Project Document

Agricultural incentives, growth and poverty in Latin America and the Caribbean: cross-country evidence for the period 1960-2005

Did trade liberalization increase the incomes of the poorest?

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Abstract

This study focuses on the link between agricultural trade openness and the sector's performance, an improvement in which could have significant impacts on poverty reduction. We emphasize Latin America, during the 1960-2005, using a recently constructed data base of agricultural support Nominal and Relative Rates of Assistance (NRA and RRA) that includes information for several developing countries, beyond the region. The principal question addressed is, does the trade regime influence sectoral growth? With the answer to this question we then make some inferences regarding the influence of sectoral growth on poverty, using estimates of the impact of agricultural growth on national economic growth which in turn impacts the incomes of the poorest quintile. The empirical analysis takes advantage of cross-country panel data from several sources, covering many developing countries in Africa, Asia and the LAC region. The LAC countries are Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua. We compare groups of countries, defined by their levels of protection and changes in those levels (using both NRA and RRA), to assess the effects of the trade regime on growth in agricultural value added and production (using FAO's production index). A panel data regression analysis is also presented to estimate the impacts of the levels and changes in protection.

The findings are: First, based on both the comparison of country groups and the regression analysis, when explaining agricultural GDP or production indices changes in the trade regime are more important than the absolute values of the protection levels themselves. Second, based on the regression analysis, for a representative country, removing the taxation of the trade regime (prevailing in the 1970s and 1980s) would have resulted in an increase over trend growth (at least over a five-year horizon) in the average agricultural GDP growth of about 50%. Third, using the regression model estimates and previous estimates of the links between agricultural growth and national growth and income of the poorest quintile, we simulate what would have been the impact on the income of the poorest if a representative high-tax country (a negative and stable NRA) had moved to a neutral trade regime (an NRA of zero). Annual average income growth would have risen approximately one-quarter point, or about 9 percent over its average rate during the subsequent five-year period. We offer arguments why this is likely a low estimate. Finally we discuss the implications for a future policy agenda, especially in light of the large number of LAC countries which still have high levels of interventions, both positive for importables and negative for exportables, although average sectoral protection indicators are now relatively small.

I. Introduction

This study investigates the relationship between trade policy interventions that affect agricultural incentives and their influence on farm sector growth and poverty alleviation. The study places emphasis on Latin America during 1960-2005, although much of the analysis will make use of information for several countries, developing and developed, throughout the world. The first question to address is, Does the trade regime influence sectoral growth? And if it does so, the second question is, does the trade sectoral growth influence national or rural poverty levels? The quantitative analysis focuses on an empirical examination of the relationship between agricultural protection and agricultural sector growth in Latin America and the Caribbean. The empirical examination takes advantage of cross-country panel data from several sources, covering many developing countries in Africa, Asia and the LAC region. The LAC countries are Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua.

What are the channels by which interventions affect agricultural incentives and thereby impact poverty? Based on previous studies on these issues, we present below a discussion of the conceptual links and a synthesis of the results from the few empirical investigations available. There is a body of literature that links the growth of the agricultural sector to poverty alleviation, especially in rural areas, but there is less evidence for the link between the incentive structures, particularly as determined by trade policy, and agricultural growth.[1] A recent study by Hertel and Reimer (2005) discuss the various approaches currently being is used to estimate the poverty impacts of trade liberalization. One can distinguish between the estimation of impacts using historical data and the projection of impacts using simulation approaches, such as the use of general equilibrium models (CGEs) or household models, where trade policy changes enter in the form of shocks to input and output prices. (In some recent and innovative studies, general equilibrium mechanisms are integrated with household survey information.) In terms of empirical evidence, these policy-growth-poverty links are under-researched. The World Development Report, 2008,[2] does present much evidence regarding the links between agricultural growth and poverty reduction. Examples of previous empirical analysis for Latin America and the Caribbean is found in Valdes and Foster (2005) and the World Bank's

[1] Pioneering work on structural modeling of the impact of the incentive framework on agricultural growth by Y. Mundlak and associates for Argentina and Chile in the late 1980s unfortunately has not been updated or extended to other countries.

[2] World Bank, 2008. World Development Report: Agriculture for Development.

Beyond the City.[3] Bresciani and Valdes (2007) summarize the evidence for six countries in Latin America and Asia. And as the World Development Report 2008 notes (p. 6): "For China, aggregate growth originating in agriculture is estimated to have been 3.5 times more effective in reducing poverty growth than outside agriculture – and for Latin America 2.7 times more."

More generally, with respect to the economy as a whole, there exists much debate regarding whether or not greater openness to trade is an important factor in achieving poverty reduction. Does trade help poor families more than it hurts? While most economists would accept the assertion that open economies produce better outcomes than closed economies,[4] especially for small and medium sized countries, there is a problem of defining openness and outcomes. (See Giordano, 2009, especially Chapter 3 by Giordano and Florez.) A fairly large literature, where one finds Dollar and Kray (2001), Bhagwati and Srinivasan (2002), Sachs and Warner (1995) and other has supported the hypothesis that openness spurs growth, and growth spurs poverty reduction.

The impact of growth per se on poverty reduction is not a matter of much disagreement, but because the cross-country evidence is incomplete linking the partial effects of liberalization to growth, some economists, notably Rodrik (2000), emphasize investment and macroeconomic stability as the more important factors, implying, in effect, that liberalization has been oversold. For example, Harrison (2005) notes that export growth is generally associated with poverty reduction more so than the removal of protection, which could be associated with increasing poverty for some groups. One does have confidence, however, in the broad conclusion stated by Winters, McCulloch and McKay (2004): "The key to sustained poverty alleviation is economic growth, as is widely accepted by economists and development practitioners. Although growth can be unequalizing, it has to be very strongly so if it is to increase absolute poverty. This appears not to be the case either in general or for growth associated with freer trade. The link that has seen the most sustained debate among economists, however, is that between greater openness and growth." This openness-growth link will be the focus of this paper in the context of agriculture.

As discussed in Giordano and Florez (in Giordano, ed., 2009, Chapter 3), there is an unsettled debate over the operational definition of trade openness, as well as the measures of poverty. To capture non-tariff barriers to trade, most economists would recommend ad valorem equivalent tariffs, as being more accurate measures of openness than nominal tariffs. But in practice often economists have at hand only nominal tariffs and ex post measures of openness, such as trade volume (exports plus imports) relative to GDP, perhaps adjusted for country size and other controls.

With regard to the practical quantification of agricultural trade regimes, there have been few analytical efforts to estimate, in a form comparable across countries, policy-induced distortions to incentives in developing countries, including Latin America and the Caribbean. For Latin America, the principle cross-country comparative studies have been Krueger, Schiff and Valdes (1992), Valdes (1996), Anderson and Valdes (2008), the series of OECD analyses of producer subsidy equivalents (PSEs) for Mexico, Brazil and Chile, and the recent work by the IDB for Central America. In this present study, we present the historical patterns of agricultural price interventions in various regions, including the eight countries in the LAC region. The quantitative evidence presented regarding the evolution of the level of price-related interventions for exportables, importables and agricultural sectoral averages are based mainly on the recent Anderson and Valdes (2008) study. Special attention is focused on the period 1985 to 2005, but detailed information is also available from previous studies for 1960 to 1985 (Krueger,

[3] de Farranti, D., G.E. Perry, W. Foster, D. Lederman, and A. Valdes. 2005. Beyond the City: The Rural Contribution to Development. World Bank Latin American and Caribbean Studies.

[4] As Winters, McCulloch and McKay conclude, "[A]lthough trade liberalization may not be the most powerful or direct mechanism for addressing poverty in a country, it is one of the easiest to change. While many pro-poor policies are administratively complex and expensive to implement, the most important bits of trade reform —tariff reductions and uniformity, and the abolition of nontariff barriers— are easy to do and will frequently save resources. Thus trade reform may be one of the most cost effective anti-poverty policies available to governments. Certainly the evidence suggests that, with care, trade liberalization can be an important component of a "pro-poor" development strategy."

Schiff and Valdes, 1992) and for 1985 to 1995 (Valdes, 1996). Although the focus of the study will be on the LAC region, econometric analysis will also make use of a broader sample of developing countries. Data are available for eight countries in the region and about 30 non-LAC countries.

One contribution of this study is the pulling together and comparison of data on protection measure from three sources. It is interesting to observe that differing methodologies, although each defensible in practical terms, yield different conclusions with regard to the level of protection given to agriculture, especially for the period 1960-1980, due in large part to the treatment of economy-wide policies in estimating the protection measures. Exchange rate misalignment and industrial protection prior to economic reforms of the 1990s induced a substantial difference in the analysis of relative rates of assistance between agriculture and non-agriculture.

A specific purpose of this study is to establish a better basis for deriving lessons for future policy development and for offering general implications of pro-growth policy options to governments in Latin America and the Caribbean in their formulation of trade-related strategies. Several countries in the region have much to gain from a more-neutral trade regime, because their agricultural exports are still taxed (e.g., Argentina, Nicaragua, Dominican Republic and Mexico, during 2000-2004). On the other hand, there are several countries with significant agricultural sectors oriented toward import-competing products, and with high levels of support (e.g., Mexico, Nicaragua, Ecuador, and Colombia). With trade policy adjustments toward a more-neutral trade regime, the consequences for losers raise the importance of complementary social policies (safety nets, training, reducing friction in labor markets). For example, the impact of FTA implementation (e.g., CAFTA) on import-competing sectors (especially small farmers) will have to be addressed by complementary policies to ease the transition of sectors currently enjoying high levels of support.

This paper is structured in the following manner. The following section addresses in the context of Latin America the state of rural poverty in the region, the importance of agricultural trade, and the historical patterns of agricultural price intervention. In the course of presenting the data on trade-related interventions, the section also discusses briefly the conceptual and practical differences in some recent protection measures. The third section then presents the results of our analysis of the effects of trade regime on agricultural growth, where growth rates are in terms of farm sector value added (from national accounts) and aggregate production value (as compiled by the FAO STAT). The fourth section discusses the link between agricultural trade interventions, agricultural growth and the alleviation of poverty, using that which has been emphasized in a fairly wide conceptual literature but documented only in very few studies. We present our results from the correlation of protection measures and growth and poverty. Finally, in the fifth section we present some concluding comments.

II. Rural poverty, agricultural trade and the historical patterns of protection in Latin America and the Caribbean

A. Rural poverty in the region

As is discussed at some length in World Bank (2005), the various official definitions of "rural" in LAC countries tend to underestimate the size of the population living in areas that can be reasonably called rural in terms of population density and remoteness. Nevertheless, using the official statistics, one can note a significant heterogeneity of the rural economy across countries in the region in terms of the contribution of agricultural production to national GDP, the importance and composition of agricultural trade, the number of persons in rural areas, their income sources, and the incidence of poverty. With some exceptions, poverty in the LAC region still affects the rural population more than the urban. Despite the high incidence of rural poverty, many countries tend to focus on urban poverty, and some countries —notably Argentina— lack good data on poverty in rural areas. Table 1 presents the official data that we have from available household surveys (from CEPAL). Bolivia, Honduras, Nicaragua, Paraguay and Peru have at least 70% or more of their rural populations living in poverty. The World Bank (2005) reports that more than a third of the rural population lives in extreme poverty in Bolivia, Colombia, El Salvador, Guatemala Honduras, Nicaragua, Paraguay and Peru.

B. The importance of agriculture in exports

Agriculture products contribute significantly to trade flows in the LAC region, and the net trade position varies widely across countries. Not only are the levels of total national exports and imports of crop, livestock, and forestry products important, but one should distinguish between the net overall agricultural trade position and the net food trade position. The net food trade position is often the most important factor in domestic agricultural policy debates, entering considerations of national food security and food import dependence. Agricultural trade in a wider sense involves not only primary agriculture —the size of which is reflected in sectoral value added found in national accounts— but also agro-processing, which is not included in agricultural value added but in other sectors. The growth in agro-processing sectors— especially linked to exports— has been notable in the region, and adds greater emphasis to farm policy because the performance of agro-processing depends ultimately on the performance of primary agriculture. Moreover, from the perspective of poverty, paying some greater attention to processed agricultural exports is warranted by the growing importance of non-farm employment and income in rural areas. Much of this non-farm employment is linked to agro-processing and attendant up- and down-stream services. While much of agro-processing is not accounted for in agricultural GDPs, the importance of international trade to determining the contribution of these agricultural-linked industries to both rural and national households should not be overlooked. This is especially important in a region that is relatively land abundant and where the growth of agriculture is constrained by domestic demand, leaving export markets as an avenue both for sectoral growth and, more generally, for growth in the rural economy.

TABLE 1
RURAL AND URBAN POVERTY IN LATIN AMERICA AND THE CARIBBEAN, SELECTED COUNTRIES AND AVAILABLE HOUSEHOLD SURVEY DATA

(Population living below the poverty line, by urban and rural areas, selected Latin American countries, 1979-2007)

Country	National					Urban					Rural				
	1979-1985	1986-1990	1991-1995	1996-2000	2001-2007	1979-1985	1986-1990	1991-1995	1996-2000	2001-2007	1979-1985	1986-1990	1991-1995	1996-2000	2001-2007
Argentina	10.4	-	-	-		8.5	-	16.1	23.7	30.5	19.0	-	-	-	
Bolivia (Plurinational State of)	-	-	-	61.4	61.1	-	52.6	51.6	50.5	50.5	-	-	-	79.6	79.1
Brazil	45.1	48.0	45.3	36.7	35.6	33.5	41.2	40.3	31.8	32.3	68.2	70.6	63.0	55.5	52.1
Chile	-	41.9	27.6	21.7	16.2	-	41.1	27.0	20.8	16.2	-	45.2	31.1	27.2	16.2
Colombia	42.3	-	54.3	52.9	49.7	39.7	-	49.1	47.8	48.6	47.7	-	61.6	61.0	52.4
Costa Rica	23.6	26.3	23.1	21.4	19.9	18.2	24.9	20.7	18.7	18.4	28.4	27.3	25.0	23.6	22.0
Dominican Republic	-	-	-	46.9	47.6	-	-	-	42.3	44.9	-	-	-	55.2	52.6
Ecuador	-	-	-	-	46.3	-	62.1	57.9	59.9	44.1	-	-	-	-	53.0
El Salvador	-	-	54.2	52.7	48.2	-	-	45.8	41.6	40.3	-	-	64.4	67.1	59.6
Guatemala	71.1	69.4	-	61.1	57.5	47.0	53.6	-	49.1	43.7	83.7	77.7	-	69.0	67.3
Honduras	-	78,5	77.9	79.4	73.1	-	64.1	74.5	72.1	62.2	-	86.5	80.5	85.3	82.8
Mexico	42.5	47.7	45.1	47.0	35.9	36.1	42.1	36.8	39.1	30.0	53.5	56.7	56.5	58.7	45.7
Nicaragua	-	-	73.6	69.9	65.6	-	-	66.3	64.0	59.1	-	-	82.7	77.0	74.3
Panama	42.0	41.0	-	-	31.5	36.1	38.5	29.0	22.8	22.1	-	-	-	-	47.7
Paraguay	-	-	-	60.6	62.0	-	-	49.9	47.7	54.9	-	-	-	73.9	71.1
Peru	52.9	59.9	-	48.1	50.3	38.4	52.3	-	34.9	38.0	79.7	72.1	-	72.6	72.9
Uruguay	14.6	20.4	-	-		12.8	18.6	10.9	9.5	18.3	26.7	28.7	-	-	
Venezuela, (Bolivarian Republic of)	25.0	36.0	42.9	48.7	38.0	19.5	34.2	41.6	-		43.0	44.1	55.6	-	
Latin America and the Caribbean	40.5	45.8	45.7	43.3	40.5	29.8	38.5	38.7	36.5	35.1	59.9	62.7	65.1	63.1	58.5

Source: CEPALSTAT (http://www.cepal.org/estadisticas/bases/default.asp?idioma=IN).

Table 2 reports agriculture and processed food as a share in total merchandise exports and imports for various five-year sub-periods between 1961 and 2005. Agricultural exports represent more than 25% of total export revenue for nine countries, reaching as high as 40% for Argentina, Cuba, Guatemala, Honduras, Paraguay and Uruguay. Countries for which the share is relatively small are the oil-exporting countries of Mexico, Trinidad and Tobago, and Venezuela, and the Caribbean. On the import side, the shares of agricultural and forestry products are generally smaller, ranging between 8 to 20%. The only country with an import share greater than 20% is Haiti (34%). Crop and livestock products clearly predominate. In terms of totals for crop, livestock and forestry, export products deriving from crops and livestock average more than 75% of total agro-forestry exports. Chile is notable for the size of share of exports due to forestry products (35%). The share of crop and livestock products averages around 80% for agro-forestry imports for the three sub regions. Unlike exports, forestry's share of imports is high for many countries. The highest shares for forestry imports are found in Argentina (40%), Costa Rica (33%), Ecuador (20%), the Dominican Republic (23%), and Trinidad and Tobago (22%).

One notable resultof countries' net food trade position[5] is that only five of the 22 countries considered are net exporters of food, and all are in MERCOSUR or are associated members see de Farranti et al. (2005), pg. 41).[6] At odds with the common perception of Latin America as an agricultural continent, 16 of the 22 countries are net food importers, nine of which are also net importers of all agricultural products. But in contrast to food products only, for all agricultural products there are ten net importers and twelve net agricultural exporters compared to five net food exporters. Notably, there are seven countries that are both net agricultural exporters and net food importers: Chile, Colombia, Ecuador, Costa Rica, Guatemala, Honduras, and Nicaragua. Finally note that, despite the high growth rate for agricultural exports, Table 2 shows that the share of agricultural products in total merchandise exports has declined, and in some countries, such as Brazil, this decline has been large. Chile is an exception, where agricultural exports began with a low base and where economic reforms created a "vent for surplus."

These data regarding the importance of agriculture and food are relevant for trade negotiations. The common perception is that there exists a high cost of agricultural protection in OECD countries for Latin America, based on the presumption that most countries in the region are net exporters. Only five countries are net food exporters, and they are losers with current OECD protectionism —and subsidy-induced lower world prices. But the increase in world prices due to a reduction in the protection and subsidies in the OECD would be beneficial for nonfood agricultural exports, affecting many more countries (12). While it is clear why most LAC countries —seeking to expand their exports— would be enthusiastic for trade liberalization and subsidy reduction in the OECD, the case of net-food and net-agriculture importers is ambiguous. It is, however, important to note that there is hypothetical possibility that today's net food import position in some products could decline due to trade reversals arising from higher world prices that would result from trade liberalization in the OECD.

TABLE 2
SHARE OF AGRICULTURE, RAW AND PROCESSED, IN MERCHANDISE EXPORTS AND MERCHANDISE IMPORTS, SELECTED LATIN AMERICAN COUNTRIES, 1961–2005

Country		1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005
Argentina	X	93.0	87.5	75.5	70.7	70.1	58.7	52.4	44.4	44.4
	M	7.6	8.5	7.6	6.8	5.7	6.2	5.9	5.4	4.5
Brazil	X	82.3	75.9	62.1	52.1	39.4	29.3	26.9	28.3	27.5
	M	18.0	14.7	7.9	9.7	9.1	10.5	11.8	9.2	5.6

(continued)

[5] The food group includes cereals, dairy products, eggs, vegetable oils, meats, and sugar. The concept of food here is broader than that used by some international agencies, such as FAO, which often excludes sugar and vegetable oils, based on a definition of "essential foods."

[6] Two countries, Bolivia and Guatemala are borderline cases of net food importation. Bolivia particularly in the Santa Cruz area produces soybeans, rice and other grains.

Table 2 (concluded)

Country		1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005
Chile	X	5.4	3.2	4.7	8.4	11.4	13.8	15.1	16.2	14.7
	M	24.7	20.1	26.6	17.0	14.0	5.6	6.9	7.1	6.8
Colombia	X	80.3	79.0	71.7	77.3	67.0	46.8	35.9	29.7	21.3
	M	12.0	11.2	12.3	11.1	10.1	7.8	9.0	12.1	11.1
Dominican Republic	X	90.7	90.2	79.4	66.5	66.8	53.0	51.8	66.0	58.6
	M	17.1	17.8	19.4	16.2	14.1	15.0	15.6	11.8	12.9
Ecuador	X	91.5	86.6	41.8	35.4	20.8	31.3	32.7	34.0	28.2
	M	13.1	12.6	9.5	8.1	9.7	8.2	7.8	11.1	9.1
Mexico	X	59.3	56.5	40.4	22.2	6.9	12.0	11.6	9.5	9.5
	M	8.5	7.4	13.9	13.4	15.3	15.3	11.8	10.0	10.2
Nicaragua	X	86.7	78.9	74.4	80.3	83.5	73.5	62.5	54.1	66.6
	M	10.3	10.2	9.9	11.3	13.9	14.7	21.1	16.2	15.7
Paraguay	X	70.5	65.3	76.9	81.0	73.7	78.3	76.3	75.3	66.9
	M	19.4	17.4	14.7	14.7	10.8	9.6	16.5	18.5	9.3
Uruguay	X	77.5	71.1	64.3	46.9	52.7	44.8	42.0	47.2	52.8
	M	15.8	17.2	15.6	10.9	9.1	9.2	11.0	11.8	11.9
Total selected countries	X	73.7	69.4	59.1	54.1	49.2	44.1	40.7	40.5	39.0
	M	14.7	13.7	13.7	11.9	11.2	10.2	11.7	11.3	9.7

Source: FAOSTAT.
Notes: X = value of agricultural exports (including agro-process goods) relative to total de merchandise exports. M = value of agricultural imports (including agro-process goods) relative to total de merchandise imports.

What are the lessons from the importance of agricultural trade in the region? First, the primary sector contributes significantly to overall national trade: more than a third of export revenues in recent years are in agro-forestry exports, although this share has been declining. There is considerable interest in obtaining market access in world markets to expand these agro-forestry exports. But the share of agro-forestry export trade to total trade is quite heterogeneous across LAC countries. Second, this high degree of heterogeneity carries over to countries' net trade positions in both food and all agro-forestry products. In terms of the number of countries, there is a high degree of food import dependence, relevant for future WTO negotiations. Third, exports of agro-processed products are increasing rapidly in this region, in spite of the pronounced degree of tariff escalation encountered in most countries.

C. Protection indicators 1960-2005, method and data sources

We first consolidate and process time-series data from previous multi-country studies measuring policy-induced distortions to agricultural incentives in Latin America and the Caribbean. These studies include Schiff and Valdes[7] (1992), Valdes (1996), and Anderson and Valdes (2008). The principle indicators for measuring price-related agricultural support at the farm level are the Nominal and Effective Protection Rates (NPR and EPR), which have become standard measures in trade policy discussions. The NPR measures the output price interventions alone and typically is expressed as a tariff equivalent of tariff and non-tariff barriers. The EPR measures how the value added of particular activities is altered by trade barriers and price interventions that affect jointly the product and its tradable inputs. The Producer Subsidy Equivalent (PSE), which has been used by the OECD for monitoring the agricultural support of member countries, incorporates price interventions and adds

[7] Volume 4 of Krueger, Schiff and Valdés.

domestic income payments and input subsidies. The Effective Rate of Assistance (ERA) is conceptually close to the PSE, because it includes both price and non-price subsidies (and taxes), but instead of measuring the effect on gross output value (as in the PSE) it measures the effect on value added (see, for example, Valdes's 1996 Surveillance report).

One measure of importance in what follows is the Nominal Rate of Assistance (NRA). NRAs are defined for individual tradable outputs and tradable farm inputs in the same way as the NPRs are defined using outputs only. Because tariffs are not the only trade barriers, measure of NPRs and NRAs are estimated by direct price comparison between prices received or paid by farms (adjusted for transport and marketing costs and quality differences) and border prices (see Anderson and Valdes, 2008, Appendix A). The NRA for an individual product is the ad valorum tariff equivalent, t_E. For an individual output or input, i, one finds the percent deviation of the domestic price, P_i^d, from the border price in the domestic currency (world price, P_i^w, in dollars adjusted by the exchange rate, E):

$$NRA_i = \frac{P_i^d - E \cdot P_i^w}{E \cdot P_i^w} = \frac{E \cdot P_i^w \cdot (1 + t_E) - E \cdot P_i^w}{E \cdot P_i^w} = t_E$$

An NRA for an activity and for the sector as a whole is defined as the sum of the individual NRAs for all tradable outputs and inputs: $NRA_{outputs} + NRA_{inputs} = NRA_{total}$.

Another important measure is the Relative Rate of Assistance (RRA) to agriculture, which is defined as the NRA for agriculture relative to the NRA for non agriculture:

$$RRA_A = \frac{NRA_A + 1}{NRA_{NA} + 1} - 1$$

Assuming no distortions in the markets for non-tradables, and that the value shares of agricultural and non-agricultural non-tradable remain constant, "then the economy wide effects of the distortions to agricultural incentive may be captured by the extent to which the tradable parts of agricultural production are assisted or taxed relative to producers of other tradables" (pp. 19-20, Anderson and Valdes).

With respect to the RRA measure, the reader should note that, although NRAs in both agriculture and non-agriculture could be positive (i.e., domestic prices greater than world prices), the RRA measure could be negative, indicating that agriculture is being "taxed" relative to the non-agriculture sector.

For the period 1960 to 1985 and 18 developing countries, Schiff and Valdes (1992) report NPRs, with and without for adjustment for what they refer to as "indirect" interventions. Direct interventions are sector specific, and indirect interventions reflect macroeconomic and industrial policies, manifested by measures of the tariff equivalent of import protection of industrial products and the exchange rate misalignment. For the period 1985 to 1995 and 8 Latin American countries, Valdes (1996) reports NPRs (only direct), ERAs and PSEs. The estimates of NRAs and RRAs used below also do not adjust for the indirect effects of economy wide policies, including exchange rate misalignment.

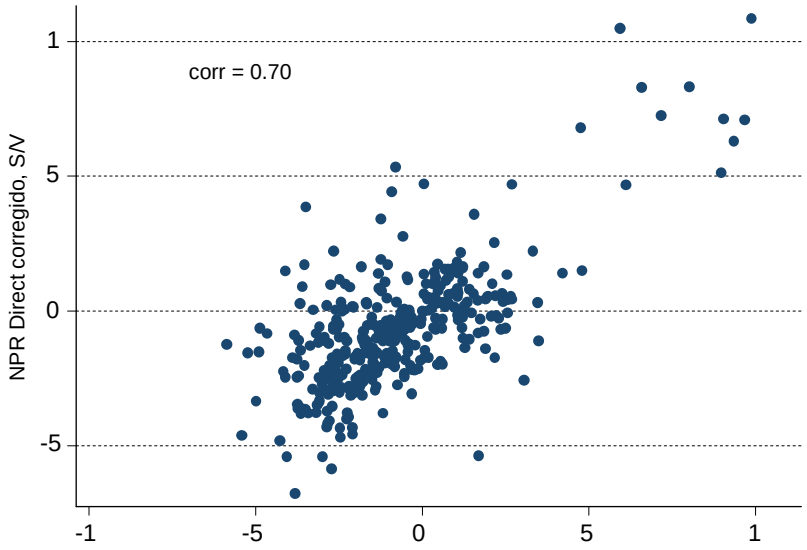
The various protection measures from the three sources mentioned above for the original set of LAC countries found in Schiff and Valdes are presented in Table 3. The NPR direct measure reported by Schiff and Valdes is conceptually closest to the NRA measure of the recent Anderson World Bank project, differences arising due to the inclusion of inputs in the NRA measure and to differences in databases. The two measures are notably correlated, as seen in Figure 1. It is understandable that the NPR direct would differ from the NPR total, because the latter include distortions beyond the agricultural sector. When the direct NPR is dominated by exportables, such as in the case of Argentina, the indirect reinforces the negative protection. But the direct and positive NPR for import-competing products is offset by the indirect interventions, and the total NPR tends to be compressed for this group of products. During the period 1960-1985, the NPR total falls below that of the NPR direct, and sometimes significantly below, emphasizing the implicit taxation on agriculture of economy-wide policies.

TABLE 3
INDICATORS OF AGRICULTURAL SECTOR PROTECTION, SELECTED LATIN AMERICAN COUNTRIES, 1960–2005

Country	1960-84						1985 - 1995							1996 - 2005		
	SV Study			Anderson Study			Surveillance study				Anderson Study			Anderson Study		
	Direct	Indirect	Total	NRA Cov.	NRA Total	RRA	NPR	EPR	PSE	ERA	NRA Cov.	NRA Total	RRA	NRA Cov.	NRA Total	RRA
Argentina	-18.5	-21.3	-39.7	-25.9	-22.1	-42.3	-10.0	-19.7	-14.7	-16.9	-12.6	-10.7	-21.0	-12.4	-11.4	-17.7
Brazil	10.4	-18.4	-8.1	-24.3	-23.6	-44.4	3.7	-10.4	-4.0	.	-20.9	-14.3	-26.1	2.3	6.0	-0.3
Chile	-0.7	-20.4	-21.1	-0.5	13.0	-13.2	21.9	38.7	13.7	43.6	17.1	10.4	3.2	7.8	6.5	1.2
Colombia	-5.1	-25.2	-30.3	-7.5	-6.0	-23.8	15.2	24.1	8.6	30.4	2.4	4.4	-7.8	21.4	20.9	18.3
Dominican Republic	-19.0	-21.3	-40.3	-18.1	-18.1	-25.9	34.9	45.9	-22.6	44.9	-19.2	-19.2	-26.6	7.8	7.8	3.5
Ecuador	-	-	-	-14.2	-10.3	-17.4	-21.5	-22.6	-54.4	-20.9	-4.5	-3.7	-8.9	4.2	3.2	-3.7
Mexico	-	-	-	0.7	2.9	-4.2	-	-	-	-	11.8	14.0	8.9	7.3	10.4	4.9
Nicaragua	-	-	-	-	-	-	-	-	-	-	-8.5	-4.3	-10.5	-13.0	-7.7	-12.7
Paraguay	-	-	-	-	-	-	-5.4	-18.6	-18.4	-5.9	-	-	-	-	-	-
Uruguay	-	-	-	-	-	-	-8.2	-22.6	-15.2	-29.0	-	-	-	-	-	-
Total	-6.6	-21.3	-27.9	-12.8	-9.2	-24.5	3.8	1.8	-13.4	6.6	-4.3	-2.9	-11.1	3.2	4.5	-0.8

Source: Authors' elaboration.

FIGURE 1
NRA TOTAL (ANDERSON) VERSUS DIRECT PROTECTION (SCHIFF AND VALDES), LATIN AMERICAN COUNTRIES, 1960 – 1985



Source: Authors' elaboration.
Note: The correlation coefficient between NPRs and NRAs is 0.7. Year end points differ by country due to data availability.

Figures 2A and 2B show the evolution of average NRAs for the Latin American covered countries as a group, distinguishing between import-competing products and exportables. The simple averages across countries are shown in Figure 2a, and averages weighted by each country's value share in agricultural trade. Overall, what is obvious from these Figure is that since approximately the early 1990s there has be a decline in the negative protection to exportable agriculture (Argentina notwithstanding), which has raised the average level of protection for all tradables in LAC countries. This is also generally true for non-LAC countries.

Turning to RRAs, the first thing to note is that they tend to be highly persistent over time (autocorrelated), as shown in Figure 3 using five-year averages of RRAs starting with the 1961-1965 quinquennium. Considering that the RRA is relative measure of protection to two sectors, one expects dispersion across countries and time. Nevertheless, the data reveal that countries that have taxed agriculture in the past tend to continue to do so through time; and countries that have protected agriculture similarly tend to continue protection. The RRA, as calculated in the Anderson project, tends also to be highly correlated with the NRA, as seen in Figure 4, using five-year averages. This high correlation may present a problem with respect to the measurements of protection in non-agricultural sectors. As mentioned above, and for very practical difficulties of addressing the question, the RRA measure excludes the home-goods sector in non-agriculture (the largest sector of the economy). Also note that the denominator of the RRA —the NRAs for non-farm tradables— dealt only with importables and then in terms of official tariffs only. For agriculture, by contrast, tariff-equivalent price comparisons were made at the level of individual products. As an empirical matter, therefore, variability of the RRA measures tends to be dominated by the variability of the numerator — the NRAs of agriculture.

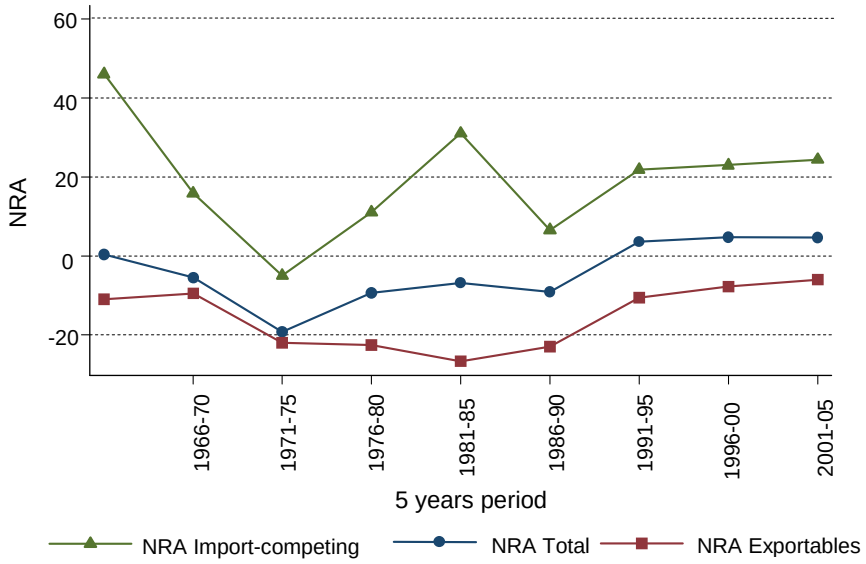
Regarding trends in protection, Figure 5 shows a scatter plot of average changes in RRAs by country in relation to average RRAs during the period 1986-2005, which includes the period of economic reforms. Note most countries that were "taxing" their agricultural sectors during 1986-2005 were also reducing their taxation (average NRAs less than zero and average changes in NRAs greater

than zero). Of the few countries that were, on average, supporting agriculture relative to non-agriculture, most reduced support, except for Colombia and Mexico. There are a few countries that both tax agriculture and increased taxes during the period, most prominently Zimbabwe.

With respect to lessons for future policy development, the evolution of protection indicators shows that there has been significant policy adjustment since the mid-1980s in reducing the degree of anti-export bias, that is, a move toward a more-neutral trade regime. This reduction of the anti-export bias is due primarily to the reduction of taxes on exportables. As seen in Table 4, however, except for Argentina, Brazil and Chile all other countries maintain fairly high levels of support for import-competing activities, most notably Colombia and the Dominican Republic. And several other countries that still tax exportables: Argentina, Dominican Republic, Mexico and Nicaragua. In these countries there is both the protection of importables and taxation of exportables (except for Argentina, where importables were not studied). Evidently, there is much room remaining for adjusting trade policy as it affects agriculture, particularly in terms of reducing the protection of import-competing crops.

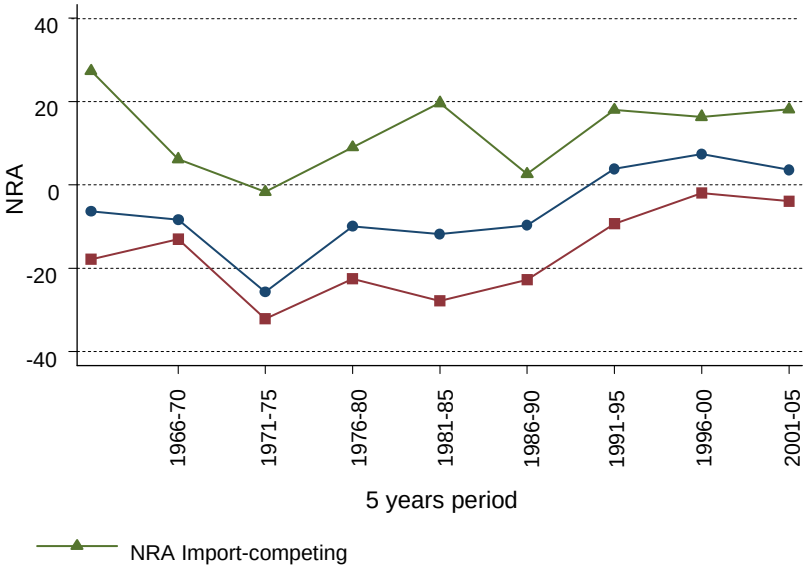
FIGURE 2
EVOLUTION OF AVERAGE NOMINAL RATES OF ASSISTANCE, LATIN AMERICA, 1965-2004

A) UNWEIGHTED AVERAGES ACROSS 8 COUNTRIES



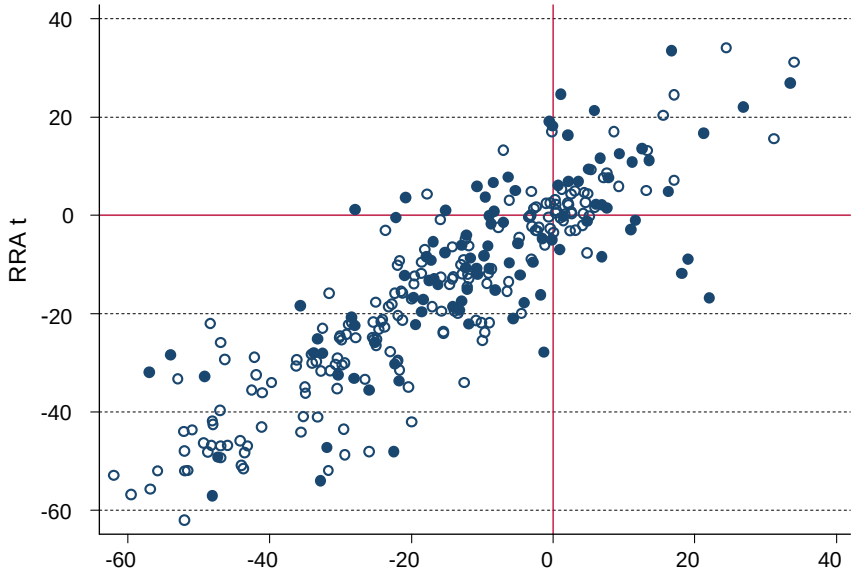
Source: From the database used to construct Figure 1.3 in Anderson and Valdés, p. 26.

B) WEIGHTED AVERAGES ACROSS 8 COUNTRIES



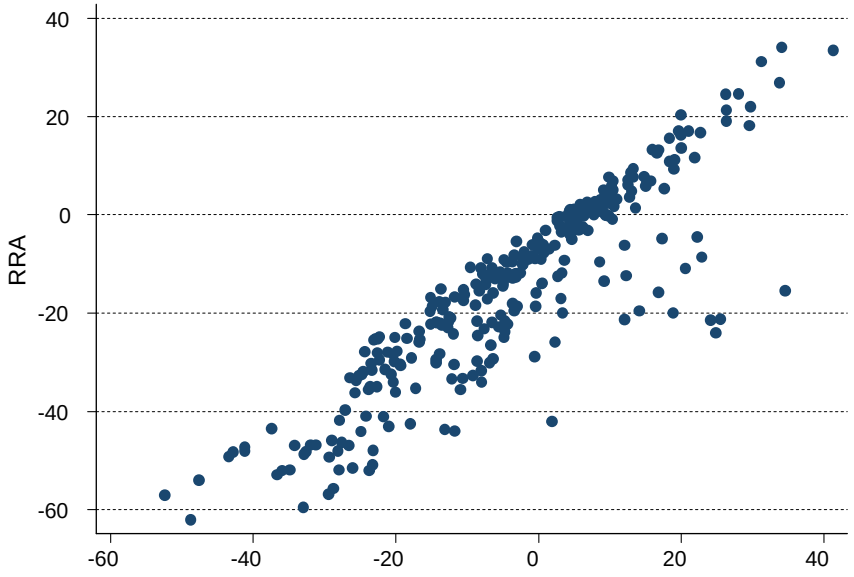
Source: From the database used to construct Figure 1.3 in Anderson and Valdés, p. 26.

FIGURE 3
PERSISTENCE OF RELATIVE RATES OF ASSISTANCE: RRA VERSUS LAGGED RRA (FIVE YEAR AVERAGES). LATIN AMERICA, 1960 - 2005



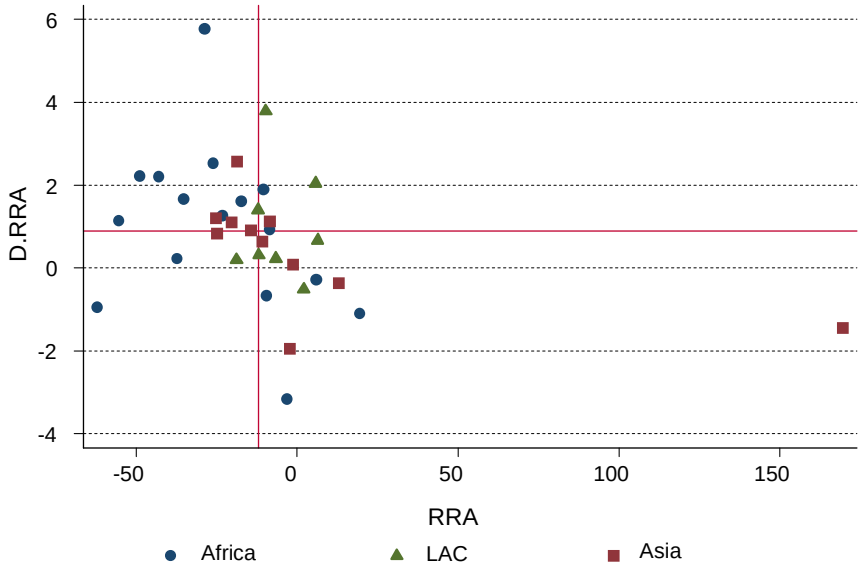
Source: Authors' calculations.

FIGURE 4
CORRELATION BETWEEN NRAS AND RRAS. LATIN AMERICA, 1960 - 2005



Source: Authors' calculations.
Notes: The correlation coefficient for LAC, 1960 – 2005 = 0.8923.

FIGURE 5
AVERAGE CHANGES IN RRAS VERSUS AVERAGE FOR 1986-2005, RRA LEVELS BY COUNTRY, DEVELOPING COUNTRIES INCLUDED IN ANDERSON STUDY (SEE APPENDIX TABLE 1)



Source: Authors' calculations.

TABLE 4
NRAS (%) ACROSS PRODUCTS BY COUNTRY, EXPORTABLES AND IMPORTABLES, AVERAGES 1980-1984 AND 2000-2004

Country	Exportables		Importables		Anti-export bias	
	1980-1984[a]	2000-2004	1980-1984[a]	2000-2004	1980-1984[a]	2000-2004
Argentina	-19.3	-14.9	-----	-----	-----	-----
Brazil	-31.5	1.2	-6.8	11.6	-0.26	-0.09
Chile	-2.0	-0.3	10.1	6.3	-0.11	-0.06
Colombia	-9.2	26.0	52.7	46.2	-0.40	-0.13
Dominican Republic	-51.7	-29.4	20.2	43.7	-0.59	-0.51
Ecuador	-31.1	-3.2	53.8	22.2	-0.55	-0.20
Mexico	-35.1	-19.9	21.4	21.4	-0.47	-0.34
Nicaragua[a]	-14.9	-18.1	12.5	24.9	-0.24	-0.33
Unweighted average	-25.7	-7.5	25.2	25.1	-0.41	-0.26

Source: Anderson and Valdes, 2008.
[a] The first observations for Nicaragua are during the period 1990-1994. The unweighted average for 1980-84 does not contain Nicaragua. Anti-export bias is defined as the (NRAEx – NRAIm)/(100+ NRAIm).

III. The effects of the trade regime on agricultural growth

A. Comparing growth rate averages across all countries in the data base: counterintuitive results when mixing high-income and Eastern and Central Asian countries with other developing countries

This section presents some results of our analysis of the relationship between agricultural growth and the trade regime, using the data discussed in the previous section. The first approach is to make a comparison of sectoral growth rates and levels of support by examining value added growth and agricultural production growth in relation to both levels of support as defined by the RRA and the NRA and to changes in levels of support. We distinguish between the pre-reform period, 1960-1985, and the post-reform period, 1986-2005. During the mid-1980s many countries began significant reforms, both in terms of economy-wide policy changes as well as reforms to specific policies related to agricultural production and trade.

We classify a country as a low-protection country (or high sectoral tax country) if its protection measure (RRA or NRA) averaged over a sub-period was below the median of annual average for all countries. It is classified as a high-protection country, if its average annual protection measure falls above this median. Furthermore, we distinguish between countries according to whether they were increasing or decreasing their protection measures. A country is classified as a decreasing protector (or increasing taxer) if the average annual change of the RRA or NRA during the sub-period falls below the median of these averages based on all countries. And it is an increasing protector (or a decreasing taxer) if the contrary.

As an initial starting point, Tables 5A and 5B present the average rates of growth in agricultural value added for low protection countries and for high protection countries using RRAs (Table 5A) and NRAs (Table 5B) for the sub periods 1960-1985 and 1986-2005, and for the entire period 1960-2005. To assess the sensitivity of the results to the definition of sectoral growth, Tables 5 report average growth rates using the value added measures for each country deflated by the country's consumer price index and by the countries wholesale price index. Also average growth rates are calculated using value added in purchasing-power-parity terms. The final column of Tables 5 also report the average relative growth rate of agriculture: average percent changes in the value added of

agriculture relative to the average percent change in national GDP. Note that Tables 5 show that countries in the low-protection group (the group that on average taxes agriculture) appear to have, on average, higher average annual growth rates of their farm sectors. These higher growth rates for low-protection countries are consistent across growth measures and for the three time periods.

One source of this apparently counterintuitive result is found in the selection of countries in the database, which comprises countries ranging in level of development. First, high-income countries are likely both to subsidize their farmers and to have more-slowly-growing agricultural sectors. Standard growth theory holds that national economic growth rates should decline with national income due to the declining marginal product of capital investments; and given a declining number of farmers relative to non-farm taxpayers and a rising level of national wealth, the logic of political economy explains subsidies for agriculture as a consequence of rent-seeking (concentrated benefits paid for by spreading the costs over many households). Second, the database includes countries of eastern and central Europe, the national economies and agricultural sectors of which suffered severe disruptions following the collapse of the Soviet block.

TABLE 5A
AGRICULTURAL PROTECTION (RRAS) AND AVERAGE SECTORAL GDP GROWTH (WDI) ACROSS HIGH PROTECTION AND LOW PROTECTION COUNTRIES

RRA and Ag. Growth, 1960 - 1985					
	RRA	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-30.5	3.1	2.7	2.1	0.6
High protection	77.2	0.0	1.8	-0.3	-0.4
Average	7.6	2.2	2.3	1.1	0.3
Note: 54 countries.					
RRA and Ag. Growth, 1986 – 2005					
	RRA	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-14.0	1.5	1.6	1.8	-0.1
High protection	81.8	-1.0	0.2	-1.1	-0.3
Average	19.9	0.6	1.0	0.7	-0.1
Note: 69 countries.					
RRA and Ag. Growth, 1960 – 2005					
	RRA	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-22.4	2.2	2.3	1.9	-0.1
High protection	79.5	-0.7	0.4	-1.0	0.3
Average	13.8	1.2	1.4	0.8	0.0

Source: Authors' calculations from Anderson project data for RRA and from WDI for agricultural GDP and price deflators. Note CPI = consumer price index, and WPI = wholesale price index.

TABLE 5B
AGRICULTURAL PROTECTION (NRAS) AND AVERAGE SECTORAL GDP GROWTH (WDI) ACROSS HIGH PROTECTION AND LOW PROTECTION COUNTRIES

NRA Total and Ag. Growth, 1960 - 1985					
	NRA Tot.	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-8.7	2.8	2.3	2.1	0.2
High protection	87.0	0.6	2.3	-0.1	0.5
Average	20.5	2.2	2.3	1.4	0.3
Note: 59 paises					
NRA Total and Ag. Growth, 1986 – 2005					
	NRA Tot.	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-1.2	1.6	3.1	1.7	1.0
High protection	84.4	-1.1	0.2	-1.2	-0.2
Average	25.2	0.7	1.8	0.7	0.7
Note: 74 paises					
NRA Total and Ag. Growth, 1960 – 2005					
	NRA Tot.	Ag GDP Growth (CPI, %)	Ag GDP Growth (WPI, %)	Ag GDP Growth (PPP, %)	Relative Growth
Low protection	-5.0	2.1	2.9	1.7	0.7
High protection	85.0	-0.6	0.7	-0.9	0.1
Average	22.9	1.3	2.0	0.9	0.5

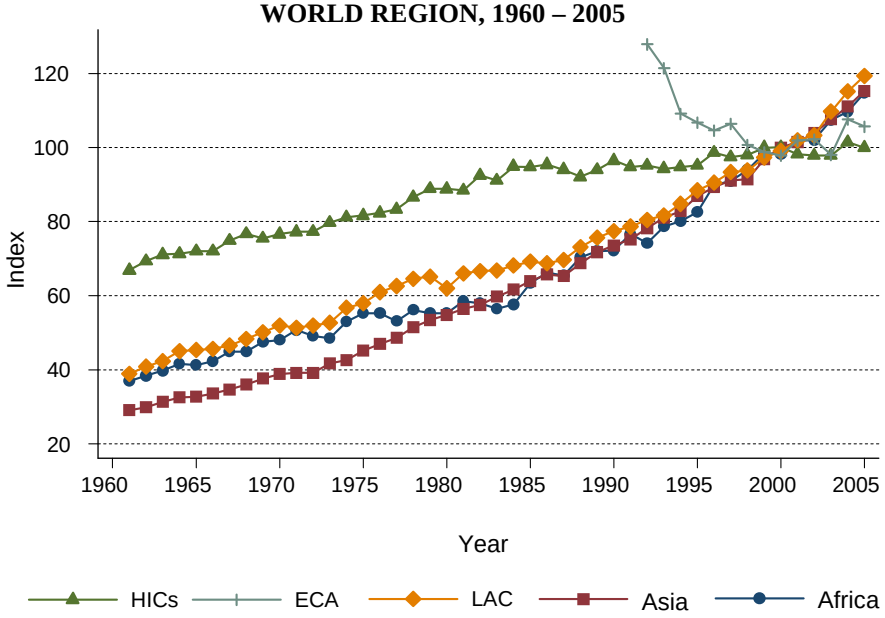
Source: Authors' calculations from Anderson project data for NRA and from WDI for agricultural GDP and price deflators. Note CPI = consumer price index, and WPI = wholesale price index.

To illustrate very clearly the heterogeneity —between regions and periods— of the agriculture sector growth rates of the countries in the basic database, consider Figure 6, which shows the evolution of FAO's gross agriculture production indices for five groups of countries, Africa, Asia, high income countries, Latin America and the Caribbean, and eastern and central Europe.[8] Note that the production index is set to a common reference value of 100 using average production values during the period 1999 to 2001; absolute levels of production (measured in dollars, say) will differ. The relatively (much) slower rate of growth of HICs is demonstrated in Figure 6 by the relatively lower slope of the path of the HIC index over time, compared to the paths of the indices of Africa, Asia and Latin America. (Protection levels in HICs are the highest.) The problems of the agricultural sectors in ECA countries are revealed by the steep decline in the average production index for this group.

What is also striking is that the slopes of the paths of the production indices for Africa, Asia and Latin America are nearly identical after 1986. The growth rates by region for the two sub-periods are presented in Table 6, which distills the graphical information into simple averages. The reader should take careful note of the increases in average production growth rates in Table 6 for Africa, Asia and Latin America when moving from the pre-reform period to the reform period. Corresponding to these economically significant increases in the developing world was a significant decrease in the production growth rates in high income countries.

[8] The countries falling into the Africa, Asia and Latin America groups are developing countries (i.e., not high income), and so Japan, although geographically Asian, is classified as HIC.

FIGURE 6
EVOLUTION OF GROSS AGRICULTURE PRODUCTION INDICES (BASE 1999-2001), BY WORLD REGION, 1960 – 2005



Source: FAOSTAT. Note that each point corresponds to a simple average of the observations of countries that fall in each regional group. The countries in each grouping are those in the Anderson World Bank project. With the exception of Turkey (for which data exist since 1961), data for countries in the eastern and central Europe group (ECA) exist only since 1992. The inclusion of Turkey in the ECA group is a World Bank administrative decision rather than the result of economic, cultural or geographic commonalities.

TABLE 6
GROWTH OF AGRICULTURAL PRODUCTION 1960-1985 AND 1986-2005 BY WORLD REGION

Period	Africa	Asia	ECA	HICs	LAC
1960 - 1985	1.1	1.5	2.0	1.2	1.3
1986 - 2005	2.6	2.6	-0.8	0.3	2.5
Total	1.8	2.0	0.7	0.8	1.8

Source: Authors' calculation using FAOSTAT gross agriculture production index. Note that the ECA group contains only Turkey in the 1960-1985 period.

B. Comparing growth rate averages across developing countries: Africa, Asia and Latin America

As Table 7 shows, among developing countries in Africa, Asia and Latin America, high-protection countries as measured by RRAs during the period 1960-1985 tended to have higher average annual growth rates in agricultural production and in sectoral value added. (For the growth rates by individual countries that make up each country grouping, see Appendix Tables 2 through 5.) And increasing-protection countries also had higher average growth rates. Table 7 also shows these production growth rates for the period 1986-2005, but in this latter period the trend in protection seems to be more influential than the level, although the relationship between growth and levels of protection are not contrary to the hypothesis of a positive aggregate supply elasticity. Although from an economy-wide

perspective the relative measures of support would tend to reflect better the incentives for resource movement between sectors, thereby affecting aggregate sectoral growth, we have more confidence in the NRA measures. Table 8 shows that high protection countries —as measured by NRAs— and increasing protection countries again have average growth rates. Finally, Tables 9a and 9b show the average annual rate of growth (%) in agricultural value added according to average levels of protection and average changes in levels of protection as measured by RRA for Africa, Asia and Latin America in the two periods 1960-1985 and 1986-2005. The same patterns hold, and one conclusion is clear: It is not merely the average level of protection, but the trend in protection —particularly the lowering of taxation— that was important in stimulating private investments in the sector.

During the pre-reform period 1960 to 1985, agricultural trade policy was more or less stable, and so the division of countries into the four categories is even in terms of the number of countries in each category. During the second period, 1986-2005, however, many countries that had been taxing their agricultural sectors (low protection), reduced their taxation, principally of their exportables, and so their NRA and RRA levels increased. Similarly, many countries that had protected their sectors, reduced their protection. Therefore, during this second period the division of countries into the four categories is unbalanced in terms of numbers. Because we observe so few countries in the two categories high-level-and-high-change in protection and low-level-and-low-change in protection, the differences in sectoral growth rates might be sensitive to the inclusion or exclusion of specific countries. For example, as seen in Appendix Table 3a, Sri Lanka and Zimbabwe are two countries where civil unrest and insecurity would likely have prevented high production growth after 1986, regardless of the level of protection, which was low and which changed little. They, however represent two of the four countries in the category, of low-average protection and low change in protection using unconditional medians. Therefore, Tables 7 and 8 also report the sectoral growth rates using categories based on the median of protection change conditional on the protection level. That is, for those countries with low protection averaged over the period ("low" based on the median of protection level for all countries), we divide this group into two subgroups of roughly equal size base on this particular group's median for changes in protection levels. And for those countries with high average protection, we divide this group into two subgroups of roughly equal size base on this group's median for changes in protection levels. The results are less stark in the case of conditional medians, but nevertheless hold.

Finally, Table 10 presents a panel-data regression analysis of the rate of growth of agricultural value added using as explanatory variables lagged NRAs and lagged changes in NRAs, in addition to a number of other variables used in explaining national GDP growth rates. For this latter set of variables we make use of Norman Loayza's data set used in Loayza and Soto (2002). The model here is a simple growth model, where the rate of change of agricultural value added depends on its lagged value, plus additional control variables. The data are averages for 5-year periods. We use lagged values of NRAs and changes in NRAs due to the likely endogeneity of the NRAs. There are at least two reasons that the NRAs are endogenous. First, from a political economy standpoint, when agriculture is doing poorly, politicians have incentives either to increase protection (i.e., to give more subsidies), or to reduce taxation. And vice versa. Second, various authors have noted that as countries get richer they tend to support more (or tax less) their agricultural sectors (e.g., Hayami, 2007). To the extent that growth rates decline with income levels (ceteris paribus, as predicted by standard growth theory) then one might expect a negative correlation between NRAs and growth rates, regardless of the existence or not of a cause-effect relation between them.

The results indicate that, in addition to an expected (and strong) rate of convergence (as indicated by the negative coefficient on lagged agricultural value added), lagged average changes in NRAs are significantly positively correlated with value added growth, but lagged average levels of NRAs are not. This result is highly consistent with the comparisons of simple averages found in Tables 7 and 8, and Tables 9a and 9b. Note that this regression model makes use of five-year averages and a simple lag of levels and changes. The interpretation of the coefficient on lagged change in NRA is as follows: an increase in the NRA from taxation (a negative) to trade-regime neutrality would produce an increase in the average rate of agricultural growth in the subsequent five-year period of (7.228 times the

change in NRA). Due to the limited number of observations for many countries, and to the use of lagging to eliminate endogeneity, only one lag was employed. Therefore, the influence of changes in NRAs on growth rates in periods beyond the next five-year horizon are not estimated; and so the model cannot say anything about more lasting changes in rates of growth, merely the increase in the average rate in the period immediately following. What we can say is that, controlling for changes in NRAs, the average level itself during the previous five-year period does not have a significant impact on agricultural growth rates. Of the other variables, usually important for national GDP growth rates, only infrastructure (the per capita availability of telephones) appears to have a statistically significant positive relation with agricultural value added growth. This same model was estimated using, instead of NRAs, the lagged values of RRAs and changes in RRAs, and is presented in Appendix Table 6. The results are similar to those when using NRAs, although the regression explains slightly less of the variation of agricultural value-added growth. Given our discussion in section 2.3 on the high correlation between the measurements of NRAs and RRAs this is not surprising.

TABLE 7
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985

Simple medians of both protection levels and changes		
1960-1985	Low RRA growth	High RRA growth
Low RRA	3.1	3.2
High RRA	2.8	3.4
Simple medians of protection levels but median of changes conditional on average protection level		
1960-1985	Low RRA growth	High RRA growth
Low RRA	2.9	3.4
High RRA	3.0	3.4
Simple medians of both protection levels and changes		
1986-2005	Low RRA growth	High RRA growth
Low RRA	1.6	3.3
High RRA	3.2	3.6
Simple medians of protection levels but median of changes conditional on average protection level		
1986-2005	Low RRA growth	High RRA growth
Low RRA	2.4	3.4
High RRA	3.5	3.2

Source: Authors'elaboration.

TABLE 8
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (NRA), AFRICA, ASIA AND LATIN AMERICA

Simple medians of both protection levels and changes		
1960-1985	Low NRA growth	High NRA growth
Low NRA	2.7	3.4
High NRA	3.0	3.3
Simple medians of protection levels but median of changes conditional on average protection level		
1960-1985	Low NRA growth	High NRA growth
Low NRA	2.7	3.4
High NRA	3.0	3.3

(continued)

Table 8 (concluded)

Simple medians of both protection levels and changes		
1986-2005	Low NRA growth	High NRA growth
Low NRA	2.9	3.5
High NRA	3.2	3.4
Simple medians of protection levels but median of changes conditional on average protection level		
1986-2005	Low NRA growth	High NRA growth
Low NRA	3.0	3.6
High NRA	3.1	3.4

Source: Authors'elaboration.

TABLE 9A
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL VALUE ADDED ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

		Ag. Growth (%)			Number of observations		
Average RRA over period		Low RRA growth	High RRA growth	Total	Low RRA growth	High RRA growth	Total
Low RRA	WDI	2.5	3.1	2.8	144	140	284
	CPI	3.2	3.5	3.3	116	115	231
	WPI	2.7	3.5	3.2	44	81	125
	PPP	0.6	5.8	2.7	42	30	72
High RRA	WDI	3.1	3.3	3.2	111	225	336
	CPI	2.4	3.7	3.2	113	209	322
	WPI	-0.1	4.4	4.3	5	130	135
	PPP	1.0	2.2	1.8	25	50	75
Total	WDI	2.8	3.2	3.0	255	365	620
	CPI	2.8	3.6	3.3	229	324	553
	WPI	2.4	4.1	3.8	49	211	260
	PPP	0.7	3.6	2.3	67	80	147

Source: Authors'elaboration.

TABLE 9B
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL VALUE ADDED ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1986-2005. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

		Ag. Growth (%)			Number of observations		
Average RRA over period		Low RRA growth	High RRA growth	Total	Low RRA growth	High RRA growth	Total
Low RRA	WDI	2.0	3.8	3.3	80	255	335
	CPI	1.6	3.6	3.1	80	242	322
	WPI	4.8	2.8	3.6	43	70	113
	PPP	2.2	3.2	3.0	60	246	306
High RRA	WDI	2.6	2.6	2.6	234	100	334
	CPI	0.0	3.8	1.1	227	90	317
	WPI	1.6	4.2	1.9	179	20	199
	PPP	1.5	3.3	2.1	234	100	334

(continued)

Table 9B (concluded)

Average RRA over period		Ag. Growth (%)			Number of observations		
		Low RRA growth	High RRA growth	Total	Low RRA growth	High RRA growth	Total
Total	WDI	2.5	3.4	3.0	314	355	669
	CPI	0.4	3.7	2.1	307	332	639
	WPI	2.2	3.1	2.5	222	90	312
	PPP	1.7	3.2	2.5	294	346	640

Source: Authors'elaboration.
Note: WDI = real sector GDP from World Development Indicators (Real Ag Value Added); CPI = Nominal Ag. GDP Ag deflated by the country's CPI; WPI = Nominal GDP deflated by the wholesale price index CPI; PPP = purchasing power GDP from World Development Indicators. Note that an observation is for one year and one country.

TABLE 10
PANEL DATA REGRESSION (FIXED EFFECTS) EXPLAINING THE GROWTH RATE OF AGRICULTURAL VALUE ADDED: CROSS-COUNTRY, 1960-2000, 5-YEAR AVERAGES

Dependent variable: average % change in agricultural value added over 5 year intervals. See Appendix Table 1 for countries included in the data set	Estimated coefficient	Standard error	p-value
Lagged NRA averaged over 5 years	-0.301	1.113	0.787
Lagged average change in NRA	**7.228**	**3.477**	**0.039**
Lagged average ag value added.	**-7.081**	**1.790**	**0.000**
Income per capita	-1.879	1.429	0.190
Initial output gap (log[actual GDP/potential GDP])	2.096	8.099	0.796
Education - log of secondary enrollment rate	-0.127	1.116	0.909
Financial depth (log of credit to the private sector over GDP)	-0.396	0.651	0.544
Trade openness index (residual of regression of trade over GDP on several variables)	-0.731	1.019	0.474
Government burden (log of government consumption over GDP)	0.832	1.072	0.439
Public infrastructure (log of phone lines per 1000 population)	**1.429**	**0.861**	**0.099**
Governance index (first principal component of ICRG indicators)	0.052	0.329	0.875
Lack of price stability (log of inflation rate+100)	-0.203	0.798	0.800
Cyclical volatility (standard deviation of output gap)	-1.894	15.724	0.904
Real exchange rate overvaluation (log of real exchange rate over-valuation index)	-1.029	0.718	0.154
Systemic banking crises (fraction of period during which the country had a systemic crisis)	-0.437	0.743	0.558
Terms-of-trade shocks (terms of trade growth)	0.004	0.003	0.224
Period dummies (reference 1996-2000):			
1966-1970	-3.314	1.587	0.038
1971-1975	-2.752	1.386	0.049
1976-1980	-2.263	1.156	0.052
1981-1985	-1.832	0.974	0.062
1986-1990	-1.558	0.756	0.041
1991-1995	-1.713	0.581	0.004
_Constant	178.417	39.185	0.000

Source: Authors'elaboration.
Note: unbalanced panel, fixed-effects (within) regression, number of observation = 245, number of groups = 5 0, R-sq: within = 0.2208, between = 0.1208, overall = 0.0468, F(22,173)= 2.23(p-value = 0.0022).

IV. Connecting the impacts of agricultural protection on poverty reduction via agricultural growth

A. The relationship between agricultural growth and poverty reduction: what do we know?

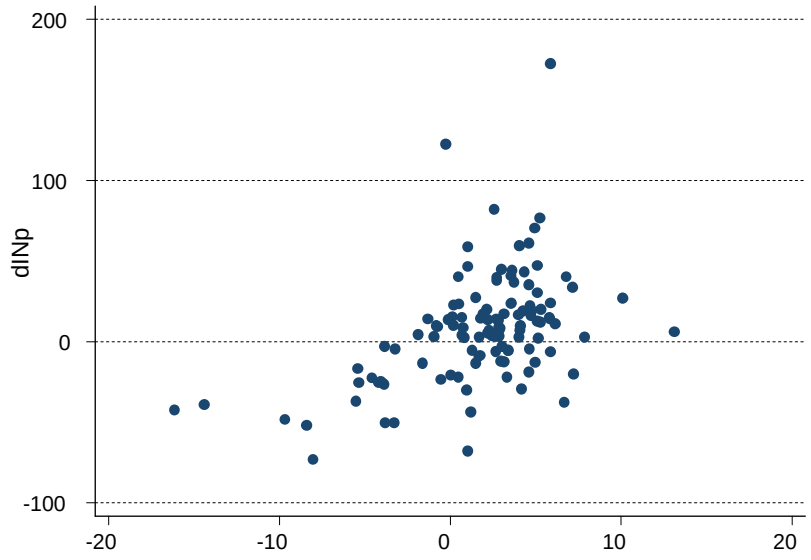
In this section we summarize some important findings regarding the link between agricultural growth and poverty reduction. In the next section we analyze the link between the trade regime to agricultural growth. Many of the econometric studies showing the importance of the agriculture sector's growth for poverty reduction make use of cross-country data to estimate the partial correlation of growth measures with income levels or poverty incidence rates, controlling for other determinants. The basic statistical problem is to make sense of the scatter diagrams as shown in Figures 7a and 7b, which show a positive relationship between agricultural sector growth, whether measured in terms of production or value added, and the rate of increase of per capita income of the poorest decile. In the Figures the rates of growth are five-year averages for each country in our sample (discussed in the previous section) over a series of five-year periods beginning in 1980. In Figures 7a and 7b, the simple correlation between the average rate of growth in production and the average rate of growth in per capita income of the first decile is 0.47, and the simple correlation with the average rate of growth in value added is 0.34. But of course there are other factors determining the income growth of the poorest and changes in poverty rates. What is the evidence we have that agricultural growth is important to economic development and poverty reduction?

Timmer (2002) notes that agriculture's contribution to national economic development is an "old and honorable question, dating back to the Physiocrats." From a longer-term perspective, the most fundamental and obvious contribution has been the direct contribution of agricultural growth to lower food prices, and therefore higher living standards. In a closed economy, with agricultural growth the non-farm sector enjoys lower real wage costs, which yields rents that stimulate investments and structural changes (this is the classic model of Lewis, 1954; Johnson, 1957). From the perspective of an individual country open to trade, however, the benefits of lower food prices can be accessed by imports, and so the spillovers from the dynamism of the domestic agriculture sector are of much less importance.

The 2002 review article by Timmer is a useful starting point for assessing the econometric evidence linking agriculture and economic development. Timmer presents an analysis of the

relationship between the rate of economic growth and the growth of agriculture, expanding upon the panel data approach to the estimation of endogenous growth models,[9] finding that a contemporaneous increase of 1 percent in the agricultural sector growth rate contributes about a 0.2 percent increase in the non-agricultural growth rate. This does not show causality, however, because both sectors could have grown in response to other factors, such as macroeconomic policies. More to the point of inferring causality, Timmer finds that a 1 percent increase in the five-year lagged agricultural growth rate contributes to about a 0.14 percent increase in the non-agricultural growth rate.

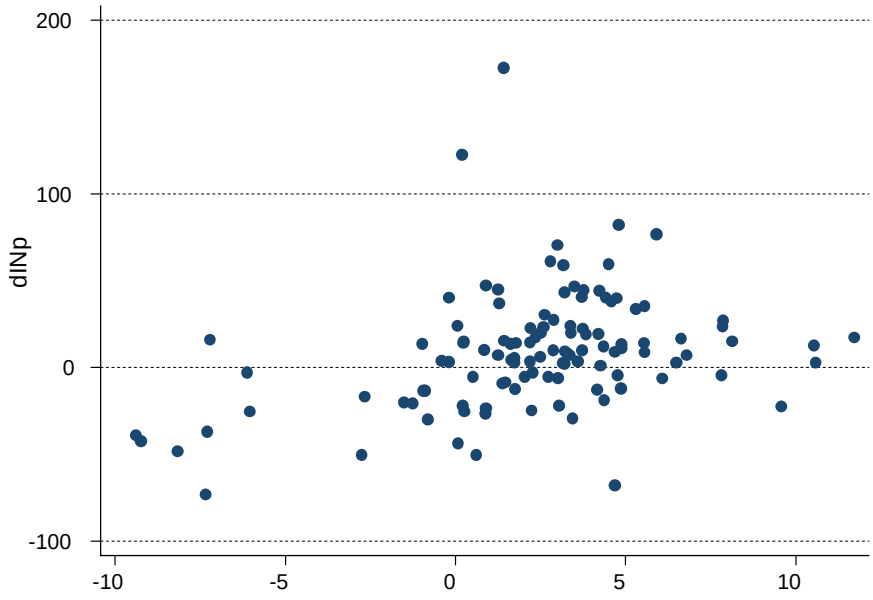
FIGURE 7A
PERCENT CHANGE IN THE AVERAGE INCOME OF THE FIRST DECILE VERSUS PERCENT CHANGE IN FAO'S GROSS AGRICULTURE PRODUCTION INDEX, SELECTED COUNTRIES 1981-2005



Source: Authors' calculations.
Note: Simple correlation = 0.4694. List of countries is found in Appendix Table 1.

[9] Timmer uses 65 developing countries for 1960-1985.

FIGURE 7B
PERCENT CHANGE IN THE AVERAGE INCOME OF THE FIRST DECILE VERSUS PERCENT CHANGE IN AGRICULTURE SECTOR VALUE ADDED, SELECTED COUNTRIES 1981-2005



Source: Authors' calculations.
Note: Simple correlation = 0.3367. List of countries is found in Appendix Table 1.

Bravo-Ortega and Lederman (2005) also examine econometrically the links between agricultural growth and the growth of the non-agriculture sector using panel data of over 120 countries for the period 1960-2000. Non-agricultural sector value added was regressed on the one-year lag of agricultural sector value added, controlling for lagged non-agricultural value added,[10] and a Granger style "causality" test was done to resolve the question of which sector leads the other in predictive terms. The results are that in developing countries historically a 1 percent increase in agricultural growth leads to between a 0.12 percent (for Latin America) to 0.15 percent (other developing countries) increase in non-agricultural growth.[11] For high income countries, however, agricultural growth is associated with a subsequent decline (–0.09 percent) in non-agricultural growth, perhaps through a resource-pull effect. Also there is a reverse growth effect: a 1 percent increase in the non-agricultural growth rate leads to a decrease in agricultural growth in non-LAC developing countries. In LAC and in developed countries non-agricultural growth appears unrelated to subsequent agricultural growth. Looking at individual countries, there is a substantial heterogeneity, which can be illustrated in the case of Latin America. In all LAC countries except for Uruguay, agricultural is positively related to subsequent non-agricultural growth, and this relationship for 10 of the 20 other LAC countries is considerably above the regional average cross-sector growth elasticity of 0.12, with some countries having very high elasticities of cross-sector growth impacts (e.g., Chile, Jamaica, Guatemala, Argentina and Brazil).

The Bravo-Lederman World Bank study also extended the definition of agriculture to include the food processing sectors. Using the same breakdown of country groups, the results indicate that the LAC average cross-sector growth elasticity from agriculture to non-agriculture increases from 0.12

[10] This control was not included in Timmer's analysis. Using lagged non-agricultural GDP also is a way to control for the level of development: one expects faster non-agricultural growth at lower levels of development.
[11] Although statistically different from zero, these regional averages are not statistically different from each other.

when excluding food processing to 0.18 when including processing. In the case of LAC, this strongly suggests that the positive spillovers of agriculture are stronger when the sector's downstream industries are included in the "rural" economy. By contrast, adding the food processing industries to non-LAC developing countries' agricultural sectors reduces the average cross-sector growth elasticity. This suggests that, in non-LAC developing countries, much of the subsequent growth in non-agriculture that is related to current primary agricultural growth is found in processing industries more closely related to agriculture. That is, a substantial part of what is measured as the non-agricultural growth correlated with agriculture is in the food processing sector.

In LAC countries it appears that forward links have a longer reach into industries beyond food processing, probably due to the region having better articulation between markets domestically and between domestic and international markets. If one considers both the direct contribution of agriculture (its share in GDP) plus its indirect contribution on other sectors for non-LAC developing countries one finds that agriculture "contributes" about 1.5 times the size of the sector to growth. For LAC countries agriculture contributes about 1.8 times its size. In the case of non-LAC countries, non-agriculture contributes slightly less its share to GDP growth. In LAC and developed countries the non-agricultural contribution is approximately equal to its share in GDP. The results suggest significant spillover effects of agriculture to non-agriculture in developing countries. Along with the lower income elasticity of demand for primary products, the above results imply all the more strongly that agricultural growth would lead over time to a lower share of agriculture in total GDP, which corresponds to historical trends.

Lengthening the period of analysis to 1960-2004, Christiaensen, Demery, and Kuhl (2006) perform a similar econometric analysis, focusing on Africa,[12] finding a small impact of past agricultural growth on non-agricultural growth (though only in low income countries outside Sub-Saharan Africa), but finding no evidence of an impact from nonagriculture growth to agriculture growth. Tiffen and Irz (2006) use a VAR approach and find that, for most developing countries, value added per worker in agriculture "causes" national GDP per capita growth, but for developed countries the evidence is ambiguous.

Finding indirect effects of agriculture on non-agriculture is not an argument for subsidizing agricultural production, because "causality" tests show predictive links, not the mechanisms by which agricultural growth would lead to non-agricultural growth. Such mechanisms would have to be clear for practical policy applications. The results do, however, reinforce the argument against taxing agriculture relative to other sectors (as in Schiff and Valdes, 1992), and they imply that, in assigning public expenditures to public goods, one should take into account this documented historical relationship between agricultural growth and subsequent non-agricultural growth.

Another important question addressed in the literature concerns the role of the sectoral composition of growth in linking overall growth to poverty. Timmer's (2002) econometric analysis of the impact of agriculture on poverty makes use of countries where agriculture represents at least 5% of total GDP[13] and estimates the relationthsip between average income of persons living in each quintile to the sectoral labor productivities of agriculture and non-agriculture. This estimated relationship yields an "elasticity of connection" (see Roemer and Gugerty, 1997) for each quintile, representing the marginal impact of a sector's growth on per capita incomes. Of special interest is the elasticity of connection for the poorest quintile. The Bravo-Lederman World Bank study goes further than Timmer and estimates an elasticity of connection that includes both the direct effects of sectoral composition

[12] Their specification for agriculture includes yearly deviations from long-run average rainfall.

[13] Timmer uses data from 27 countries for the period 1960-1995. The average agricultural share of GDP in his data set is 25% and the average share of agricultural workers of the total workforce is 51%. His data are therefore very much representative of least developed countries.

and the indirect effects on poverty through sectoral growth on the growth of the other sector (discussed above).[14]

Timmer finds that for countries where the disparity between the richest and poorest is relatively small, growth in agricultural labor productivity is "slightly but consistently" more important in generating per capita income in every quintile. But in countries where the income gap is large, the elasticities of connection of both sectors for the poorest quintile are small, but rise sharply by income class. Timmer thus concludes that, for high income gap countries, the poorest quintile is "nearly left out of the growth process altogether." Furthermore, in this case agricultural growth is less successful than non-agricultural growth at raising the incomes of the poorest. Timmer notes that, because over the period of analysis the income gap tended to increase with growth, agriculture has had a declining influence in reducing poverty relative to non-agriculture, although there is an exception: the fastest growing countries during the decade 1985-1995 showed on average a narrowing of the income gap.

The Bravo and Lederman study similarly examines the per capita average incomes of quintiles, expanding the number of countries to 84 and updating the data to 2002. Their estimates show that the elasticities of connection are higher for non-agricultural than for agricultural growth across quintile groups. In the case of non-LAC developing countries, for example, the elasticities of connection for the poorest quintile are 0.36 for agriculture and 0.64 for non-agriculture. In terms of absolute impact, in both LAC and non-LAC developing countries, generally growth of the non-agriculture sector is more important than growth of agriculture. The relative impact of agricultural growth is least for the lowest quintile compared to higher income quintiles, as also in Timmer's high inequality scenario. The elasticities of connection for agriculture compared to non-agriculture are even less in the case of Latin America. And the agriculture elasticities fall relative to non-LAC developing countries and the non-agriculture elasticities increase.

But the indirect effects of agriculture on poverty reduction, through the influence of agricultural growth on non-agricultural growth, also aids in poverty reduction. For LAC countries the total elasticity is 0.28 for agriculture and 0.77 for non-agriculture, but for other developing countries the elasticities are 0.48 and 0.58. But the indirect effect of agriculture's growth on poverty reduction is a large proportion of its total effect both in LAC (a third) and non-LAC developing countries (a fifth). Compared to LAC countries, in non-LAC developing countries agricultural growth has slightly higher impact on non-agricultural growth, but that non-agricultural growth has a smaller impact on poverty reduction. In non-LAC developing countries the direct effect of agricultural growth is relatively more important than in LAC countries for poverty reduction. More interestingly, relative to its GDP share agriculture has a greater impact on poverty reduction than non-agriculture. Agriculture's GDP share averages 0.12 for LAC and 0.22 for non-LAC developing countries. Relative to their shares in GDP, on average, agriculture's contribution to raising the incomes of the poorest is at least 2.5 times that of non-agriculture (2.5 for LAC, 2.9 for non-LAC developing countries).

Recently, the 2008 World Development Report, entitled Agriculture for Development, notes that, due to resource endowments and a difficult investment climate for the near future, many developing countries will continue to find their comparative advantages in the primary activities of agriculture and mining, and in agro-processing. Realistically, in at least the next several decades, countries with agriculture-based economies must design a growth strategy based on spurring the farm sector. The WDR finds that agricultural growth can aid in reducing poverty across all country types (p.7). Again using cross-country estimates, it appears that agriculture-based GDP is at least twice as effective in reducing poverty as non-agricultural-based GDP growth (see the report's Figure 3, p. 6). For example, in the case of China, estimates suggest that agriculture-based growth has been 3.5 times

[14] Note that the elasticity of connection between growth and income is not the same as a growth elasticity of poverty measured by a change in the poverty level relative to a given poverty threshold (where the location of the poverty line varies across countries). Heltberg (2004) demonstrates, the headcount ratio of poverty has drawbacks, relying on a proportion of people who cross a poverty line if all incomes increase, and ignoring what happens to those who might benefit but remain below the poverty. In contrast, the elasticity of connection measures the impact of growth on the mean income of poorest. There will always be a first quintile, but the mean income of this 20% is changing.

more effective in poverty reduction than non-agriculture-based growth. In the case of Latin America the estimate is 2.7 times more effective (p. 6). The WDR 2008 also cites the significant declines in rural poverty due to rapid agricultural growth in India linked to the introduction of high yielding varieties and other technologies. Ghana is a more recent example of a notable fall in poverty being due in large part to raising the incomes of rural households linked to agricultural growth.

B. Some estimates of the impact of growth on the income of the poorest

The previous section sets out the evidence that the taxation or protection of agriculture – or, more accurately, the reduction of taxation or increase in protection – affects agricultural growth. This present section first discusses the contribution of agricultural growth to economic growth, and then the connection from growth to poverty reduction.

As noted in the preceding section, the key question here is with respect to the role of the sectoral composition of growth: Does the sectoral composition of national economic activities influence the strength of the link between overall economic growth and poverty? One approach (e.g., Timmer, 2002) to answer this question is to relate the average income of persons living in each income quintile (j = 1,…,5) to the sectoral labor productivities ($g_i = G_i/L_i$, where L_i is the labor force in sector i) of agriculture and non-agriculture:

$$\ln y_j = f(\ln g_A, \ln g_{NA}) \quad j = 1,...,5$$

The estimation of this relationship produces the "elasticity of connection" (Roemer and Gugerty, 1997) for each quintile, which represents the marginal impact of a sector's growth on per capita incomes. Of most interest is the elasticity of connection for the first quintile, the poorest:

$$\frac{\partial \ln y_1}{\partial \ln g_A} \text{ and } \frac{\partial \ln y_1}{\partial \ln g_{NA}}$$

The Bravo-Lederman World Bank study goes further by estimating an elasticity of connection that includes both the direct effects of sectoral composition and the indirect effects on poverty – as measured by the average income of the first quintile – through sectoral growth on the growth of the other sector:

$$\frac{d \ln y_1}{d \ln g_A} = \left.\frac{\partial \ln y_1}{\partial \ln g_A}\right|_{\Delta g_{NA}=0} + \frac{\partial \ln y_1}{\partial \ln g_{NA}} \cdot \frac{\partial \ln g_{NA}}{\partial \ln g_A}$$

$$\frac{d \ln y_1}{d \ln G_{NA}} = \left.\frac{\partial \ln y_1}{\partial \ln G_{NA}}\right|_{\Delta g_A=0} + \frac{\partial \ln y_1}{\partial \ln G_A} \cdot \frac{\partial \ln g_A}{\partial \ln g_{NA}}$$

If the sectoral labor force is exogenous (valid in the short and medium term, when migration is less significant), then the elasticity of per-capita income in one sector with respect to the other is well-approximated by the elasticity of total income of one sector with respect to the other: (this latter elasticity is discussed in the previous section.)

Table 11 shows both the direct and indirect effects and the total effect of agricultural and non-agricultural growth on income of the poorest (taken from Beyond the City).[15] For the LAC countries

[15] The reader should note that the estimates of indirect growth effects from agriculture to non-agriculture and vice versa might be sensitive to the grouping of countries in the econometric specifications. For example, Bravo-Ortega and Lederman grouped countries by first high income and low income, and then within low income by Latin America and non-LAC. Christiaensen, Demery and Kuhl grouped countries by high, middle and low income, and

the total elasticity with respect to agricultural growth is 0.28 and with respect to non-agriculture, 0.77. For non-LAC developing countries the values are 0.48 and 0.58 respectively. Note is that the indirect effect of agricultural growth on poverty reduction represents a large proportion of its total effect. This is the case in LAC countries, where the indirect effect is one-third of the total, and in non-LAC countries, where it make up one fifth. In comparison to LAC countries, agricultural growth in non-LAC countries effects non-agricultural growth to a greater degree, although non-agricultural growth has smaller effects on poverty reduction. In short, the direct effect of agricultural growth is more important for poverty alleviation in non-LAC countries than in LAC countries. In all cases the growth of the non-agricultural sector is more important for poverty reduction in absolute terms. But relative to its GDP share, agriculture has a greater impact on poverty reduction than non-agriculture. For the LAC countries, agriculture's GDP share averages 0.12 (0.22 for non-LAC developing countries), and so, on average, agriculture's contribution to raising the incomes of the poorest is at least 2.5 times that of non-agriculture (2.5 for LAC, 2.9 for non-LAC developing countries).

TABLE 11
PARTIAL AND TOTAL SECTORAL POVERTY ELASTICITIES: IMPACT OF A 1% INCREASE OF EACH SECTOR'S GDP ON AVERAGE INCOME OF THE POOREST QUINTILE

	LAC countries	Non-LAC developing countries	Developed countries
Partial effect of			
1% growth Ag. on average income of poorest quintile	0,191	0,362	0,0[a]
1% growth non-Ag. on average income of poorest quintile	0,772	0,642	0,903
Cross-sectoral growth elasticities:			
$\frac{\partial \ln g_{NA}}{\partial \ln g_A}$	0,12	0,148	– 0,09
$\frac{\partial \ln g_A}{\partial \ln g_{NA}}$	0,01	– 0,168	– 0,03
Indirect effect of			
1% growth Ag. on average income of poorest quintile	0,093	0,095	– 0,081
1% growth non-Ag. on average income of poorest quintile	0,002	– 0,061	0,0
Total effect[b] of			
1% growth Ag. on average income of poorest quintile	0,283	0,457	– 0,081
1% growth non-Ag. on average income of poorest quintile	0,774	0,581	0,903

Source: Bravo-Ortega and Lederman (2005), also Tables 3.5 and 3.16 in de Ferranti et al. (2005).
[a] Not statistically significantly different from zero. b/ For example: 0.191 + 0.772×0.12 = 0.283.
[b] For example: 0,191 + 0,772 x 0,12 = 0,283.

also grouped by Sub-Saharan African countries and non-SSA countries. (Their specification also differed slightly in other respects from the Bravo-Ortega and Lederman approach.) Our emphasis in this paper is the LAC region, and so we use the Bravo-Ortega and Lederman results. Christiaensen, Demery and Kuhl do not separate middle and low income country groups by regions other than SSA.

C. Pulling these results together using regional averages

Suppose that we begin from a base period of agricultural GDP growth of 2%, which is the average growth rate corresponding to high taxation countries (low RRAs) that did not vary their level of intervention during the period 1986-2005 (see Table 9b). The average NRAs for countries in the period 1985-2005 with high sectoral taxation was -0.132. What would have been the impact on agricultural growth if a representative country removed the relative taxation of agriculture, changing its NRA from -0.132 to zero, a neutral trade regime? Using the coefficient of 7.228 linking the average percent change in agricultural value added (over five-year periods) to the average change in NRA (in the previous five-year period) from Table 10, one can calculate an increase in agricultural growth due to the policy change. As Table 12 shows agricultural growth rates would have almost increased 50% from 2% to 2.95% annual growth (2.0% + 0.132*7.228% = 2.95%). This is the direct effect on the acceleration of agricultural growth due to the change from the average taxation regime (during 1986-2005) to a neutral regime.

Furthermore, there is heterogeneity with respect to the indirect effects of taxing the sector through the spillover of slower agricultural growth on the rest of the economy ($\partial lnG_{NA}/\partial lnG_A$ from Section IV.B and Table 11).We do have estimates of the indirect effects of agriculture on non-agriculture for LAC countries (Beyond the City, p. 73), which are summarized for some LAC countries in Table 13. Although the spillover effects are not statistically significantly different from the regional average for several countries, there are some countries with notably higher indirect effects. For example, in the cases of Chile and Panama, the percent change in non-agricultural GDP with respect to a one percent rise in agricultural GDP is at least one, if not higher. In these two cases the multiplier effects or positive externalities of agricultural activities are extremely high (likely due to stronger linkages with downstream industries) and one would expect therefore that the final impact on incomes of the poor from taxing the sector would be greater. Many countries with large agricultural sectors in the region also have higher indirect elasticities than the regional average —approximately 0.5, such Brazil and Argentina. It is an interesting question for future research why it should be that these indirect effects differ so widely across countries: Is it due to the structure of agricultural production and processing, the degree of trade openness and its implications for exchange along the value chain, or the extent of "dualism" in the economy that might tend to isolate agriculture?

Table 13 presents another simulation of the impacts on the income of poorest quintile due to reducing the NRA from the average of -0.132 to neutrality. The income sensitivity of eliminating this representative tax on agriculture depends on the country-specific indirect effect of agricultural growth on non-agriculture. Table 13 again supposes that non-agriculture grows at 3% annually and agriculture prior to relaxing the tax grows at 2%. With these reference growth rates the average income in the poorest quintile would increase at approximately 2.95% annually. Taking Chile as an example, the country's indirect elasticity of agricultural growth on non-agricultural growth is so high (1.29) that annual income growth rates of the poorest quintile would have risen to 4% if Chile were to have reduced the NRA from -0.132 to neutrality. Looking at this result from a slightly different perspective, it illustrates what would have been the cost in terms of poverty reduction of not opening the economy and maintaining implicit taxation on agriculture. One is tempted to speculate, given Argentina's fairly large estimate of the indirect growth elasticity of 0.5, that the country's policy of taxing agriculture could be causing significant foregone income gains of the poorest.[16]

[16] In Argentina's case, that agricultural exports are wage goods to a significant degree (grains and meat) would complicate the analysis of the net effect on the poor of taxing agriculture.

TABLE 12
SIMULATED CHANGES IN AGRICULTURAL VALUE-ADDED GROWTH RATES AS A FUNCTION OF DECREASES IN SECTORAL TAXATION AS MEASURED BY NRAS AND THE CONSEQUENTIAL EFFECT ON THE GROWTH RATE OF PER CAPITA INCOME OF THE LOWEST QUINTILE
(In percentages)

Change in NRA	Initial ag GDP growth rate	Ag growth after change in NRA	Impact on ag growth rate	Change in growth rate of income of lowest quintile		
				Direct effect	Indirect effect	Total effect
0.05	2.00	2.36	0.36	0.07	0.03	0.10
0.10	2.00	2.72	0.72	0.14	0.07	0.21
0.132	**2.00**	**2.95**	**0.95**	**0.18**	**0.09**	**0.27**
0.150	2.00	3.08	1.08	0.21	0.10	0.31
0.20	2.00	3.45	1.45	0.28	0.13	0.41
0.25	2.00	3.81	1.81	0.35	0.17	0.51
0.30	2.00	4.17	2.17	0.41	0.20	0.62

Source: Authors'elaboration.
Note: Initial agriculture growth of 2% and non-agricultural growth of 3%.

TABLE 13
SENSITIVITY OF THE IMPACTS ON INCOME OF THE POOREST QUINTILE FROM TAXING AGRICULTURE TO THE COUNTRY-SPECIFIC INDIRECT EFFECT OF AGRICULTURAL GROWTH ON NON-AGRICULTURE: MOVING FROM AN NRA OF -0.132 TO NEUTRALITY BASED ON INITIAL AGRICULTURE GROWTH OF 2% AND NON-AGRICULTURAL GROWTH OF 3%

Reference country for the indirect effect of ag growth on rest of economy	Indirect elasticity Ag growth on nonAG GDP growth	Income elasticity of poorest quintile: indirect effect	Income elasticity of poorest quintile: total effect	Total effect of an increase in NRA of 0.132 on income of poorest quintile %	Rate of annual growth average income poorest quintile (base 2.89%)
LAC Regional Average	0.12	0.093	0.284	0.27	3.16
Argentina	0.53	0.409	0.600	0.57	3.46
Chile	1.29	0.996	1.187	1.13	4.02
Brazil	0.57	0.440	0.631	0.60	3.49
Mexico	0.79	0.610	0.801	0.76	3.65
Panama	1.07	0.826	1.017	0.97	3.86
Peru	0.24	0.185	0.376	0.36	3.25

Source: Authors'elaboration.

V. Conclusions

This study has focused on the link between agricultural openness and the sector's performance, an improvement in which could have significant impacts on poverty reduction. We have emphasized Latin America, during 1960 to 2005, using a recently-constructed data base of agricultural support that includes information for several developing countries beyond the region. The principal question addressed is, does the trade regime influence sectoral growth? With the answer to this question we then make some inferences regarding the influence of sectoral growth on poverty, using estimates of the impact of economic growth on the incomes of the poorest quintile. The empirical analysis takes advantage of cross-country panel data from several sources, covering many developing countries in Africa, Asia and the LAC region. The LAC countries are Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua.

There is an unsettled debate in the literature regarding the definitions of some basic concepts, How to define the openness of the trade regime? How to measure the outcome in terms of agricultural growth? And, how to define the most important outcome: poverty reduction? In the case of trade openness, we make use of NRAs and RRAs, as indicators of effective levels of supports, although these measures of intervention have their drawbacks. Indicators of agricultural growth are the sector's value added and production levels; we have examined both here.

Using simple comparisons of averages we find that among developing countries in Africa, Asia and LAC, those with high-protection (which in many cases corresponds to less negative protection – i.e., taxation) during the period 1960-1985 tended to have higher average growth rates in agriculture production and in sectoral value added; and countries that were increasing protection (i.e., reducing taxation) during this period also had higher average growth rates. For the period 1986-2005, the trend in protection seems to be even more influential than the level, although the relationship between growth and levels of protection is not contrary to the hypothesis of a positive aggregate supply elasticity. We interpret these results as saying that it is not merely the average level of protection, but the trend in protection —particularly the lowering of taxation— that was important in stimulating private investments in the sector. A panel data analysis using five-year averages of the data supports the contention that changes in agricultural support —as measured by NRAs— are more important that levels. Investors generally look to the future, and potential investors in agriculture would look to possible future effects of protection or taxation of the sector on returns in the medium and longer term. It is not surprising, therefore, that trends in the trade regime, being more accurate than levels as predictors of the future environment for returns on investment, would correlate more closely with sectoral performance associated with changes in investments, positive or negative.

Using the panel data regression estimate of the effect of changes in NRAs on agricultural growth rates, we simulate what would have been the impact on average agricultural growth in the subsequent five-year period if a representative country removed the relative taxation of agriculture, changing its NRA from an average for countries in the period 1985-2005 with high sectoral taxation (-0.132) to zero, a neutral trade regime. As a point of reference we use a sectoral growth rate of 2% (the average rate corresponding to high taxation countries that did not vary their level of intervention during the period 1986-2005). The response in growth to this reduction in taxation shows that growth rates would have increased almost 50% from 2% to an average of 2.95% in the subsequent five year period. This is the direct effect on the acceleration of agricultural growth due to the change from the average taxation regime (during 1986-2005) to a neutral regime. For several countries in the LAC region, the level of taxation was considerably higher, prior to the economic reforms of the 1980s, and so the effect of moving to a neutral trade regime on agricultural GDP would have been all the greater.

With respect to poverty, while we do not empirically test the final impact of protection on poverty, we discuss the large body of evidence the supports the hypothesis that economic growth, especially agricultural growth in the case of developing countries, alleviates poverty, particularly when measured in terms of the average income of the lowest decile or quintile (this does not imply that growth automatically reduces inequality.) Then, using our own estimation of the effects of the trade regime on sectoral growth, and taking previously-estimated links between growth and income of the poorest, and between agricultural growth and national growth, we simulate the effects on the average income of the first quintile due to a reduction in taxation on agriculture. Using averages for the LAC region, a reduction in taxation on the sector from an NRA of –0.132 to neutrality (NRA = 0) would have increased the sector's growth (in the next five-year period) by about a percentage point, which would have led to an increase in the income growth rate of the poorest of slightly over a quarter percentage point (0.27). Assuming that without the removal of taxation, agricultural would have grown at 2% yearly and non-agriculture at 3%, and income of the poorest would have grown at about 2.9%; while without taxation growth would have been about 3.2% (i.e., an increase of slightly more than 9% in the income growth rate).

These estimates of the impact of reducing the taxation on agriculture likely give a lower bound for rural areas and poor countries, because the direct impact of an increase in agricultural growth would be felt significantly among those in farm-related activities (concentrated in rural areas); and in some countries the poorest quintile likely is more rural, having a greater proportion of rural people than is representative in the total population. One can think of this simulation in terms of what would have otherwise been forgone if reforms had not taken place and reduced taxation on agriculture. It also provides a cautionary tale for countries that have yet to reduce fully their taxation of agriculture (e.g., Argentina, Nicaragua); they may be foregoing significant gains in incomes received by the poorest.

The empirical discussion above is bases on sectoral average NRAs, which combines all tradables. Nevertheless, as can be observed in Figure 3 above, distinguishing the patterns of protection of importables and exportables shows that there still remains much that might be done in the LAC region to reduce the protection of import-competing crops and the taxation of the export-oriented sector. For the agriculture sector as a whole, the latest data for 2000-2004 might indicate misleadingly that governments are not intervening in price signals. But looking at importables and exportables separately would reveal that there is yet much to be done to remove a still strong anti-export bias. Our results above likely underestimate the benefits of trade liberalization, because we are working with aggregate NRAs, an indicator that conflates importables and exportables under one category of "tradables." Unfortunately the data are not available to separate the two sectors in terms of their value-added growth patterns and perhaps their distinct impacts on poverty.

With respect to lessons for future policy development, the evolution of protection indicators shows that there has been significant policy adjustment since the mid-1980s in reducing the degree of anti-export bias. There has been a movement toward a more-neutral trade regime, but this reduction in anti-export bias has been due mainly to the reduction of taxes on exportables. Notably in the region, Argentina, Dominican Republic, Mexico and Nicaragua still tax exportables, and (except for

Argentina, where we have no information) they offer high levels of protection to importables. Evidently, there is much room remaining for adjusting trade policy as it affects agriculture, particularly in terms of reducing the protection of import-competing crops. For example, there are very high positive protection rates for importables in the cases of Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua.

From our analysis, a result from moving toward a neutral regime by reducing taxation on agriculture is to increase the sector's growth rate. Reducing taxation on exports and reducing protection for imports would raise the incentives to expand the production of exports even further, which —to the extent the two subsectors compete for domestic resources— would lead to faster growth of the agricultural sector as a whole. What would be the precise effect on poverty of this faster growth cannot be determined a priori, because the nature of pro-poor growth depends on the labor intensity —especially the unskilled labor intensity— of importables to exportables throughout the value chain. These labor intensities vary by activity, but as a general rule, they are higher in the case of fruits and vegetables and lower for field crops such as soy and wheat.

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Annex

TABLE A.1
LIST OF COUNTRIES IN THE DATA SET OF THE PROJECT AGRICULTURAL DISTORTIONS (SEE ANDERSON AND VALDES, 2008), BY REGION

Africa	Asia	Latin America	ECA	HIC
Benin	Bangladesh	Argentina	Bulgaria	Australia
Burkina Faso	China	Brazil	Czech Republic	Austria
Cameroon	India	Chile	Estonia	Canada
Chad	Indonesia	Colombia	Hungary	Denmark
Cote d'Ivoire	Korea, Rep.	Dominican Republic	Kazakhstan	Finland
Egypt, Arab Rep.	Malaysia	Ecuador	Latvia	France
Ethiopia	Pakistan	Mexico	Lithuania	Germany
Ghana	Philippines	Nicaragua	Poland	Iceland
Kenya	Sri Lanka	Paraguay	Romania	Ireland
Madagascar	Thailand	Uruguay	Russian Federation	Italy
Mali	Vietnam		Slovak Republic	Japan
Mozambique			Slovenia	Netherlands
Nigeria			Turkey	New Zealand
Senegal				Norway
South Africa				Portugal
Sudan				Spain
Tanzania				Sweden
Togo				Switzerland
Uganda				United Kingdom
Zambia				United States

Source: Authors'elaboration.

TABLE A.2A
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

	Low RRA growth		High RRA growth	
Low RRA	Brazil	4.1	Argentina	2.1
	Cameroon	3.1	China	4.3
	Cote d'Ivoire	4.8	Egypt	3.2
	Ghana	1.7	India	2.8
	Madagascar	2.0	Pakistan	3.7
	Mozambique	0.5	Sri Lanka	2.7
	Uganda	6.5	Tanzania	3.6
	Zambia	2.9		
	Zimbabwe	4.5		
	Total	3.1	Total	3.2

(continued)

Table A.2A (concluded)

	Low RRA growth		High RRA growth	
	Dominican Rep.	2.1	Bangladesh	1.9
	Kenya	3.7	Chile	1.9
	Nigeria	1.8	Colombia	2.8
	Senegal	3.8	Ecuador	2.2
	South Africa	2.8	Indonesia	3.9
High RRA	Sudan	3.1	Korea,. Rep.	4.6
			Malaysia	5.1
			Mexico	4.1
			Philippines	3.3
			Thailand	4.4
	Total	2.8	Total	3.4

Source: Authors'elaboration.

TABLE A.2B
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985. SIMPLE MEDIANS OF PROTECTION LEVELS BUT MEDIAN OF PROTECTION CHANGES CONDITIONAL ON AVERAGE PROTECTION LEVEL

	Low RRA growth		High RRA growth	
	Brazil	4.1	Argentina	2.1
	Cameroon	3.1	China	4.3
	Cote d'Ivoire	4.8	Egypt	3.2
	Ghana	1.7	India	3.8
Low RRA	Madagascar	2.0	Pakistan	3.7
	Mozambique	0.5	Sri Lanka	2.7
	Uganda	6.5	Tanzania	3.6
	Zambia	2.8	Zimbabwe	4.5
	Total	2.9	Total	3.4
	Colombia	2.8	Bangladesh	1.9
	Dominican Rep.	2.1	Chile	1.9
	Kenya	3.7	Ecuador	2.2
	Nigeria	1.8	Indonesia	3.9
High RRA	Senegal	3.8	Korea, Rep.	4.6
	South Africa	2.6	Malaysia	5.1
	Sudan	3.1	Mexico	4.1
	Thailandia	4.5	Philippines	3.3
	Total	3.0	Total	3.4

Source: Authors'elaboration.

TABLE A.3A
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1986-2005. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

	Low RRA growth		High RRA growth	
Low RRA	Argentina	2.6	Bangladesh	2.7
	Cote d'Ivore	2.7	Brazil	3.8
	Sri Lanka	0.8	Cameroon	2.8
	Zimbabwe	0.2	China	4.7
			Ethiopia	5.3
			Indonesia	3.5
			Madagascar	1.5
			Mozambique	3.0
			Pakistan	3.8
			Sudan	3.4
			Tanzania	1.8
			Zambia	4.1
	Total	1.6	Total	3.3
High RRA	Chile	4.2	Colombia	2.8
	Ecuador	3.7	Dominican Rep.	1.4
	Egypt	4.3	Ghana	5.9
	India	2.8	Kenya	2.8
	Korea, Rep.	1.7	Vietnam	5.1
	Malaysia	4.3		
	Mexico	2.1		
	Nicaragua	3.0		
	Nigeria	5.7		
	Philippines	3.1		
	Senegal	3.2		
	South Africa	1.9		
	Thailand	2.1		
	Total	3.2	Total	3.6

Source: Authors' elaboration.

TABLE A.3B
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (RRA), AFRICA, ASIA AND LATIN AMERICA, 1986-2005. SIMPLE MEDIANS OF PROTECTION LEVELS BUT MEDIAN OF PROTECTION CHANGES CONDITIONAL ON AVERAGE PROTECTION LEVEL

	Low RRA growth		High RRA growth	
Low RRA	Argentina	2.6	Brazil	3.8
	Bangladesh	2.7	Cameroon	2.8
	Cote d'Ivore	2.7	China	4.7
	Indonesia	3.5	Ethiopia	5.3
	Madagascar	1.5	Mozambique	3.0
	Pakistan	3.8	Sudan	3.4
	Sri Lanka	0.8	Tanzania	1.8
	Zambia	4.1		
	Zimbabwe	0.2		
	Total	2.4	Total	3.4

(continued)

Table A.3B (concluded)

	Low RRA growth		High RRA growth	
High RRA	Chile	4.2	Colombia	2.8
	Egypt	4.3	Dominican Rep.	1.4
	India	2.8	Ecuador	3.7
	Korea	1.7	Ghana	5.9
	Malaysia	4.3	Kenya	2.8
	Nigeria	5.7	Mexico	2.1
	Philippines	3.1	Nicaragua	3.0
	Senegal	3.2	Thailand	2.1
	South Africa	1.9	Vietnam	5.1
	Total	3.5	Total	3.2

Source: Authors' elaboration.

TABLE A.4A
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (NRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

	Low RRA growth		High RRA growth	
Low RRA	Brazil	4.1	Argentina	2.1
	Cameroon	3.1	China	4.3
	Cote d'Ivoire	4.8	Ecuador	2.2
	Dominican Rep.	2.1	Egypt	3.2
	Ghana	1.7	Senegal	3.8
	Madagascar	2.0	Sri Lanka	2.7
	Mozambique	0.5	Tanzania	3.6
	Sudan	3.1	Thailand	4.4
	Zambia	2.9	Zimbabwe	4.5
	Total	2.7	Total	3.4
High RRA	Burkina Faso	3.7	Bangladesh	1.9
	Chile	1.9	Benin	3.0
	Kenya	3.7	Chad	1.2
	Mali	2.6	Colombia	2.8
	Nigeria	1.8	India	2.8
	Pakistan	3.7	Indonesia	3.9
	South Africa	2.6	Korea, Rep.	4.6
	Togo	2.2	Malaysia	5.1
	Uganda	6.5	Mexico	4.1
			Philippines	3.3
	Total	3.0	Total	3.3

Source: Authors' elaboration.

TABLE A.4B
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (NRA), AFRICA, ASIA AND LATIN AMERICA, 1960-1985. SIMPLE MEDIANS OF PROTECTION LEVELS BUT MEDIAN OF PROTECTION CHANGES CONDITIONAL ON AVERAGE PROTECTION LEVEL

	Low RRA growth		High RRA growth	
Low RRA	Brazil	4.1	Argentina	2.1
	Cameroon	3.1	China	4.3
	Cote d'Ivoire	4.8	Ecuador	2.2
	Dominican Rep	2.1	Egypt	3.2
	Ghana	1.7	Senegal	3.8
	Madagascar	2.0	Sri Lanka	2.7
	Mozambique	0.5	Tanzania	3.6
	Sudan	3.1	Thailand	4.4
	Zambia	2.9	Zimbabwe	4.5
	Total	2.7	Total	3.4
High RRA	Benin	3.0	Bangladesh	1.9
	Burkina Faso	3.7	Chad	1.2
	Chile	1.9	Colombia	2.8
	Kenya	3.7	India	2.8
	Mali	2.6	Indonesia	3.9
	Nigeria	1.8	Korea,Rep.	4.6
	Pakistan	3.7	Malaysia	5.1
	South Africa	2.6	Mexico	4.1
	Togo	2.2	Philippines	3.3
	Uganda	6.5		
	Total	3.0	Total: 3.3	3.3

Source: Authors'elaboration.

TABLE A.5A
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (NRA), AFRICA, ASIA AND LATIN AMERICA, 1986-2005. SIMPLE MEDIANS OF PROTECTION LEVELS AND CHANGES

	Low RRA growth		High RRA growth	
Low RRA	Argentina	2.6	Brazil	3.8
	Benin	5.1	China	4.7
	Cote d'Ivoire	2.7	Dominican Rep	1.4
	Indonesia	3.5	Ethiopia	5.3
	Togo	3.4	Ghana	5.9
	Zimbabwe	0.2	Madagascar	1.5
			Nicaragua	3.0
			Pakistan	3.8
			Sudan	3.4
			Tanzania	1.8
			Thailand	2.1
			Vietnam	5.1
			Zambia	4.1
	Total	2.9	Total	3.5

(continued)

Table A.5A (concluded)

	Low RRA growth		High RRA growth	
	Bangladesh	2.7	Burkina Faso	5.3
	Chad	4.1	Cameroon	2.8
	Chile	4.2	Colombia	2.8
	Ecuador	3.7	Mali	4.2
	Egypt	4.3	Mexico	2.1
	India	2.8	Mozambique	3.0
	Kenya	2.8		
High RRA	Korea	1.7		
	Malaysia	4.3		
	Nigeria	5.7		
	Philippines	3.1		
	Senegal	3.2		
	South Africa	1.9		
	Sri Lanka	0.8		
	Total	3.2	Total	3.4

Source: Authors'elaboration.

TABLE A.5B
AVERAGE ANNUAL RATE OF GROWTH (%) IN AGRICULTURAL PRODUCTION ACCORDING TO AVERAGE LEVELS OF PROTECTION AND AVERAGE CHANGES IN LEVELS OF PROTECTION (NRA), AFRICA, ASIA AND LATIN AMERICA, 1986-2005. SIMPLE MEDIANS OF PROTECTION LEVELS BUT MEDIAN OF PROTECTION CHANGES CONDITIONAL ON AVERAGE PROTECTION LEVEL

	Low RRA growth		High RRA growth	
	Argentina	2.6	China	4.7
	Benin	5.1	Dominican Rep.	1.4
	Brazil	3.8	Ethiopia	5.3
	Cote d'Ivoire	2.7	Ghana	5.9
	Indonesia	3.5	Madagascar	1.5
Low RRA	Nicaragua	3.0	Sudan	3.4
	Pakistan	3.8	Tanzania	1.8
	Thailand	2.1	Vietnam	5.1
	Togo	3.4	Zambia	4.1
	Zimbabwe	0.2		
	Total	3.0	Total	3.6
	Bangladesh	2.7	Burkina Faso	5.3
	Chile	4.2	Cameroon	2.8
	Egypt	4.3	Chad	4.1
	India	2.8	Colombia	2.8
	Kenya	2.8	Ecuador	3.7
High RRA	Korea, Rep.	1.7	Malaysia	4.3
	Nigeria	5.7	Mali	4.2
	Philippines	3.1	Mexico	2.1
	Senegal	3.2	Mozambique	3.0
	Sri Lanka	0.8	South Africa	1.9
	Total	3.1	Total	3.4

Source: Authors'elaboration.

TABLE A.6
PANEL DATA REGRESSION (FIXED EFFECTS) EXPLAINING THE GROWTH RATE OF AGRICULTURAL VALUE ADDED: CROSS-COUNTRY, 1960-2000, 5-YEAR AVERAGES

Dependent variable: average % change in agricultural value added over 5 year intervals. See Appendix Table 1 for countries included in the data set	Estimated coefficient	Standard error	p-value
Lagged RRA averaged over 5 years	0.5366	1.0173	0.599
Lagged average change in RRA	**6.0461**	**3.2912**	**0.068**
Lagged average ag value added.	**-6.9521**	**1.8254**	**0.000**
Income per capita	-2.0486	1.4871	0.170
Initial output gap (log[actual GDP/potential GDP])	2.4368	8.4853	0.774
Education - log of secondary enrollment rate	-0.2887	1.1868	0.808
Financial depth (log of credit to the private sector over GDP)	-0.1395	0.6653	0.834
Trade openness index (residual of regression of trade over GDP on several variables)	-0.6756	1.0597	0.525
Government burden (log of government consumption over GDP)	0.6910	1.0889	0.527
Public infrastructure (log of phone lines per 1000 population)	1.0969	0.8816	0.215
Governance index (first principal component of ICRG indicators)	0.1326	0.3328	0.691
Lack of price stability (log of inflation rate+100)	-0.2381	0.8045	0.768
Cyclical volatility (standard deviation of output gap)	2.4109	16.4630	0.884
Real exchange rate overvaluation (log of real exchange rate over-valuation index)	-0.9232	0.7274	0.206
Systemic banking crises (fraction of period during which the country had a systemic crisis)	-0.6402	0.7659	0.404
Terms-of-trade shocks (terms of trade growth)	0.0042	0.0033	0.209
Period dummies (reference 1996-2000):			
1966-1970	-3.5684	1.6287	0.030
1971-1975	-2.9834	1.4235	0.038
1976-1980	-2.3709	1.1769	0.046
1981-1985	-1.7654	0.9836	0.075
1986-1990	-1.4407	0.7694	0.063
1991-1995	-1.8295	0.5961	0.003
_Constant	178.8948	39.5942	0.000

Source: Authors'elaboration.
Note: unbalanced panel, fixed-effects (within) regression, number of observation = 236, number of groups = 46, R-sq: within = 0.225, between = 0.956, overall = 0.028, F(22,173)= 2.19(p-value = 0.0028).