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Global Distortions to Agricultural Markets

New Indicators of Trade and Welfare Impacts, 1955 to 2007

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Abstract

Despite recent reforms, world agricultural markets remain highly distorted by government policies. Traditional indicators of those price distortions can be poor guides to the policies' economic effects. Recent theoretical literature provides indicators of trade and welfare-reducing effects of price and trade policies which this paper builds on to develop more-satisfactory indexes. The authors exploit a new Agricultural Distortion database to generate estimates of them for developing and high-income countries over the past half century. These better approximations of the trade and welfare effects of sector policies are generated without a formal model of global markets or even price elasticity estimates.

This paper—a product of the Trade Team, Development Research Group—is part of a larger effort in the department to better understand trends in policy distortions to agricultural incentives globally. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at kym.anderson@adelaide.edu.au or via wmartin1@worldbank.org.

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Global Distortions to Agricultural Markets: New Indicators of Trade and Welfare Impacts, 1955 to 2007

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Global Distortions to Agricultural Markets: New Indicators of Trade and Welfare Impacts, 1955 to 2007

Despite reforms over the past quarter-century, world agricultural markets remain highly distorted, and international trade in farm products has grown much slower than trade in non-farm goods.[1] Traditional indicators such as the nominal rate of tariff protection from import competition understate the degree of distortion if there are other border taxes or subsidies or quantitative restrictions, and even more so if there are also domestic producer or consumer taxes or subsidies on farm products. The OECD's producer and consumer support estimates (PSEs and CSEs) based on domestic to border price comparisons for high-income countries, and the World Bank's new comparable estimates of nominal rates of assistance and consumer tax equivalents (NRAs and CTEs) for both high-income and developing countries, provide better indicators (OECD 2008; Anderson and Associates 2009).[2] Those estimates can be used in national and global computable general equilibrium models to provide an indication of the true trade and welfare effects of such distortionary policies. However, such models typically are calibrated only for a recent year, and so are incapable of providing estimates of trends over time; and they are not yet available for many smaller and poorer economies.

[1] Based on their sample of 75 countries comprising more than 90 percent of the world's agriculture, Anderson and Associates (2009) estimate that the share of global production of agricultural goods that is exported has increased from 11 percent in the 1960s and 1970s to just 16 percent in 1990-2004, a far smaller increase than for non-farm goods during that period of rapid globalization. When intra-EU trade is excluded, agriculture's share of global production exported was just 8 percent in 2004, compared with 31 percent for other primary products and 25 percent for all other goods, according to the GTAP Version 7 database (www.gtap.org).

[2] The main difference between the PSE/CSE and NRA/CTE concepts is that the former are expressed as a percentage of the distorted price whereas the latter are a percentage of the undistorted price (and the CSE has the opposite sign to the CTE). 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, typically there are domestic production or consumption taxes or subsidies also in place, so the NRA often differs from the CTE.

There is a need for better indicators over time of the trade- and welfare-reducing effects of price-distorting policies than the existing weighted average NRA/CTE (or PSE/CSE) estimates for the farm sector, because the averaging process hides the fact that distortions vary across industries within the sector. This is especially problematic in cases where NRAs have opposite signs, as when trade taxes apply to both imports and exports, or when dual exchange rates operate. In those cases the NRA may be close to zero even though the trade- and welfare-reducing effects of those interventions could be substantial.

Recent theoretical literature provides partial equilibrium indicators of the trade- and welfare-reducing effects of import policies. The purpose of this paper is to draw on that literature in order to develop indexes to capture global distortions to agricultural incentives that are based directly on estimates of NRAs and CTEs. We then exploit the Agricultural Distortion database recently compiled by the World Bank to generate the first set of estimates of consistent indexes for the agricultural sector for both developing and high-income countries over the past half century.

The new World Bank global panel dataset contains comparable estimates of annual NRAs and CTEs for a wide range of agricultural products for around 75 countries that together account for all but one-tenth of the world's population, GDP and agricultural production (Anderson and Valenzuela 2008). Applying our indexes to these data takes us much closer to understanding the true trade and welfare effects of policies without needing a formal model of global markets or even price elasticity estimates.

The remainder of the paper is structured as follows. After a brief literature review the next section presents the theory for estimating welfare- and trade-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,

followed by presentations of the trade- and welfare-reduction index numbers for all countries studied in the Agricultural Distortions project and for the world as a whole. The methods of analysis developed in this paper are then used to quantify the contributions which the policies of individual countries have made to the reduction in world trade. Some concluding observations and directions for further research are presented in the final section.

The recent literature

There is a growing theoretical literature that identifies ways to measure the welfare- and trade-reducing effects of international trade policy in scalar index numbers. This literature serves a key purpose: it overcomes aggregation problems (across different forms of policy and across industries) by using a theoretically sound aggregation procedure that answers precise questions regarding the trade and welfare reductions imposed by each country's trade policies. The literature has developed 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 partial equilibrium 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). Following the approach of Feenstra, they recently estimated a series for developing and developed countries, but they provide estimates only for a snapshot in time (the early 2000s) and based only on import barriers.[3] Most other studies have

[3] Those estimates, which rely mostly on reported tariff rates but include also estimated tariff equivalents of some non-tariff import measures, have been reported in the World Bank's *Global Monitoring Report* (e.g., World Bank 2008, pp.121-23). The present estimates, by contrast, rely on domestic to border price comparisons for each product and so directly capture the effects of all border measures as well as domestic prices subsidies or taxes.

been country specific, such as an application to Mexican agriculture in the late 1980s (Anderson and Bannister 1992).

The indexes we estimate are well grounded in this theory: they belong to the family of indexes first developed by Anderson and Neary (2005) under the catch-all name of trade restrictiveness indexes. Specifically, we define two indexes. To avoid confusion with previous measures, we coin terms that are more precise descriptors. The names of the two indexes in this paper are a trade reduction index (TRI) and a welfare reduction index (WRI). The TRI and WRI are computed from sub-indexes of the NRA and CTE across product groups. NRAs to producers and CTEs are required whenever there are domestic subsidies or taxes on production or consumption in addition to border measures – as so often is the case for foods and other farm products. Thus the indexes we estimate capture the aggregate trade- and welfare-reducing effects of all policies affecting consumer and producer prices of farm products from all price-distorting policy measures in place.[4]

Defining the welfare and trade reduction indexes

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 the 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. They did so for a small, open economy in which imports are restricted by tariffs and non-tariff measures (NTMs). They then provided variants of the Trade

[4] It should be kept in mind that these are partial equilibrium measures, in that they are true measures of national trade- and welfare-reducing effects of a country's agricultural policies only if the NRAs and CTEs for all other industries are zero.

Restrictiveness Index, including one based not on a welfare criterion but instead on an import volume criterion, which they called the Mercantilist Trade Restrictiveness Index.

We develop versions of each of those two indexes for situations where, in addition to import measures, there may be direct domestic producer and consumer price distortions resulting from beyond-the-border measures and also export measures.[5] While these versions are less general than the Anderson and Neary indexes, in that they are partial rather than general equilibrium measures, they have the advantage of being more comprehensive in terms of instrument coverage. They 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

[5] Anderson and Neary (2005, chapter 12) deals with domestic distortions in a general equilibrium model.

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 consumer price in percentage terms. In general, $r_i \bullet s_i$. 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 welfare loss 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

$$T = \{Ra + Sb\} \tag{4a}$$

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)

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

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

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

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.[6]

[6] 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

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:

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

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

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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.

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:

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

with $\mathrm{d}y_i / \mathrm{d}p_i = const.$ 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.[7] If $r_i \bullet s_i$, as is frequently true in 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

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

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

[7] 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).

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 WTI 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.[8] 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:

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

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

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 WTI. This is done in the Appendix.

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):

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

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

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:

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

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

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

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 database

The database generated by the World Bank's Agricultural Distortions project (Anderson and Valenzuela 2008), using a methodology summarized in Anderson et al. (2008), provides a

timely opportunity to estimate welfare and trade reduction indexes. The database contains consistent estimates of annual nominal rates of assistance (NRAs) to the agricultural sector and the same number of consumer tax equivalents (CTEs) for 75 countries over a time period between 1955 and 2007 (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 in the focus countries, which in turn account for 92 percent of global agricultural GDP. 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.[9]

The range of 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 presented in Tables 1 and 2. These support the

[9] Estimates of the NRA for total agricultural production in the focus 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 Table 1.

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. Table 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 in the latter 1980s. It is clear from Table 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. 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.

Tables 1 and 2 also show the trends in NRAs and CTEs, respectively, for the four studied regions of Africa, Asia, Latin America and Europe's transition economies. On the production side, Africa is where there has been least tendency to reduce the taxing of farmers and subsidizing of consumers of 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 is now 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, 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 extent of 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 industries.

Measures of the welfare and trade reduction indexes

Table 3 reports the TRIs 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.[10] For developing countries as a group, the trade restrictiveness of agricultural policy was roughly constant or slightly rising until the early 1990s and thereafter it declined, especially for Asia and Latin America. 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 3). For high-income countries, policies support both exporting and import-competing agricultural products and, even though they favour the latter much more heavily, 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

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

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 3.

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 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.

Table 4 reports the WRIs, again 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. The WRI results for covered products show a similar pattern over the five regions: there is a 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. 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 about the WRI, then, is that it has the desirable property of correctly identifying 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 in Tables 1 and 2). Although the latter are a significant contribution in their own right, they can be misleading as a pair of indicators of the extent of the welfare

costs of assistance or taxation. This is due to the inclusion in the WRI of the ‘power of two’. That is, a weighted arithmetic mean NRA and CTE do 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: the NRA series for high-income countries is everywhere positive, but the WRI series lies above the NRA series owing to its capturing of the dispersion of the NRA. That is, the WRI captures the so-called ‘disparity’ issue discussed in Lloyd (1974): the larger the variance in assistance levels within a sector, 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) — unlike the arithmetic mean measures of assistance/taxation (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 positive levels of protection for import-competing farm products (Table 1). In 1985-89 the weighted average NRA for African import-competing and exporting farmers was close to zero, yet the WRI for Africa peaks in that time period. That is, 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.

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 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.

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 1 shows the WRI and TRI for the world as a whole tracing out a hill-shaped path and thus providing less misleading indicators of the evolving disarray in world agricultural markets. Figure 1 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.

Conclusion

This paper contributes to the theoretical and empirical literature on welfare and trade reduction indexes. On the theory side, it develops a method of calculating the TRI and WTI directly from estimates of the rates of distortion of producer and consumer markets. The Appendix shows that these calculations of the TRI and the WTI are equivalent to an alternative method using, for each good, a calculation of the import-equivalent and the welfare-equivalent tariff rates.

Empirically, it provides a panel set of index estimates for agricultural goods that is well-grounded in trade theory, accounts for different forms of price distortions, and can be decomposed into producer assistance and consumer tax measures. The panel set covers 75 developing and developed countries over the past half-century. Using the estimates of the average changes in consumer and in consumer prices, we have calculated indexes of the changes induced in world trade and in the welfare of the trading countries. The indexes are more useful than just aggregate NRAs and CTEs 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 provide a much more accurate view of the extent of distortions in agricultural markets at the present time, and they trace its history since soon after the end of the Second World War and the establishment of the GATT/WTO multilateral system. Our estimates suggest that the level of distortion of world agricultural markets has been far higher than suggested by the global average NRA or CTE, especially during the 1970s and 1980s, but it was considerably less distorted by 2007 than it was in 1960.

There would be high returns to further research in this area. In a companion paper, we estimate global TRIs and WRIs for individual commodities and show the contributions of different countries to those indexes (Lloyd, Croser and Anderson 2009). The estimates could be refined by relaxing the assumption of equal demand and supply elasticities across products within a country. 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.

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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, forthcoming). 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.[11]

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

[11] 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.

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

Hence,

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

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

In general, $r_i \bullet s_i$. 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))

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

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

$$\tfrac{1}{2}\{(p_i^* r_i)^2 \mathrm{dx}_i / \mathrm{d}p_i - (p_i^* s_i)^2 \mathrm{dy}_i / \mathrm{d}p_i\} = -\tfrac{1}{2}(p_i^* t_i^W)^2 \mathrm{dm}_i / \mathrm{d}p_i$$

Hence,

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

$$b_i = -(\mathrm{dy}_i / \mathrm{d}\, p_i^P)/(\mathrm{dm}_i / \mathrm{d}p_i) > 0 \qquad \text{(A.4)}$$

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.[12] 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

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

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

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

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.[13] 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.

[13] 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.

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: 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 4: 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)

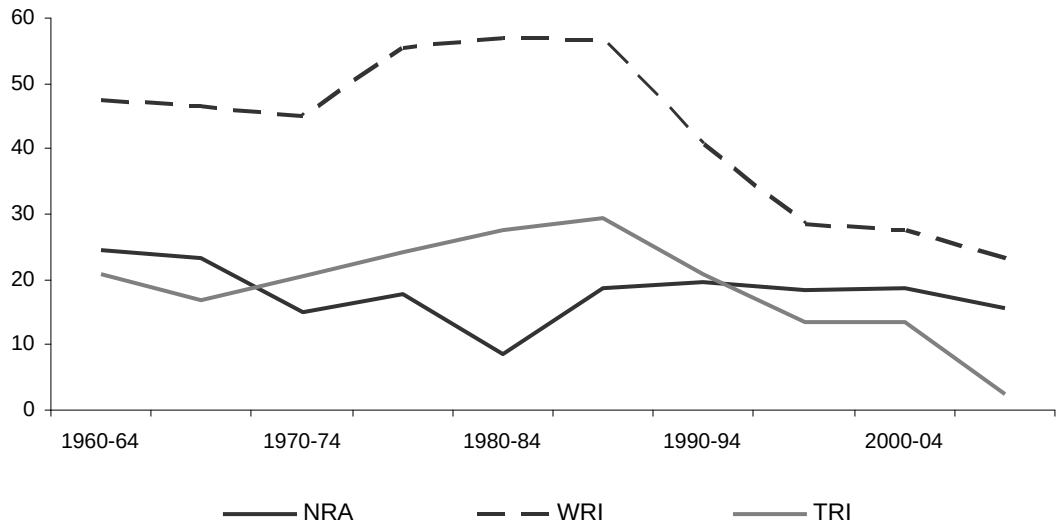
	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-07
Import-competing products										
Africa	59	52	53	47	51	98	43	32	30	na
Asia	36	45	46	50	48	62	48	44	48	na
Latin America	54	34	27	37	47	40	46	26	32	na
All developing countries	49	46	43	44	44	54	36	28	30	na
Europe's transition 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.

Figure 1: 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).