Changing contributions of different agricultural policy instruments to global reductions in trade and welfare

Johanna Croser
University of Adelaide
johanna.croser@adelaide.edu.au

and

Kym Anderson
University of Adelaide
kym.anderson@adelaide.edu.au

January 2010

Contributed Paper for the 54th Annual Conference of the Australian Agricultural and Resource Economics Society, Adelaide, 9-12 February 2010. This is a product of a World Bank research project on Distortions to Agricultural Incentives (see www.worldbank.org/agdistortions). The authors are grateful for collaboration on earlier papers with Peter Lloyd, and for funding from World Bank Trust Funds provided by the governments of the Netherlands (BNPP), the United Kingdom (DfID) and Ireland, as well as from the Australian Research Council. The views expressed are the authors' alone and not necessarily those of the World Bank and its Executive Directors, nor the countries they represent, nor of the institutions providing the project research funds.

Changing contributions of different agricultural policy instruments to global reductions in trade and welfare

Abstract

Trade negotiators and policy advisors are keen to know the relative contribution of different farm policy instruments to international trade and economic welfare. Nominal rates of assistance or producer support estimates are incomplete indicators, especially when (especially in developing countries) some commodities are taxed and others are subsidized in which case positive contributions can offset negative contributions. This paper develops and estimates a new set of more-satisfactory indicators to examine the relative contribution of different farm policy instruments to reductions in agricultural trade and welfare, drawing on recent literature on trade restrictiveness indexes and a recently compiled database on distortions to agricultural prices for 75 developing and high-income countries over the period 1960 to 2004. Results confirm earlier findings that border taxes are the dominant instrument affecting global trade and welfare, but they also suggest declines in export taxes contributed nearly as much as cuts in import protection to global welfare gains from agricultural policy reforms since the 1980s.

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

JEL codes: F13, F14, F15, N57, Q17, Q18

Author contact:
Kym Anderson
School of Economics
University of Adelaide
Adelaide SA 5005 Australia
Phone +61 8303 4712
Fax +61 8223 1460
kym.anderson@adelaide.edu.au

Changing contributions of different agricultural policy instruments to global reductions in trade and welfare

The relative contribution of different policy instruments to reductions in trade and welfare are of interest to (a) trade negotiators as a way of prioritizing their negotiating efforts, and (b) agricultural policy analysts as a way of pointing to the inefficiencies in governments' choices of policy measures. This has been the subject of particular interest during the Doha round of World Trade organization (WTO) negotiations, especially the relative importance of high-income country agricultural subsidies versus import market access restrictions (Anderson, Martin and Valenzuela 2006).

In comparing across policy instruments economists commonly calculate weighted averages of the nominal rates of assistance (NRAs) or consumer tax equivalents (CTEs) for various products of different policy instruments. However, aggregates of NRAs and CTEs for different instruments are not able to capture accurately the relative contribution of those different instruments to trade and welfare reductions. This is especially so when some policies (such as import taxes) have negative effects on trade while other policies (such as export subsidies) have positive trade effects. Likewise, if the import-competing and exportables sectors are each subject to trade taxes, aggregate NRAs and CTEs may be close to zero even though both policies are trade- and welfare-reducing. Furthermore, the welfare effect of a policy instrument is related to the square of the individual ad valorem distortion rate, which means aggregates of the NRA (or CTE) fail to capture the fact that widely different rates of intervention across commodities within a policy instrument group have worse welfare effects than if all commodities had similar NRAs and CTEs.

Certainly sectoral partial equilibrium or economy-wide computable general equilibrium (CGE) models can be and are used to estimate trade and welfare effects of different policy instruments, drawing on available estimates of NRAs and CTEs by instrument. However, such models are intensive in their needs for data and parameter (e.g. price elasticity) estimates, and typically they are calibrated to just one past year and so are not well suited to timely on-going monitoring or historical analysis of

policy developments. For example, Diao, Somwara and Roe (2001) and Hertel and Keeney (2006) draw on the GTAP database for 1995 and 2001, respectively. That GTAP database, which is updated every three years but typically with a long delay,[1] recognizes the 'three pillars' in the WTO agricultural negotiations (import tariffs, export subsidies and domestic production subsidies) but it tends to ignore export taxes, import subsidies and production taxes. While the latter set may have been relatively unimportant in 1995 or 2001, export taxes were re-introduced in Argentina at the end of 2001 and export restrictions were used by numerous developing countries when international food prices spiked upwards in 2008. Also, new evidence suggests changes in those latter measures, especially export taxes, are a significant part of the evolving global story of agricultural distortions over the past half century (Anderson 2009).

In the wake of this latest food price spike, and with the arrival of the new Distortions to Agricultural Incentives database compiled by the World Bank (Anderson and Valenzuela 2008) together with new methodological developments by Anderson and Neary (2005), it is timely to re-examine the relative contributions of different policy instruments to the trade- and welfare-reducing effects of agricultural policies across the world.

This paper makes two contributions over and above existing studies. First, it offers a new methodological approach for estimating the relative contributions of different policy instruments to trade and welfare reductions from agricultural policy. Scalar index numbers developed from the Anderson and Neary (2005) family of trade restrictiveness indexes are estimated for different policy instruments and then compared so as to show their relative contributions. Second, this study applies the methodology to the World Bank's new dataset that allows for the estimation of the changing relative contributions over time of a comprehensive set of agricultural policy instruments to national, regional and global trade and welfare losses. The measures include all forms of border measures (import and export taxes and subsidies or the equivalent of non-tariff measures) as well as domestic production and consumption taxes and subsidies and farm input taxes and subsidies.

[1] See, for example, Narayanan and Walmsley (2008) for the 2004 GTAP database.

The indicators estimated in this paper are defined by two descriptors: the instrument trade reduction index (ITRI) and the instrument welfare reduction index (IWRI). The ITRI (or IWRI) is the ad valorem trade tax rate for a particular policy instrument which, if applied uniformly across all tradable agricultural commodities in a country, would generate the same reduction in trade volume (or same economic welfare loss) as the actual cross-product structure of NRAs and CTEs for that instrument in that country. Because the NRAs and CTEs capture the presence of domestic measures that can distort just farmer or consumer incentives (in addition to trade measures that distort both equally), the ITRI and IWRI are computed from sub-indexes that herein are called the instrument producer distortion index (IPDI) and the instrument consumer distortion index (ICDI).

The use of ITRI (or IWRI) for computing the relative contribution of different policy instruments has the advantage of providing a single theoretically sound partial equilibrium indicator of the trade (or welfare) effects of different policy measures that is comparable across time and countries. Because the Anderson and Valenzuela (2008) dataset covers 5 decades (1955 to 2007), the data can indicate trends over time, which a comparative static CGE model can only do if it is calibrated to a series of past years rather than to just one or a small number of particular years.

The paper is structured as follows: The next section provides the theory for deriving the ITRI and IWRI. The theory is first presented for the import-competing sector of a country and subsequently extended to the exportable sector. This is followed by a description of the World Bank's Distortions to Agricultural Incentives dataset and its breakdown of the NRA and CTE estimates by instrument. The following section presents and discusses the estimates of the two indexes by policy instrument. Caveats and sensitivity analysis follows, and the final section concludes.

Trade and welfare reduction indexes at the policy instrument level

There is a growing literature that identifies ways to measure the welfare- and trade-reducing effects of international trade policy in scalar index numbers. This literature is traditionally used to overcome aggregation problems across products for a country

by using a theoretically sound aggregation procedure that answers precise questions regarding the trade and welfare reductions imposed by each country's price- and trade-distorting policies. The literature has developed considerably over the past two decades, particularly with advances by Anderson and Neary (summarized and extended beyond their 2005 book) and the partial equilibrium simplifications by Feenstra (1995).

Notwithstanding these advances, there are few series of consistently estimated indexes across countries. A prominent exception is the work of Kee, Nicita and Olarreaga (2009) who, following the approach of Feenstra, estimate a series for developing and developed countries. However, they provide estimates only for a snapshot in time (the mid-2000s), and their estimates are based only on import barriers. Other studies have been country and sector specific, such as an application to Mexican agriculture in the late 1980s (Anderson, Bannister and Neary 1995). All previous work appears to have focused on constructing index numbers of distortions for a single country; and most do not provide them for long time periods, exceptions being Irwin (2008) for U.S. import protection policy and Lloyd, Croser and Anderson (2010) for global agricultural policy (but not disaggregated by instrument).

There are several reasons why scalar index numbers are superior to aggregates of NRAs and CTEs for comparing contributions of different policy instruments. With respect to welfare losses, the IWRI, always positive because it is a mean of order two measure (see below), has the desirable attribute that contributions of different instruments sum to 100 percent of a country's welfare loss from its agricultural policies. Further, the IWRI correctly takes into account that the welfare effect of a policy is related to the square of the price distortion. As for the ITRI, it correctly assesses the positive and negative impacts on trade volume of different measures (e.g., a positive production subsidy in both an import-competing and exportable sector would have offsetting effects on the volume of trade), whereas they could be masked in NRA and CTE aggregates. Furthermore, the theory of the ITRI and IWRI allows for the differential responses of different products when faced with the same ad valorem rate of policy distortion, because elasticity terms appear in the indices' formulae.

Indexes for the import-competing sector

The analysis begins with a consideration of scalar indexes for the import-competing sector of a small open economy, in which all markets are competitive. 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 producer or consumer taxes or subsidies or quantitative restrictions. The ITRI measures the effect of an individual policy instrument in the import-competing sector on a country's import volume. The ITRI is the uniform import tariff rate for a particular instrument which, if applied to all commodities in place of the disaggregated policies, would result in the same reduction in the aggregate volume of imports as the actual distortions.

Consider the market for one product, good *i*, which is affected by a combination of measures that distort consumer and producer prices. One type of distorting measure is a border measure (such as an import tariff or import subsidy) which affects producers and consumers of the good. The distorted domestic price in country *j* from a border measure, p_{ij}, is related to the world price, p_i*, by the relation $p_{ij} = p_i^*(1 + t_{ij})$, where t_{ij} is the rate of distortion of the border price in proportional terms. Using this relation, the change in imports in the market for good *i* in country *j* from a border policy instrument, ΔM_{Bij},[2] is given by:

$$\begin{aligned} \Delta M_{Bij} &= p_i^* \Delta x_{ij} - p_i^* \Delta y_{ij} \\ &= p_i^{*2} dx_{ij} / dp_{ij} t_{ij} - p_i^{*2} dy_{ij} / dp_{ij} t_{ij} \end{aligned} \tag{1}$$

where the quantities of good *i* demanded and supplied in country *j*, x_{ij} and y_{ij}, are assumed to be functions of own domestic price alone: $x_{ij} = x_{ij}(p_{ij})$ and $y_{ij} = y_{ij}(p_{ij})$ respectively. The neglect of cross-price effects, among other things, makes the analysis partial equilibrium.

[2] The *B* subscript is used to denote border measures. The border expressions in this section can always be simplified since t_{ij} is the same on the production and consumption sides of the economy. However, throughout the paper production and consumption are kept separate to allow for domestic production or consumption distortions and because the data are available in that form.

Strictly speaking, this result holds only for small distortions. In reality, rates of distortion to agricultural markets are not small. If, however, it is assumed that the demand and supply functions are linear, the reduction in imports is given by Equation (1) with dx_{ij} / dp_{ij} and dy_{ij} / dp_{ij} equal to constants. If the functions are not linear, this expression provides an approximation to the loss.

Now consider the same import-competing good to be subject also to domestic distortions to producer and consumer prices. For the producers of the good, the overall distorted domestic producer price in each country, p_{ij}^{P} , is given by $p_{ij}^{P} = p_i^{*} (1 + (s_{ij} + t_{ij}))$ where s_{ij} is the rate of domestic producer distortion in proportional terms. For the consumers of the good, the distorted domestic consumer price, p_{ij}^{C} , is given by $p_{ij}^{C} = p_i^{*} (1 + (r_{ij} + t_{ij}))$ where r_{ij} is the rate of the domestic consumer distortion in proportional terms. If $r_{ij} = s_{ij} = 0$, then $p_{ij}^{C} = p_{ij}^{P} = p_{ij}$. In general, $r_{ij} \neq s_{ij} \neq 0$. An example, with linear demand and supply curves of this situation, is depicted in Figure 1.

[Insert Figure 1 about here]

With both border and domestic distortions, the change in imports in the market for good *i* in country *j*, ΔM_{Tij} , is given by:

$$\Delta M_{Tij} = p_i^{*2} dx_{ij} / dp_{ij}^{C} (t_{ij} + r_{ij}) - p_i^{*2} dy_{ij} / dp_{ij}^{P} (t_{ij} + s_{ij}) \quad (2)$$

The change in imports from domestic measures alone, ΔM_{Dij} ,[3] is given by $\Delta M_{Dij} = p_i^{*} \Delta x_{ij} - p_i^{*} \Delta y_{ij}$ where Δx_{ij} in this instance is the change in quantity demanded in moving from p_{ij} to p_{ij}^{C} because of the domestic consumption distortion, r_{ij}, and Δy_{ij} is the change in quantity supplied in moving from p_{ij} to p_{ij}^{P} because of the domestic production distortion, s_{ij}. This can be written as:

$$\Delta M_{Dij} = p_i^{*2} \cdot dx_{ij} / dp_{ij}^{C} \cdot r_{ij} - p_i^{*2} \cdot dy_{ij} / dp_{ij}^{P} \cdot s_{ij} \quad (3)$$

[3] The *D* subscript is used to a denote domestic measures, to distinguish it from the *T* subscript which is used to denote total (i.e. border plus domestic) measures..

With *n* import-competing products each subject to different levels of distortions, the aggregate reduction in imports for country *j*, in the absence of cross-price effects, from border and domestic measures separately, can be found by summing Equations (1) and (3) across products, respectively:

$$(4) \qquad \Delta M_{Bj} = \sum_{i=1}^{n} p_i^{*2} dx_{ij} / dp_{ij} t_{ij} - \sum_{i=1}^{n} p_i^{*2} dy_{ij} / dp_{ij} t_{ij}$$

$$(5) \qquad \Delta M_{Dj} = \sum_{i=1}^{n} p_i^{*2} \cdot dx_{ij} / dp_{ij}^{C} \cdot r_{ij} - \sum_{i=1}^{n} p_i^{*2} \cdot dy_{ij} / dp_{ij}^{P} \cdot s_{ij}$$

The aggregate reduction in imports from all measures can be found by summing Equation (2) across all import-competing products:

$$(6) \qquad \Delta M_{j} = \sum_{i=1}^{n} p_i^{*2} dx_{ij} / dp_{ij}^{C} (t_{ij} + r_{ij}) - \sum_{i=1}^{n} p_i^{*2} dy_{ij} / dp_{ij}^{P} (t_{ij} + s_{ij})$$

Setting the result of Equations (4) and (5) equal to the reduction in imports from a uniform border measure (B_j) and a uniform domestic measure (D_j) gives:

$$(7) \qquad \sum_{i=1}^{n} p_i^{*2} dx_{ij} / dp_{ij} t_{ij} - \sum_{i=1}^{n} p_i^{*2} dy_{ij} / dp_{ij} t_{ij} = \sum_{i=1}^{n} p_i^{*2} dm_{ij} / dp_{ij} B_j$$

$$(8) \qquad \sum_{i=1}^{n} p_i^{*2} \cdot dx_{ij} / dp_{ij}^{C} \cdot r_{ij} - \sum_{i=1}^{n} p_i^{*2} \cdot dy_{ij} / dp_{ij}^{P} \cdot s_{ij} = \sum_{i=1}^{n} p_i^{*2} dm_{ij} / dp_{ij}^{D} D_j$$

where p_{ij}^{D} is the price at the intersection of import demand and export supply where domestic distortions (additional to border distortions) are taken into account.

Solving for B_j and D_j gives an index of average tariff rates across commodities for all border policy instruments and domestic policy instruments, respectively, since what is held constant is the volume of imports at constant prices. For border prices, the scalar indexes are given by:

$$(9a) \qquad B_j = \{R_{Bj} a_{Bj} + S_{Bj} b_{Bj}\}, \text{ where}$$

$$(9b) \qquad R_{Bj} = \left[\sum_{i=i}^{n} t_{ij} u_{Bij} \right] \text{ with } u_{Bij} = p_i^{*2} dx_{ij} / dp_{ij} / \sum_{i} p_i^{*2} dx_{ij} / dp_{ij}$$

(9c) $$S_{Bj} = \left[\sum_{i=i}^{n} t_{ij} v_{Bij} \right] \text{ with } v_{Bij} = p_i^{*2} dy_{ij} / dp_{ij} / \sum_i p_i^{*2} dy_{ij} / dp_{ij} \text{ and}$$

(9d) $$a_{Bj} = \sum_i p_i^{*2} dx_{ij} / dp_{ij} / \sum_i p_i^{*2} dm_{ij} / dp_{ij}$$

$$b_{Bj} = \sum_i p_i^{*2} dy_{ij} / dp_{ij} / \sum_i p_i^{*2} dm_{ij} / dp_{ij}$$

B_j is computed as a weighted average of producer and consumer distortions (Equation 9a). R_{Bj} and S_{Bj} are indices of average consumer and producer border distortions, each arithmetic means. Since B_j is an index of border measures, the distortions being aggregated on both the producer and consumer side are t_{ij} values. The weights for each commodity to compute R_{Bj} and S_{Bj}, u_{Bij} and $v_{Bij,}$, are proportional to each country's marginal response of domestic production or consumption to changes in international trade prices. Each of the weights in (9b) and (9c) can be written as functions of, among other things, the domestic price elasticities at either the protected trade situation, or the free trade situation:

(11) $$u_{Bij} = p_i^* x_{ij} \cdot [\rho_{Bij} /(1+t_{ij})] / \sum_i^n (p_i^* x_{ij}) \cdot [\rho_{Bij} /(1+t_{ij})] \text{ and}$$

$$v_{Bij} = p_i^* y_{ij} \cdot [\sigma_{Bij} /(1+t_{ij})] / \sum_i^n (p_i^* y_{ij}) \cdot [\sigma_{Bij} /(1+t_{ij})]$$

where σ_{Bij} and ρ_{Bij} are elasticities of demand and supply, respectively, at the protected trade situation when border measures are in place.

For domestic policy instruments, the analogous ITRI expressions are given by:

(11a) $D_j = \{R_{Dj} a_{Dj} + S_{Dj} b_{Dj}\}$, where

(11b) $$R_{Dj} = \left[\sum_{i=i}^{n} r_{ij} \cdot u_{Dij} \right] \text{with} u_{Dij} = p_i^{*2} dx_{ij} / dp_{ij}^C / \sum_i p_i^{*2} dx_{ij} / dp_{ij}^C$$

(11c) $$S_{Dj} = \left[\sum_{i=i}^{n} s_{ij} \cdot v_{Dij} \right] \text{ with } v_{Dij} = p_i^{*2} dy_{ij} / dp_{ij}^P / \sum_i p_i^{*2} dy_{ij} / dp_{ij}^P \text{ and}$$

(11d) $$a_{Dj} = \sum_i p_i^{*2} dx_{ij} / dp_{ij}^C / \sum_i p_i^{*2} dm_{ij} / dp_{ij}^D$$

$$b_{Dj} = \sum_i p_i^{*2} dy_{ij} / dp_{ij}^P / \sum_i p_i^{*2} dm_{ij} / dp_{ij}^D$$

The index D_j gives the reduction in trade associated with a move from border support to border plus domestic support. Analysis of these equations is analogous to that for B_j. The weight u_{Dij} (or v_{Dij}) is proportional to each product's response to domestic consumption (or production) to changes in prices from a border-only distortion to a border-plus-domestic distortion. These weights differ from those in Equation (9) because they are computed at different prices. Once again, however, the weights can be written as functions of domestic price elasticities.

Consider now the derivation of the IWRI, which captures the overall effect of an individual policy instrument across many commodities on a country's economic welfare. The derivation follows the same steps as the derivation of the ITRI. It is assumed that a border measure is first implemented, and this may be supplemented by additional domestic protection.[4] The border measure distortion in the market for good *i* in country *j* creates a welfare loss, L_{Bij}. In partial equilibrium terms, this loss is given by the sum of the change in producer plus consumer surplus net of the tariff revenue. The loss of producer and consumer surplus is given by:

$$(12) \qquad L_{Bij} = \frac{1}{2}\left\{ (p_i^* t_{ij})^2 dy_{ij} / dp_{ij} - (p_i^* t_{ij})^2 dx_{ij} / dp_{ij} \right\}$$

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

Again, this result holds only for small distortions. If, however, it is assumed that the demand and supply functions are linear, the welfare loss is given by (12) with dx_{ij} / dp_{ij} and dy_{ij} / dp_{ij} equal to constants, in which case welfare losses are defined by the familiar triangular-shaped dead-weight loss areas under the demand and supply curves for the good in a small open economy. If the functions are not linear, this expression provides an approximation to the loss.

[4] This assumption is made because there is evidence in agriculture that this is what happens in practice. The assumption does not have implications for the estimates of the border and domestic ITRIs, but it does for IWRIs. For example, in the simple case presented in Figure 1, the assumption implies that the rectangular areas *bghc* and *dije* are attributed to domestic distortions. The assumption means that the IWRI derived for domestic measures is an upper bound.

Equation (12) 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 (Harberger 1959).

With domestic distortions also in place, the welfare loss of producer and consumer surplus is given by:

$$(13) \qquad L_{Tij} = \frac{1}{2}\left\{ (p_i^*(t_{ij} + s_{ij}))^2 dy_{ij} / dp_{ij}^P - (p_i^*(t_{ij} + r_{ij}))^2 dx_{ij} / dp_{ij}^C \right\}$$

Assuming that domestic measures are imposed as a supplement to border measures, the welfare loss from domestic producer and consumer measures is given by the difference between Equations (13) and (12).[5] Algebraically:

$$(14) \qquad L_{Dij} = \frac{1}{2}\left\{ (p_i^*(t_{ij} + s_{ij}))^2 dy_{ij} / dp_{ij}^P - (p_i^* t_{ij})^2 dy_{ij} / dp_{ij} \right\}$$

$$- \frac{1}{2}\left\{ (p_i^*(t_{ij} + r_{ij}))^2 dx_{ij} / dp_{ij}^C - (p_i^* t_{ij})^2 dx_{ij} / dp_{ij} \right\}$$

The aggregate welfare loss for a country from the separate border and domestic measures, in the assumed absence of cross-price effects, can be found by summing Equations (12) and (14) across all import-competing products, which gives the left-hand side of Equations (15) and (16) below, respectively. Setting the result equal to the welfare loss from a uniform border measure (WB_j), and a uniform domestic measure (WD_j), respectively, gives the following expressions:

$$(15) \qquad \sum_{i=1}^{n} (p_i^* t_{ij})^2 dy_{ij} / dp_{ij} - \sum_{i=1}^{n} (p_i^* t_{ij})^2 dx_{ij} / dp_{ij} = \sum_{i=1}^{n} (p_i^* WB_j)^2 dm_{ij} / dp_{ij}$$

$$(16) \qquad \begin{aligned} &\sum_{i=1}^{n} (p_i^*(t_{ij} + s_{ij}))^2 dy_{ij} / dp_{ij}^P - \sum_{i=1}^{n} (p_i^* t_{ij})^2 dy_{ij} / dp_{ij} \\ &- \sum_{i=1}^{n} (p_i^*(t_{ij} + r_{ij}))^2 dx_{ij} / dp_{ij}^C + \sum_{i=1}^{n} (p_i^* t_{ij})^2 dx_{ij} / dp_{ij} \\ &= \sum_{i=1}^{n} (p_i^* WD_i)^2 dm_{ij} / dp_{ij}^D \end{aligned}$$

[5] In the example depicted in Figure 1, this is the sum of the two quadrangles *bgnc* and *dmje*.

Solving for the IWRI border measure (WB_j) first gives an expression in a similar form to Equation (9):

$$(17) \qquad WB_j = \{R'_{Bj} a_{Bj} + S'_{Bj} b_{Bj}\}, \text{ where } R'_{Bj} = \left[\sum_{i=i}^{n} t_{ij}^2 u_{Bij}\right]^{1/2} \text{ and } S'_{Bj} = \left[\sum_{i=i}^{n} t_{ij}^2 v_{Bij}\right]^{1/2}$$

and u_{Bij}, v_{Bij}, a_{Bj} and b_{Bj} are as given in Equation (9).

WB_j is the uniform tariff that gives the same deadweight loss as that of the actual border distortions in country j. It is an appropriately weighted average of the level of distortions of consumer and producer prices from border measures. It is a mean of order two, which is critically different from the ITRI in Equation (9). As with the ITRI, the index is constructed by working with the production and consumption sides of the economy separately, and aggregating the production and consumption indexes in the last step.

The IWRI for domestic measures, WD_j, is given by a more complex expression owing to the need to find the difference in welfare between all measures and border measures. As such the expression has four terms, instead of the usual two:

$$(18) \qquad WD_j = \{(R'_{Dj1} a_{Dj1} - R'_{Di2} a_{Dj2}) + (S'_{Dj1} b_{Dj1} - S'_{Dj2} b_{Dj2})\}$$

Indexes for exportable product instruments

Each of the ITRI and IWRI measures can be written also for exportable products. For an exportable good, a positive price distortion (such as an export subsidy) reduces welfare in the same way as a positive import-competing distortion (such as an import tax), but the positive price distortion for an exportable increases trade whereas a positive import-competing price distortion reduces trade. That is why it is necessary to keep separate track of import-competing and exporting products for the purpose of estimating ITRIs and IWRIs.

The ITRI for border measures for exportable products is the same as that for Equation (9) where there are *i* exportable products and R_{BjM} and S_{BjM} are replaced by:

$$(19) \qquad R_{BjX} = \left[\sum_{i=i}^{z} -t_{ij}u_{Bij}\right];\ S_{BjX} = \left[\sum_{i=1}^{z} -t_{ij}v_{Bij}\right]$$

As in the previous section, when estimating indexes for exporting products, they are estimated separately for producers and consumers and aggregated only in the last step. The aggregates in Equation (19) are the weighted average levels of distortions to consumer and producer prices for exportable products, respectively, with weights u_{Bij} and v_{Bij} given in Equation (9b) and (9c). Importantly, distortions to exportable products enter Equation (19) as negative values. This is because whilst a lowering of t_{ij} in the import-competing sector reduces the reduction index, a lowering of t_{ij} in the exporting sector increases it.

The ITRI measure B_j can be regarded as the country *j* export tax which, if applied uniformly across all products, would give the same reduction in trade as the combination of individual border measures distorting consumer and producer prices in the exporting sector.

The ITRI for domestic measures, and the IWRI for border and domestic measures separately, can each be adapted to the exportables sector from the import-competing sector expressions in an analogous way, and the exporting instrument indexes have the same properties as the indexes for the import-competing instruments.

In the empirical section of the paper below, ITRIs and IWRIs can be reported not only at the level of the 4 sub-indexes developed above, D_j, B_j, WD_j and WB_j, but they can also be reported individually for positive or negative distortionary measures. This means, for example, that separate indexes can be reported for the trade- and welfare-reducing effects of import taxes, import subsidies, export taxes, export subsidies, and domestic producer and consumer taxes and subsidies on outputs or inputs.

IWRIs and ITRIs can be aggregated across countries using as weights an average of each country's value of production and consumption at undistorted prices. In this paper, because the focus is on the relative contribution of different instruments to reductions in trade and welfare, each ITRI and IWRI index on the production (consumption) side of a country's economy is converted to a constant dollar value of production (or consumption) index by multiplying the ad valorem index by the value of production (or consumption) at undistorted prices for that instrument group. The dollar values are divided by the country's overall value of production (or consumption) of all covered tradable goods to recover what can be considered as a decomposition of an overall country-level TRI or WRI.

Simplifying assumptions to estimate the indices

In Equation (11) it is shown that the weights for the ITRI and IWRI can be written as functions of, among other things, the domestic price elasticities at either the protected trade situation or the free trade situation. In the absence of estimates of domestic demand and supply elasticities, a simplifying assumption can be made that the domestic price elasticities of supply are equal across products for a particular country, and likewise domestic price elasticities of demand are equal across products for a particular country. In that case, the elasticities in the numerator and denominator of Equation (11) cancel. R_{Bj} (or S_{Bj}) can therefore be found by aggregating the change in consumer (or producer) prices across commodities, using as weights shares of each commodity's domestic value of consumption (or production) at undistorted prices.

A further necessary step in estimating B_j in Equation (9a) requires an assumption about the weights a_{Bj} and b_{Bj}. The weight a_{Bj} (or b_{Bj}) is proportional to the ratio of the marginal response of domestic demand (or supply) to a price change from border distortions relative to the marginal response of imports to the same price

change. If one is willing to assume that the marginal responses of supply and demand to a price change are the same in aggregate, then $a=b=0.5$.[6]

Thus from a practical viewpoint, B_j can be computed with all the information available for calculating NRAs and CTEs (or the PSEs and CSEs generated by the OECD), provided two assumptions are made: (1) equal domestic price elasticities of supply across products within a country (and the same for domestic price elasticities of demand); and (2) equal responsiveness of aggregate supply and demand to price changes for the set of products of concern for an economy. Ideally policy analysts would incorporate elasticity estimates and information on responsiveness of aggregate supply and demand where available. However, where they are not available, estimates of the indices B_j, R_{Bj} and S_{Bj} are nonetheless superior to existing widely-used agricultural policy measures of trade distortions. Analogous assumptions can be made for the domestic measures derived in this paper.

The Distortions to Agricultural Incentives database

A new database (Anderson and Valenzuela 2008), generated by the World Bank's Distortions to Agricultural Incentives research project using a methodology summarized in Anderson et al. (2008), provides a timely opportunity to estimate indexes of the trade- and welfare-reducing effects of different policy instruments. The database includes estimates of different agricultural policy instruments for 75 countries that together account for over 90 percent of the world's population, farmers, agricultural GDP and total GDP. The estimates in the database are consistent estimates of annual NRAs and CTEs over the years 1955 to 2007. The country coverage is most complete for the years 1960 to 2004 so only that period is reported in this manuscript. The series contains data at the commodity level for a subset of agricultural products (called covered products) that account for around 70 percent of total agricultural production in each of the 75 countries.

[6] With linear demand and supply curves for a country's economy, this equates to an assumption that the aggregate demand and supply curves have the same slope, so that each side of the economy contributes equally to the ITRI.

The range of measures included in those NRA and CTE estimates is wide. By calculating domestic-to-border price ratios, the overall estimates include the price effects of all tariff and non-tariff trade measures (positive or negative), plus any domestic price measures (positive or negative), plus an adjustment for the output-price equivalent of direct interventions in farm input markets. Where multiple exchange rates operate, estimates of the import or export tax equivalents of that distortion are included as well. The database is especially well suited to the analysis in this paper because it separately identifies each of the price effects of the different policy instruments referred to above.

The most aggregated summaries of NRA and CTE estimates for covered products for developing and high income countries are provided in Figure 2. Figure 2a supports the widely held view 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. Indeed since the mid-1990s those farmers have enjoyed slightly positive assistance on average. Figure 2b shows the growth of agricultural protection in high-income countries since the 1960s and its reversal on average after the 1980s. Consumers have experienced changes similar to producers in recent years: in developing countries consumers were effectively subsidized for most of the last 50 years although that has lessened since the 1990s, while in high-income countries the implicit taxation of consumers from agricultural support rose until the late 1980s but has fallen since then.

[Insert Figure 2 about here]

Figure 3 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 the 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 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, while in Europe's transition economies assistance to farmers has trended upward following the initial shock in the early 1990s. 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.

[Insert Figure 3 about here]

Assistance to import-competing farmers is typically well above that for the export producers (Table 1), and conversely for consumers of farm products. This means there is an anti-trade bias in the structure of agricultural distortions. In the case of developing countries where the import-competing NRA is positive and the NRA for exportables is 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 comparing across countries that have varying degrees of dispersion in their NRAs for different farm industries.

[Insert Table 1 about here]

Of most relevance for this paper is the instrument level NRA and CTE data. Table 2 summarizes the contributions of different policy measures to the overall estimated NRAs and CTEs for the two periods 1981-84 and 2000-04. It show that trade measures always account for the largest share of the total NRA for both developing and high-income countries, and even more so for the total CTE because direct domestic consumer subsidies/taxes, as distinct from the indirect ones provided by border measures, are relatively rare. The dominance of border measures in both CTEs and NRAs ensures that the two price distortion indicators are highly correlated. For all focus countries, covered products and available years in the panel set, the coefficient of correlation between NRAs and CTEs is 0.93.

[Insert Table 2 about here]

The Distortions to Agricultural Incentives database also includes measures of so-called decoupled support and other non-product-specific assistance. These measures account for one-third of the aggregate NRA of all focus countries in 2000–04, and even more in high-income countries. Because decoupled payments and non-product-specific supports are not reported at the product level in the database, they are not captured in the ITRI and IWRI estimates. However, they are clearly important for the overall story of agricultural policy — especially in high-income countries where

there has been a move to forms of support decoupled from production in recent decades – and so an attempt is made in the Caveat section below to gauge the potential contribution of these measures.

Estimates of the instrument indexes

The results from estimation of ITRIs and IWRIs are summarized in Tables 3 and 4 for the main regions of the world. The first thing to notice is that border measures dominate in terms of the trade- and welfare-reducing effects of agricultural policies in all regions being studied. This comes partly from the dominance of border measures in the NRA/CTE estimates, but also from the fact that a border measure affects both sides of the market whereas a domestic measure affects only one side (production or consumption).

[Insert Tables 3 and 4 about here]

Within border measures, import taxes are the most significant reducer of global trade, followed by export taxes which were especially prominent in developing countries through to the 1980s (Figure 4). The other two categories of border measures (export and import subsidies) expand trade, but the TRI estimates for these instruments are at such low levels that they have little offsetting impact on the trade-reducing effects of the trade-taxing border measures.

[Insert Figure 4 about here]

Comparing the ITRI results to those reported in Table 2 (contributions to the aggregate NRA and CTE from different policy instruments) highlights the usefulness of the TRI approach: in the NRA/CTE aggregates, the two most distorting policies (import taxes and export taxes) more or less offset one another, while for the ITRI they are reinforcing.

As for relative contributions to the aggregate IWRI, border measures dominate in all time periods, accounting for between 86 percent (1965-69) and 96 percent (1980-84) of global welfare losses (Table 4). Import taxes contribute most

to the reduction in global welfare due to border measures, followed by developing countries' export taxes (Figure 5c). For the developing country group, export taxes were the most significant contributor to welfare losses prior to the 1990s (Figure 5a), but their relative importance has fallen in all regions since then (Table 4).

[Insert Figure 5 about here]

A comparison of the IWRI results in Table 4 with those in Table 2 for NRA and CTE aggregates reveals the usefulness of the IWRI method. Take import taxes in 2000–04, for example: they account for slightly more than 100 percent of border measure NRAs and CTEs globally but, according to the IWRI, those taxes account for around only three-quarters of the global welfare loss from all border measures.

The global border measure IWRI peaked for the world in 1985–89, after which it nearly halved to just over 30 percent by 2000–04. Table 5 reveals the relative contributions of each of the four border measures to this overall reduction, for each of the studied regions and globally. Import and export taxes contribute just over and a little under half of the overall global reduction, respectively. For developing countries, however, the fall was driven overwhelmingly by falls in export taxes: they account for 86 percent of their IWRI reduction. This dramatic result receives no comment in the previous studies cited at the start of this paper, not only because they include no time series but also because they ignore export taxes (as well as production taxes and import subsidies).[7]

[Insert Table 5 about here]

Finally, annual time series reveal what happens to the relative contributions of different policies when international prices for farm products spike up or down. Insulation of domestic markets from such shocks, by varying border trade restrictions, is a common practice in both developing and high-income countries. The net effect is clear in Figure 5: when international prices spike up, as in 1973–74, the contribution of import tariffs falls dramatically but the contribution of export taxes rises, and conversely when international prices collapse, as in 1986.

[7] Dioa, Somwaru and Roe (2001, p 37) find 89 percent of their cost of agricultural policies comes from import tariffs (market access), 10 percent from domestic producer support and 1 percent from export subsidies. Anderson, Martin and Valenzuela (2006) suggest 93 percent of the global cost of agricultural import protection and subsidies is due to tariffs, the costs of domestic support measures are around 5 percent and those of export subsidies are just 2 percent.

Caveats

A number of important caveats are worth mentioning. Perhaps the most important caveat has to do with the simplifying assumptions about elasticities. For lack of a comprehensive set of country- and commodity-specific own-price elasticity estimates, it is assumed above that the own-price elasticity of supply (and also of demand) within a country is the same for each farm product. The effect of this assumption on the ITRI and IWRI estimates is likely to be small because those indexes draw on the production assistance and consumption tax indexes which each has three terms (e.g., for the PAI they are the production-weighted average price distortion, its variance, and its covariance with the output price elasticity of supply) and the elasticity appears only in the third term. We also ignore cross-price effects, as the algebra becomes far more complex without that assumption. And in the aggregation of country producer and consumer distortion indexes, we assume the aggregate marginal response of domestic demand to a price change is the same as the aggregate marginal response of domestic supply. To explore this last assumption we altered the weights on consumption and production (the *a* and *b* terms in the ITRI and IWRI formulae, respectively); we found this left the estimates for the border ITRI and IWRI almost unchanged at the aggregate level for all countries. This is not surprising given the high correlation between the IPDI and ICDI (and equivalents for the ITRI) for border distortions.

Another caveat is that the ITRI and IWRI do not include forms of support that are not given at the product level. In the Anderson and Valenzuela (2008) database, non-product-specific (NPS) assistance in some countries is a significant component of overall agricultural sector distortion rate (see Table 2). NPS assistance is reported there in three forms: general non-product-specific assistance, those farm input subsidies for high-income countries that are not attributed at the product level in the database, and so-called decoupled payments. Recalling that the ITRI (or IWRI) 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) as the actual cross-product structure of NRAs and CTEs for that

country, it is possible to make a simple assumption to incorporate NPS measures. If one assumes 100 percent pass-through of NPS distortions to producer prices, the upper bound of the contribution of NPS support can be derived by attributing the NRA from NPS equally to the ad valorem NRA for each covered product. When this is done, it makes little difference to the estimated indexes for developing countries, while for high-income countries it reduces the decline in the estimated WRI (but by a smaller degree than it reduces the decline in the NRA, because the NRA contributions so attributed to decoupled payments have zero variance across commodities and so reduce the variance in overall NRAs). It provides an approximate guide to the increased relative importance of decoupled payments and non-product-specific support to the overall WRI for high-income countries (Figure 6)[8]

[Insert Figure 6 about here]

Conclusions

This paper contributes to the theoretical and empirical literature on trade and welfare reduction indexes. On the theory side, it develops a method of calculating trade and welfare reduction indexes for individual policy instruments from estimates of the rates of distortions of producer and consumer prices. The main contribution is to show that, provided one is willing to make simplifying assumptions about price elasticities, it is possible to use the same data as existing NRAs/CTEs (or PSEs/CSEs) indicators to estimate superior measures of the relative contribution of different policies to global reductions in trade and welfare. Empirically, the paper's main contribution is to apply the methodology to generate a time series of indexes for agricultural products that are well-grounded in trade theory and answer precise questions about the trade- and welfare-reducing effects of different policy instruments. The paper estimates these contributions for a greater set of policy instruments than previous studies. Further, the indexes are generated for 75 developed and developing countries over the past half century. They are useful as inputs into trade negotiations and for monitoring national

[8] To better capture the welfare effects of these measures further research is needed. Serra, Zilberman, Goodwin and Featherstone (2006) find, for example, that decoupled payments affect input use and output mean and variance — which have potential welfare effects that may be non-trivial.

policy developments and making cross-country comparisons of their trade and welfare effects.

The most significant result empirically is the importance of export taxes prior to the 1990s and their contribution to the fall in the global trade- and welfare-restrictiveness of agricultural policies over the past two decades. Previous studies aimed at estimating the relative contributions of different policy instruments to global welfare reduction ignore export taxes (and import subsidies and production taxes) altogether, and find that import taxes contributed as much as 85 percent of the reduction to global farm trade and 93 percent of global welfare losses from agricultural policies in 2001. By contrast, this paper finds that export taxes played a significant role in the aggregate reduction of global trade and welfare (contributing as much as one-third in some time periods). It is likely they will continue to do so when international food prices rise — as indeed happened in 2008. We also find that export taxes have contributed substantially to the almost halving of the global WRI (for border measures) from its peak in the latter 1980s. Globally import and export taxes each contributed roughly half to the decline in the IWRI for border measures. For the most recent period reported above (2000-04), import taxes are certainly by far the most dominant instrument reducing global agricultural trade and associated economic welfare, a result that reinforces the conclusions of earlier studies that import market access is the most important of the 'pillars' being negotiated in the agricultural part of the WTO's Doha Development Agenda. But the widespread re-emergence of food export taxes in 2008 is a reminder that those measures too need to be disciplined by the WTO if it is to fulfill its welfare-enhancing role of reducing uncertainty in international trade – hence the importance of including such instruments in the estimation of TRIs and WRIs.

References

Anderson, J.E. and J.P. Neary (2005), *Measuring the Restrictiveness of International Trade Policy*, Cambridge MA: MIT Press.

Anderson, J.E., G. Bannister and J.P. Neary (1995), "Domestic Distortions and International Trade", *International Economic Review* 36(1): 139–57.

Anderson, K. (2009), 'Five Decades of Distortions to Agricultural Incentives', Ch 1 in Anderson, K. (ed.), *Distortions to Agricultural Incentives: A Global Perspective, 1955–2007*, London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. and J.L. Croser (2009), *National and Global Agricultural Trade and Welfare Reduction Indexes, 1955 to 2007*, database at www.worldbank.org/agdistortions.

Anderson, K., M. Kurzweil, W. Martin, D. Sandri and E. Valenzuela (2008), "Measuring Distortions to Agricultural Incentives, Revisited", *World Trade Review* 7(4): 1-30, October.

Anderson, K., W. Martin and E. Valenzuela (2006), 'The Relative Importance of Global Agricultural Subsidies and Market Access', *World Trade Review* 5(3): 357–76.

Anderson, K. and E. Valenzuela (2008), *Estimates of Global Distortions to Agricultural* Incentives*, 1955 to 2007*, database at www.worldbank.org/agdistortions.

Diao, X,, A. Somwaru and T. Roe (2001). 'A Global Analysis of Agricultural Policy Reform in WTO Member Countries', in M. Burfisher et al. (eds.), *Agricultural Policy Reform in the WTO: The Road Ahead*, Agricultural Economics Report No. 802, Economic Research Services, U.S. Department of Agriculture, Washington DC.

Feenstra, R.C. (1995) "Estimating the Effects of Trade Policy", in G.N. Grossman and K. Rogoff (eds.), *Handbook of International Economics, Vol. 3*, Amsterdam: Elsevier.

Harberger, A.C. (1959), "Using the Resources at Hand More Effectively", *American Economic Review* 49(2): 134-46, May.

Hertel, T.W. and R. Keeney (2006), 'What's at Stake: The Relative Importance of Import Barriers, Export Subsidies and Domestic Support', Ch. 2 in K. Anderson and W. Martin (eds.), *Agricultural Trade Reform and the Doha*

Development Agenda, London: Palgrave Macmillan and Washington DC: World Bank.

Hoekman, B., F. Ng, and M. Olarreaga (2004), 'Agricultural Tariffs versus Subsidies: What's More Important for Developing Countries?', *World Bank Economic Review* 18(2): 175–204.

Irwin, D. (2008), 'Trade Restrictiveness and Deadweight Losses from U.S. Tariffs, 1859-1961', NBER Working Paper No. W13450, Cambridge MA.

Kee, H.L., A. Nicita and M. Olearraga (2009), "Estimating Trade Restrictiveness Indexes", *Economic Journal* 119(534): 172-99, January.

Krueger, A.O., M. Schiff and A. Valdes (1988). 'Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economy-wide Policies', *World Bank Economic Review* 2(3): 255–72, September.

Krueger, A.O., M. Schiff and A. Valdes (1991), *The Political Economy of Agricultural Pricing Policy*, Vol. 1: Latin America, Vol. 2: Asia and Vol. 3: Africa and the Mediterranean, Baltimore: John Hopkins University Press for the World Bank.

Lloyd, P.J., J.L. Croser and K. Anderson (2010), 'Global Distortions to Agricultural Markets: New Indicators of Trade and Welfare Impacts, 1960 to 2007', *Review of Development Economics* 14(2), May (forthcoming).

Narayanan, G., and T.L. Walmsley (eds.) (2008), *Global Trade, Assistance, and Production: The GTAP 7 Data Base,* West Lafayette IN: Center for Global Trade Analysis, Purdue University, http://www.gtap.org

OECD (2005), *Agricultural Policies in OECD Countries: Monitoring and Evaluation*, Paris: Organization for Economic Cooperation and Development.

OECD (2009), *Agricultural Policies in Emerging Economies: Monitoring and Evaluation*, Paris: Organization for Economic Cooperation and Development, March.

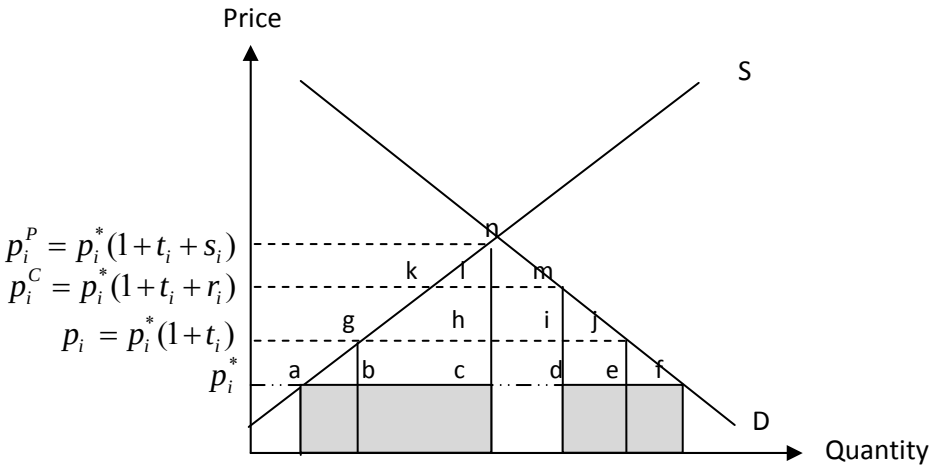
Orden, D., F. Cheng, H. Nguyen, U. Grote, M. Thomas, K. Mullen and D. Sun (2007), *Agricultural Producer Support Estimates for Developing Countries: Measurement Issues and Evidence from India, Indonesia, China and Vietnam*,

IFPRI Research Report 152, Washington DC: International Food Policy Research Institute.

Serra, T., D. Zilberman, B.K. Goodwin and A. Featherstone (2006) 'Effects of Decoupling on the Mean and Variability of Output', *European Review of Agricultural Economics* 33(3): 269-88.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

Figure 1: Representation of the import-competing agricultural sector of a small open economy with a border tax and a domestic consumer tax and a domestic producer subsidy

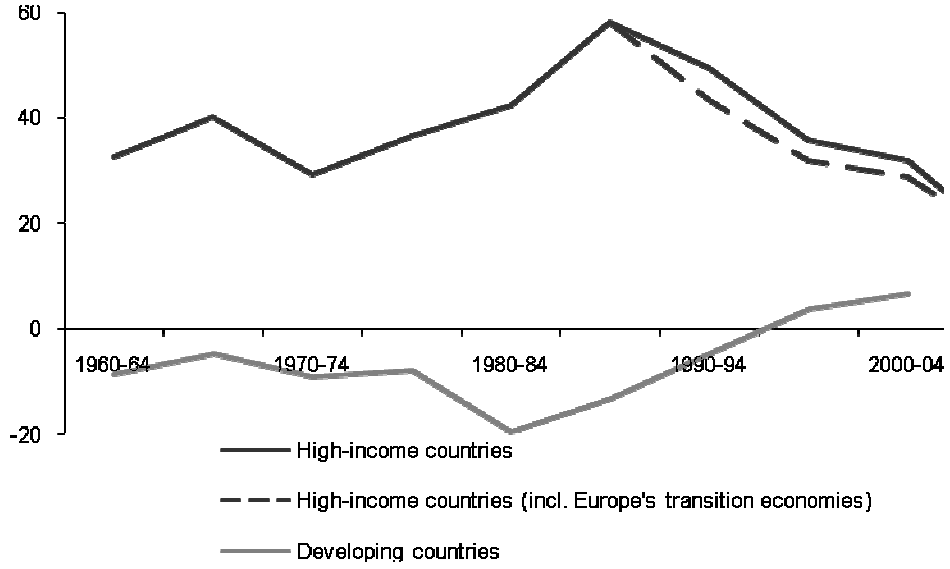


Source: Authors' depiction.

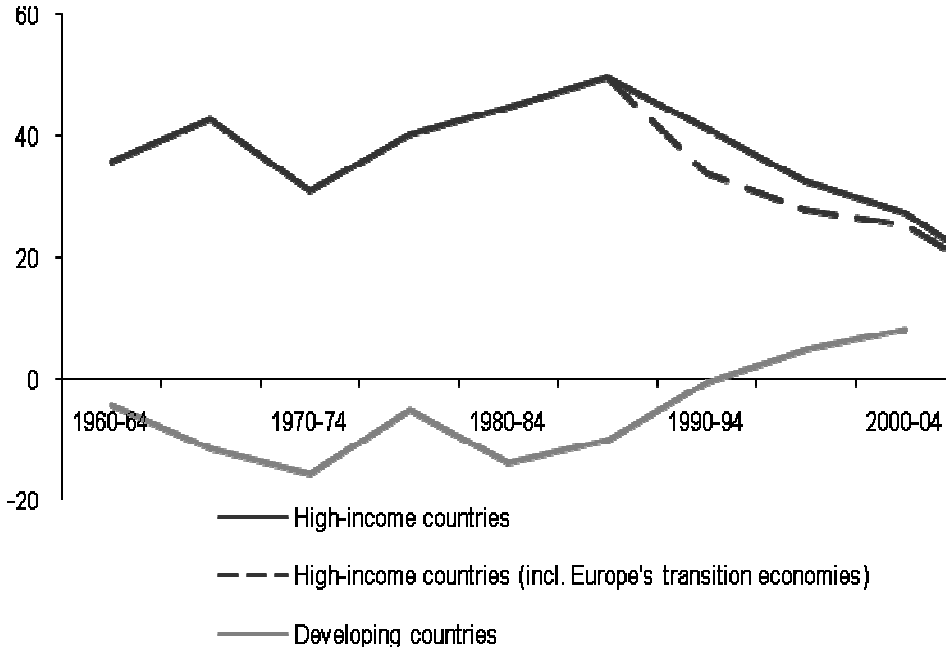
Figure 2: Nominal rates of assistance to farmers and consumer tax equivalents in high-income and developing countries, all covered farm products, 1960 to 2007

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

(a) Nominal rates of assistance



(b) Consumer tax equivalents

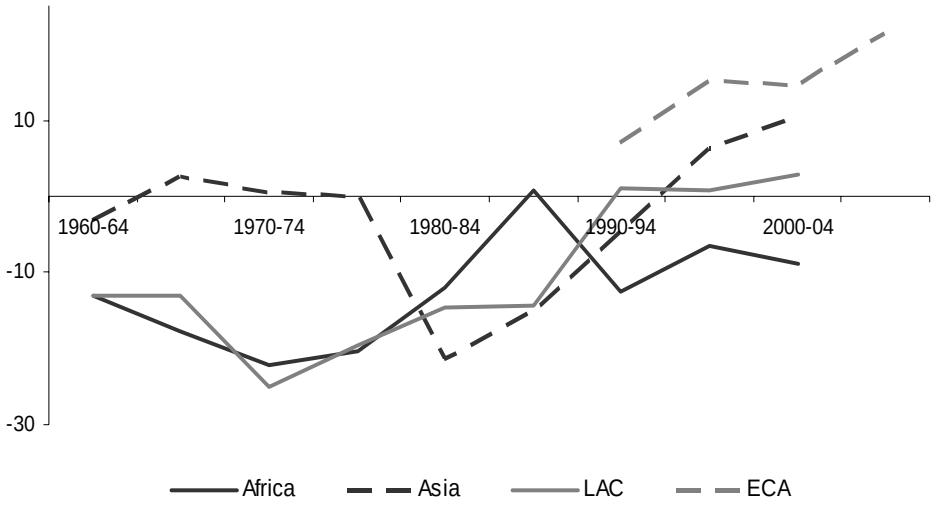


Source: Anderson and Valenzuela (2008).

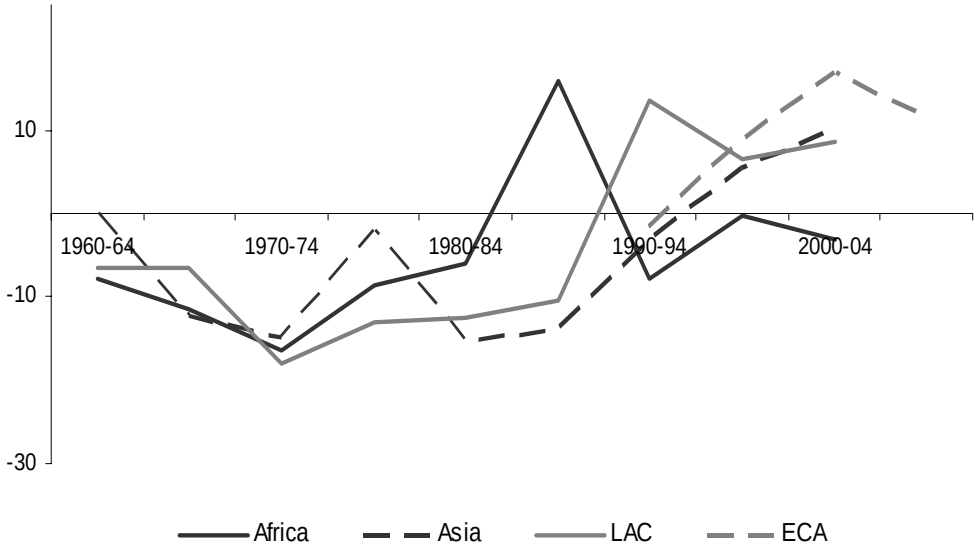
Figure 3: Nominal rate of assistance to farmers and consumer tax equivalents in developing country regions and in Europe's transition economies (ECA), all covered farm products, 1960 to 2007

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

(a) Nominal rates of assistance



(b) Consumer tax equivalents

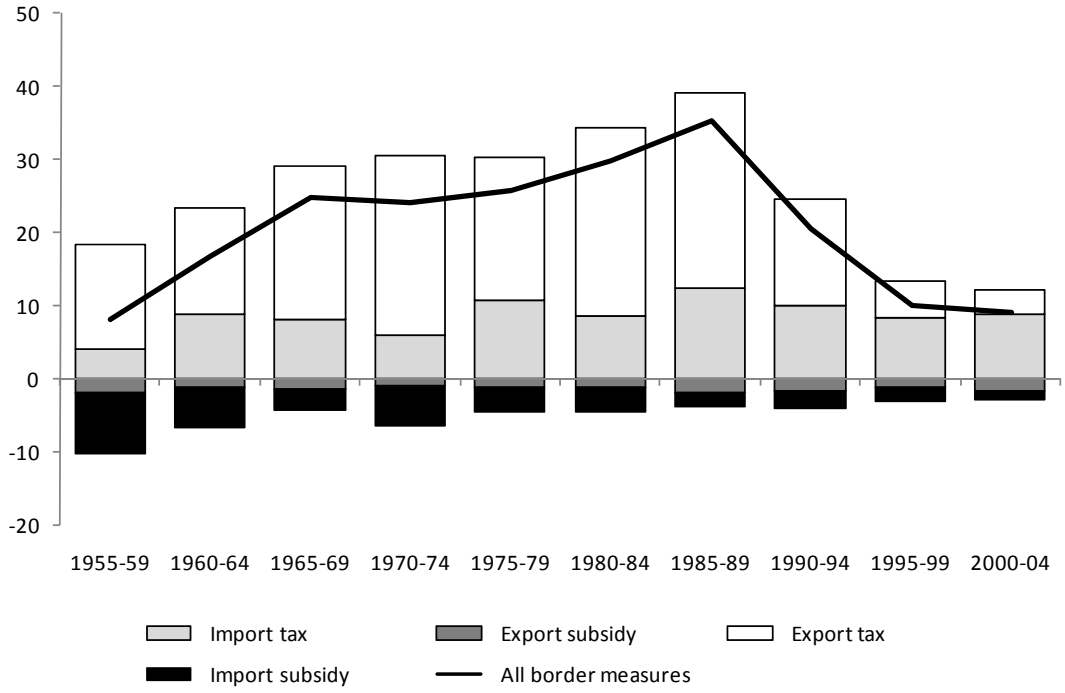


Source: Anderson and Valenzuela (2008).

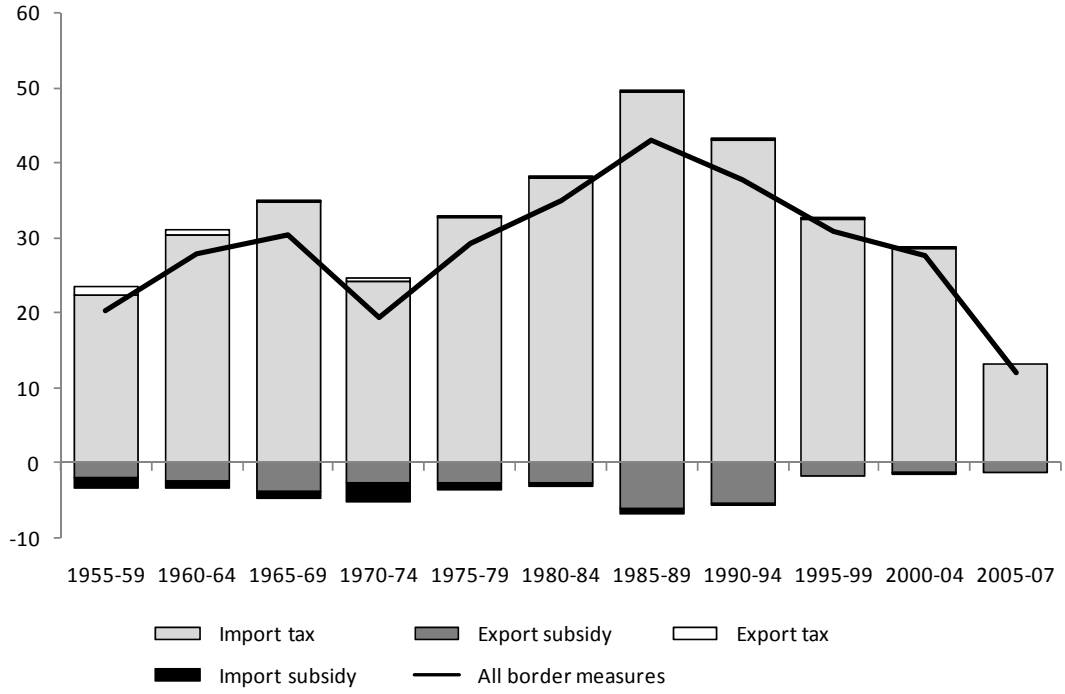
Figure 4: Relative contributions of different border policy instruments to trade reduction from agricultural policies (ITRI), 1960 to 2004

(percent)

(a) Developing countries



(b) High-income countries

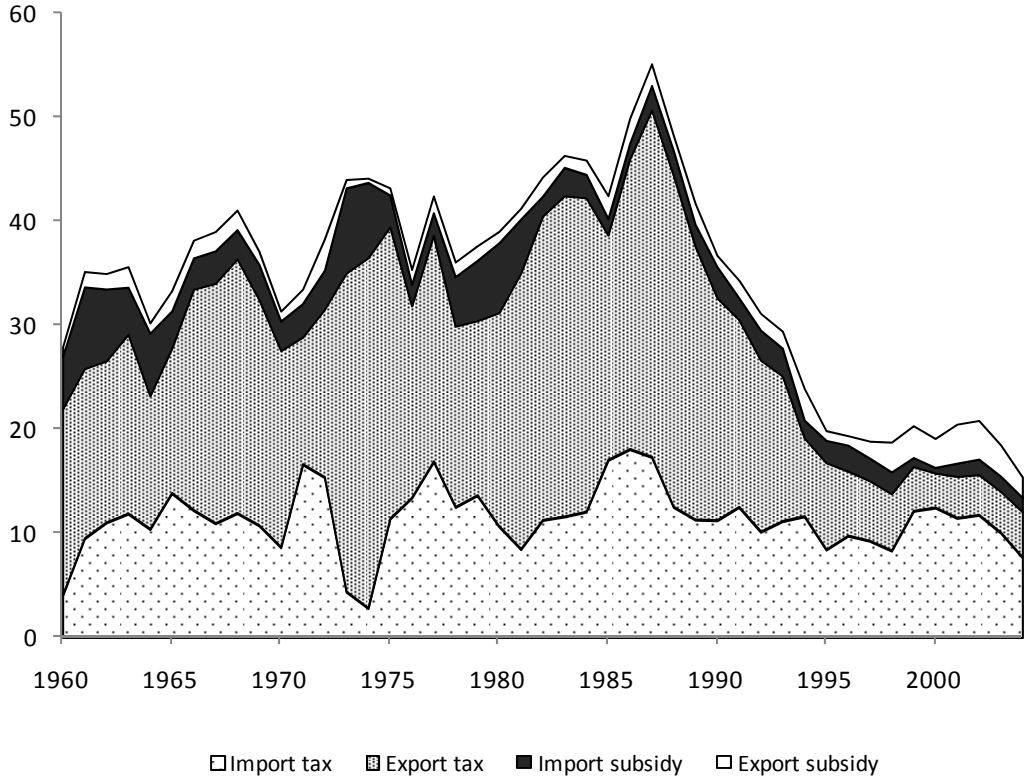


Source: Authors' calculations using data in Anderson and Valenzuela (2008).

Figure 5: Relative contributions of different border policy instruments to welfare reduction from agricultural policies (IWRI), 1960 to 2004

(percent)

(a) Developing countries



(b) High-income countries

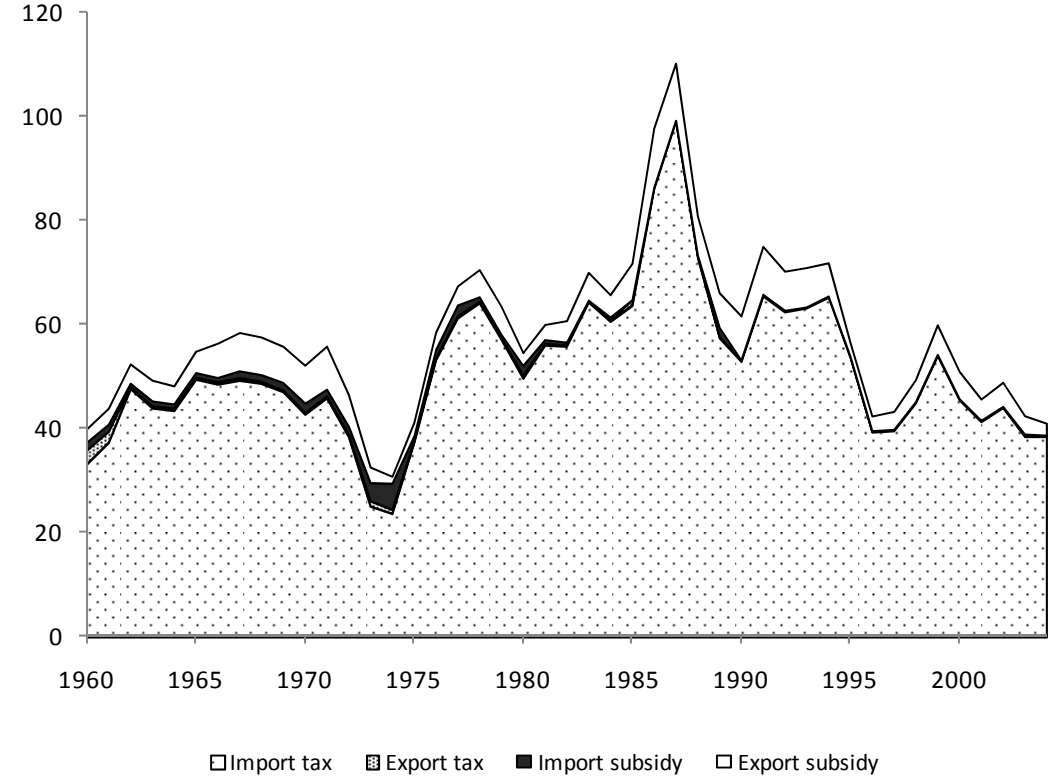
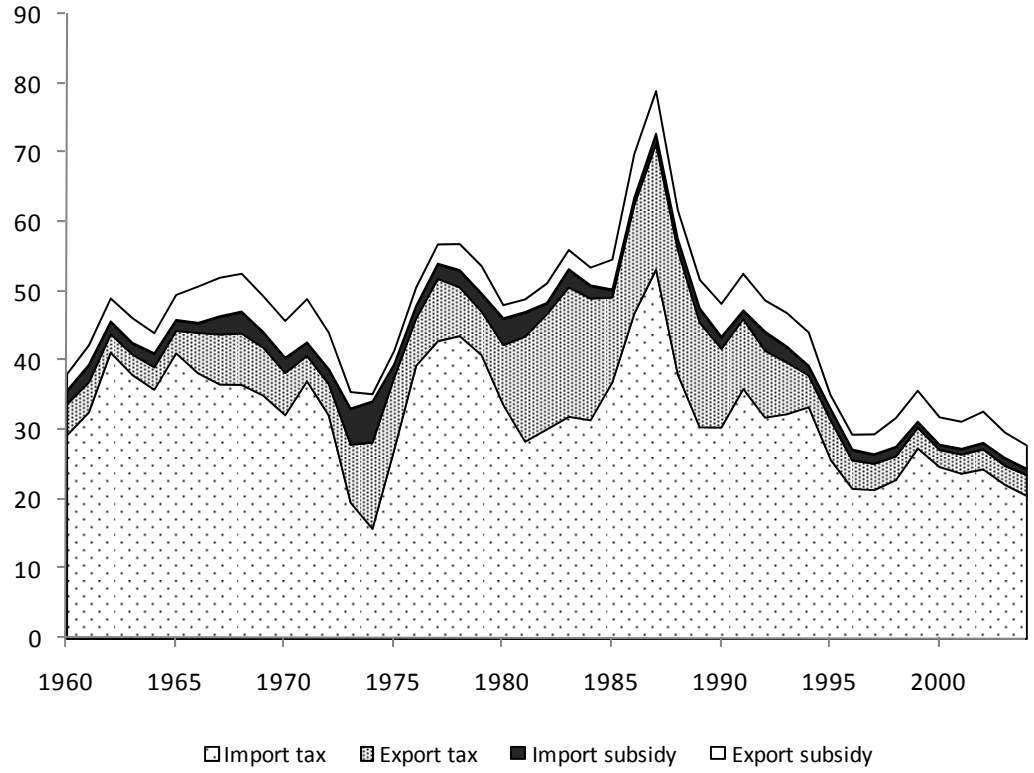


Figure 5 (continued): Relative contributions of different border policy instruments to welfare reduction from agricultural policies (IWRI), 1960 to 2004
(percent)

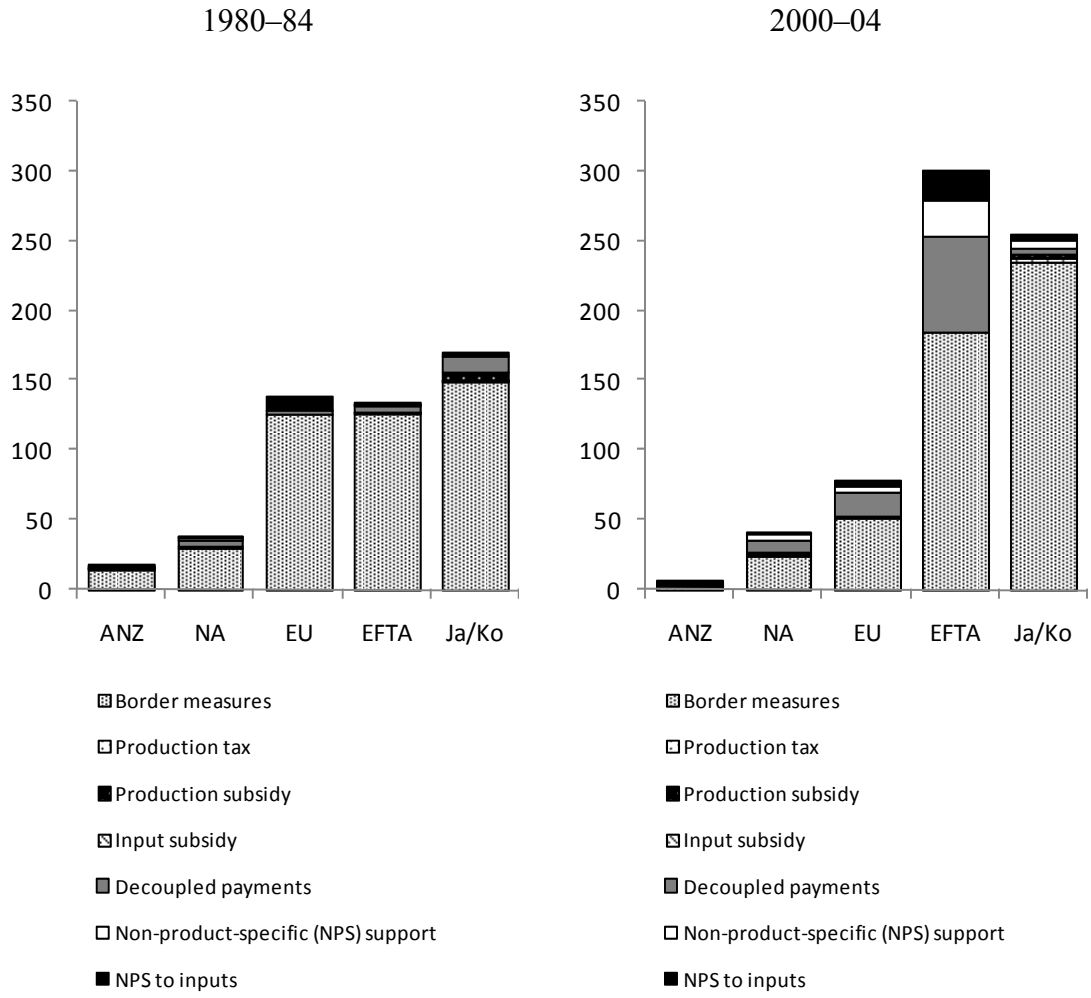
(c) All focus countries



Source: Authors' calculations using data in Anderson and Valenzuela (2008).

Figure 6: Relative contributions to welfare reduction from agricultural policies (IWRI) of different policy instruments including non-product-specific support[a], high-income countries, 1980-84 and 2000-04

(percent)



Source: Authors' calculations using data in Anderson and Valenzuela (2008).

[a] Both 'decoupled' measures plus other non-product-specific support.

Table 1: Nominal rates of assistance[a] for import-competing, exportable and all farm products, by region and globally, 1960 to 2004 (percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Covered import-competing products									
Africa	12	4	-7	8	8	65	2	7	3
Asia	4	34	26	31	21	45	28	28	35
Latin America	20	3	-4	2	10	4	17	9	19
All developing countries	11	26	17	23	17	39	22	22	28
Europe's transition economies	na	na	na	na	na	na	31	34	34
High-income countries	54	59	42	56	70	84	73	64	60
World	48	50	37	46	46	66	51	43	44
Covered exportables									
Africa	-31	-39	-44	-45	-36	-36	-39	-26	-28
Asia	-13	-26	-20	-25	-44	-39	-19	-4	0
Latin America	-23	-17	-30	-26	-27	-24	-9	-3	-4
All developing countries	-25	-29	-29	-30	-40	-37	-19	-5	-3
Europe's transition economies	na	na	na	na	na	na	-4	-1	0
High-income countries	4	10	8	7	8	17	13	6	5
World	-2	-4	-7	-11	-24	-21	-8	-1	0
All covered farm products[b]									
Africa	-13	-18	-22	-20	-12	1	-12	-7	-9
Asia	-3	3	0	0	-21	-15	-5	6	10
Latin America	-13	-13	-25	-20	-15	-14	1	1	3
All developing countries	-9	-5	-9	-8	-20	-13	-5	4	7
Europe's transition economies	na	na	na	na	na	na	7	15	15
High-income countries	32	39	29	36	43	58	49	36	32
World	24	24	15	18	6	16	18	16	16

Source: Anderson and Valenzuela (2008)

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

[b] Includes nontradables.

[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: Contributions to total agricultural NRA and CTE from different policy instruments,[a] by region, 1981-84 and 2000–04

(percent)

(a) Nominal Rates of Assistance[b]	1981-84			2000-04		
Border measures	All developing countries	High-income countries	All focus countries	All developing countries	High-income countries	All focus countries
Import tax equivalent	6	34	18	8	24	14
Export subsidies	1	2	2	1	1	2
Export tax equivalent	-20	0	-13	-3	0	-2
Import subsidy equivalent	-2	0	-2	-1	0	-1
ALL BORDER MEASURES	**-15**	**36**	**5**	**5**	**25**	**13**
Domestic measures						
Production subsidies	1	2	1	1	1	1
Production taxes	-5	0	-3	-1	0	-1
farm input net subsidies	1	3	2	2	2	2
Non-product-specific (NPS) assistance except to inputs	1	1	1	2	5	3
ALL DOMESTIC PRODUCTION MEASURES	**-2**	**6**	**1**	**4**	**8**	**5**
‘Decoupled’ payments to farm households	0	6	2	0	11	4
TOTAL NRA (including NPS and decoupled payments)	**-17**	**48**	**8**	**9**	**44**	**22**
Producer subsidy equivalent, in real 2000 US$ billion	***-113***	***223***	***99***	***58***	***173***	***250***

Table 2 (continued): Contributions to total agricultural NRA and CTE from different policy instruments,[a] by region, 1981-84 and 2000–04

(percent)

(b) Consumer Tax Equivalents[c]	1981-84			2000-04		
	All developing countries	High-income countries	All focus countries	All developing countries	High-income countries	All focus countries
Border measures						
Import tax equivalent	10	46	24	10	32	19
Export subsidies	1	2	1	1	1	2
Export tax equivalent	-22	0	-13	-2	0	-2
Import subsidy equivalent	-3	0	-2	-1	0	-1
ALL BORDER MEASURES	**-14**	**48**	**10**	**8**	**33**	**18**
Domestic measures						
Consumption subsidies	-1	0	-1	-1	-6	-3
Consumption taxes	0	0	0	1	0	1
ALL DOMESTIC CONSUMPTION MEASURES	**-1**	**0**	**-1**	**0**	**-6**	**-2**
TOTAL CTE (covered farm products only)	**-15**	**48**	**9**	**8**	**27**	**16**
Consumer tax equivalent, in real 2000 US$ billion	***-67***	***146***	***73***	***34***	***79***	***125***

Source: Authors' compilation based on data in Anderson and Valenzuela (2008).

[a] In the absence of data, it is assumed the share of input tax/subsidy, domestic production tax/subsidy and border tax/subsidy payments for non-covered farm products are the same as those for covered farm products. The first period begins in 1981 because that was the first year for which estimates for China are available.

[b] All entries have been generated by dividing the producer subsidy equivalent of all (including NPS and 'decoupled') measures by the total agricultural sector's gross production valued at undistorted prices.

[c] All entries have been generated by dividing the consumer tax equivalent of all measures by the total consumption value (at the farmgate level, valued at undistorted prices).

Table 3: Contributions to Trade Reduction Index for covered products by different policy instruments,[a] by region,[b] 1980-84 and 2000–04 (percent)

(a) Production side of economy

	1980-84						2000-04					
	Africa	**Asia**	**LAC**	**DCs**	**HIC**	**World**	**Africa**	**Asia**	**LAC**	**DCs**	**HIC**	**World**
All measures	**24**	**37**	**21**	**33**	**35**	**33**	**16**	**10**	**7**	**10**	**27**	**17**
Border measures	**22**	**33**	**20**	**30**	**35**	**32**	**13**	**9**	**7**	**9**	**28**	**17**
Export tax	24	27	21	26	0	14	15	2	6	3	0	2
Export subsidy	-4	-1	-1	-1	-3	-2	-3	-1	-3	-2	-1	-2
Import tax	10	9	6	8	38	22	7	10	5	9	29	17
Import subsidy	-8	-2	-5	-3	-1	-2	-6	-1	-2	-1	0	-1
Domestic taxes & subsidies	**2**	**4**	**1**	**3**	**0**	**1**	**3**	**1**	**0**	**1**	**-1**	**0**
Production tax on output	2	3	0	2	0	1	3	1	0	1	0	0
Production subsidy on output	0	0	0	0	0	0	0	0	0	0	-1	0
Farm input net subsidies	0	0	1	1	0	0	0	0	0	0	0	0

(b) Consumption side of economy

	Africa	**Asia**	**LAC**	**DCs**	**HIC**	**World**	**Africa**	**Asia**	**LAC**	**DCs**	**HIC**	**World**
All measures	**12**	**35**	**16**	**29**	**41**	**34**	**12**	**11**	**11**	**11**	**30**	**19**
Border measures	**12**	**34**	**16**	**29**	**41**	**34**	**11**	**11**	**10**	**11**	**31**	**20**
Export tax	14	26	15	23	0	12	11	1	4	3	0	2
Export subsidy	-3	-1	-1	-1	-2	-1	-2	-1	-2	-1	-1	-2
Import tax	13	11	8	11	43	25	9	12	11	11	33	21
Import subsidy	-12	-3	-7	-4	-1	-3	-6	-1	-2	-1	0	-1
Domestic taxes & subsidies	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**-1**	**-1**
Consumption tax	0	0	0	0	0	0	0	0	2	0	0	0
Consumption subsidy	0	0	0	0	0	0	0	0	-2	0	-1	-1

Source: Authors' compilation based on data in Anderson and Valenzuela (2008).

a. Each instrument share is computed in the following two steps: (1) ITRI indices are converted to constant 2000 $US by multiplying the index by the average value of production or consumption for that instrument group at the country level; (2) each instrument dollar amount index is divided by the country average value of production or consumption. The measures in the table — which are like a weighted average of an overall regional TRI — therefore reflect both the absolute size of the index for each policy instrument and the relative importance of that policy instrument in the region.
b. Asia excludes Japan; LAC = Latin America and the Caribbean; DCs = developing countries; HIC = high-income countries; and World includes Europe's transition economies for 200-04 (not shown separately) but not for 1980-84.

Table 4: Contributions to Welfare Reduction Index for covered products by different policy instruments,[a] by region, [b] 1980-84 and 2000–04 (percent)

(a) Production side of economy

	1980-84						2000-04					
	Africa	**Asia**	**LAC**	**DCs**	**HIC**	**World**	**Africa**	**Asia**	**LAC**	**DCs**	**HIC**	**World**
All measures	**54**	**61**	**46**	**58**	**64**	**60**	**38**	**20**	**25**	**23**	**53**	**36**
Border measures	**48**	**44**	**38**	**43**	**61**	**51**	**33**	**17**	**18**	**19**	**45**	**31**
Export tax	25	29	23	28	0	15	16	2	7	4	0	3
Export subsidy	4	1	1	1	4	2	3	3	3	3	4	4
Import tax	11	12	7	11	57	31	8	12	7	11	41	23
Import subsidy	8	2	6	4	1	3	6	1	2	1	0	1
Domestic taxes & subsidies	**6**	**17**	**8**	**14**	**2**	**9**	**5**	**3**	**7**	**4**	**7**	**5**
Production tax on output	5	15	1	12	0	6	4	1	2	1	1	1
Production subsidy on output	1	0	1	0	2	1	0	0	2	1	6	3
Farm input net subsidies	0	1	7	2	0	1	0	2	3	2	0	1

(b) Consumption side of economy

	Africa	**Asia**	**LAC**	**DCs**	**HIC**	**World**	**Africa**	**Asia**	**LAC**	**DCs**	**HIC**	**World**
All measures	**47**	**47**	**39**	**45**	**69**	**55**	**33**	**21**	**22**	**22**	**55**	**37**
Border measures	**46**	**41**	**37**	**40**	**69**	**53**	**32**	**20**	**22**	**21**	**53**	**36**
Export tax	14	25	17	23	0	13	12	2	4	3	0	2
Export subsidy	3	1	1	1	3	2	2	3	3	3	3	3
Import tax	15	13	11	13	65	35	11	15	13	14	50	29
Import subsidy	13	2	8	4	1	3	7	1	2	1	0	1
Domestic taxes & subsidies	**1**	**6**	**2**	**5**	**0**	**3**	**1**	**2**	**0**	**1**	**1**	**1**
Consumption tax	1	6	2	5	0	3	1	2	0	1	1	1
Consumption subsidy	0	0	0	0	0	0	0	0	0	0	0	0

Source: Authors' compilation based on data in Anderson and Valenzuela (2008).

a. Each instrument share is computed in the following two steps: (1) IWRI indices are converted to constant 2000 $US billions by multiplying the index by the average value of production or consumption for that instrument group at the country level; (2) each instrument dollar amount index is divided by the country average value of production or consumption. The measures in the table — which are like a weighted average of an overall regional WRI — therefore reflect both the absolute size of the index for each policy instrument and the relative importance of that policy instrument in the region.
b. Asia excludes Japan; LAC = Latin America and the Caribbean; DCs = developing countries; HIC = high-income countries; and World includes Europe's transition economies for 200-04 (not shown separately) but not for 1980-84.

Table 5: Contributions of different policy instruments to the decline in the border policy component of the agricultural Welfare Reduction Index,[a] by region, between 1985-89 and 2000–04

(percent)

	Africa	Asia	LAC	**DCs**	HICs	**World**
Export tax	21	94	93	**86**	0	**42**
Export subsidy	8	-4	-10	**-3**	10	**2**
Import tax	79	9	-17	**15**	88	**54**
Import subsidy	-8	1	34	**2**	1	**2**
All border measures	100	100	100	**100**	100	**100**

Source: Authors' compilation based on data in Anderson and Valenzuela (2008).

a. Contributions are computed using the value of the IWRI in constant 2000 $US billions.