Online Appendix for:
Agricultural Distortions, Structural Change, and Economic Growth

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February 22, 2010

This Online Appendix is organized as follows. In Section 1 below we provide a discussion of the relationship between the nominal rate of protection (NRP) of agriculture, and nominal rate of assistance (NRA) to agriculture measures reported in the Anderson and Valenzuela (2008). We conclude that these measures are conceptually very similar, and are highly correlated across the set of countries that overlap in both samples.

In Section 2 we compare the relations between NRP and NRA on the one hand and several economic outcome measures on the other hand. These measures are per capita income levels, per capita income growth rates, and agricultural TFP growth rates. For the set of countries that overlap in both samples we find that bivariate correlations between these economic outcome measures and both the old and new agricultural distortions measures are very similar. Therefore, we conclude that the broader themes that motivate our economic analysis of the link between agricultural distortions and economic growth are equally relevant for the Anderson and Valenzuela (2008) data set.

In Section 3 we discuss how we construct the new extended data set to investigate the relationship between agricultural distortions and economic growth within a multivariate analysis. Here we also present the descriptive statistics corresponding to this extended sample.

In Section 4 we inspect the mechanisms by relating structural change to agricultural taxation. These findings were briefly discussed in the paper, but were omitted for space limitations.

1 Distortions: The Original versus the New Data Set

We can compare the NRP and NRA in several ways. The first is *conceptual.* In the original version of the paper we used the nominal rate of agricultural protection (NRP) as our measure of agricultural distortions. NRP is defined as the percentage by which the local producer price exceeds (or falls below) the border price. Before the World Bank study, this had been the conventional measure of direct policy interventions in agriculture; see, e.g., Anderson and Hayami (1986) and Krueger et al. (1992). The recent World Bank study builds on this tradition, and offers a more general measure of agricultural distortions called nominal rate of assistance to agriculture (NRA). We emphasize that the NRA includes the border market price distortions at the product level (BMS), as well as domestic market price distortions and

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non-product-specific assistance. So, we conclude that from a conceptual standpoint NRP and NRA are closely related.

The second dimension of comparison is *data quality*. In the original version of our paper we built on the seminal work of Anderson and Hayami (1986) and Krueger et al. (1992), which is itself a World Bank study. At the time, these were the "best" estimates available to us, and we did not undertake any primary data collection. One important feature of these estimates is their "bottom-up" approach, aggregating from specific product prices to an aggregate measure of distortions, with weights applied to a basket of commodities. The most recent World Bank project had immensely more resources, and possibly had access to more data than that were available to earlier researchers. For example, the Anderson and Valenzuela (2008) project constructs an important variable called the *relative* rate of assistance to agriculture (RRA). This variable is highly relevant because it measures agricultural distortions relative to distortions against other traded sectors in the economy. That being said, even the World Bank study is subject to data limitations. For example, in about 30 percent of the cases, the most recent World Bank study uses extrapolations and imputations for products on which there are no reliable data on prices or quantities (Anderson and Valenuzela, 2008). Moreover, we are not aware of any study which concludes that NRP is flawed and is superceded by the new data set. So, we conclude that *a priori* there is little reason to believe that the NRP is an inferior measure of agricultural distortions.

Another related dimension is the *correlation* between the NRP we used in the original paper and the three alternative distortions measures that come from the recent World Bank study; NRA, RRA, and BMS, with BMS being conceptually closest to our NRP measure.* Here we can be more specific. Table 1 shows the correlations across these measures for the overlapping countries in the two data sets, and we summarize our findings as follows.

Table 1: Correlations across different measures of agricultural distortions

	NRP(60-72)	NRA(60-75)	RRA(60-75)	NRA(76-90)	RRA(76-90)	BMS(76-90)
NRP(76-84)	0.834			0.814	0.812	0.823
NRA(60-75)	0.759			0.829		
RRA(60-75)	0.668	0.937	1		0.849	
BMS(60-75)	0.750	0.995	0.946			0.833
NRA(76-90)				1	0.986	0.983
RRA(76-90)					1	0.972

Notes: NRP is nominal rate of agricultural protection as described in the text. NRA is nominal rate of assistance to agriculture. RRA is relative rate of assistance to agriculture. BMS is border market price support for covered agricultural goods. The last three measures are from Anderson and Valenzuela (2008). For each correlation the number of observations is as follows: NRA(60–75)=39; NRA(76-90)=44; RRA(60–75)=37; RRA(76–90)=42; BMS(60–75)=39; BMS(76-90)=44. The number of countries on which we have NRP data is 47.

*The World Bank study contains many other measures. However, after carefully studying the database we concluded that the vast majority of the economically significant information about agricultural distortions was concentrated in these three measures.

1. *Correlations over periods.* In the original version of the paper we had measures of NRP for two periods: 1960–1972 and 1976–1984. Again we were constrained by what was available to us then. We had concluded that the country NRPs were highly persistent across these two periods (correlation 0.83). In the most recent World Bank data set for roughly comparable periods, the correlation is 0.83 for NRA, 0.85 for RRA and 0.83 for BMS. So, our finding that NRP is highly persistent over time is consistent with the most recent data base.

2. *Correlations between the old and new measures.* For the period from 1960 to mid-1970s the correlation between the NRP and NRA is 0.76, and for the period from mid-1970s to 1980s is .81. We think that these are high correlations. Corresponding correlations for RRA are 0.67 and 0.81, and for BMS they are 0.75 and 0.82. Bearing in mind that BMS is conceptually the closest measure to NRP, it is reasonable to conclude that previous studies provide a picture of cross-country variation in agricultural distortions that is highly correlated with the most recent World Bank data.

3. *Correlations across new measures.* For those countries that overlap with the original data set, the three new measures that are included in the most recent World Bank study are also highly correlated among themselves. (We present the corresponding correlations for the full sample of countries in the new data set below.) For the first period from 1960 to 1975, these pairwise correlations are above 0.94, and for the period from 1976 to 1990 they are above 0.97. Thus, at least in terms of cross-country variation in agricultural distortions, both in absolute and relative terms, border market prices are a remarkably good indicator of agricultural distortions. This suggests that the basic economic rationale advanced for the NRP measure that we used in the original paper is consistent with the most recent evidence.

One further dimension of comparison is country and time coverage. In the original version of the paper, we had data on 47 countries and for two non-overlapping periods: 1960–1972 and 1976–1984 (see the Data Appendix of the paper for exact periods for each country). Not surprisingly, the new data set has advantages in both dimensions: Its country coverage is wider and observations are updated for some countries until about 2007. Table S1 shows the country coverage in the original data set and in the new data set for distinct measures of agricultural distortions. For the recent World Bank Data set, we denote by "X" those country–decade observations for which we have information on NRA, RRA and BMS. Similarly, we denote by "N" those country-decade observations where we have information on NRA and BMS only. The country coverage in the World Bank study changes over time: very few countries have data dating back to 1955, and the coverage increases over time. Specifically, we did not have data on the former Soviet republics and many former centrally planned economies in Europe and Asia. The new World Bank data base has information on these countries, but these data start toward the end of period.

Considering the widest country coverage for all the measures, we have the following comparison of the two data sets. The original data set has 47 countries for the entire sample period (from 1960 to mid-1980s). The new data set has fewer (44) observations for the 1960s, has a slightly higher number of observations for the 1970's (54), and significantly more number of observations for the 1980s and beyond. Notably, there are several countries that were included in the data set we used in the original version of the paper, but are not in the recent World Bank study (e.g., Morocco). Given that the original studies we used to collect the NRP data were conducted in the 1980s and early 1990s, we think that the country coverage in the original data set is rather remarkable. At the same time, the new data set allows us to extend the analysis to about 60 countries toward the end of our sample period.

2 Bivariate Correlations: the Original and New Data Sets

In the paper, we motivate the study of agricultural distortions and their impact on economic growth through a range of bilateral correlations. These demonstrated that (i) on a (roughly) decade by decade basis the NRP was highly persistent, (ii) the NRP was not highly correlated with subjective measures of trade openness, (iii) the NRP was positively correlated with total factor productivity growth rate (discriminating countries had on average lower TFP growth), (iv) the NRP was weakly positively correlated with initial level of GDP per capita, and (v) the NRP was positively correlated with subsequent economic growth.

We provide a comparison of these correlations based on the original and new measures of agricultural distortions. For this comparison, we continue to use the sample of countries that overlap in the old and new data sets. (So, the bivariate correlations we show below are not for the full sample of countries that is available to us in the new data set—although this is not a significant issue for these bivariate correlations because the sample of countries overlap significantly in the early decades of our data sets.) Our (and other scholars') views about the impact of agricultural distortions on economic outcomes were critically influenced by such correlations and by analysis based on the original distortions measures (and based on the countries that had consistent agricultural distortions data). Since the original data had so much influence on our perceptions concerning the growth-retarding impact of discrimination against agriculture, it is useful to compare these correlations from a historical standpoint.

Figure 1 panels a) and b) show the relation between a subjective measure of international trade orientation and agricultural distortions, as well as persistence of agricultural distortions over time. In the previous version of our paper, we had concluded based on the NRP that trade orientation was not highly related to the degree of agricultural distortions: both outward and inward oriented countries implemented economic policies that distorted agricultural incentives. A comparison of panels a) and b) reveals that this conclusion does not change when we use nominal rate of assistance (NRA) to agriculture as our measure of distortions. The figure also shows that from 1960 to 1990 economic policies toward agriculture varied considerably across countries, from heavy discrimination to significant support, and has been highly persistent. The correlation coefficients across periods are about 85 percent (see Table 1).

Figure 1 panels c) and d) show the relation between the two measures of distortions and the TFP

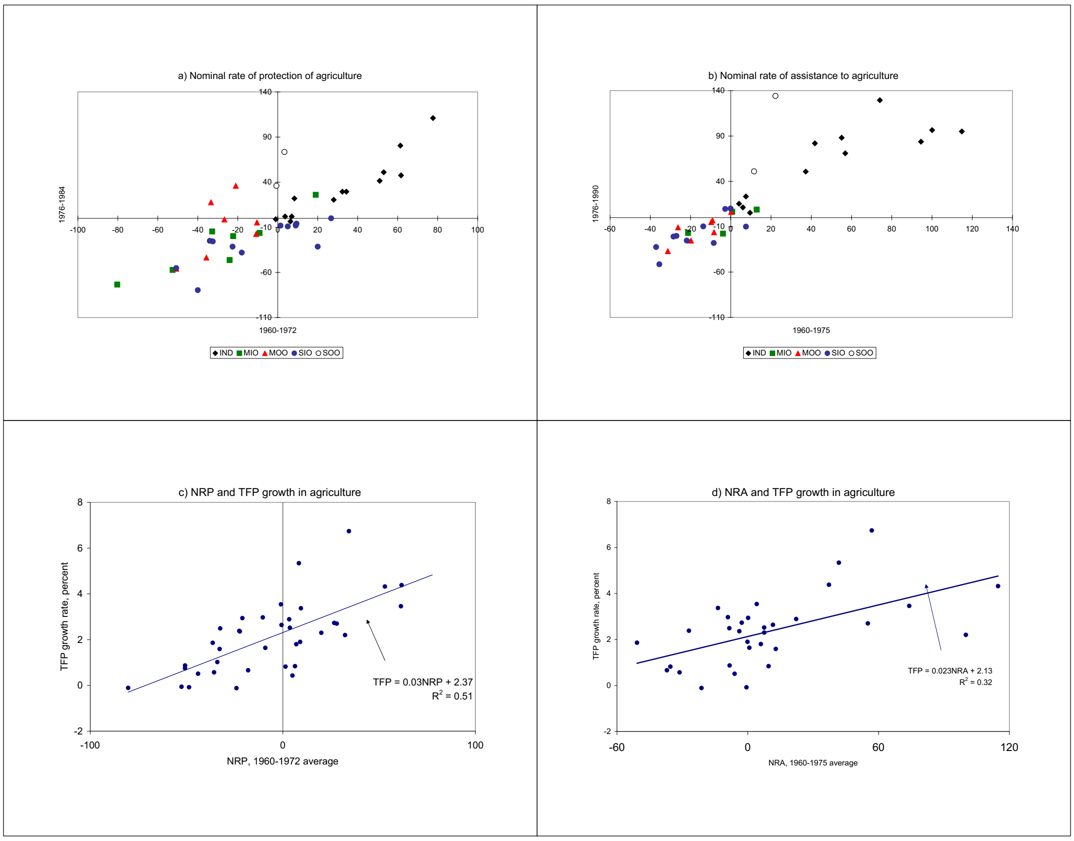

Figure 1: Agricultural distortions, trade orientation, policy persistence, and agricultural TFP growth

Notes: NRP is agricultural nominal rate of protection of agriculture. NRA is nominal rate of assistance to agriculture. TFP is total factor productivity. The number of countries N varies across panels: a) $N = 42$, b) $N = 36$, c) $N = 37$, d) $N = 34$. Legend: IND = industrial market economy; MIO = moderately inward oriented developing country; MOO = moderately outward oriented developing country; SIO = strongly inward oriented developing country; SOO = strongly outward oriented developing country.
Sources: For NRP see the data appendix. NRA is from Anderson and Valenzuela (2008). For outward orientation see World Bank (1987) and the data appendix. TFP growth rates are from Martin and Mitra (2001) and Fulginiti et al. (2004).

growth rate in agriculture. Consistent with the smaller samples of Fulginiti and Perrin (1993, 1999), we had documented a positive relationship between agricultural protection (NRP) and the TFP growth rate in agriculture (panel c). The nominal rate of assistance to agriculture from Anderson and Valenzuela (2008) is also positively correlated with the agricultural TFP growth rate, although the sample size is smaller and the correlation is slightly lower.

Figure 2 shows the bivariate relationships between the NRP and the NRA on the one hand, and income per capita and income per capita growth on the other hand. Panels a) and c) demonstrate, using both the NRP and NRA, the well-known pattern that economic policies tend to discriminate against agriculture in developing countries and tend to protect agriculture in industrial countries. In the original version of our paper we had observed “a strong negative relationship between agricultural taxation and economic

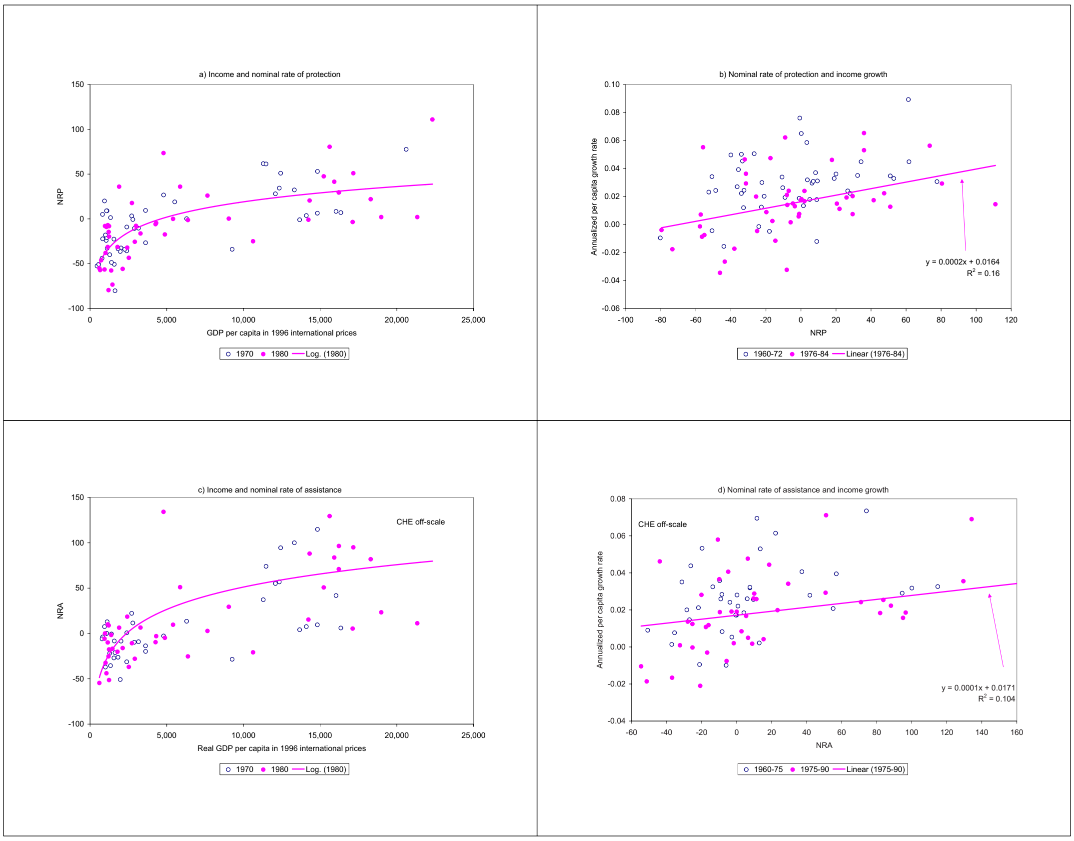

Figure 2: Agricultural distortions, income per capita and income per capita growth

Notes: NRP is agricultural nominal rate of protection of agriculture. NRA is nominal rate of assistance to agriculture. GDP is gross domestic product in 1996 international prices (PPP). The number of countries N varies across panels and across periods within panels: in panels a) and b) $N = 47$, in panels c) and d) $N = 39$ for the period 1960–1975 and $N = 44$ for the period 1976–1990.
Sources: For NRP see the data appendix. NRA is from Anderson and Valenzuela (2008). Income per capita are from Penn World Tables mark 5.6 and World Development Indicators (for former West Germany and Sudan).

growth.” This relationship continues to hold when we use nominal rate of assistance to agriculture as our measure of agricultural distortions, though it is slightly weaker for the period from 1976 to 1990.

We therefore conclude that the nominal rate of protection we had compiled from the seminal works of Anderson and Hayami (1986) and Krueger et al. (1992) and the nominal rate of assistance from the new World Bank data set are consistent with regard to the potential consequences of agricultural distortions for economic growth and structural change.

The next two figures are the counterparts of Figures 1 and 2 using relative rate of assistance or border market support instead of either NRP or NRA.

In order investigate whether these conclusions carry over to the multivariate regression analysis we proposed in the original version, we next discuss the construction of the new data set.

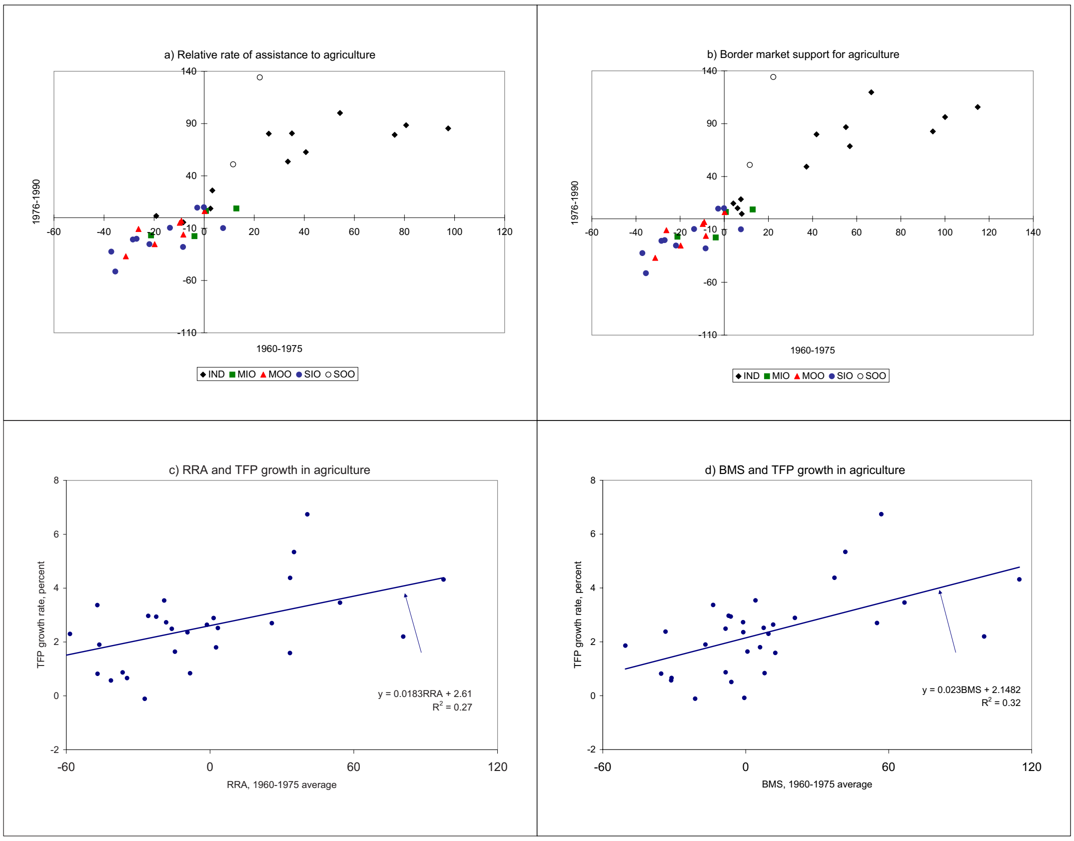

Figure 3: Agricultural distortions, trade orientation, policy persistence and agricultural TFP growth

Notes: RRA is relative rate of assistance to agriculture. BMS is border market support to agriculture.
Source: See the paper for data sources.

3 The New Data Set

3.1 Construction of the Variables

In the previous sections, we compared the agricultural distortions measures from the old and new data sets for the set of countries that overlap in both samples. However, the new data set has observations on more countries (see Section 1 above) especially towards the end of the sample period in 1980s and 1990s. This calls for an extension of our original data set. Moreover, in the original version of the paper we were constrained by the availability of data, and thus formed two periods; 1960–1972 and 1976–1984. The new data set has longer time series available. This thus calls for a further extension of the original data set.

Extending the data set in both of these dimensions requires us to make certain decisions. We list the principle choices and emerging data limitations next.

1. We drop the observations from the 1950s and 2000s. Observations in the recent World Bank data

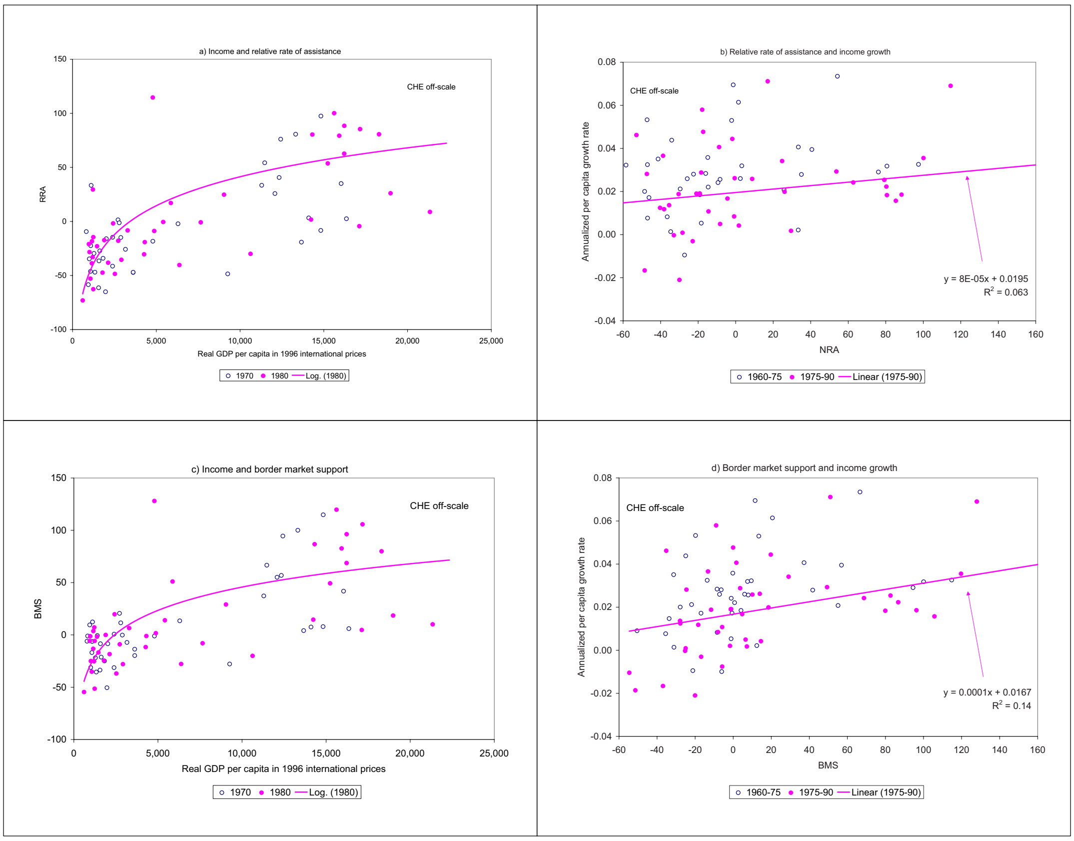

Figure 4: Agricultural distortions, income per capita and income per capita growth

Notes: RRA is relative rate of assistance to agriculture. BMS is border market support to agriculture.
Source: See the paper for data sources.

start in 1955 but cover very few countries. We exclude data on 2000s because we have limited data on income per capita in international prices and other variables.

2. We exclude the former Soviet Republics and former central planned Eastern European countries from the analysis. The data on these countries start only halfway into the 1990s, and these few observations are unlikely to be informative about the relationship between agricultural distortions and long-term economic growth on which we focus in this paper.

3. Our time series data start in 1960 and end in 2000. We divided this period into four subperiods: 1960–1970, 1970–1980, 1980-1990, and 1990-2000.

4. The gross enrollment ratio for primary education is one of the conditioning variables in our convergence regressions. These data (from Barro and Lee) end in 1985.

5. Given the extended country coverage, we expanded the coverage for the the variables (i) the real GDP per capita in constant prices, (ii) agriculture value added per worker, (iii) share of agriculture

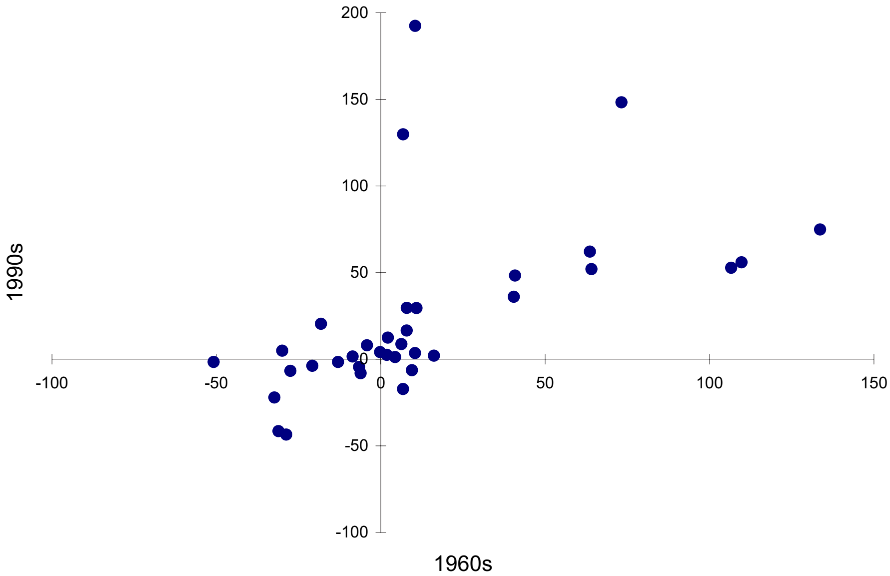

Figure 5: Nominal rate of assistance to agriculture (%), 1960s versus 1990s.

Note: The number of countries N is 44 for the 1960s.
Source: Anderson and Valenzuela (2008).

in employment, and (iv) the parallel market premium. We have revised the entries for these variables in the Data Appendix in the paper accordingly.

One salient feature of the data is that we observe a significant convergence in agricultural policies starting after the 1990s. Figure 5 demonstrates this trend using nominal rate of assistance to agriculture data for 44 countries from 1960s and 1990s (the results are similar for RRA and BMS). While the number of countries that have distorted their agricultural sectors either by protection or discrimination has decreased over time, there is an especially stark decline in the number of those countries that discriminate against agriculture. By contrast, in several cases we have dramatic increases in agricultural protection (e.g., in South Korea and Taiwan). Overall, however, it is reasonable to speak of an agricultural policy convergence since 1990s, and the information from that decade onward may not be as informative in identifying the impact of agricultural distortions on economic growth and structural change.

3.2 Summary Statistics

In the paper we report descriptive statistics on the NRP, on the economic structure of those countries included in the sample, and other price distortion variables. In Table 3 below we show the correlations among NRA, RRA and BMS for the extended sample, as well as the cross correlations between these agricultural distortions variables and the relative price of investment, parallel market premium (which have in the previous studies been used as price distortions variables) and trade connectedness. In Table 4 we present the corresponding statistics for NRA, RRA, BMA, as well as for economic structure and other price distortions for the extended sample.

Overall, in the extended sample, the cross-correlations are very high among the three agricultural distortions measures we consider. As a result, we focus our empirical analysis in the paper on the border market support measure, which is closest in concept to the NRP used in our original analysis. We have also estimated our convergence regressions using both the NRA and the RRA, and find that the broader conclusions of the analysis are identical (see the Online Appendix).

3.3 Regression Results with NRA and RRA

These regressions are distortthr09.out reported in the text file (available on this website) and are grouped as follows

- NRA = nominal rate of assistance to agriculture
- RRA = relative rate of assistance to agriculture
- BMS = border market support for agriculture

Regressions are further labeled by letters

- a: NRA and the period 1960–2000 (by decades)
- b: NRA and the period 1960–1990
- c: RRA and the period 1960–2000
- d: RRA and the period 1960–1990
- e: BMS and the period 1960–2000
- f: BMS and the period 1960–1990

3.3.1 Output of 'distortthr09.out'

Table 2 in the paper reports the threshold regression results of specification 5 (output per capita).

Table 3 in the paper reports the threshold regression results of specification 6 (L_M).

Figure 5 in the paper displays the threshold regression results for specifications 5-8.

3.3.2 Output of 'distortgr09.out'

These are the sensitivity results reported in the paper.

Table 2 in the paper reports the threshold regression results of the sensitivity specification (output growth) 1, 5 and 7.

Table 3 in the paper reports the threshold regression results of the sensitivity specification (L_M) 2, 6 and 8.

4 Agricultural Taxes and Structural Change

At least since Kuznets (1966), economists have extensively documented the strong negative association between real income per capita and the share of labor in agriculture (see also Chenery and Syrquin, 1975). Although we do not report in the paper, Figure 6 shows that these patterns also hold in our data set. The common interpretation of these patterns is that countries that have become rich did so by reallocating labor out of agriculture. However, there is much less systematic evidence about how such a reallocation of labor has been possible for some countries, but not for others.

Our empirical analysis relates sectoral reallocation of labor out of agriculture $\hat{L}_{Mt}$ to the three principle drivers of structural change identified in the paper: the capital accumulation effect (as captured by the investment rate), the subsistence consumption effect (as captured by the ratio of agricultural to non-agricultural employment at the beginning of the sample period, $(1 - L_{M0})/L_{M0}$), and the relative productivity effect.[†] Next we provide the details for the estimating equation.

4.1 Derivation of the Structural Change Regressions

Here, for convenience, we reproduce the key equation in the text, which gives the share of labor in the M-sector as

$$L_{Mt} = [1 + p(z_t)]^{-1} \times [p(z_t)s_{Mt} + (1 - s_{At})], \tag{1}$$

where the *subsistence consumption* effect, which captures the influence of non-homothetic preferences, is

$$s_{At} = \frac{\gamma_A}{(1 - \tau_A)Y_{At}/L_{At}}, \tag{2}$$

the *relative productivity* effect on the employment share of non-agriculture is

$$p(z_t) = \left(\frac{1 - \eta}{\eta}\right)\left(\frac{b}{1 - \tau_A}\right)^{1-\nu} z_t(\tau_A)^{1-\nu}, \tag{3}$$

and the *capital accumulation* effect, or the influence of the rate of (gross) investment on the employment share of non-agriculture, is

$$s_{Mt} = \frac{I_t}{Y_{Mt}/L_{Mt}}. \tag{4}$$

[†] By considering the changes in the sectoral allocation of non-agricultural labor, rather than its level, we account for the potential influence of country-specific fixed effects, such as geography and natural endowments, on structural change.

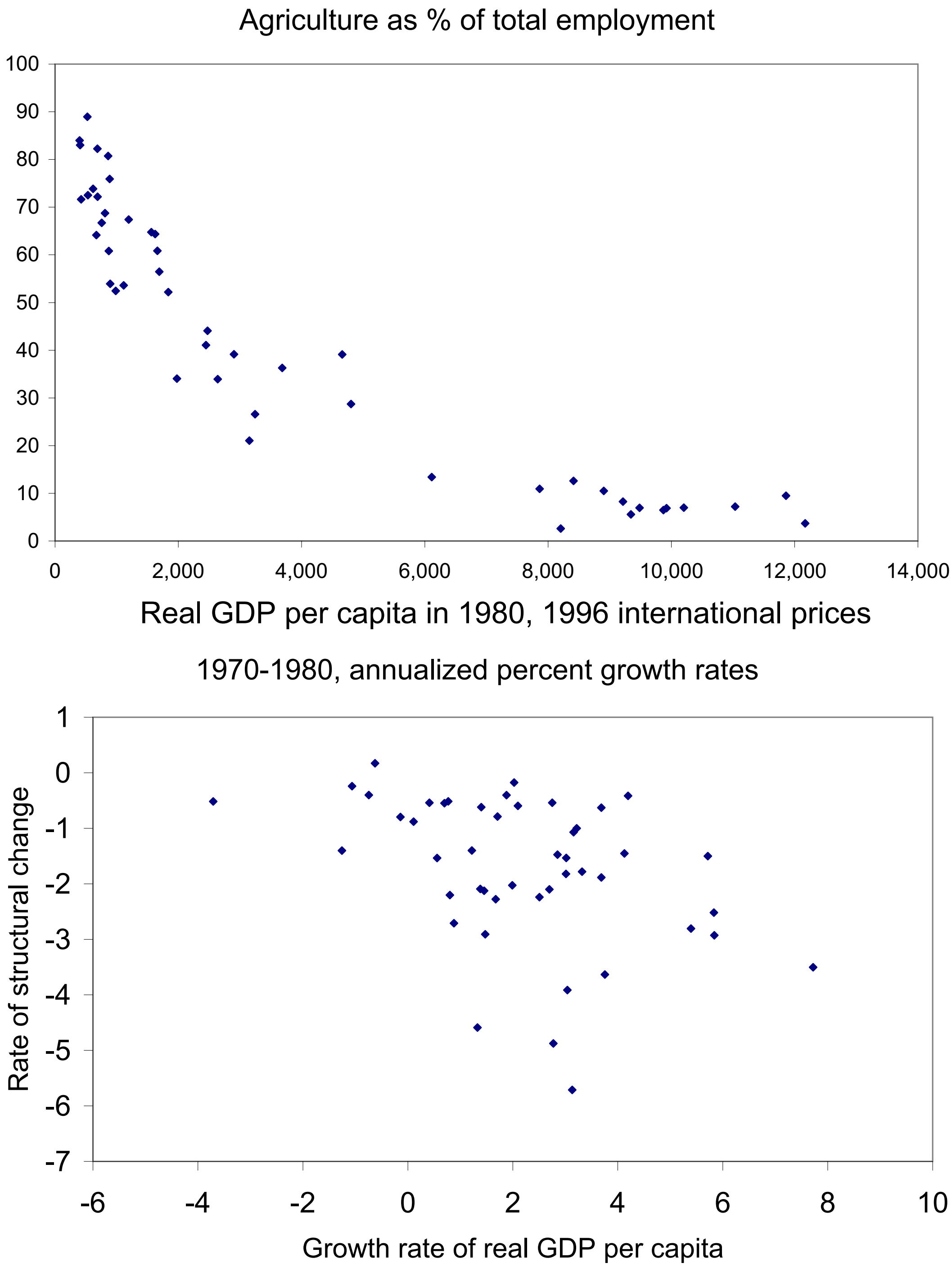

Figure 6: Structural change

Notes: The rate of structural change is measured by the annualized percent change in the share of employment in agriculture. A larger absolute value corresponds to a faster rate of reallocation of labor out of agriculture. Real GDP per capita is in constant 1996 international prices (PPP).

We begin with equation (1), which determines the sectoral allocation of labor, and measure structural change by computing the changes in the sectoral composition of employment over time:

$$(1+p_t)\hat{L}_{Mt} = \frac{p_t s_{Mt}}{L_{Mt}}\ \hat{s}_{Mt} - \left(\frac{1-L_{Mt}}{L_{Mt}}\right)\frac{s_{At}}{1-L_{Mt}}\ \hat{s}_{At} + (\nu-1)p_t g_{zt}. \tag{5}$$

Equation (5) relates structural change to distortions through capital accumulation, relative productivity, and subsistence consumption effects. We link the individual terms in equation (5) to their empirical counterparts as follows:

$$\begin{aligned}
S_M \equiv \frac{s_M}{L_M} &= \text{ratio of investment to non-agricultural output,}\\
\hat{s}_M &= \text{growth rate of "investment to non-agricultural output ratio",}\\
l_M \equiv \frac{1-L_M}{L_M} &= \text{ratio of agricultural to non-agricultural employment,}\\
S_A \equiv \frac{s_A}{1-L_M} &= \text{ratio of subsistence consumption to agricultural output,}\\
\hat{s}_A &= \text{growth rate of "subsistence consumption to agricultural output ratio",}\\
p &= \text{ratio of non-agricultural to agricultural productivity.}
\end{aligned}$$

Here we link the relative price variable p to the ratio of productivity levels (i.e., the relative non-agricultural productivity level); see equation (**??**). This variable is central to our analysis, because it allows us to gauge the influence of distortions on structural change through their indirect impact on relative prices. We refer to our measure of relative prices adjusted for agricultural taxation as "with taxes", and unadjusted actual prices as "without taxes." Because the prices that producers receive can be significantly distorted by agricultural taxation, it is important to address this price distortion effect in accounting for the impact of this taxation. We therefore compute relative prices received by producers using the ratio of "after tax" value added per worker in agriculture divided by GDP per worker. The tax rate we use for agricultural value added per worker is derived from the NRP.

Also, we label $\hat{s}_A$ and $\hat{s}_M$ as growth rates, but for an exact correspondence the denominators must be multiplied by the respective employment shares. Finally, in our data, GDP in current international prices (cgdp) is measured using a consumption-based price index, so the empirical counterpart of $p \cdot S_M$, which corresponds to the first ratio on the right-hand side of equation (5), is the ratio of investment to non-agricultural GDP:

$$p \cdot S_M = \frac{\text{investment}}{\text{cgdp} \times \text{share of non-agricultural output in GDP}}.$$

The ratio of subsistence consumption to agricultural output is difficult to measure. We interpret the influence of this variable on labor reallocation as a parameter that potentially varies across time periods, and thus estimate the following regression equation:

$$(1+p_{jt_0})\hat{L}_{Mjt} = b_{0t} + b_{1t}p_{jt_0}S_{Mjt_0}\hat{s}_{Mjt} + b_{2t}l_{Mjt_0} + b_{3t}p_{jt_0} + \varepsilon_{jt}, \tag{6}$$

where $j = 1, \ldots, J$ indexes the countries in our sample, b_{it} (where $i = 0, \ldots, 3$) are parameter coefficients that are allowed to vary across time periods, and ε_{jt} is an error term. Each time period t corresponds to a decade within which we compute the growth rates, and t_0 corresponds to the initial observation of time period t. In our sample, $t_0 = 1970, 1980$.[‡] We estimate the model using OLS and control for cross-sectional heteroscedasticity.

Re-arranging the terms, and restricting parameters give us the regression model

$$\hat{L}_{Mt} = b_0 + b_1 \text{ Investment rate}(\tau_A)_t + b_2 \left(\frac{1 - L_{M0}}{L_{M0}} \right) + b_3 \text{ Relative productivity}(\tau_A)_0 + \varepsilon_t. \qquad (7)$$

The regression model assigns specific weights to each of the drivers of structural change, and in our empirical analysis we investigate whether the estimated coefficients are consistent with the framework developed in the previous section. More importantly for our purposes, in the regression model, investment rate and relative productivity effects are directly influenced by agricultural taxation. Therefore, to assess the significance of agricultural taxation on structural change, we first estimate equation (7) using investment rates and relative productivity levels but without making any adjustments for agricultural taxation. This, under our maintained hypothesis, yields a misspecified model. We also estimate the model after constructing our variables by properly adjusting them for the presence of agricultural taxation (see appendix 4.1 for details). We then examine whether the model with agricultural taxation performs better than the model without agricultural taxes using several statistical and economic criteria.

4.2 Regression results

Table 2, panel (a), reports for regression equation (7) the parameter estimates for pooled data, and for the models with and without an adjustment for agricultural taxes. Although qualitatively both sets of estimates are similar, controlling for agricultural taxation leads to important differences that are relevant for our analysis. First, accounting for agricultural taxes leads to a considerable improvement in the in-sample goodness-of-fit as shown by an increase in the adjusted R^2. Second, with agricultural taxes the coefficient estimates on employment shares increase significantly. According to our theoretical framework, the coefficient on employment shares in part captures the influence of subsistence consumption on structural change (see appendix 4.1). Consequently, such an increase imparts a larger role to subsistence consumption effect. This result is especially relevant within our context, because, as we will discuss in detail below, the interaction between the subsistence consumption and agricultural taxation is critical for both slow structural change and slow convergence in income per capita in poor economies.

In addition, the model makes the prediction that the coefficient on the investment rate is one. The point estimates are below one for the model without distortions, and above one for the model with

[‡]We first estimated this equation using $\hat{p}$ as an interaction term for p_{jt}, but preliminary specification tests were considerably more favorable to regression model (6). Unfortunately, theoretically more appropriate relative TFP growth rates (that is, agriculture versus non-agriculture) are only available for a small set of countries and only in most cases for agriculture and manufacturing; see, e.g., Martin and Mitra (2001).

distortions—although in both cases these coefficient estimates are not statistically different from zero at conventional levels.

We also calculated Vuong's (1989) statistic to perform a likelihood ratio test for model selection and non-nested hypotheses. Note that models with and without agricultural taxes are (partially) non-nested. Under the null hypothesis that the two models are equivalent, Vuong's statistic has a standard normal distribution. When we test the baseline model in column 1 against the model in column 3 (table 2, panel a), Vuong's statistic gives -0.333 with a p-value $= 0.63$. Although the results are more favorable for the model that accounts for agricultural taxes, statistically we cannot discriminate between the two models.

Because the agricultural taxes influence $\hat{L}_M$ entirely through the relative productivity, capital accumulation and subsistence consumption effects, the regression model does not call for an independent influence of the NRP on structural change. Indeed, the results in table 2 show that including the NRP as an independent variable does not improve the statistical fit of the model, and the coefficient estimate on the NRP is economically small and not statistically different from zero. The results are the same when we test for nonlinear effects by including the squared NRP instead of simply the level of the NRP. We thus conclude that our regression equations appropriately capture the links between agricultural taxes and structural change.

Table 2: Determinants of Structural Change

Dependent variable: Rate of structural change, $(1+p)\hat{L}_M$

a) *Pooled estimates* ($N = 86$)

	Without taxes		With taxes		
	[1]	[2]	[3]	[4]	[5]
Investment rate,	0.7097	0.7034	1.3148	1.2183	1.3066
$p\, S_M \hat{s}_M$	(0.5292)	(0.5323)	(0.9086)	(0.8731)	(0.8971)
Employment shares,	0.0161	0.0153	0.0287	0.0279	0.0290
l_M	(0.0030)	(0.0029)	(0.0056)	(0.0056)	(0.0059)
Relative productivity,	0.0069	0.0068	0.0062	0.0042	0.0057
p	(0.0034)	(0.0034)	(0.0031)	(0.0035)	(0.0033)
Protection	–	−0.0001	–	−0.0003	–
		(0.0001)		(0.0002)	
Protection squared	–	–	–	–	0.0000
					(0.0000)
Adjusted R^2	0.579	0.576	0.672	0.677	0.669
Hamilton's statistic	7.4061	24.7376	2.0831	7.6923	5.6893
p-value	0.0130	0.0010	0.1099	0.0140	0.0210

b) *Cross-section estimates with taxes* ($N = 43$)

	1970–1980		1980–1990	
Investment rate,	1.1182	0.1695	1.2708	1.6138
$p\, S_M \hat{s}_M$	(1.6841)	(1.8321)	(0.9661)	(1.0758)
Employment shares,	0.0291	0.0268	0.0206	0.0204
l_M	(0.0078)	(0.0074)	(0.0061)	(0.0063)
Relative productivity,	0.0093	0.0067	0.0062	0.0037
p	(0.0053)	(0.0054)	(0.0056)	(0.0063)
Protection	–	−0.0005	–	−0.0004
		(0.0003)		(0.0003)
Adjusted R^2	0.712	0.716	0.581	0.590
Hamilton's statistic	0.0603	2.2009	16.8979	11.5877
p-value	0.7772	0.1029	0.0020	0.0080

Note: All equations include a constant that is not reported. Heteroskedasticity-consistent standard errors are in parentheses. Hamilton's (2001) test statistic is distributed $\mathcal{X}^2(1)$ under the null hypothesis that the true relationship is linear. Bootstrapped p-values are based on 1000 draws from the same sample. See equation (7) and appendix 4.1 for the baseline equation. N is the number of observations.

There is also an indirect but interesting way to assess the plausibility of our estimates. Relative productivity growth in favor of the agricultural sector manifests itself through lower agricultural prices, and ultimately leads to the reallocation of labor across sectors; see equations (3). In our regression model, the coefficient on the relative productivity effect, b_3, informs us about this channel because it reflects the joint influences of gross complementarity between agricultural and non-agricultural goods and relative agricultural productivity growth. Specifically, given that the elasticity of substitution between agricultural and nonagricultural goods is less than one ($\nu < 1$), a positive coefficient on relative productivity $\hat{b}_3 > 0$ would suggest that, in our sample, agricultural productivity growth has exceeded that of the non-agricultural sector. Our estimate of this coefficient is positive and it is precisely estimated. Consequently, our estimates imply that, on average, the contribution of relative productivity growth to structural change has been positive.

4.3 Sensitivity analysis

To check the sensitivity of our results to pooling the data, we also estimated equation (7) for the decades 1970 and 1980 separately. Table 2, panel (b), shows the estimation results. We display only those results that properly adjust for agricultural taxation because, as in the case of pooled estimates, specification tests are more favorable to the model with taxes. The estimates suggest that the empirical model explains the data reasonably well for the 1970s (with an adjusted R^2 of 71 percent), but its performance declines for the 1980s.

We performed additional sensitivity analysis and found that our baseline regression results are remarkably robust.[§] First, we allowed the coefficient on the employment shares, b_2, which captures the subsistence consumption affect to vary across decades (while keeping other parameters constant across periods), but this did not affect our results. The coefficient estimate on the employment share is remarkably stable across our sample period, and we cannot reject the equality restriction. This suggests that the influence of subsistence consumption effect on structural change was stable over the 1970s and 1980s. Since poor countries tend have a larger share of income devoted to subsistence consumption, and since during these decades economic growth in poor countries was particularly disappointing, we also find the stability of this parameter estimate economically plausible.

Second, the theoretical model permits an interaction term that involves the rate of investment and the relative productivity growth rate. We allowed for this possibility by multiplying the share of investment in nonagricultural output by the NRP (divided by 100), and incorporated this interaction term into the baseline specification with agricultural taxes. For both the pooled and cross-section regression models with the interaction term, the estimation results were very similar to those from the baseline model. However, Vuong's statistic decidedly favored the baseline model over these alternatives.[¶]

[§] The detailed results are available from the authors upon request.

[¶] We have also checked the sensitivity of our results to the inclusion of the enrollment rate in primary school (proxy for human capital) in our structural change regressions. The results (available upon request) show that, once we control for agricultural taxation and the three principle channels we identified above, this control contains no additional information

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about structural change.

Table 3: Correlations for NRA, RRA, and BMS

a) Distortion measures: cross-correlations

Period	60-69	70-79	80-89	90-99
i) NRA with				
RRA	0.936	0.962	0.982	0.977
BMS	0.996	0.996	0.964	0.993
ii) RRA with				
BMS	0.945	0.970	0.965	0.966

b) Relative price of investment (pi), parallel market premium (premium), and trade connectedness (openc)

Period	60-69	70-79	80-89	90-99
i) NRA with				
pi	-0.087	-0.061	0.027	0.432
premium	-0.472	-0.368	-0.258	-0.316
openc	0.034	0.187	0.390	0.162
ii) RRA with				
pi	-0.052	-0.140	0.003	0.441
premium	-0.592	-0.467	-0.309	-0.340
openc	0.057	0.272	0.437	0.169
iii) BMS with				
pi	-0.087	-0.061	0.018	0.444
premium	-0.496	-0.374	-0.291	-0.309
openc	0.053	0.217	0.423	0.170

Note: NRA is nominal rate of assistance to agriculture, RRA is relative rate of assistance to agriculture and BMS is border market support for agricultural products.
Source: Assistance measures from Anderson and Valenzuela (2008). For other variables, see the text.

Table 4: Descriptive statistics

a) Agricultural and other price distortion variables

X1= nra6069 nra7079 nra8089 nra9099
rra6069 rra7079 rra8089 rra9099
bms6069 bms7079 bms8089 bms9099
premium6069 premium7079 premium8089 premium9099
pi6069 pi7079 pi8089 pi9099

Variable	Mean	Std Dev	Variance	Minimum	Maximum	Valid
X1	0.1429	0.4330	0.1875	-0.5084	1.3361	44
X2	0.0338	0.3943	0.1555	-0.5608	0.9474	54
X3	0.2809	0.7622	0.5810	-0.5608	2.9633	61
X4	0.2745	0.6475	0.4192	-0.4350	2.5799	62
X5	-0.0234	0.4374	0.1913	-0.6730	1.1186	43
X6	-0.0928	0.4287	0.1838	-0.7667	0.8040	49
X7	0.1750	0.7748	0.6003	-0.7749	2.9032	56
X8	0.2031	0.6490	0.4211	-0.5680	2.3345	57
X9	0.1398	0.4322	0.1868	-0.5057	1.3361	44
X10	0.0329	0.3865	0.1494	-0.5608	0.9474	54
X11	0.2324	0.6025	0.3630	-0.5608	2.0548	61
X12	0.2687	0.6229	0.3880	-0.4369	2.4739	62
X13	58.0146	295.4763	87306.2575	-0.0945	2276.4020	59
X14	40.3957	82.9327	6877.8408	0.0000	451.7920	60
X15	173.7799	841.3893	707935.9951	-1.4083	6406.6125	60
X16	15.7959	35.1836	1237.8836	-0.3478	151.8638	62
X17	73.9119	64.2290	4125.3583	25.2000	516.9000	59
X18	99.4517	120.0851	14420.4286	31.1000	974.3000	60
X19	89.6967	57.7918	3339.8917	23.4000	432.6000	61
X20	82.5516	30.3467	920.9222	31.4000	144.7000	62

b) Initial per capita income (rcgdp) and mean per capita income growth (ggdp)

X1= rcgdp60 rcgdp70 rcgdp80 rcgdp90
rcgdp00 ggdp6070 ggdp7080 ggdp8090 ggdp9000

Variable	Mean	Std Dev	Variance	Minimum	Maximum	Valid
X1	7.8155	0.9982	0.9963	5.9441	9.6144	61
X2	8.0840	1.0937	1.1963	6.3370	9.9336	61
X3	8.2829	1.1704	1.3697	6.0938	10.0133	61
X4	8.3919	1.2478	1.5570	6.2019	10.1833	62
X5	8.5483	1.3270	1.7610	6.1777	10.4131	60
X6	0.0275	0.0226	0.0005	-0.0223	0.0970	61
X7	0.0203	0.0227	0.0005	-0.0325	0.0772	61
X8	0.0127	0.0250	0.0006	-0.0566	0.0759	61
X9	0.0160	0.0215	0.0005	-0.0428	0.0769	60

c) Agricultural employment (agremp), value added (agrva) share and relative productivity (rlp)

X5=agremp60 agremp70 agremp80 agremp90
agrva60 agrva70 agrva80 agrva90
agrva00 rlp70 rlp80 rlp90 X18=rlp00

Variable	Mean	Std Dev	Variance	Minimum	Maximum	Valid
X5	53.1864	28.5927	817.5417	4.0000	93.8000	44
X6	47.0818	29.0470	843.7304	2.8000	92.6000	44
X7	43.2721	29.0213	842.2334	2.6000	92.2000	61
X8	38.8733	29.1161	847.7467	2.2000	92.4000	60
X9	34.9344	28.6177	818.9713	1.8000	92.2000	61
X10	37.6226	14.0358	197.0040	9.4360	63.8500	24
X11	22.2186	15.1153	228.4720	2.9412	66.0230	57
X12	19.3440	14.7389	217.2342	2.2094	72.0290	59
X13	19.0164	14.3297	205.3410	1.7340	56.5770	60
X14	16.4236	13.9828	195.5200	1.0503	46.6210	60
X15	0.6379	0.4727	0.2234	0.1357	2.5316	54
X16	0.6489	0.4808	0.2311	0.1356	2.7416	55
X17	0.6815	0.5236	0.2742	0.1205	2.1548	58
X18	0.7916	0.6579	0.4328	0.0915	2.6537	58

d) Primary school enrollment rates (p)

X1= p60 p70 p80 p85

Variable	Mean	Std Dev	Variance	Minimum	Maximum	Valid
X1	0.7361	0.3048	0.0929	0.0700	1.0000	59
X2	0.7927	0.2623	0.0688	0.1300	1.0000	60
X3	0.8915	0.2064	0.0426	0.2100	1.0000	59
X4	0.8865	0.2017	0.0407	0.2500	1.0000	60

e) Investment share in GDP (ci) and trade connectedness (openc)

X1= ci60 ci70 ci80 ci90
openc6069 openc7079 openc8089 openc9099

Variable	Mean	Std Dev	Variance	Minimum	Maximum	Valid
X1	17.1229	10.6106	112.5848	1.1762	37.1893	59
X2	19.0312	10.4834	109.9013	1.6931	38.4900	61
X3	18.6384	8.9921	80.8585	1.2366	34.6187	61
X4	16.4515	9.4136	88.6158	2.8183	40.4002	62
X5	39.7590	20.2662	410.7188	6.7000	92.4000	61
X6	46.0787	21.9215	480.5500	8.0000	96.6000	61
X7	51.0661	23.4205	548.5187	14.5000	113.9000	62
X8	58.8081	27.1060	734.7332	18.0000	180.4000	62

Table S1: Country coverage

	Original Dataset	X=NRA, BMS, RRA; N=NRA, BMS World Bank (2009) dataset					
		50s	60s	70s	80s	90s	2000s
Argentina	A		X	X	X	X	X
Australia	A	X	X	X	X	X	X
Austria		X	X	X	X	X	X
Bangladesh	A			X	X	X	X
Benin				N	N	N	N
Brazil	A		N	X	X	X	X
Burkina Faso				N	N	N	N
Cameroon	A		X	X	X	X	X
Canada	A		X	X	X	X	X
Chad				N	N	N	N
Chile	A		X	X	X	X	X
China	A				X	X	X
Colombia	A		X	X	X	X	X
Congo, Dem. Rep. (Zaire)	A						
Côte d'Ivoire	A		X	X	X	X	X
Denmark	A	X	X	X	X	X	X
Dominican Republic	A	X	X	X	X	X	X
Ecuador			X	X	X	X	X
Egypt	A	X	X	X	X	X	X
Ethiopia					X	X	X
Finland		X	X	X	X	X	X
France	A	X	X	X	X	X	X
Germany, FR	A	X	X	X	X	X	X
Ghana	A	X	X	X	X	X	X
Iceland					X	X	X
India	A		X	X	X	X	X
Indonesia	A			X	X	X	X
Ireland		X	X	X	X	X	X
Italy	A	X	X	X	X	X	X
Japan	A	X	X	X	X	X	X
Kenya	A	X	X	X	X	X	X
Korea, Republic of	A	X	X	X	X	X	X
Madagascar		N	X	X	X	X	X
Malawi	A						
Malaysia	A		X	X	X	X	X
Mali	A			N	N	N	N
Mexico	A				X	X	X
Morocco	A						
Mozambique				X	X	X	X
Netherlands	A	X	X	X	X	X	X
New Zealand	A	X	X	X	X	X	X
Nicaragua						X	X
Nigeria	A		X	X	X	X	X
Norway					X	X	X
Pakistan	A		X	X	X	X	X
Philippines	A		X	X	X	X	X
Portugal	A	X	X	X	X	X	X
Republic of South Africa		N	X	X	X	X	X
Senegal	A		X	X	X	X	X
Spain		X	X	X	X	X	X
Sri Lanka	A	X	X	X	X	X	X
Sudan	A	N	X	X	X	X	X
Sweden	A	X	X	X	X	X	X
Switzerland	A				X	X	X
Taiwan, China	A	X	X	X	X	X	X
Tanzania	A			X	X	X	X
Thailand	A			X	X	X	X
Togo	A			N	N	N	N
Turkey	A		X	X	X	X	X
Uganda			X	X	X	X	X
United Kingdom	A	X	X	X	X	X	X
United States	A	X	X	X	X	X	X
Vietnam					X	X	X
Zambia	A		X	X	X	X	X
Zimbabwe		X	X	X	X	X	X
N	47	25	44	54	61	62	62