Agricultural Distortions in Sub-Saharan Africa: Trade and Welfare Indicators, 1961 to 2004

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Abstract

For decades, agricultural price and trade policies in Sub-Saharan Africa hampered farmers' contributions to economic growth and poverty reduction. While there has been much policy reform over the past two decades, the injections of agricultural development funding, together with on-going regional and global trade negotiations, have brought distortionary policies under the spotlight once again. A key question asked of those policies is: how much are they still reducing national economic welfare and trade? Economy-wide models are able to address that question, but they are not available for many poor countries. Even where they are, typically they apply to just one particular previous year and so are unable to provide trends in effects over time. This paper provides a partial-equilibrium alternative to economy-wide modelling, by drawing on a modification of so-called trade restrictiveness indexes to provide theoretically precise indicators of the trade and welfare effects of agricultural policy distortions to producer and consumer prices over the past half-century. We generate time series of country level indices, as well as Africa-wide aggregates. We also provide annual commodity market indices for the region, and we provide a sense of the relative importance of the key policy instruments used.

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

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

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In the 1960s and 1970s, governments of many Sub-Saharan African countries adopted macroeconomic, sectoral, trade and exchange rate policies that directly or indirectly taxed farm households seeking to export their way out of poverty. This anti-agricultural, anti-trade, welfare-reducing policy stance, which was also prevalent in numerous other developing country regions up to the early 1980s (Krueger, Schiff and Valdes 1988), has since begun to be reformed. How far has that reform effort gone in altering the trade- and welfare-reducing characteristics of farm and food policies in Sub-Saharan Africa? This matters greatly for economic development and poverty alleviation, because 60 percent of Sub-Saharan Africa's workforce is still employed in agriculture, nearly 40 percent of the population is earning less than $1/day, and more than 80 percent of the region's poorest households depend directly or indirectly on farming for their livelihoods (World Bank 2007, Chen and Ravallion 2008).

There are important questions to be addressed about future agricultural policy reform in Africa because African agriculture is currently the subject of several new agricultural development assistance programs, as well as being important in on-going multilateral and preferential trade negotiations. A first step in considering possible future policies is to examine the impacts of past policy choices, and in particular to ask by how much are the policies still reducing national economic welfare and trade?

Economy-wide models are able to address that question, but such models are not available for many of Africa's poorer countries. Even where they are, typically they depend on myriad assumptions about parameter (for lack of econometric estimates) and they apply to just one particular previous year and so are unable to provide trends in effects over time.

This paper provides a partial-equilibrium alternative to economy-wide modelling, by drawing on a modification of so-called trade restrictiveness indexes to provide theoretically precise indicators of the trade and welfare effects of agricultural policy distortions to producer and consumer prices. By drawing on a recent comprehensive database covering most of Sub-Saharan African agriculture, we generate annual country level indices for the past half-century, as well as region-wide aggregates including for individual commodities and a sense of the relative importance of the key policy instruments used. In doing so we make a methodological advance by incorporating a number of key nontradable products in our estimates of the indices, which turns out to be important in the African agricultural policy context.

Data for construction of the indices come from the World Bank's Distortions to Agricultural Incentives database (Anderson and Valenzuela 2008). The database gives consistent measures of price-distorting policies for 75 countries for the period 1955 to 2007. The data for the 21 African countries in that database is discussed comprehensively in Anderson and Masters (2009). In this paper we focus on 19 of those African countries, leaving aside Egypt and South Africa because they are both large and very different from the others. That sample comprises five countries of eastern Africa (Ethiopia, Kenya, Sudan, Tanzania, and Uganda), four in southern Africa (Madagascar, Mozambique, Zambia, and Zimbabwe), five large economies in Africa's western coast (Cameroon, Côte d'Ivoire, Ghana, Nigeria, and Senegal), and

five smaller economies of West and Central Africa for which cotton is a crucial export (Benin, Burkina Faso, Chad, Mali, and Togo). We concentrate on the period 1961 to 2004, since those are the years for which the African data are most complete.

This paper is structured as follows: the next section presents the methodology we use. This is followed by a discussion of the data in the World Bank's Agricultural Distortions database. We then report our estimates of the series of indices before presenting our conclusions and listing some caveats and areas for further research.

Methodology

There is a growing literature that identifies ways to measure the trade- and welfare-reducing effects of international trade-related policies in scalar index numbers. This literature serves a key purpose: it overcomes aggregation problems (across different intervention measures and across industries) by using a theoretically sound aggregation procedure to answer precise questions regarding the trade or welfare reductions imposed by each country's trade policies.

These measures represent a substantial improvement on commonly used measures. The usual tools for summarizing price-distorting policy trends in a country or region (see, e.g., Anderson and Masters 2009) are measures of the unweighted or weighted mean nominal rate of assistance (NRA) and consumer tax equivalent (CTE), the standard deviation of NRAs, and in a few instances the weighted mean NRA for exportable versus import-competing covered products.[1] Authors often need to report more than one measure to gain an appreciation of the nature of the policy regime. For

[1] The OECD (2009) measures similar indicators to the NRA and CTE, called producer and consumer support estimates (PSEs and CSEs). The main difference, apart from the CSE having the opposite sign to the CTE, is that the NRA and CTE are expressed as a percentage divergence from undistorted (e.g., border) prices whereas the PSEs/CSEs relate to the divergence from actual (distorted) prices.

example, indicators of dispersion of NRAs give some idea of the additional welfare losses that come from greater variation of NRAs across industries within the sector (Lloyd 1974). Further, if import-competing and exportable sub-sectors have NRAs of opposite sign, they need to be reported separately because those policies would offset each other in calculating the aggregate sectoral NRA.

While those various indicators are useful as a set, it is often helpful to have a single indicator to capture the overall trade or welfare effect of an individual country's regime of agricultural price distortions in place at any time, and to trace its path over time and make cross-country comparisons. To that end, the scalar index literature is very useful. The pioneering theoretical work is by Anderson and Neary (summarized in their 2005 book), with an important partial equilibrium contribution by Feenstra (1995). The theory defines an ad valorem trade tax rate which, if applied uniformly across all tradable agricultural commodities in a country will generate the same reduction in trade, or in welfare, as the actual cross-product structure of distortions.[2]

In recent years, several empirical papers have provided series of estimates of scalar index numbers for individual countries. Irwin (2008) uses detailed tariff data to calculate the Anderson–Neary Trade Restrictiveness Index for the United States in 1859 and annually from 1867 to 1961. Kee, Nicita and Olarreaga (2009) estimate partial-equilibrium indexes for 78 developing and developed countries for a single point in time (mid-2000s). Lloyd, Croser and Anderson (2010) estimate indexes for 75 developed and developing countries in the World Bank's recently released

[2] Other indices define an ad valorem trade tax rate which, if applied uniformly across all tradable products, will generate the same government revenue (Bach and Martin 2001), or the same real national income and general equilibrium structure of the economy (Anderson 2009a), as the actual cross-product structure of distortions.

Distortions to Agricultural Incentives database (Anderson and Valenzuela 2008) over the period 1955 to 2007.

In addition to being useful to summarize the agricultural and food policy regime in an individual country, the Anderson-Neary scalar index measures can be usefully adapted to summarize two other aspects of agricultural policy: they can be computed for individual policy instruments, to show the relative contributions of different policy instruments to reductions in trade and welfare (Croser and Anderson 2010); and they can be computed to measure the trade- and welfare-reducing effects of policy in a single global or regional commodity market (Croser, Lloyd and Anderson 2009). In this paper we utilise the methodology to estimate all three types of indexes. In doing so, we extend the theory and analysis to include nontradables, which have not been addressed in previous studies.

Country level trade- and welfare-reduction indexes

To capture distortions imposed by each country's border and domestic policies on its economic welfare and its trade volume, we adopt the methodology from Lloyd, Croser and Anderson (2010). Those authors define a Welfare Reduction Index (WRI) and a Trade Reduction Index (TRI) and estimate them by considering separately the distortions to the producer and consumer sides of the agricultural sector (which can differ when there are domestic measures in place in addition to or instead of trade measures). As their names suggest, the two indexes respectively capture in a single indicator the (partial equilibrium) welfare- or trade-reducing effects of all distortions to consumer and producer prices of farm products from all agricultural and food policy measures in place. The WRI and TRI thus go somewhat closer to what a

computable general equilibrium (CGE) can provide in the way of estimates of the trade and welfare (and other) effects of price distortions, while having the advantage of providing an annual time series. Fortuitously, estimates of the actual price distortions are available in the NRAs and CTEs of the World Bank's Distortions to Agricultural Incentives database.

The derivation of the two indexes for *n* import-competing industries leads to the expressions for the TRI and WRI for the import-competing sector of a country shown in Box 1.

Box 1: Expressions for the TRI and WRI

TRI	**WRI**
$T = \{Ra + Sb\}$, with $R = \left[\sum_{i=1}^{n} r_i u_i \right]$ and $S = \left[\sum_{i=1}^{n} s_i v_i \right]$	$W = \{R'^2 a + S'^2 b\}^{1/2}$, with $R' = [\sum_{i=1}^{n} r_i^2 u_i]^{\frac{1}{2}}$ and $S' = [\sum_{i=1}^{n} s_i^2 v_i]^{\frac{1}{2}}$
where $u_i = p_i^{*2} dx_i / dp_i^C / \sum_i p_i^{*2} dx_i / dp_i^C = \rho_i (p_i^* x_i) / \sum_i \rho_i (p_i^* x_i)$ $v_i = p_i^{*2} dy_i / dp_i^P / \sum_i p_i^{*2} dy_i / dp_i^P = \sigma_i (p_i^* y_i) / \sum_i \sigma_i (p_i^* y_i)$, $a = \sum_i p_i^{*2} \mathrm{dx}_i / \mathrm{d}\, p_i^C / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i$, and $b = -\sum_i p_i^{*2} \mathrm{dy}_i / \mathrm{d}\, p_i^P / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i$.	
Variable definitions: *T* — Trade Reduction Index; *W* — Welfare Reduction Index; *R* — index of average consumer price distortions; S —index of average producer price distortions; R' — Consumer Distortion Index; S' — Producer Distortion Index; s_i — the rate of distortion of the producer price in proportional terms; r_i — rate of distortion of the consumer price in proportional terms; u_i — weight for each commodity in *R* and *R*', which is proportional to the marginal response of domestic consumption to changes in international free-trade prices and can be written as a function of the domestic price elasticity (at the	

protected trade situation) of demand (ρ_i); v_i — weight for each commodity in *S* and *S'*, which is proportional to the marginal response of domestic production to changes in international free-trade prices and can be written as a function of the domestic price elasticity (at the protected trade situation) of supply, (σ_i); p_i^* — border price; $p_i^P = p_i^*(1 + s_i)$ — distorted domestic price; $p_i^C = p_i^*(1 + r_i)$ — distorted domestic consumer price; $x_i = x_i(p_i^C)$ — quantity of good *i* demanded (as a function of own domestic price); $y_i = y_i(p_i^P)$ — quantity of good *i* supplied (as a function of own domestic price); a (b) — weight of consumption (production) in the WRI or TRI, which 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.

Source: Lloyd, Croser and Anderson (2010).

Essentially the import-competing TRI and WRI are constructed from appropriately weighted averages of the level of distortions of consumer and producer prices. The TRI is a mean of order one, and the WRI a mean of order two, but they use the same weights. Because the WRI is a mean of order two, it better reflects the welfare cost of agricultural price-distorting policies because it recognizes that the welfare cost of a government-imposed price distortion is related to the square of the price wedge. It thus captures the disproportionately higher welfare costs of peak levels of assistance or taxation, and is positive regardless of whether the government's agricultural policy is favouring or hurting farmers.

The TRI and WRI can each be extended so as to add the exportable and nontradable sub-sectors of agriculture (see Appendix). Distortions to exportable industries are inputted into the TRI as negative values because a positive (negative) price distortion in an exporting industry has a trade-expanding (-reducing) effect, and thus decreases (increases) the TRI. Distortions to nontradable industries are inputted into the TRI as zero values because a domestic price distortion in a

nontradable industry by definition has neither a trade-expanding nor trade-reducing effect because of assumed prohibitively high trade costs. This extension of the TRI and WRI to include nontradables is a methodological contribution of this paper,[3] and is of practical significance in the case of Sub-Saharan Africa where nontradables account for a non-trivial share of the gross value of agricultural production (discussed below).

The expressions for the TRI and WRI weights above show that estimates of price elasticities are required to compute the indexes. In line with Lloyd, Croser and Anderson (2010), in the absence of elasticities we adopt some simplifying assumptions in this paper. We assume that domestic price elasticities of supply (demand) are equal across commodities within a sub-sector. This powerful simplifying assumption allows us (in the empirical section below) to find appropriately weighted aggregates of distortions on the production and consumption sides simply by aggregating the change in consumer (producer) prices across commodities and using as weights the sectoral share of each commodity's domestic value of consumption (production) at undistorted prices. We expect this simplifying elasticity assumption to have a very small impact on the reported indices. This is because elasticities appear in both the numerator and denominator of the weight expressions, and therefore cancel each other out to some extent. Further, Kee, Nicita and Olarreaga (2009) show that the TRI and WRI can be decomposed into three components and the elasticity only enters into one of the three components, which in practice is a very small component relative to the other two. This transparent assumption also makes sense in the context of computing time series of indices for

[3] Anderson and Neary (2005), chapter 12 discusses the possibility of extending indices to nontradable sub-sectors and including domestic distortions in their general equilibirum framework.

Africa, where there is a dearth of reliable and consistent elasticity estimates across time for all our focus countries and their covered agricultural products.

Policy instrument trade and welfare reduction indexes

The above country-level TRI and WRI measures are the aggregate of the trade- and welfare-reducing effects of all the policy measures in place. The variables s_i and r_i, as domestic-to-border price ratios, can theoretically encompass distortions provided by all trade tax/subsidy and trade non-tax/subsidy measures, plus domestic price support measures (positive or negative), plus direct interventions affecting farm input prices. Furthermore, where multiple exchange rates operate, the measures can encompass an estimate of the import or export tax equivalent of that distortionary regime too.

Whilst it is desirable to have such an aggregated country level indicator that is so encompassing, agricultural policy analysts are sometimes interested in the relative contribution of different policy instruments to reductions in trade and welfare. To provide this insight, it is possible to use the Anderson-Neary framework to construct indicators of policy distortions at the instrument level to facilitate this comparison.[4]

To capture distortions imposed by each African country's different policy instruments on its economic welfare and its trade volume, we adopt the methodology from Croser and Anderson (2010). These authors define an Instrument Welfare Reduction Index (IWRI) and an Instrument Trade Reduction Index (ITRI), which can be estimated by considering the distortion from a single policy instrument to the producer and consumer sides of the economy.

[4] We note that most of the series of TRI and WRI indicators in the literature are for single instruments anyway. For example, Irwin (2008) uses only import tariffs; and Kee, Nicita and Olarreaga (2009) report two series of indices — one based on tariffs only; and the other on tariffs plus NTBs. However, we are unaware of other studies that use the Anderson-Neary framework to directly compare the distortionary effects of different instruments on trade and welfare.

The methodology in Croser and Anderson (2010) identifies four types of border distortions (import taxes and subsidies, and export taxes and subsidies), for which individual ITRI and IWRI series can be estimated. In addition to the border measures, the series for domestic distortions in the form of production, consumption and input taxes and subsidies can be estimated. To estimate the trade-reducing effect of an individual instrument, those authors derive expressions for the change in import volume from the individual policy measures, which are used as the basis for deriving ITRIs. To estimate the welfare-reducing effect of individual instruments, the authors make an assumption about the allocation of the total welfare loss from the combination of individual policy instruments. The authors assume that border measures are applied first, and that this may be supplemented by additional domestic distortions. Thus the domestic distortion's welfare reduction is the residual from subtracting the border measures' effects from the total welfare reduction of all policy measures. This allocation assumption provides a lower-bound on welfare losses from border measures and an upper-bound on welfare losses from domestic measures.

The derivation of the ITRI and IWRI follows essentially the same steps as those for the country-level indices which encompass all forms of distortion. The difference in the algebraic methodology is to specify separate indices for the nine different types of policy instrument. Simplifying price elasticity assumptions can be made in the absence of reliable estimates, and again these assumptions have a minimal effect on the estimates.

Commodity market trade and welfare reduction indices

In addition to constructing country-level and instrument-specific indices, this paper makes use of another methodology within the Anderson-Neary framework to analyse a different aspect of agricultural policy in Africa's poorest nations. We construct indices that show the extent to which African markets for individual farm commodities are distorted relative to others. We employ the methodology in Croser, Lloyd and Anderson (2010) for this purpose. This methodology is novel because whereas all previous work within the trade restrictiveness indices literature has focused on constructing index numbers of distortions from the perspective of a single country, this methodology instead takes a regional view of individual commodity markets.

The commodity TRI (WRI) is equal to the uniform trade tax that has the same effect on regional trade volume (welfare) as the existing set of distortions in the region's national commodity markets. The measures are constructed in the same way as those for individual country indices, except that instead of summing across distortions in different industries for a single country, the measures are constructed by summing across distortions in different countries for a single commodity.

The indices are computed using data on the domestic production and consumption sides of the region's national commodity markets, and the measures account for all forms of border and domestic price distortion in each country for the commodity market of interest, as well as incorporating import-competing and exportable countries into the measure. In the absence of elasticity estimates, we make simplifying assumptions analogous to those made for national indexes. Croser, Lloyd and Anderson (2010) demonstrate that these assumptions have a minimal impact on the estimated series when constructing indices for global markets.

Distortions to Agricultural Incentives database

This study makes use of the World Bank's Distortions to Agricultural Incentives database (Anderson and Valenzuela 2008). The database came out of a global research project seeking to improve the understanding of agricultural policy interventions and reforms in Asia, Europe's transition economies, Latin America and the Caribbean as well as Africa. The database contains annual estimates of nominal rates of assistance (NRA) (positive or negative) for key farm products in 75 countries that together account for between 90 and 96 percent of the world's population, farmers, agricultural GDP, and total GDP. There are 21 African countries in the database.

We concentrate on the sample of 19 Sub-Saharan African countries listed in the introduction, but exclude relatively affluent Egypt and South Africa which together account for between one-third and one-fifth of Africa gross value of production at undistorted prices over the period under analysis. For the 19 African focus countries, the database contains around 6000 consistent estimates of annual NRAs to the agricultural sector and the same number of CTEs between 1955 and 2005. Country coverage up to 1960 is much less than from 1961, so the series of estimates presented in this paper begins in that latter year.

The estimates of NRA and CTE in the database are at the commodity level and cover a subset of 41 agricultural products in Africa. These so-called covered products account for around 70 percent of total agricultural production over the period studied. The data identifies each year the extent to which each commodity in each country is considered an importable, exportable or nontradable, a status that

may change over time. In the 19 African focus countries, nontradable products account over time for between 40 and 55 percent of the gross value of production of all covered agricultural products (last column of Table 1).

The range of policy measures included in the NRA estimates in the Distortions to Agricultural Incentives database is wide. By calculating domestic-to-border price ratios, the estimates include assistance provided by all tariff and nontariff 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 and subsidies and 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.

Anderson and Masters (2009) note several patterns that emerge in the distortions to agricultural incentives in the 21 focus countries. In the 1960s and 1970s, many African governments had macroeconomic, sectoral and trade policies that increasingly favoured the urban sector at the expense of farm households and favoured production of import-competing farm goods at the expense of exportables. The policy regime was characterized as pro-urban (anti-agricultural) and pro-self-sufficiency (anti-agricultural trade). Since the 1980s, Africa has reduced its anti-agricultural and anti-trade biases, but many distortions still remain.

For the 19 countries in this study, Table 1 and Figure 1 illustrate those patterns. The weighted average NRA for the 19 countries is almost always below zero, indicating that together agricultural price, trade and exchange rate policies have reduced the earnings of farmers in these countries. The average rate of direct

taxation (negative NRA) of African farmers rose until the late 1970s before declining by more than half over the next 25 years. Meanwhile, assistance to non-agricultural sectors rose (thereby making farming less attractive in relative terms) and then declined slower than for agriculture, as reflected in the Relative Rate of Assistance (RRA) estimates in Table 1.

Table 2 reports the country-level NRAs for covered products for each of the 19 countries in this sample. It reveals the considerable diversity within the sample. In some countries — such as Cameroon, Ghana, Senegal, Uganda, Tanzania, and Madagascar — there was a reduction in taxing farmers since the regional peak in 1975–79, while in other countries — such as and Cote d'Ivoire, Zambia, and Zimbabwe — high levels of agricultural taxation persist.

The country level aggregate measures hide the degree of variation in NRA estimates within countries. Anderson and Masters (2009) report the standard deviations around the weighted mean NRA for covered products in each country, showing that the variation is significant. An indication of the extent of variation between groups of products is seen when comparing the average NRAs for import-competing and exportable product groups, which reflects the antitrade bias (Figure 1).

Notwithstanding the valuable contribution of the measures reported in Anderson and Masters (2009), sectoral averages of NRAs and RRAs can be misleading as indicators of the aggregate extent of price distortion within the sector. They can also be misleading when compared across countries that have varying degrees of dispersion in their NRAs (and CTEs) for farm products. We therefore now turn to consideration of the TRI and WRI series estimated for this paper, and the additional insights these measures can provide.

Trade and welfare reduction index estimates

The regional aggregate TRI for the 19 African focus countries for all covered products is positive and of a significant magnitude over the period under analysis (Figure 2). The positive TRI indicates that overall agricultural policy in African countries resulted in reduced trade. The extent of that has decreased over time, however, with the five-year TRI averages of between 20 and 25 percent in the first two decades of data falling to around 10 percent in the most recent decade. The TRI has the opposite sign to the NRA because the TRI correctly aggregates policies that reduce trade volume, regardless of whether the NRA is positive or negative. The importance of the difference in these aggregations of the trade-reducing effect of policies can be seen in the early-1960s, for example, when the average NRA was around zero but the TRI was quite high (capturing the trade-reducing effect of both import taxes and export taxes, which offset one another in the NRA estimate). Similarly in the late 1980s, the NRA trends from around -15 to -10 percent at a time when the TRI increases from 20 to 30 percent. The aggregate NRA gives the impression that policies are becoming less distorted in this period but, because the upward trend in the NRA is caused by an increase in import taxes, the TRI correctly reveals that agricultural policies are in fact becoming more restrictive in this time period.

The WRI series for all covered products is necessarily positive and everywhere lies above the TRI series (Figure 2). The WRI series correctly demonstrates the negative welfare consequences that flow from both negative and positive price distortions. Furthermore, the WRI series provides a better indicator of

the welfare cost of distortions than the average level of assistance or taxation, due to the inclusion in the WRI of the 'power of two'. A weighted arithmetic mean does not fully reflect the welfare effects of agricultural distortions because the dispersion of that support or taxation across products has been ignored. By contrast, the WRI captures the higher welfare costs of high and peak levels of assistance or taxation. That is, the WRI reflects the disparity issue discussed in Lloyd (1974): the larger the variance in assistance levels, the greater the potential for resources to be used in activities which do not maximize economic welfare.

The aggregate African results mask country-level diversity in the TRI and WRI series. Some countries — such as Cote d'Ivoire, Ethiopia, Sudan, Tanzania and Zimbabwe — persistently restrict trade (in aggregate) throughout the period under analysis (Table 3). Other countries — such as Kenya, Zambia and Mozambique — have had periods in which policies in aggregate have expanded agricultural trade slightly. In terms of the WRI, there is less diversity across countries, since WRI measures are all necessarily positive (Table 4). The extent to which agricultural policy reduced aggregate welfare does differ across countries, however. Some countries have low reductions in welfare, including Uganda and most cotton-exporting countries. Figure 3 provides a snapshot for 2000–04 of the diversity in the WRI and TRI for each of the 19 countries, with the weighted African average in the middle.

A useful way of understanding the overall welfare reduction for Africa from agricultural policy is to compute the country contributions to the WRI for the 19 African focus countries as a whole. Contributions can be found by computing dollar values of the welfare reduction for each country (by multiplying the WRI percent by the average of the gross value of production and consumption at undistorted prices). Such contributions will therefore take account of the magnitude of national WRIs as

well as the significance of each country in terms of its share of the gross value of production and consumption at undistorted prices. Table 5 shows that Nigeria and Sudan are the two countries that dominate the region's contributions, with Sudan becoming more important over time (as its WRI series trends upwards). Ethiopia accounts for up to 10 percent of the focus region's welfare reduction. The last column of Table 5 reports country contributions to the decline in the regional WRI from its value of 44 percent in 1975–79 to its value of 27 percent in 2000–04. Once again, Nigeria and Sudan dominate the overall reduction, together accounting for around 80 percent of the fall in the WRI. However, Uganda, Cameroon, Senegal and Madagascar have a slightly offsetting effect on the regional fall in the WRI over that period.

Figure 4(a) shows commodity contributions to the regional WRI and TRI. In line with the significance of nontradables in the focus countries, the products cassava, and yam dominate the contribution to the overall WRI. Cassava and yam both have average NRAs close to zero in all time periods (five year averages between -4 and 0 percent over the period studied) and are nontraded for most countries. The next contributor is maize, which on average has high levels of assistance in several import-competing focus countries – and significant negative levels of protection in exporting countries. None of the livestock products in the focus countries contribute significantly to the WRI for all covered products, because their share in regional gross value of production of covered products is low.

It is useful to compare the TRI and WRI series reported above for all covered products, with those for just covered tradables in Africa.[5] In Table 6, it can be seen that the TRI and WRI for all covered products is significantly lower than that for

[5] Note that Lloyd, Croser and Anderson (2010) report measures for covered tradables only.

covered tradables. This is because, as noted above, nontradables account for a large share of the gross value of production and consumption. The TRI estimates for all covered products are roughly half, and WRI estimates are roughly two-thirds, what there were with nontradables included. Figure 4(b) shows that commodity contributions to the regional WRI are substantially different when considering only tradables. Beef and groundnut make the largest contributions to the reduction in regional welfare when considering only tradables.

Another point to note from Table 6 is that the country sample matters for the reporting of TRI and WRI results. For comparison, we report the results from Lloyd, Croser and Anderson (2010), which computed TRI and WRI series for an alternative sample of African countries in the Distortions to Agricultural Incentives database. Their sample is the same 19 countries in this paper, with the addition of Egypt and South Africa, and excluding the five cotton countries of Benin, Burkina Faso, Chad, Mali and Togo, because these countries only have one covered tradable product (cotton). In general, the 19 focus countries in this study have higher TRI and WRI 5-year averages. This is driven by the exclusion of Egypt and South Africa, which had low country-level TRI and WRI estimates. The exception to the general pattern is the time period 1985–89, where the Lloyd, Croser and Anderson (2010) estimates are higher, owing to very high protection in Egypt in that five-year average period (when international food prices collapsed just as Egypt raised its previously very low domestic food prices).

It is also useful to compare the TRI and WRI results for the 19 focus countries to the TRI and WRI estimates for other developing country regions, which are reported in Lloyd, Croser and Anderson (2010). The 19 African focus countries had the most welfare reducing policies over time, and generally the most trade-distorting.

All three regions have shown a trend towards less trade and welfare reducing agricultural policies in recent years, however (Figure 5).

Policy instrument results

We now turn to the national decompositions of the TRI and WRI to the policy instrument level. Figure 6 provides a summary of the estimates of the contribution to the weighted average WRI series for the 19 African focus countries of four different border measures: taxes and subsidies on both imports and exports. The figure demonstrates the very substantial role that export taxes have played in the reduction of welfare in the region. On average, more than half the welfare reductions have come from anti-agricultural export taxing policies over the period studied. Notwithstanding their significant distortionary contribution, export taxes have also been the area in which there has been most reform in recent decades. The contribution of export taxes to the reduction in the WRI over the period 1985–89 to 2000–04 is 93 percent. Import taxes reduced the overall WRI by 34 percent; while there were offsetting increases in the contribution of export subsidies (13 percent) and import subsidies (15 percent) to the WRI. The contributions to TRI and WRI estimates for the 19 African countries from domestic distortions are small, never accounting for more than 2 percent of the overall regional TRI or WRI.

Commodity TRI and WRI results

The TRI and WRI estimates for individual regional commodity markets provide a different perspective on the level of distortion in the 19 focus countries over the

period under analysis. Table 7 reports the five-year average WRI estimates for the focus region for individual commodity markets. The table reveals considerable diversity in the distortions in different commodity markets. Fruit and vegetable commodity markets, which tend to have a high share of nontradable production, have low WRI estimates on average, whereas traded commodities such as tropical crops, oilseeds and livestock tend to have more welfare-reducing policies in place. Grains, which comprise a mixture of tradable and nontradable products, had highly-distortionary policies in place in the 1960s on average, but these have been reduced over time.

Figure 7 gives a snapshot of the diversity across commodity markets in the regional TRI and WRI for 2000–04. Sugar and cotton markets continue to have highly distorted policies in terms of both the trade and welfare effects of policies. Soybean, by contrast, has trade-expanding policies in aggregate, but the policies are nevertheless welfare reducing.

Conclusions, caveats and areas for further research

Reform of agricultural policy in Africa is topical at present. Recently announced international investment programs, domestic policy reforms, and the negotiation of international and regional trade agreements are on the agenda. To assess each of these policy initiatives, measurement of intervention levels is required. Certainly, economy-wide models can measure the welfare and trade (and other) effects of policy in a particular country or market. But such models require reliable data on the structure of the economy, and econometric estimates of myriad parameters, neither of which can be easily found for the poorer countries of Africa. Even where economy-wide models

are available, they may be calibrated to a particular year and so incapable of providing a long time-series of estimates of the regional effect of distortional policies over time.

Scalar index measures, by contrast, can meaningfully summarize the welfare and trade effects of policy intervention in agriculture in poorer countries. These indices can be estimated using already available price, quantity and distortions data, and so are relatively inexpensive to generate. We demonstrate this for a subset of 19 African countries from the World Bank's recently released Distortions to Agricultural Incentives database.

The estimates in the paper reveal several important findings. The national level TRIs and WRIs indicate that although there has been policy reform in African agriculture over the past 50 years, the overall trade- and welfare-reducing effects of current policies remain significant. Export taxes in particular continue to reduce African welfare and trade. Some individual commodity markets in Africa are more distorted than others, sugar and cotton being two of the most distorted.

The scalar index numbers reported in this paper provide a better measure of policy intervention than widely-used NRA-type measures because they correctly aggregate offsetting policies and the WRI captures the higher welfare costs of more disparate policies across industries. These scalar measures have the advantage of making policies more transparent, which can facilitate further reforms.

Notwithstanding their contribution, there are a number of limitations to the indices. Some are empirical. First, the estimates can only take account of agricultural products which have commodity level data in the World Bank's database. The database has product level data for approximately 70 percent of the 19 African focus countries' farm production value, and somewhat less of their consumption value. We, therefore, necessarily miss some information about distortions to production and

consumption and therefore trade and welfare in Africa. Furthermore, the data in the World Bank's database are not highly disaggregated, which is not ideal for capturing the full extent of welfare and trade distortions from African policies. Finally, in the absence of reliable, consistently estimated time-series of elasticities of demand and supply, we make simplifying assumptions about those elasticities to compute the scalar index number series. The estimates would be more precise if we had access to reliable elasticity estimates, although probably not a lot different, according to sensitivity analysis conducted by Croser, Lloyd and Anderson (2010).

There are also some methodological caveats worth noting. The methodology in the paper adopts the standard approach still presented in most textbooks on trade policy or welfare economics, based on the benchmark of competitive markets. The methodology ignores the existence of divergences and governance problems, including administrative costs. Thus the trade and welfare reduction indexes reported above may be over- or under-stated to the extent that such problems exist. For example, in some cases where there is market failure, we know from second-best theory that policies that increase assistance to a lightly protected industry may increase rather than decrease national economic welfare. These neoclassical assumptions we make are unlikely to be realistic for many of the poorest nations in Africa. In particular, the RRA measure reported in Table 1 suggest that distortions to non-farm tradables sectors in Africa exist. Even so, the series reported in this paper are useful aggregations of data and almost certainly give a better indication of trade and welfare effects of policy than average NRA-type measures.

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Appendix: Derivation of Trade- and Welfare-Reduction Indexes

Lloyd, Croser and Anderson (2010) outline a methodology for computing indices which accurately capture the state of trade policy regime in an individual country in a theoretically meaningful way. Their methodology, which draws heavily on the Anderson and Neary (2005) methodology, defines partial equilibrium indexes which aggregate the production and consumption sides of the economy separately (instead of trade data as is more commonly done with trade restrictiveness indexes). This form of index is well-suited to agricultural distortions research, where data is available for production and consumption of individual farm commodities. This Appendix briefly outlines that theory for the import-competing sector of a small open economy.

Start by considering an individual country, assuming it has a small, open economy in which all markets are competitive. The market for an import good may be distorted by a tariff and other nontariff border measures or by behind-the-border measures such as domestic subsidies and price controls.The first measure of interest is 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 border and behind-the-border price distortions, would result in the same reduction in the volume of imports (summed across products by valuing them at the undistorted border price) as the actual distortions.

Consider the market for one good, good *i*, which is distorted by a combination of measures that distort its consumer and producer prices. For the producers of the good, the distorted domestic producer price, p_i^P, is related to the

border 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 proportional terms. For the consumers of the good, the distorted domestic consumer price, p_i^C, is related to the border 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 proportional terms. In general, $r_i \neq s_i$. Using these relations, the change in the value of imports in the market for good *i* is given by:

$$\Delta M_i = p_i^* \Delta x_i - p_i^* \Delta y_i$$

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

where the quantities of good *i* demanded and supplied, x_i and y_i, are functions just of their own domestic price: $x_i = x_i(p_i^C)$ and $y_i = y_i(p_i^P)$.

Strictly speaking, this result holds only for small distortions. In reality rates of distortion may not be small. If, however, the demand and supply functions are linear over the relevant price range, the effect on imports is given by equation (1) with constant slopes of the demand and supply curves (dx_i / dp_i^C and dy_i / dp_i^P, respectively). 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:

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

Setting the result equal to the reduction in imports from a uniform tariff, T, gives:

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

Solving for T, give

$$T = \{Ra + Sb\} \tag{3a}$$

$$\text{where } R = \left[\sum_{i=1}^{n} r_i u_i \right] \text{ with } u_i = p_i^{*2} \mathrm{dx}_i / \mathrm{d}\, p_i^C / \sum_i p_i^{*2} \mathrm{dx}_i / \mathrm{d}\, p_i^C , \tag{3b}$$

$$S = \left[\sum_{i=1}^{n} s_i v_i \right] \text{ with } v_i = p_i^{*2} \mathrm{dy}_i / \mathrm{d}\, p_i^P / \sum_i p_i^{*2} \mathrm{dy}_i / \mathrm{d}\, p_i^P \text{ , and} \tag{3c}$$

$$a = \sum_i p_i^{*2} \mathrm{dx}_i / \mathrm{d}\, p_i^C / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i \text{ and } b = -\sum_i p_i^{*2} \mathrm{dy}_i / \mathrm{d}\, p_i^P / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i \tag{3d}$$

Evidently, the uniform tariff T can be written as a weighted average of the level of distortions of consumer and producer prices (R and S are indices of average consumer and producer price distortions; they are arithmetic means). 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 that affect the two sides of the market differently.

In equation 3c (equation 3b), the weights for each commodity are proportional to the marginal response of domestic production (consumption) to changes in international free-trade prices. These weights can be written as, among other things, functions of the domestic price elasticities (at the protected trade situation) of supply and demand (σ_i and ρ_i , respectively):[6]

$$u_i = \rho_i \, (p_i^* x_i) / \sum_i^n \rho_i \, (p_i^* x_i) \quad \text{and} \quad v_i = \sigma_i \, (p_i^* y_i) / \sum_i^n \sigma_i \, (p_i^* y_i) \tag{4}$$

The other index defined in Lloyd, Croser and Anderson (2010), the WRI, measures the effect of a country's distortions on its economic welfare. The derivation follows the same steps as in the derivation of the TRI except that instead of starting from the loss in trade volume from a policy, one starts from a loss of consumer and producer surplus (a welfare loss, L_i). With n importable goods

[6] These expressions can also be written as functions of, among other things, the domestic price elasticities at the free trade points.

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

$$L = \tfrac{1}{2}\{\sum_{i=1}^{n}(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^{\mathrm{P}} - \sum_{i=1}^{n}(p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^{\mathrm{C}}\} \qquad (5)$$

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

$$\sum_{i=1}^{n}(p_i^* s_i)^2 \mathrm{d}y_i / \mathrm{d}p_i^P - \sum_{i=1}^{n}(p_i^* r_i)^2 \mathrm{d}x_i / \mathrm{d}p_i^C = -\sum_{i=1}^{n}(p_i^* W)^2 \mathrm{d}m_i / \mathrm{d}p_i \qquad (6)$$

W is thus 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:

$$W = \{R'^2 a + S'^2 b\}^{1/2} \qquad (7a)$$

where $R' = [\sum_{i=1}^{n} r_i^2 u_i]^{\frac{1}{2}}$ (7b)

$$S' = [\sum_{i=1}^{n} s_i^2 v_i]^{\frac{1}{2}} \qquad (7c)$$

with u_i, v_i, a and b as defined for equation 3 above. W is the desired Welfare Reduction Index, while R' and S' are the contributions to W from consumer and producer price distortions, respectively. They, like their appropriately weighted average W, are means of order two. As with the index T, we can deal with, and analyse, the production and consumption sides of the sector separately.

Extension to exportable sectors

Lloyd, Croser and Anderson (2010) report how the indexes can each be extended to include the exportables sub-sector. This is facilitated by way of aggregating the

import-competing and exportables sub-indices 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). The resulting measure is the import tax/export subsidy which, if applied uniformly to all products in the sector, would give the same loss of welfare as the combination of measures distorting consumer and producer prices in the import-competing and exportable sub-sectors.

The only trick in the case of the TRI is to keep separate track of the subsets of import-competing and exportable goods because the sign of an NRA in exportable sector (positive or negative) has the opposite effect on the TRI. That is, while an export subsidy in the exportable sub-sector reduces welfare in the same way as an import tax in the import-competing sub-sector, the export subsidy will increase trade and the import tariff reduces trade.

Extension to nontradables sectors

In this paper we make a further methodological extension to the theory. We extend indices to include nontradable, as well as tradable sectors. This is important for Africa, because in many countries the share of nontradables in the gorss value of agricultural production is high. Becasue nontradables are generally free of distortions, an index that does not take into account these sectors will tend to overstate the trade- and welfare-reducing effect of agricultural policy.

To include nontradables, we keep separate track of three subsectors of the economy: import-competing, exportable and nontradable sub-sectors. We generate sub-sector specific TRI and WRI indices (as we previously did for each of the import-competing and exportable subsectors). The three sub-sector indices are then

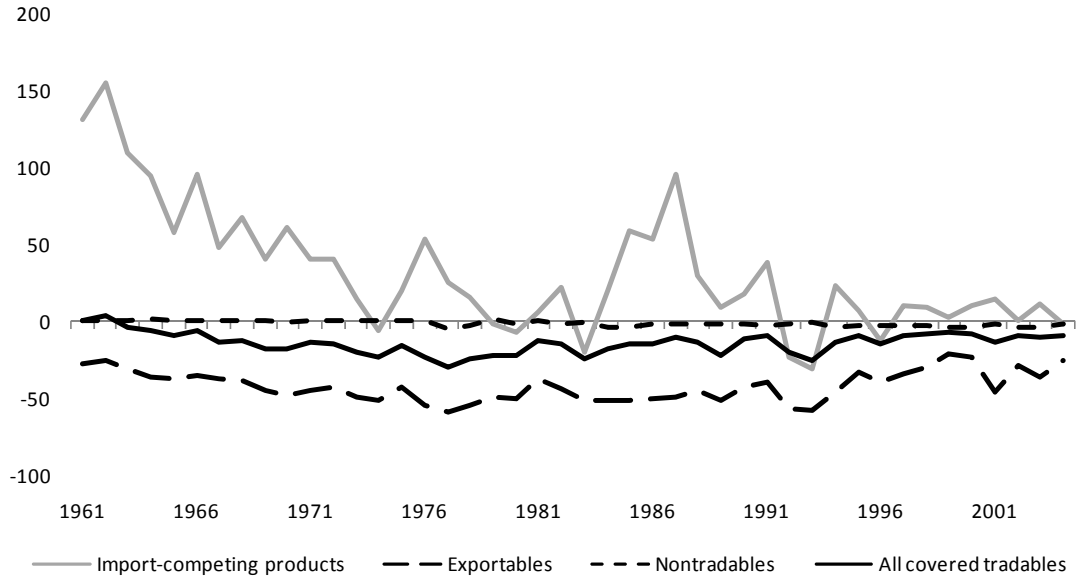
aggregated using as weights each sub-sectors' share of value of production (consumption) in the total value of production (consumption).

For the WRI, because distortions in nontradable secotrs cause welfare distortions, we proceed as expected and s_i and r_i values in equations 7b and 7c are the actual level of distortion in the nontradable sectors.

For the TRI, however, we make an asusumption that s_i and r_i values in equations 3b and 3b are zero. This assumption is such that distortions to nontradable products are assumed not to expand or reduce trade volume. The assumption recognises the high trade costs in these products. s_i and r_i values). This is the case for the vast majority of non-tradable products in any case. It means that the contribution of nontradables to TRI is only through the share of nontradables in value of production (consumption) in the total value of production (consumption).

Figure 1: Nominal Rates of Assistance for import-competing, exportable and all covered products, 19 African countries, 1961 to 2004

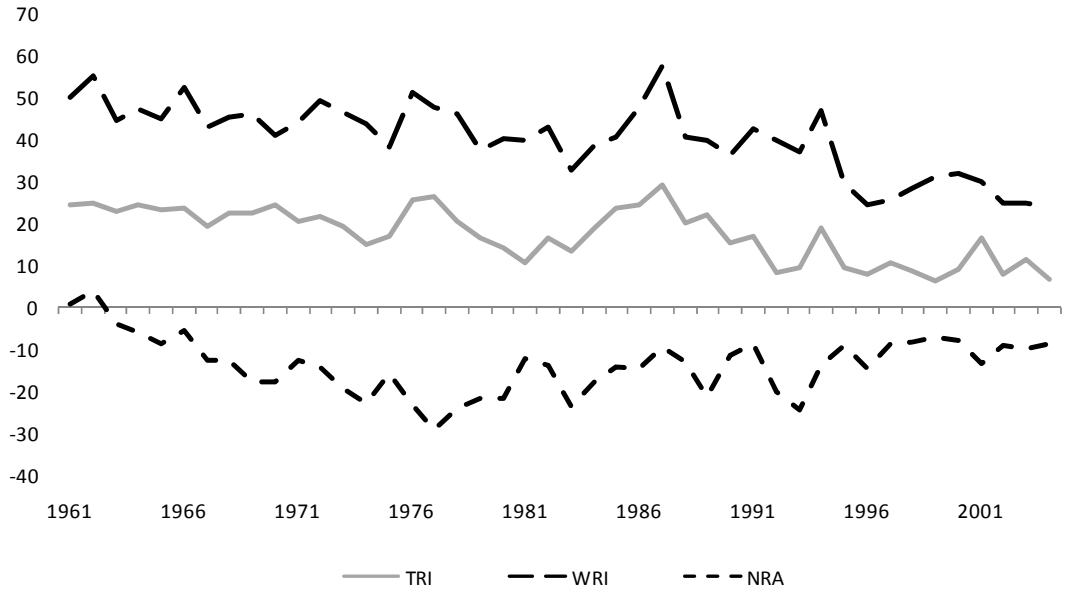
(percent)



Source: Anderson and Valenzuela (2008)

Figure 2: Trade and Welfare Reduction Indices, and Nominal Rate of Assistance for all covered products, 19 African countries, 1961 to 2004

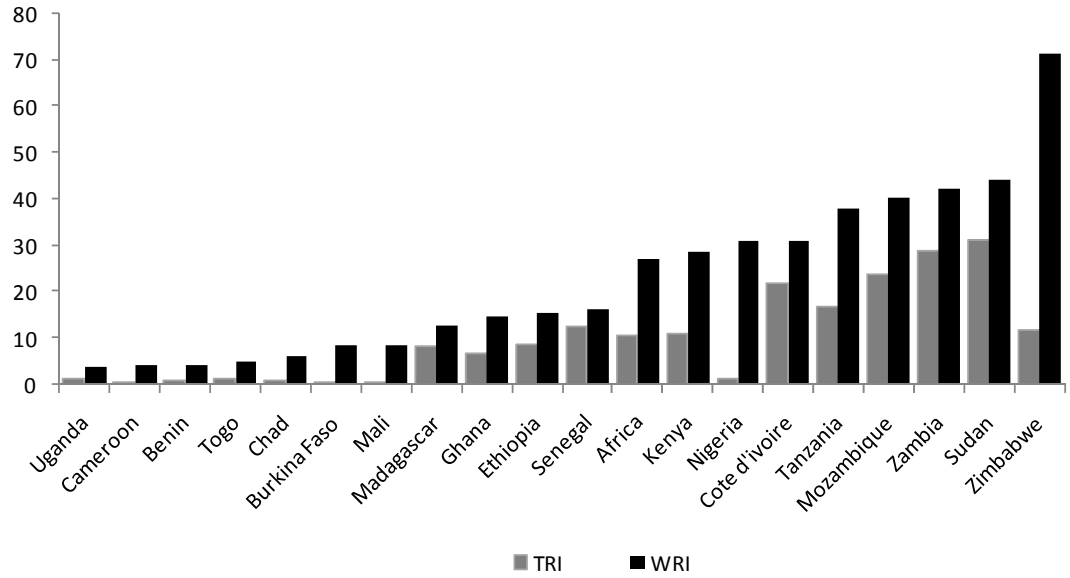
(percent)



Sources: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008)

Figure 3: Trade and Welfare Reduction Indices, all covered products, 19 African countries and regional average[a], 2000–04

(percent)



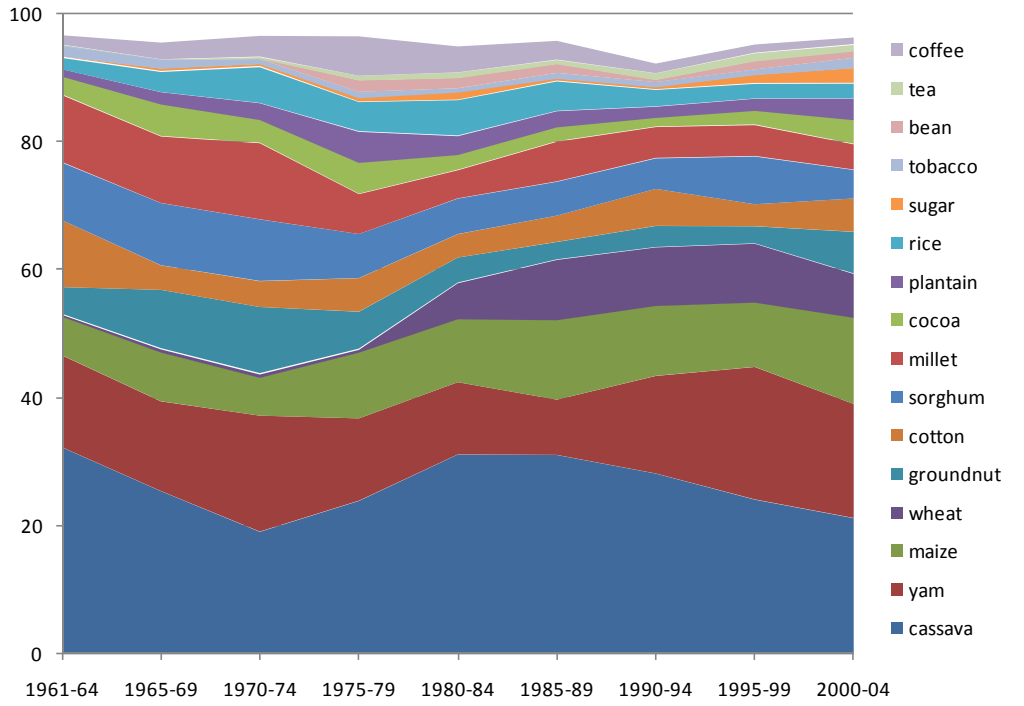
Source: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008)

a. To get the regional average the national indexes are weighted by the average of the gross value of production and consumption at undistorted prices.

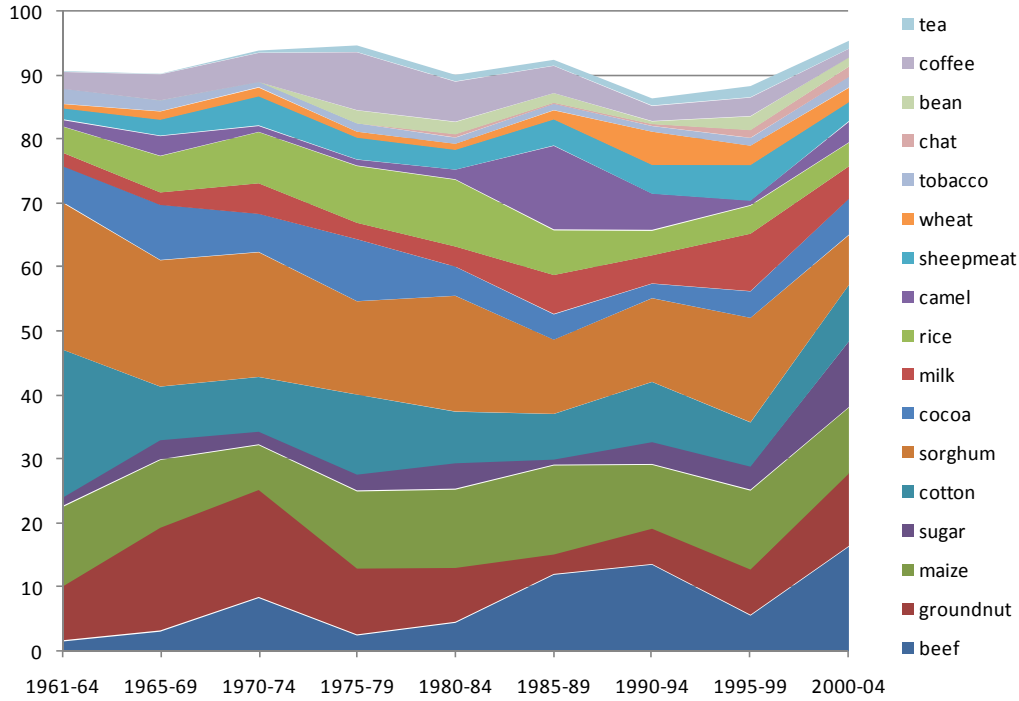
Figure 4: Product contributions[a] to the regional Welfare Reduction Index for 19 African countries, 1961–64 to 2000–04

(percent)

(a) Contributions to WRI, all covered products



(b) Contributions to WRI, all covered tradables (excludes nontradables)



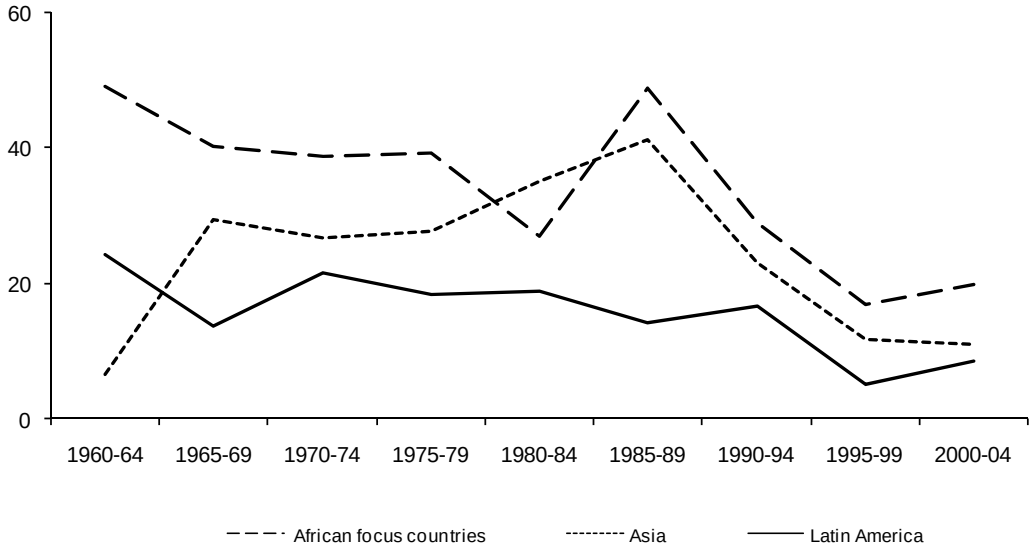
Source: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008)

a. Products which contribute less than 1 percent to the WRI dollar amount in 2000–04 are omitted from the charts.

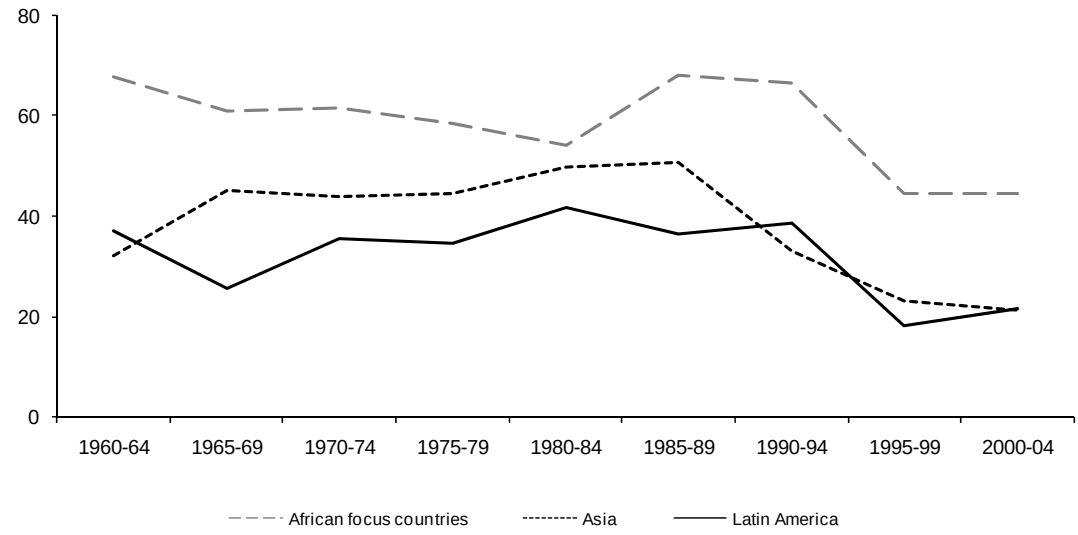
Figure 5: Trade- and Welfare-Reduction Indices, 19 African focus countries, Asia and Latin America, covered tradables, 1960–64 to 2000–04[a]

(percent)

(a) TRI



(b) WRI

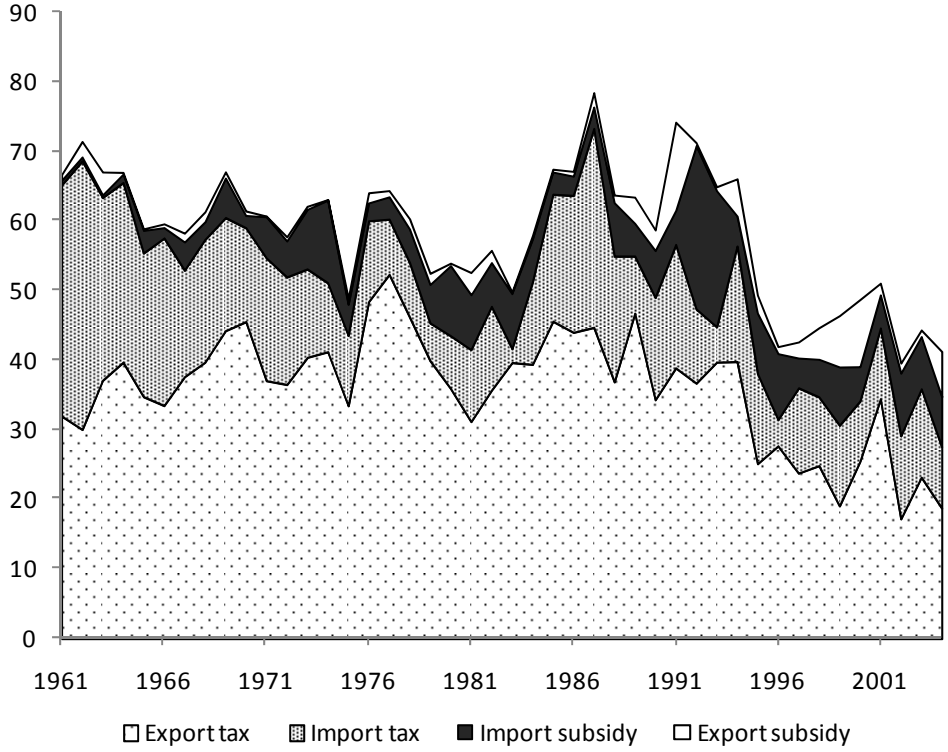


Source: Modified from Lloyd, Croser and Anderson (2009) using Anderson and Croser (2009), which is based on NRA and CTE data in Anderson and Valenzuela (2008)

a. 1960–64 is 1961–64 for Sub-Saharan African countries.

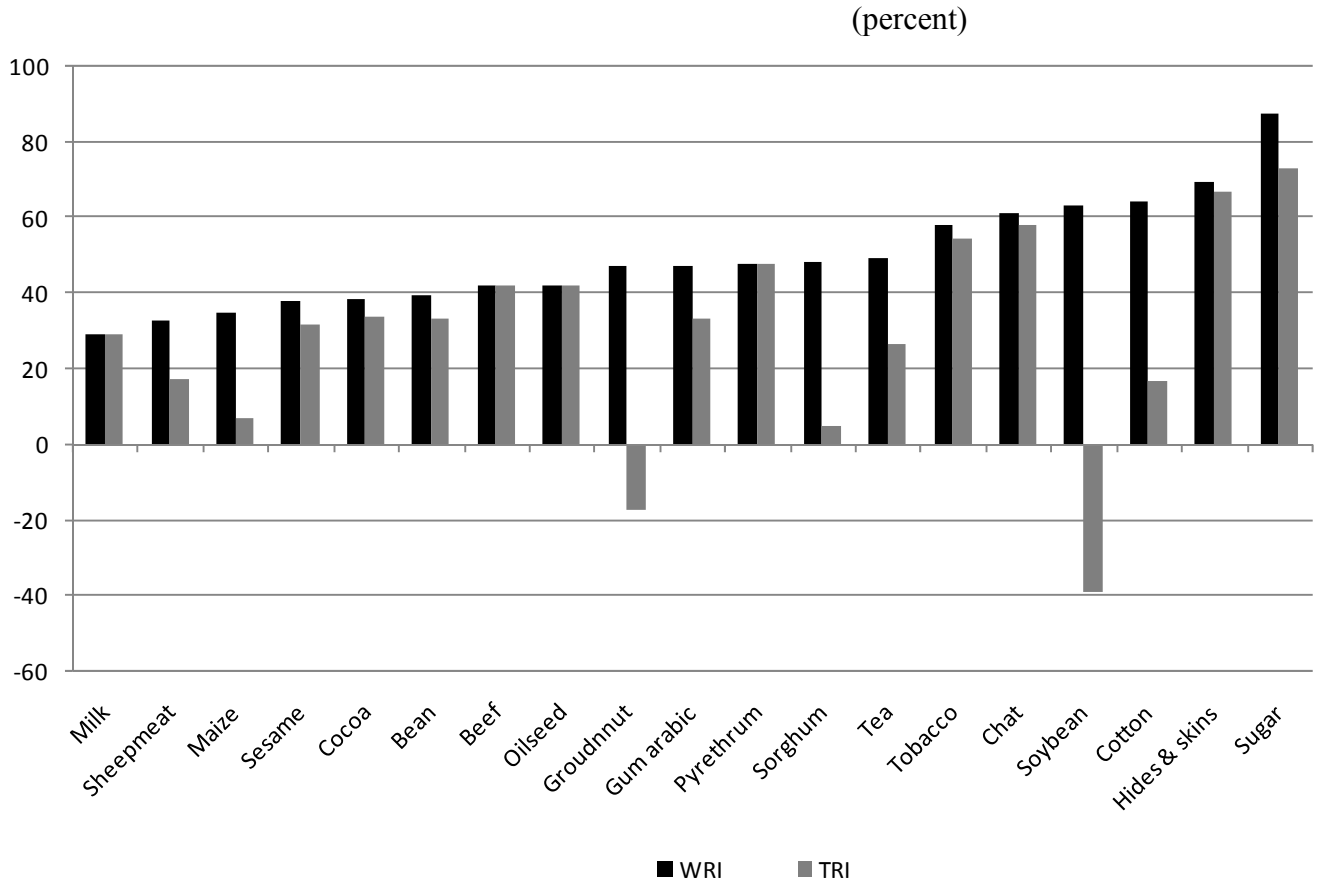
Figure 6: Decomposition of the Welfare Reduction Index[a] due to border measures, by policy instrument, 19 focus African countries, 1961 to 2004

(percent)



Source: Croser and Anderson (2010) based on NRA and CTE data in Anderson and Valenzuela (2008)

Figure 7: Commodity Trade and Welfare Reduction Indexes, markets of 19 African focus countries, all covered products[a], 2000–04



Source: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008)
a. Products with a WRI of less than 30 percent in 2000–04 are omitted from the chart; and camel — which has the highest WRI in 2000–04 — is also omitted.

Table 1: Summary of Nominal Rates of Assistance for import-competing, exportable, nontradable, and all covered agricultural products, Relative Rate of Assistance and Trade Bias Index, 19 African focus countries, 1961–64 to 2000–04

(percent)

	NRA, agricultural products[a]							
	Covered exportables	Covered importables	All covered tradables[b]	Covered nontradables	All covered products	Standard deviation of NRAs[b]	RRA[c]	Tradables share (%) of value of all covered agric. production
1961-64	-30	123	3	0	-1	34	5	49
1965-69	-39	62	-15	0	-11	33	-12	55
1970-74	-47	30	-27	0	-17	31	-19	55
1975-79	-52	22	-30	-1	-23	37	-27	54
1980-84	-47	4	-28	-1	-18	35	-17	46
1985-89	-50	49	-26	-2	-15	33	-22	46
1990-94	-49	5	-27	-2	-16	31	-19	41
1995-99	-32	3	-15	-3	-10	25	-11	39
2000-04	-32	7	-16	-3	-10	26	-18	43

Source: Anderson and Valenzuela (2008)

a. Nominal rates of assistance for the 19 African focus countries are weighted by the gross value of production at undistorted prices for the relevant sub-sector.
b. The simple average of the 19 focus countries' standard deviation of NRA around its weighted mean.
c. The RRA is defined as $100*[(100+NRAag^t)/(100+NRAnonag^t)-1]$, where $NRAag^t$ and $NRAnonag^t$ are the percentage NRAs for the tradables parts of the agricultural and non-agricultural sectors, respectively. The regional RRA is a weighted average of national RRAs, with weights being the gross value of production at undistorted prices for all agriculture.

Table 2: Nominal rates of assistance, all covered products, 19 African focus countries, 1961–64 to 2000–04

(percent)

	1961–64	1965–69	1970–74	1975–79	1980–84	1985–89	1990–94	1995–99	2000–04
Africa	**-1**	**-11**	**-17**	**-23**	**-18**	**-15**	**-16**	**-10**	**-10**
Benin	na	na	-3	-1	-1	-1	-4	-4	-1
Burkina Faso	na	na	-2	-3	-4	-1	-3	-3	0
Cameroon	-4	-8	-12	-25	-19	-5	-4	-4	-1
Chad	na	na	-12	-11	-8	-1	-3	-3	-1
Côte d'Ivoire	-29	-35	-33	-40	-40	-28	-22	-22	-28
Ethiopia	na	na	na	na	-12	-15	-17	-10	-7
Ghana	-15	-28	-23	-41	-32	-8	-3	-5	-2
Kenya	13	-2	-24	-15	-30	-8	-30	-4	4
Madagascar	-19	-23	-20	-38	-51	-26	-7	-4	2
Mali	na	na	-6	-8	-7	-3	-5	-7	0
Mozambique	na	na	na	-56	-42	-51	-4	5	14
Nigeria	21	12	7	5	8	15	4	0	-5
Senegal	-15	-12	-33	-34	-30	5	7	-10	-12
Sudan	-26	-37	-48	-28	-33	-39	-54	-29	-15
Tanzania	na	na	na	-50	-60	-52	-30	-29	-17
Togo	na	na	-1	-1	-2	-2	-4	-3	-1
Uganda	-3	-5	-12	-24	-12	-14	-1	1	1
Zambia	-24	-32	-42	-57	-26	-68	-53	-34	-36
Zimbabwe	-36	-36	-44	-54	-47	-43	-45	-38	-73

Source: Anderson and Valenzuela (2008)

Table 3: Trade Reduction Index, all covered products[a], 19 African focus countries, 1961–64 to 2000–04

(percent)

	1961–64	1965–69	1970–74	1975–79	1980–84	1985–89	1990–94	1995–99	2000–04
Africa	**24**	**22**	**20**	**21**	**15**	**24**	**14**	**9**	**10**
Benin	na	na	2	1	1	0	2	3	1
Burkina Faso	na	na	2	3	4	1	3	3	0
Cameroon	2	5	6	14	12	3	2	2	1
Chad	na	na	12	11	8	1	3	3	1
Côte d'Ivoire	13	13	24	27	19	17	12	15	22
Ethiopia	na	na	na	na	14	16	19	11	9
Ghana	6	11	10	22	20	15	7	3	7
Kenya	-16	-19	-4	12	21	19	-7	9	11
Madagascar	20	15	-13	6	-1	17	3	3	8
Mali	na	na	4	7	6	3	5	7	0
Mozambique	na	na	na	27	-6	-14	1	6	24
Nigeria	39	38	31	18	11	19	7	8	1
Senegal	14	10	30	36	28	25	26	7	12
Sudan	29	28	29	29	22	56	40	17	31
Tanzania	na	na	na	16	18	34	30	16	17
Togo	na	na	0	1	2	1	4	3	1
Uganda	2	4	8	14	9	10	2	2	1
Zambia	21	1	1	36	-11	-45	-27	-7	29
Zimbabwe	33	38	43	51	29	37	19	10	12

Source: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008).

a. Includes all import-competing, exportable and nontradable products; with nontradable sectors assumed to have a zero level of distortion on the volume of trade.

Table 4: Welfare Reduction Index, all covered products, 19 African focus countries, 1961–64 to 2000–04

(percent)

	1961–64	1965–69	1970–74	1975–79	1980–84	1985–89	1990–94	1995–99	2000–04
Africa	**49**	**46**	**45**	**44**	**39**	**45**	**40**	**28**	**27**
Benin	na	na	9	6	7	4	8	7	4
Burkina Faso	na	na	9	13	14	5	9	9	9
Cameroon	9	14	17	29	22	12	11	10	4
Chad	na	na	24	23	20	5	9	8	6
Côte d'Ivoire	28	36	36	40	38	30	25	25	31
Ethiopia	na	na	na	na	22	24	27	20	16
Ghana	17	30	28	44	49	36	17	11	15
Kenya	35	39	29	34	38	28	35	26	29
Madagascar	23	27	26	43	55	37	21	11	13
Mali	na	na	16	20	18	8	13	14	9
Mozambique	na	na	na	63	52	63	18	18	41
Nigeria	87	78	68	54	45	63	48	36	31
Senegal	17	15	38	41	36	50	55	11	16
Sudan	36	40	51	40	40	65	79	42	44
Tanzania	na	na	na	58	65	62	53	46	38
Togo	na	na	4	5	9	5	10	8	5
Uganda	6	9	20	35	24	24	4	4	4
Zambia	26	41	47	57	31	69	58	39	42
Zimbabwe	39	45	50	56	46	42	46	40	72

Source: Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008).

Table 5: Country contributions to the regional Welfare Reduction Index for 19 African focus countries, all covered products, 1961–64 to 2000–04 and country contributions to the fall in the Welfare Reduction Index for all 19 countries from 1975–79 to 2000–04

(percent)

	1961-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	Contribution to fall in WRI 1975–79 to 2000–04[c]
Africa WRI	**49**	**46**	**45**	**44**	**39**	**45**	**40**	**28**	**27**	
Benin	-	-	0	0	0	0	0	0	0	0
Burkina Faso	-	-	0	0	0	0	0	0	0	0
Cameroon	2	3	3	4	2	1	1	1	0	-4
Chad	-	-	0	0	0	0	0	0	0	0
Cote d'Ivoire	3	5	5	8	6	4	4	4	5	1
Ethiopia	-	-	-	-	10	11	10	11	9	na
Ghana	2	4	3	4	4	3	2	2	3	1
Kenya	2	2	2	3	3	2	3	2	2	1
Madagascar	1	2	3	3	4	2	1	1	1	-2
Mali	-	-	0	0	0	0	0	0	0	0
Mozambique	-	-	-	2	2	1	1	1	2	2
Nigeria	74	60	51	36	37	37	38	45	35	34
Senegal	1	1	2	3	2	2	2	0	1	-3
Sudan	10	15	21	15	18	27	30	19	27	44
Tanzania	-	-	-	9	7	4	3	6	6	1
Togo	-	-	0	0	0	0	0	0	0	0
Uganda	1	2	4	7	4	2	0	1	1	-8
Zambia	1	2	2	2	1	1	1	2	2	1
Zimbabwe	3	4	4	4	3	2	3	3	5	7
Africa[b]	100	100	100	102	103	100	100	100	100	100

Source: Authors' calculations from data in Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008).

a. Country contributions are computed by converting national percentage WRIs to dollar values by multiplying by the average of the gross value of production and consumption at undistorted prices. The country contributions therefore capture both the magnitude of the WRI and the share of a country's gross value of production and consumption in the regional value of production and consumption.
b. The total for all countries does not necessarily sum to 100 for five-year averages, but it does sum to 100 for individual years.
c. This column gives the country contribution to the fall in the WRI from 1975–79 to 2000–04.

Table 6: Trade and Welfare Reduction Indexes, all covered products and all tradables, 19 African focus countries and 16 African focus countries, 1961–64 to 2000–04

(percent)

	1961-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
19 Africa focus countries									
Trade Reduction Indexes									
Covered tradables	49	40	39	39	27	49	29	17	20
All covered products	24	22	20	21	15	24	14	9	10
Welfare Reduction Indexes									
Covered tradables	68	61	61	58	54	68	67	45	45
All covered products	49	46	45	44	39	45	40	28	27
16 African focus countries[a]									
TRI, Covered tradables	21	22	21	26	18	50	18	14	14
WRI, Covered tradables	51	51	52	49	50	80	52	37	36

Source: Lloyd, Croser and Anderson (2010) and Anderson and Croser (2009) based on NRA and CTE data in Anderson and Valenzuela (2008).
a. 1961–64 results are for 1960–64 for 16 African focus countries. The 16 African focus country results are those reported in Lloyd, Croser and Anderson (2010). The 16 countries are those in this study including Egypt and South Africa, and excluding the five cotton countries — Benin, Burkina Faso, Chad, Mali and Togo.

Table 7: Commodity Welfare Reduction Index, African regional market of 19 focus countries, 31 covered products, 1961–64 to 2000–04

(percent)

	1961-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Grains	**59**	**50**	**44**	**34**	**28**	**33**	**26**	**20**	**18**
Cassava	0	0	1	1	3	1	1	4	3
Maize	114	73	63	71	54	67	40	38	35
Millet	18	18	11	5	10	13	16	18	8
Rice	31	30	40	36	48	60	38	16	18
Sorghum	153	144	118	95	83	95	80	52	49
Wheat	17	37	40	30	14	16	35	16	16
Oilseeds	**28**	**42**	**54**	**49**	**47**	**40**	**72**	**43**	**36**
Cashew	na	na	na	80	80	85	61	13	11
Groundnut	27	43	54	51	50	35	60	41	47
Oilseed	na	na	na	na	47	52	61	56	42
Palmoil	25	31	45	26	28	44	132	50	13
Sesame	50	60	62	65	56	44	47	45	38
Soybean	na	14	34	44	45	44	56	52	64
Sunflower	0	0	0	0	0	0	0	0	0
Tropical crops	**36**	**41**	**45**	**61**	**54**	**49**	**53**	**44**	**51**
Cocoa	31	51	46	62	54	41	37	37	38
Coffee	39	41	46	64	56	48	47	35	21
Cotton	42	35	44	57	59	59	71	59	64
Sugar	22	35	47	49	43	38	45	45	87
Tea	12	8	24	56	52	47	51	50	49
Tobacco	39	38	48	56	50	50	40	39	58
Fruit & vegetables	**0**	**0**	**0**	**4**	**5**	**5**	**2**	**5**	**5**
Banana	2	4	0	2	2	1	5	5	2
Bean	7	10	3	48	62	73	35	42	40
Roots & tubers	0	0	0	0	0	0	0	0	0
Pepper	na	42	9	39	47	80	30	62	27
Plantain	0	0	0	0	0	0	0	0	0
Potato	na	na	na	0	0	0	0	0	0
Sweet potato	0	0	0	0	0	0	0	0	0
Yam	0	0	0	1	2	1	1	4	4
Livestock	**30**	**36**	**52**	**35**	**33**	**68**	**66**	**40**	**38**
Beef	34	42	58	29	29	60	73	43	42
Camel	38	60	34	38	34	68	84	49	99
Milk	19	16	41	36	29	79	40	30	29
Sheepmeat	42	48	61	46	38	59	70	54	33

Source: Authors' calculations based on NRA and CTE data in Anderson and Valenzuela (2008).