exportable products										
Africa	38	45	49	52	50	53	56	39	39	na
Asia	24	37	29	31	49	44	24	9	7	na
Latin America	27	22	38	33	36	34	29	13	16	na
All developing countries	31	35	36	36	47	43	26	11	10	na
Europe's transition economies	na	na	na	na	na	na	38	34	31	37
High-income countries	11	19	16	11	12	24	19	9	10	9
All covered farm products[b]										
Africa	44	46	45	46	42	55	39	28	26	na
Asia	32	41	37	41	48	49	32	22	20	na
Latin America	29	24	36	34	42	39	35	18	23	na
All developing countries	37	40	38	40	46	46	29	18	18	na
Europe's transition economies	na	na	na	na	na	na	46	43	40	40
High-income countries	53	64	53	70	74	95	76	56	53	30

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

a. Regional aggregates are weighted using the value of production at undistorted process.

b. Includes nontradables.

Table 6: Consumer Distortion Indexes (CDIs), Asian, African, Latin American, Europe's transition economies and high-income regions[a], all covered farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	58	51	52	46	50	101	43	32	29	na
Asia	31	32	35	48	48	62	49	44	48	na
Latin America	55	35	27	39	43	34	45	25	24	na
All developing countries	45	35	35	43	42	54	37	28	28	na
Europe's transition economies	na	na	na	na	na	na	61	38	42	43
High-income countries	79	86	70	98	102	114	94	88	84	50
Exportable products										
Africa	36	43	47	45	46	58	62	42	41	na
Asia	28	50	39	37	47	46	24	10	6	na
Latin America	30	21	34	31	36	32	29	9	12	na
All developing countries	33	43	40	37	45	45	26	11	9	na
Europe's transition economies	na	na	na	na	na	na	36	32	30	47
High-income countries	12	20	17	13	10	25	22	11	11	10
All covered farm products[b]										
Africa	44	43	44	39	40	62	39	27	26	na
Asia	29	39	38	42	46	49	33	24	21	na
Latin America	33	26	34	35	40	34	40	18	19	na
All developing countries	37	38	38	39	43	46	31	19	17	na
Europe's transition economies	na	na	na	na	na	na	48	37	39	48
High-income countries	59	70	56	76	77	91	74	62	58	36

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

a. Regional aggregates are weighted using the value of consumption at undistorted prices.

b. Includes nontradables.

Table 7: Welfare Reduction Indexes, by country and region[a], all covered tradable farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Africa	**52**	**52**	**52**	**49**	**51**	**81**	**52**	**37**	**36**	**na**
Cameroon	29	37	42	54	38	23	20	18	11	na
Cote d'ivoire	35	47	45	48	44	39	37	32	41	na
Egypt	49	53	54	40	46	134	32	29	21	na
Ethiopia	na	na	na	na	44	56	58	52	47	na
Ghana	24	44	40	62	89	75	39	21	30	na
Kenya	39	39	29	19	31	27	36	22	26	na
Madagascar	26	28	26	45	58	46	30	16	15	na
Mozambique	na	na	na	72	65	75	33	31	56	na
Nigeria	148	129	121	105	102	127	94	75	58	na
RSA	20	18	25	34	48	39	31	22	20	na
Senegal	19	18	44	46	41	60	66	12	19	na
Sudan	35	40	51	40	40	65	79	42	44	na
Tanzania	na	na	na	71	72	68	62	54	50	na
Uganda	11	16	44	83	58	60	11	10	10	na
Zambia	26	38	48	59	32	70	59	40	43	na
Zimbabwe	41	45	50	56	46	42	47	40	72	na
Asia	**27**	**44**	**39**	**42**	**48**	**46**	**28**	**19**	**16**	**na**
Bangladesh	na	na	30	41	29	49	29	25	31	na
China	na	na	na	na	55	48	25	12	8	na
India	37	46	49	61	54	87	31	22	27	na
Indonesia	na	na	18	22	31	21	24	28	27	na
Korea	45	43	69	86	130	176	211	194	228	na
Malaysia	14	12	10	31	57	95	71	31	34	na
Pakistan	44	71	75	37	39	46	31	24	29	na
Philippines	18	36	30	21	33	46	32	51	42	na
Sri Lanka	32	28	29	37	26	29	39	35	30	na
Taiwan	30	46	52	35	43	85	124	155	190	na
Thailand	na	na	30	24	22	18	16	19	12	na
Vietnam	na	na	na	na	na	22	30	24	37	na
Latin America	**42**	**25**	**38**	**36**	**44**	**39**	**42**	**20**	**23**	**na**
Argentina	32	30	28	27	24	19	10	8	17	na
Brazil	na	16	43	36	42	39	34	8	7	na
Chile	53	27	28	28	16	34	23	18	13	na
Colombia	28	23	22	26	40	25	25	35	58	na
Dominican Republic	78	42	44	46	50	55	89	48	59	na
Ecuador	na	37	48	59	71	44	20	24	32	na
Mexico	na	na	na	43	48	42	54	30	33	na
Nicaragua	na	na	na	na	na	na	29	31	26	na
All developing countries	**44**	**44**	**42**	**42**	**48**	**48**	**32**	**19**	**18**	**na**

Continued over

Table 7: (cont)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Europe's transition econs.	**na**	**na**	**na**	**na**	**na**	**na**	**47**	**40**	**40**	**45**
Bulgaria	na	na	na	na	na	na	28	26	22	29
Czech Rep	na	na	na	na	na	na	39	30	40	33
Estonia	na	na	na	na	na	na	28	27	31	31
Hungary	na	na	na	na	na	na	35	34	52	31
Latvia	na	na	na	na	na	na	54	47	67	31
Lithuania	na	na	na	na	na	na	54	52	68	31
Poland	na	na	na	na	na	na	27	27	38	33
Romania	na	na	na	na	na	na	36	44	65	51
Russia	na	na	na	na	na	na	46	34	33	na
Slovakia	na	na	na	na	na	na	31	30	39	32
Slovenia	na	na	na	na	na	na	60	72	71	45
Turkey	21	36	35	41	38	38	50	58	50	59
Ukraine	na	na	na	na	na	na	39	33	25	na
High-income countries	**49**	**48**	**46**	**64**	**69**	**71**	**52**	**38**	**38**	**22**
Australia	20	31	28	18	13	21	21	9	4	2
Austria	92	93	39	43	39	82	106	60	56	33
Canada	16	15	15	50	81	90	59	37	42	35
Denmark	82	84	93	157	139	121	71	55	50	26
Finland	129	138	108	129	69	204	204	65	58	31
France	93	118	94	118	124	115	74	55	51	32
Germany	142	146	109	133	134	117	73	58	52	28
Iceland	na	na	na	188	193	365	299	201	180	194
Ireland	66	99	97	187	179	169	93	74	69	44
Italy	89	90	73	88	99	93	63	49	47	23
Japan	74	94	106	155	150	248	240	210	213	163
Netherlands	137	159	129	170	164	132	76	64	56	33
New Zealand	11	12	14	20	24	28	13	10	9	7
Norway	286	289	289	280	222	256	229	174	164	117
Portugal	22	29	31	57	30	70	56	43	42	30
Spain	35	53	29	38	40	80	59	44	41	27
Sweden	149	184	137	204	163	139	122	64	61	35
Switzerland	269	263	256	242	173	344	284	195	172	108
UK	147	142	115	140	135	128	81	62	58	37
US	13	20	12	12	26	35	22	19	25	16

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

a. Regional aggregates are weighted using the average of the value of production and the value of consumption at undistorted prices.

Table 8: Trade Reduction Indexes, by country and region[a], all covered tradable farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Africa	**32**	**33**	**33**	**34**	**18**	**54**	**17**	**16**	**22**	**na**
Cameroon	27	34	38	49	35	9	8	8	3	na
Cote d'ivoire	17	16	37	50	28	31	27	27	39	na
Egypt	-5	2	-2	15	8	95	12	17	6	na
Ethiopia	na	na	na	na	41	54	56	49	36	na
Ghana	3	13	18	42	59	66	32	11	25	na
Kenya	-27	-21	-6	-3	-7	25	-9	10	12	na
Madagascar	21	17	-15	7	-1	29	10	6	11	na
Mozambique	na	na	na	31	-6	-16	3	19	44	na
Nigeria	112	102	94	64	50	78	25	17	-7	na
RSA	1	4	9	2	4	-14	-9	-1	-2	na
Senegal	19	13	38	45	35	36	36	8	16	na
Sudan	29	28	29	29	23	56	40	18	31	na
Tanzania	na	na	na	24	22	42	41	22	30	na
Uganda	8	14	38	85	59	61	10	7	6	na
Zambia	21	1	1	36	-12	-46	-28	-7	29	na
Zimbabwe	35	39	43	51	29	37	19	10	12	na
Asia	**15**	**28**	**23**	**28**	**34**	**28**	**18**	**8**	**6**	**na**
Banglasdesh	na	na	-13	9	-1	24	1	-8	6	na
China	na	na	na	na	44	44	19	4	1	na
India	21	36	42	47	38	70	26	18	22	na
Indonesia	na	na	1	9	14	5	2	-1	19	na
Korea	5	16	44	69	119	158	189	164	184	na
Malaysia	12	4	8	19	18	21	14	5	5	na
Pakistan	7	42	19	3	4	12	-3	-2	4	na
Philippines	-4	2	1	0	3	16	18	39	27	na
Sri Lanka	26	17	20	20	13	5	23	17	4	na
Taiwan	-6	-3	-16	-8	-19	-25	37	67	96	na
Thailand	na	na	25	19	13	11	9	6	1	na
Vietnam	na	na	na	na	na	12	28	6	-11	na
Latin America	**22**	**8**	**19**	**17**	**19**	**13**	**23**	**7**	**8**	**na**
Argentina	30	27	28	25	23	18	7	3	13	na
Brazil	na	12	28	19	20	13	11	0	0	na
Chile	9	-7	-15	4	8	24	17	14	8	na
Colombia	14	5	8	8	18	11	5	12	-13	na
Dominican Republic	60	25	21	27	37	34	57	30	37	na
Ecuador	na	12	15	34	45	26	3	7	16	na
Mexico	na	na	na	12	16	13	26	8	17	na
Nicaragua	na	na	na	na	na	na	11	22	18	na
All developing countries	**26**	**27**	**27**	**28**	**28**	**29**	**21**	**9**	**10**	**na**

Continued over

Table 8: (cont)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Europe's transition econs.	**na**	**na**	**na**	**na**	**na**	**na**	**-4**	**13**	**14**	**2**
Bulgaria	na	na	na	na	na	na	11	10	6	12
Czech Rep	na	na	na	na	na	na	-20	1	12	1
Estonia	na	na	na	na	na	na	2	16	2	6
Hungary	na	na	na	na	na	na	-6	-12	-19	-12
Latvia	na	na	na	na	na	na	32	22	20	11
Lithuania	na	na	na	na	na	na	36	14	-5	-3
Poland	na	na	na	na	na	na	15	7	-8	-17
Romania	na	na	na	na	na	na	8	20	41	31
Russia	na	na	na	na	na	na	-31	16	22	na
Slovakia	na	na	na	na	na	na	-2	7	4	0
Slovenia	na	na	na	na	na	na	-8	-17	-21	-12
Turkey	4	3	10	22	9	13	16	23	17	8
Ukraine	na	na	na	na	na	na	20	11	14	na
High-income countries	**19**	**9**	**16**	**21**	**27**	**28**	**28**	**18**	**18**	**7**
Australia	-7	-11	-6	-3	-4	-7	-7	-3	-1	0
Austria	69	66	19	24	23	-22	-11	41	38	17
Canada	8	6	6	15	22	25	22	13	14	14
Denmark	-35	-35	-3	61	70	75	51	37	32	12
Finland	39	17	-7	-10	18	-106	-153	50	41	16
France	58	73	44	47	69	72	51	32	29	13
Germany	98	112	66	64	81	73	52	39	33	14
Iceland	na	na	na	130	151	-33	10	35	38	45
Ireland	-4	-12	7	96	117	128	81	63	55	26
Italy	45	48	33	34	52	49	31	25	23	8
Japan	64	73	73	102	105	144	134	132	127	106
Netherlands	89	120	86	96	110	84	55	48	40	17
New Zealand	2	2	2	-8	-11	-1	2	2	1	0
Norway	272	276	275	243	-15	155	195	155	140	88
Portugal	10	15	13	32	20	33	24	21	21	12
Spain	21	18	-1	-2	3	42	30	23	21	11
Sweden	46	41	42	51	49	-71	-59	47	42	18
Switzerland	82	86	96	107	154	81	44	17	14	37
UK	70	49	36	64	82	89	65	44	39	22
US	4	2	1	4	7	7	6	2	4	1

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

a. Regional aggregates are weighted using the absolute value of net imports (computed as the difference between the value of consumption and the value of production) at undistorted prices.

Appendix Table 1: Producer Distortion Indexes, Asian, African, Latin American, Europe's Transition economies and high-income countries, all covered tradable farm products, 1960 to 2007

(percent)

	1961-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Africa	**56**	**58**	**59**	**61**	**62**	**75**	**56**	**43**	**37**	**na**
Cameroon	29	40	44	57	40	22	23	22	11	na
Cote d'Ivoire	45	50	48	59	59	45	46	38	45	na
Egypt	50	55	56	40	45	127	31	29	23	na
Ethiopia	na	na	na	na	35	47	49	41	25	na
Ghana	25	54	47	76	87	67	38	25	27	na
Kenya	30	29	28	14	27	20	34	18	16	na
Madagascar	28	29	28	51	63	52	38	18	17	na
Mozambique	na	na	na	75	69	77	37	30	46	na
Nigeria	133	118	112	100	101	125	93	74	58	na
RSA	20	19	25	33	49	40	32	21	21	na
Senegal	20	17	44	47	44	45	50	14	20	na
Sudan	40	44	53	44	43	66	78	44	45	na
Tanzania	na	na	na	73	74	71	64	55	51	na
Uganda	11	18	47	90	66	65	12	8	9	na
Zambia	25	37	46	59	32	70	59	41	45	na
Zimbabwe	42	42	50	56	49	45	47	40	75	na
Asia	**33**	**48**	**48**	**47**	**51**	**56**	**32**	**22**	**20**	**na**
Bangladesh	na	na	30	41	29	49	29	25	30	na
China	na	na	na	na	58	48	25	11	7	na
India	51	50	55	61	54	89	30	19	28	na
Indonesia	na	na	18	23	31	21	23	28	27	na
Korea	46	45	75	90	133	185	224	212	257	na
Malaysia	13	11	14	25	29	34	32	15	16	na
Pakistan	46	71	73	36	38	45	30	24	29	na
Philippines	19	41	30	21	35	46	32	50	41	na
Sri Lanka	38	36	34	42	29	29	37	30	24	na
Taiwan	30	47	53	35	42	85	124	157	195	na
Thailand	na	na	29	24	21	18	17	18	11	na
Vietnam	na	na	na	na	na	22	30	22	35	na
Latin America	**32**	**25**	**37**	**34**	**42**	**39**	**35**	**18**	**23**	**na**
Argentina	32	29	29	27	24	20	11	10	19	na
Brazil	na	12	46	36	42	40	34	8	7	na
Chile	54	26	27	26	13	31	21	17	12	na
Colombia	23	24	23	28	37	24	23	33	55	na
Dominican Republic	59	38	42	47	51	57	83	43	56	na
Ecuador	na	35	47	56	65	40	19	23	30	na
Mexico	na	na	na	46	54	49	56	31	38	na
Nicaragua	na	na	na	na	na	na	29	35	27	na
Developing countries	**46**	**48**	**48**	**47**	**50**	**53**	**32**	**20**	**20**	**na**

Continued over

	1961-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Europe's transition econs.	**18**	**37**	**35**	**41**	**39**	**40**	**46**	**43**	**40**	**40**
Bulgaria	na	na	na	na	na	na	25	26	22	28
Czech Republic	na	na	na	na	na	na	33	32	40	28
Estonia	na	na	na	na	na	na	28	27	32	24
Hungary	na	na	na	na	na	na	35	34	48	23
Latvia	na	na	na	na	na	na	52	45	64	24
Lithuania	na	na	na	na	na	na	54	52	70	29
Poland	na	na	na	na	na	na	26	30	34	29
Romania	na	na	na	na	na	na	37	45	70	52
Russia	na	na	na	na	na	na	38	38	34	na
Slovakia	na	na	na	na	na	na	34	33	41	25
Slovenia	na	na	na	na	na	na	68	80	82	38
Turkey	23	37	35	41	39	40	51	61	50	56
Ukraine	na	na	na	na	na	na	43	36	27	na
High-income countries[b]	**53**	**64**	**53**	**70**	**74**	**95**	**76**	**56**	**54**	**31**
Australia	16	23	21	14	11	12	9	7	0	0
Austria	77	85	37	43	40	73	102	62	59	33
Canada	15	14	14	46	75	81	56	35	39	32
Denmark	72	81	86	139	131	124	75	55	48	23
Finland	126	134	107	129	70	170	175	68	58	28
France	92	117	92	116	120	124	83	57	53	29
Germany	147	150	112	137	139	131	83	63	57	29
Iceland	na	na	na	260	258	382	319	217	188	212
Ireland	75	106	102	164	172	178	99	81	79	49
Italy	89	90	73	88	97	98	66	49	46	21
Japan	77	101	113	164	160	263	261	228	236	181
Netherlands	136	161	131	168	162	133	76	65	58	31
New Zealand	9	10	12	19	25	24	10	8	7	5
Norway	276	281	287	299	298	337	291	207	188	127
Portugal	21	26	29	56	28	71	56	42	40	26
Spain	34	50	28	37	41	88	64	46	42	25
Sweden	173	185	150	196	160	126	116	66	60	30
Switzerland	261	258	252	249	220	405	325	223	183	108
UK	153	145	120	143	134	139	89	63	57	37
US	12	19	12	11	25	36	24	17	26	17
World	**51**	**58**	**51**	**60**	**61**	**71**	**53**	**37**	**35**	**na**

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

Appendix Table 2: Consumer Distortion Indexes, Asian, African, Latin American, Europe's Transition economies and high-income countries, all covered tradable farm products, 1960 to 2007

(percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Africa	**64**	**62**	**63**	**60**	**62**	**88**	**58**	**46**	**41**	**na**
Cameroon	28	34	39	51	37	24	15	12	9	na
Cote d'Ivoire	30	44	42	45	34	36	29	26	37	na
Egypt	49	51	53	38	45	139	33	30	20	na
Ethiopia	na	na	na	na	52	65	66	62	61	na
Ghana	24	31	31	37	85	79	35	16	32	na
Kenya	43	50	27	29	23	51	35	34	39	na
Madagascar	20	28	25	40	54	40	23	14	13	na
Mozambique	na	na	na	70	63	74	30	33	70	na
Nigeria	163	140	128	108	102	128	94	74	57	na
RSA	20	17	25	34	47	38	30	21	20	na
Senegal	19	18	43	45	37	72	78	11	17	na
Sudan	32	37	48	37	37	64	80	40	43	na
Tanzania	na	na	na	70	70	65	60	54	50	na
Uganda	10	15	41	80	53	58	11	11	11	na
Zambia	27	46	50	57	31	69	60	38	40	na
Zimbabwe	40	47	49	56	43	40	45	40	68	na
Asia	**29**	**40**	**40**	**48**	**49**	**57**	**34**	**24**	**23**	**na**
Bangladesh	na	na	30	42	29	48	29	25	32	na
China	na	na	na	na	52	48	25	12	9	na
India	10	39	41	61	53	84	31	24	25	na
Indonesia	na	na	19	20	30	21	23	28	28	na
Korea	44	42	62	82	127	166	197	174	195	na
Malaysia	12	8	8	22	21	34	20	9	8	na
Pakistan	43	71	78	39	40	47	31	25	31	na
Philippines	18	32	30	21	32	46	32	51	42	na
Sri Lanka	28	23	25	34	23	29	40	41	36	na
Taiwan	30	46	50	36	45	86	123	153	185	na
Thailand	na	na	30	25	24	17	16	20	14	na
Vietnam	na	na	na	na	na	22	30	26	39	na
Latin America	**38**	**26**	**34**	**35**	**40**	**34**	**40**	**18**	**19**	**na**
Argentina	33	30	28	27	25	18	9	4	15	na
Brazil	na	19	41	37	42	38	34	7	6	na
Chile	51	27	28	30	18	37	26	20	15	na
Colombia	33	24	21	26	44	28	27	36	57	na
Dominican Rep	104	45	43	42	49	53	95	52	61	na
Ecuador	na	39	49	60	76	45	20	24	33	na
Mexico	na	na	na	39	41	32	49	29	23	na
Nicaragua	na	na	na	na	na	na	30	29	27	na
Developing countries	**49**	**43**	**43**	**47**	**48**	**55**	**34**	**22**	**20**	**na**

Continued over

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Europe's transition econs.	**15**	**36**	**36**	**42**	**38**	**36**	**48**	**37**	**39**	**48**
Bulgaria	na	na	na	na	na	na	30	26	23	32
Czech Rep	na	na	na	na	na	na	41	28	41	29
Estonia	na	na	na	na	na	na	27	25	29	26
Hungary	na	na	na	na	na	na	35	33	55	25
Latvia	na	na	na	na	na	na	58	49	70	32
Lithuania	na	na	na	na	na	na	54	52	66	32
Poland	na	na	na	na	na	na	28	25	39	32
Romania	na	na	na	na	na	na	33	42	59	51
Russia	na	na	na	na	na	na	54	28	32	na
Slovakia	na	na	na	na	na	na	27	27	36	26
Slovenia	na	na	na	na	na	na	54	65	58	34
Turkey	19	36	36	42	38	36	48	54	50	62
Ukraine	na	na	na	na	na	na	34	30	22	na
High-income countries[b]	**59**	**70**	**56**	**76**	**77**	**91**	**74**	**62**	**58**	**36**
Australia	23	37	35	24	16	26	27	10	6	2
Austria	104	99	40	42	37	88	111	57	53	30
Canada	17	15	15	52	85	97	59	38	45	38
Denmark	84	83	94	166	140	116	66	55	50	24
Finland	133	141	108	129	68	225	225	62	57	29
France	93	119	97	120	128	106	65	52	50	30
Germany	137	141	106	128	130	102	61	53	48	26
Iceland	na	na	na	56	86	323	257	146	124	141
Ireland	61	98	94	206	184	160	86	67	58	30
Italy	88	89	72	88	101	86	56	49	48	23
Japan	72	86	98	144	140	231	216	189	188	141
Netherlands	137	158	126	172	166	131	75	62	55	28
New Zealand	14	14	16	21	23	33	18	13	12	9
Norway	295	298	290	248	97	124	141	131	135	107
Portugal	24	32	33	59	31	67	53	44	44	29
Spain	36	56	29	38	39	68	51	42	40	25
Sweden	139	183	130	210	165	149	124	62	62	34
Switzerland	280	270	262	232	106	275	239	164	162	108
UK	139	139	111	136	136	117	73	60	58	39
US	14	22	12	12	26	34	20	20	24	17
World	**56**	**60**	**52**	**64**	**61**	**71**	**53**	**40**	**38**	**na**

Source: Authors' calculations based on product NRAs and CTEs in Anderson and Valenzuela (2008).

Appendix Table 3: Country shares of the average of global value of production and value of consumption, and the global absolute value of trade, 2000–04

(percent)

(a) of the global average of value of production and value of consumption, at undistorted prices in current $US

Country	Share
China	24.3
US	14.6
India	6.1
Japan	4.5
France	3.4
Brazil	3.2
Germany	3.0
Mexico	2.9
Indonesia	2.8
Italy	2.6
Russia	2.5
Spain	2.3
Turkey	2.1
Australia	1.7
Canada	1.7
UK	1.6
Argentina	1.4
Philippines	1.1
Ukraine	1.0
Sudan	1.0
Korea	1.0
Pakistan	1.0
Egypt	1.0
Poland	0.9
Netherlands	0.8
Thailand	0.8
New Zealand	0.7
Bangladesh	0.7
Rep South Africa	0.7
Romania	0.6
Vietnam	0.6
Nigeria	0.5
Colombia	0.5

Continued over

(b) Share of the global absolute value of trade, at undistorted prices in current $US

Country	Share
Japan	18.3
Australia	8.0
Brazil	5.6
Mexico	5.1
Thailand	4.5
Korea	4.4
Malaysia	4.2
Argentina	4.0
Canada	3.4
France	3.0
Russia	2.8
New Zealand	2.5
UK	2.5
China	2.4
US	2.2
Germany	1.9
Denmark	1.6
Egypt	1.5
Cote d'Ivoire	1.4
Vietnam	1.3
Poland	1.3
Ukraine	1.3
Sudan	1.2
Indonesia	1.2
Netherlands	1.1
Romania	1.0
India	0.9
Kazakhstan	0.9
Ireland	0.6
Portugal	0.6
Zimbabwe	0.6
Ecuador	0.5
Italy	0.5

Continued over

Country	Share
Denmark	0.5
Portugal	0.4
Malaysia	0.4
Kazakhstan	0.4
Hungary	0.3
Austria	0.3
Ireland	0.3
Sweden	0.3
Czech Rep	0.3
Ecuador	0.3
Switzerland	0.2
Chile	0.2
Taiwan	0.2
Bulgaria	0.2
Finland	0.2
Cote d'Ivoire	0.2
Tanzania	0.1
Kenya	0.1
Sri Lanka	0.1
Zimbabwe	0.1
Nicaragua	0.1
Norway	0.1
Slovakia	0.1
Lithuania	0.1
Ethiopia	0.1
Madagascar	0.1
Ghana	0.1
Dominican Rep	0.1
Uganda	0.1
Zambia	0.1
Senegal	0.1
Latvia	0.1
Slovenia	0.0
Mozambique	0.0
Estonia	0.0
Cameroon	0.0
Iceland	0.0
Mali	0.0
Burkina Faso	0.0
Benin	0.0
Togo	0.0
Chad	0.0
Sum	100.0

Country	Share
Spain	0.5
Switzerland	0.5
Sweden	0.4
Nicaragua	0.4
Kenya	0.4
Hungary	0.4
Colombia	0.3
Sri Lanka	0.3
Ghana	0.3
Pakistan	0.3
Bangladesh	0.3
Turkey	0.3
Norway	0.3
Senegal	0.2
Philippines	0.2
Cameroon	0.2
Zambia	0.2
Taiwan	0.2
Nigeria	0.2
Tanzania	0.2
Czech Rep	0.2
Chile	0.2
Bulgaria	0.1
Ethiopia	0.1
Rep South Africa	0.1
Mozambique	0.1
Slovenia	0.1
Latvia	0.1
Dominican Rep	0.1
Madagascar	0.1
Mali	0.1
Burkina Faso	0.1
Estonia	0.1
Slovakia	0.1
Benin	0.1
Finland	0.0
Austria	0.0
Iceland	0.0
Lithuania	0.0
Uganda	0.0
Togo	0.0
Chad	0.0
Sum	100.0