**The Structural Transformation as a Pathway
out of Poverty: Analytics, Empirics and Politics**
By C. Peter Timmer and Selvin Akkus

Abstract

A powerful historical pathway of structural transformation is experienced by all successful developing countries, and this Working Paper presents the results of new empirical analysis of the process. Making sure the poor are connected to both the structural transformation and to the policy initiatives designed to ameliorate the distributional consequences of rapid transformation has turned out to be a major challenge for policy makers over the past half century. There are successes and failures, and the historical record illuminates what works and what does not. Trying to stop the structural transformation does not work, at least for the poor, and in fact can lead to prolonged immiseration. Investing in the capacity of the poor to cope with change and to participate in its benefits through better education and health does seem to work. Such investments typically require significant public sector resources and policy support, and thus depend on political processes that are themselves conditioned by the pressures generated by the structural transformation itself.

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**The Structural Transformation as a Pathway out of Poverty:
Analytics, Empirics and Politics**

C. Peter Timmer and Selvin Akkus[1]

I. Overview

A powerful historical pathway of structural transformation is experienced by all successful developing countries. This structural transformation involves four main features: a falling share of agriculture in economic output and employment, a rising share of urban economic activity in industry and modern services, migration of rural workers to urban settings, and a demographic transition in birth and death rates that always leads to a spurt in population growth before a new equilibrium is reached. Political pressures generated along the pathway have led to diverse policy approaches designed to keep the poor from falling off the pathway altogether.

This Working Paper presents the results of new empirical analysis of the structural transformation. At one level, in their broad sweep and relevance, the results reported here are very robust and have deep historical roots. Challenging them is like challenging the tides. At another level, the complexity of national diversity asserts itself in very important ways. This diversity does not alter the *pathways* themselves, but rather their consequences for income distribution and the size of the gap in labor productivity between urban and rural economies. We learn a lot about the possibilities for narrowing this gap during the process of structural transformation by comparing the historical experience of rapidly growing Asia with the rest of the world. Individual country experience is revealing as well. The stress placed on this productivity gap, how it changes during the structural transformation, and potential policy interventions to narrow it, is the major contribution of this Working Paper.

Making sure the poor are connected to both the structural transformation and to the policy initiatives designed to ameliorate the distributional consequences of rapid transformation has turned out to be a major challenge for policy makers over the past half century. There are successes and failures, and the historical record illuminates what works and what does not. Trying to stop the structural transformation does not work, at least for the poor, and in fact can lead to prolonged immiseration. Investing in the capacity of the poor to cope with change and to participate in its benefits through better education and health does seem to work. Such investments typically require significant public sector resources and policy support, and thus depend on political processes that are themselves conditioned by the pressures generated by the structural transformation itself.

This historical process of structural transformation seems like a distant hope for the world's poor, who are mostly caught up in eking out a living day by day. There are many things governments can do to give them more immediate hope, such as keeping staple foods cheap and accessible, connecting rural laborers to urban jobs, and providing adequate educational and health facilities in rural areas. But to be sustained, to be long-run pathways out of poverty, all of these actions depend fundamentally on a growing and more productive economy that successfully integrates the rural with urban sectors, and stimulates higher productivity *in both*. That is, the long-run success of poverty reduction hinges directly on a successful structural transformation.

Even a highly successful structural transformation—with its rapid economic growth--is not without its problems for the poor. Two newly revealed and analyzed features of the structural

transformation reported here give special cause for concern. First, there is a strong historical pattern of worsening income distribution between rural and urban economies during the initial stages of the structural transformation. Even the currently rich countries saw this pattern during their early development in the 19th and early 20th centuries. Absolute poverty is not necessarily worsening during such episodes, and in East Asia the evidence is that absolute poverty actually fell very rapidly during rapid structural transformation (Timmer, 2005; World Bank, 1993). But in countries with less rapid growth, or growth which connected less well to the rural poor, poverty stagnated or even rose (World Bank, 2007).

Even when absolute poverty is falling, however, the worsening distribution of income challenges policy makers to take corrective action. So far, the evidence is that these actions— agricultural protection and widespread subsidies to farmers—not only fail to help the poor, they often make their fate worse because most of the poor must purchase their food in markets. A dynamic rural economy stimulated by real productivity growth has been pro-poor in all circumstances, but a rural economy with farm profits stimulated by protection tends to hurt the poor in both the short- and long-run.

The second feature is that this tendency for sectoral income distribution to worsen during the early stages of the structural transformation is now extending much later into the development process. Consequently, with little prospect of reaching the turning point quickly, many poor countries are turning to agricultural protection and farm subsidies sooner rather than later in their development process. The tendency of these actions to hurt the poor is then compounded, because there are so many more rural poor in these early stages.

It is too soon to say whether the recent reversal of long-run downward trends in real prices of agricultural commodities—driven by rapid economic growth in China, India and several other developing countries, demand for bio-fuels in rich countries, and possibly by the impact of climate change on agricultural productivity--will also reverse the steady movement of the turning point in the structural transformation to higher income levels (Naylor, et al., 2007).[2] If so, the short-run impact on the poor is almost certain to be negative, but the higher real returns promised to commodity producers, without agricultural protection, could stimulate real productivity increases in rural areas, raise real wages, and be the long-run pathway out of rural poverty.

II. The structural transformation and economic development

No country has been able to sustain a rapid transition out of poverty without raising productivity in its agricultural sector (if it had one to start—Singapore and Hong Kong are exceptions). The process involves *a successful structural transformation* where agriculture,

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[2] High prices (by recent standards, but not historically) for staple agricultural commodities seen in world markets early in 2008 suggest this reversal is underway, but how permanent it is remains to be seen. If these prices were driven solely by market forces, one could say with confidence that they will decline, again, over time. But the strong political forces behind these high prices, especially in the form of bio-fuel mandates without regard to cost, may mean the high agricultural prices last considerably longer than the historical record would suggest. The potential of demand for bio-fuels to reverse the historical process of structural transformation is discussed at the end of this Working Paper.

through higher productivity, provides food, labor, and even savings to the process of urbanization and industrialization. A dynamic agriculture raises labor productivity in the rural economy, pulls up wages, and gradually eliminates the worst dimensions of absolute poverty. Somewhat paradoxically, the process also leads to a decline in the relative importance of agriculture to the overall economy, as the industrial and service sectors grow even more rapidly, partly through stimulus from a modernizing agriculture and migration of rural workers to urban jobs.

Despite this historical role of agriculture in economic development, both the academic and donor communities lost interest in the sector, starting in the mid-1980s, mostly because of low prices in world markets for basic agricultural commodities. Low prices, while a boon to poor consumers and a major reason why agricultural growth specifically, and economic growth more generally, was so pro-poor for the general population, made it hard to justify policy support for the agricultural sector or new funding for agricultural research or commodity-oriented projects (World Bank, 2004d). Historical lessons are a frail reed in the face of market realities and general equilibrium models that show a sharply declining role for agriculture in economic growth. The current realities of the structural transformation stare policymakers in the face, not its underlying mechanisms that actually require rising productivity in agriculture.

Still, historical lessons have a way of returning to haunt those who ignore them. This is especially true when the lessons are robust, have been observed for very long periods of time, and fit within mainstream models of how farmers, consumers (and politicians) behave. The lessons from the structural transformation fit these conditions. The purpose of this Working Paper is to translate those historical lessons into an understanding of the connections between the sectoral composition of economic growth and reductions in poverty. With this understanding come new insights into how to manage agricultural development to enhance both efficiency and equity.

A. The historical perspective

The structural transformation is the defining characteristic of the development process, both cause and effect of economic growth. Four quite relentless and interrelated processes define the structural transformation: a declining share of agriculture in GDP and employment (see Figure 1 and Timmer, 1988); migration from rural to urban areas and a rapid process of urbanization; the rise of a modern industrial and service economy; and a demographic transition from high rates of births and deaths (common in backward rural areas) to low rates of births and deaths (associated with better health standards in urban areas).

The final outcome of the structural transformation, already visible on the horizon in rich countries, is an economy and society where agriculture as an economic activity has no distinguishing characteristics from other sectors, at least in terms of the productivity of labor and capital, or the location of poverty. This stage also shows up in Figure 1, as the gap in labor productivity between agricultural and non-agricultural workers approaches zero when incomes are high enough.[3]

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[3] Alternatively, the convergence between labor productivity in the agricultural and non-agricultural sectors can be measured by the ratio of the two, which approaches one when labor productivity is equal in the two sectors.

All societies want to raise the productivity of their economies. That is the only way to achieve higher standards of living and sustain reductions in poverty. The mechanisms for doing this are well known in principle if difficult to implement in practice. They include the utilization of improved technologies, investment in higher educational and skill levels for the labor force, lower transactions costs to connect and integrate economic activities, and more efficient allocation of resources. The process of actually implementing these mechanisms over time is the process of economic development. When successful, and sustained for decades, it leads to the structural transformation of the economy.

The structural transformation complicates the division of the economy into sectors—rural versus urban, agricultural versus industry and services—for the purpose of understanding how to raise productivity levels. In the long run, the way to raise rural productivity is to raise urban productivity, or as Chairman Mao famously but crudely put it, "the only way out for agriculture is industry." Unless the non-agricultural economy is growing, there is little long-run hope for agriculture. At the same time, the historical record is very clear on the important role that agriculture itself plays in stimulating growth in the non-agricultural economy (Timmer, 2002, 2005, 2008).

This Working Paper explains the historical patterns of the structural transformation, determines empirically whether the patterns have been changing over the past four decades, and examines lessons from country experiences that diverge significantly from these patterns. These divergences can take three forms. First, a country may fail to generate economic growth, in which case the *pattern* might still hold, but the *transformation* fails to take place. Second, a country might experience an extremely rapid *transformation*—with a falling share of agriculture in GDP and employment--but not experience much economic growth, so the *pattern* fails to hold. Third, a country might experience extremely rapid economic growth, but fail to have an equally rapid structural transformation, in which case both the *pattern* and the commensurate *transformation* fail to hold. Understandably, the policy implications in each case are radically different, especially for the fate of the poor.

Figure 1. The Structural Transformation in 86 Countries from 1965 to 2000:
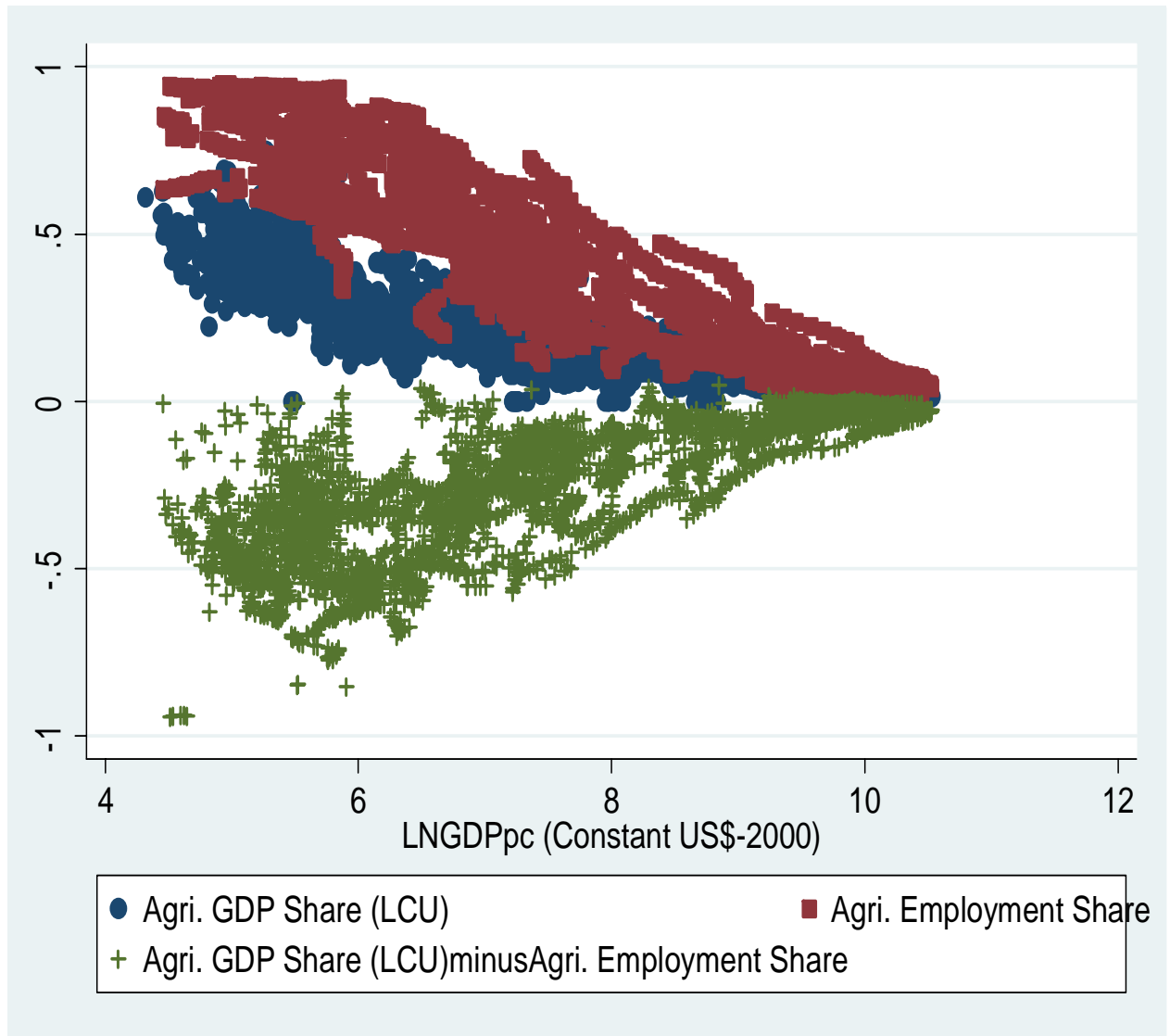
Source: Timmer (2008)

In the early stages of the structural transformation in all countries there is a substantial gap between the share of the labor force employed in agriculture and the share of GDP generated by that work force. Figure 1 shows that this gap narrows with higher incomes. This convergence is also part of the structural transformation, reflecting better integrated labor and financial markets.

However, in many countries this structural gap actually widens during periods of rapid growth, a tendency seen in even the earliest developers. When overall GDP is growing rapidly, the share of agriculture in GDP falls much faster than the share of agricultural labor in the overall labor force. The "turning point" in the gap generated by these differential processes, after which labor productivity in the two sectors begins to converge, has also been moving to the right over time.[4]

This lag inevitably presents political problems as farm incomes visibly fall behind incomes being earned in the rest of the economy. The long-run answer, of course, is faster integration of farm labor into the non-farm economy (including the rural, non-farm economy), but the historical record shows that such integration takes a long time. It was not fully achieved in the United States until the 1980s (Gardner, 2002), and evidence presented here shows the productivity gap is increasingly difficult to bridge through economic growth alone.

This lag in real earnings from agriculture is the fundamental cause of the deep political tensions generated by the structural transformation, and it is getting worse. Historically, the completely uniform response to these political tensions has been to protect the agricultural sector from international competition and ultimately to provide direct income subsidies to farmers (Lindert, 1991). Neither policy response tends to help the poor, even those remaining in rural areas.

B. The structural transformation as a general equilibrium process

The economic and political difficulties encountered during a rapid structural transformation are illustrated schematically in Figure 2, which shows a representative structural transformation, and numerically in Table 1, which presents the simple mathematics of structural change over a 20-year period of economic growth and transformation. Although Figure 2 shows the share of agricultural labor in the total labor force, and the contribution of agriculture to overall GDP, both declining smoothly until parity is reached when a country is "rich," the actual relationship between the two shares depends critically on the pace of change outside of agriculture and on the labor-intensity of those activities.

Figure 2 also shows a basic fact that is often overlooked in political discussions about the "failure" of agriculture to grow as fast as the rest of the economy, and thus to decline as a share of GDP and in the labor force: despite the structural transformation, *agricultural output continues to rise in absolute value*. Even as the number of farmers falls toward zero, total farm output sets new records. That is what rising productivity is all about. The sustainability of the

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[4] This is not a temporal statement, but one driven by movements in real per capita incomes. If per capita incomes fall over extended periods, as they have in Brazil or Nigeria, for example, the pathway "back" is not likely to track the pathway "forward" because of substantial stickiness in structural patterns of labor allocation.

production practices that generate such high levels of labor productivity in modern agriculture are the subject of intense debate (Naylor, et al., 2007).

Table 1 quantifies the impact of three alternative paths for a country's structural transformation. At the starting point industry, services and agriculture contribute 20, 30 and 50 percent to GDP respectively, and the share of workers in each sector is 9.7, 20.8 and 69.5 percent respectively, fairly typical for a country in the very early stages of development. Labor productivity in each sector is 3, 2, and 1 respectively, so overall labor productivity for the entire economy is the weighted average, or 1.4 (units of output per worker per year).

The economy then grows for 20 years, with industry growing 7.5 percent per year, services 5.0 percent per year, and agriculture growing 3.0 percent per year. The overall rate of growth at the start is 4.5 percent per year. These growth rates result from technological change that is sector specific on the supply side, and on differential demand patterns that reflect Engel's Law. The *trade implications* of these differential growth rates, which are representative of long-run rates seen in successful developing countries, are not shown in Table 1, but the economy must be relatively open to trade to sustain such rates.

The "simple mathematics" of the structural transformation show what happens to the economy and to labor productivity through 20 years of reasonably rapid growth. At an aggregate level, total GDP grows from 100 to 255, an annual growth rate of 4.8 percent per year. Notice the acceleration in the growth rate despite the assumption that each sector grows at a constant rate for 20 years, a result of changing sectoral weights. Indeed, GDP growth in the last year of the exercise is 5.2 percent, compared with just 4.5 percent per year at the start, despite the fact that each sector continues to grow at a constant rate. If the labor force grows by 2.0 percent per year during this exercise, labor productivity in aggregate will grow to 2.4 (from 1.4 in the base year), a healthy growth rate of 2.7 percent per year.

But the important story is at the sectoral level, where the structural transformation becomes visible. Table 1 show three possible growth paths that encompass modern development experience. Path A, following the basic logic of the Lewis Model, holds labor productivity *constant* in the industrial and service sectors, as they absorb labor from the agricultural sector at the same rates as each sector itself expands. This labor-intensive path of industrial and service growth leads to the fastest structural transformation of the three scenarios, and is so successful in pulling "surplus" labor out of agriculture that labor productivity in agriculture is actually higher at the end than in the service sector, and only 23 percent less than in the industrial sector. No country has actually managed a growth path with quite that much labor intensity, although the East Asian experience comes closest. The structural transformation is extremely rapid with this path, and the *absolute* number of workers in agriculture is already declining after 20 years of rapid growth.

Path C looks at the opposite extreme, where labor productivity in the industrial and service sectors grows at the same rate as the sectors themselves. Thus neither sector absorbs any new workers at all, so the entire increase in the labor force remains in agriculture. Because agricultural GDP is still rising faster than the labor force, labor productivity in the sector does rise slightly, but at only 0.3 percent per year. This pattern is closer to the African experience,

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although Indonesia in the 1950s and early 1960s looked similar. Not only is the absolute number of workers in agriculture still rising on this path, so too is the *share* of agricultural labor in the total labor force.

Path B is halfway between these two extremes, with labor productivity in the industrial and service sectors growing at half the rate of increase in sectoral output. The result is actually quite like Indonesian experience since 1970. The agricultural labor force continues to rise (to 69, from 50 at the beginning) but is clearly near its peak—ten more years of such growth would see the agricultural labor force in absolute decline. Labor productivity in agriculture increases by 1.4 percent per year over the entire period, somewhat less than the rate found by Fuglie (2004) for Indonesia from 1961 to 2000, the years of both rapid and slow growth in productivity.

But even this successful pattern of structural transformation leaves a serious problem for policymakers. As Table 1 also shows, income distribution deteriorates under this scenario, at least as measured by the ratio of labor productivity (wages) in the top quintile of laborers to the bottom quintile. From a starting ratio of 2.55, even Path B yields a ratio of 4.02. Of course, things could be worse. If output expansion in industry and services does not employ new workers (Path C), the ratio deteriorates to 7.27! Only a pure "Lewis-style" pattern of growth leads to an improvement in the distribution of labor income (Path A).

The point of this exercise is to emphasize the power, the inevitability, and the paradoxical nature of the structural transformation. Even a narrow focus on agricultural productivity *per se* must be set within this transformation. The crucial point is that the *faster* the structural transformation, the *faster* is the decline in the share of agriculture in both the economy and the overall labor force. And the paradox is that, the *faster* the structural transformation, the faster that rural productivity—proxied by rural labor productivity—*rises* (as in scenario A). *This is true even though the rate of growth of agricultural GDP is the same in all three scenarios.* Consequently, a broader focus on rural productivity and pathways out of rural poverty will inevitably incorporate the structural transformation as the basic framework for macro consistency and general equilibrium.

Figure 2. Schematic illustrating the stylized trends in total agricultural output, output per agricultural worker, agriculture as a share of the labor force and in GDP, during the course of the structural transformation (from "poor" to "rich")

Percentage
 Share

Total
Value

100

80

Value of agricultural
output per worker
in agriculture-----

-----Share of agriculture in the labor force

60

40

-------Total value of
agricultural GDP

20

Share of agriculture in GDP--------

0

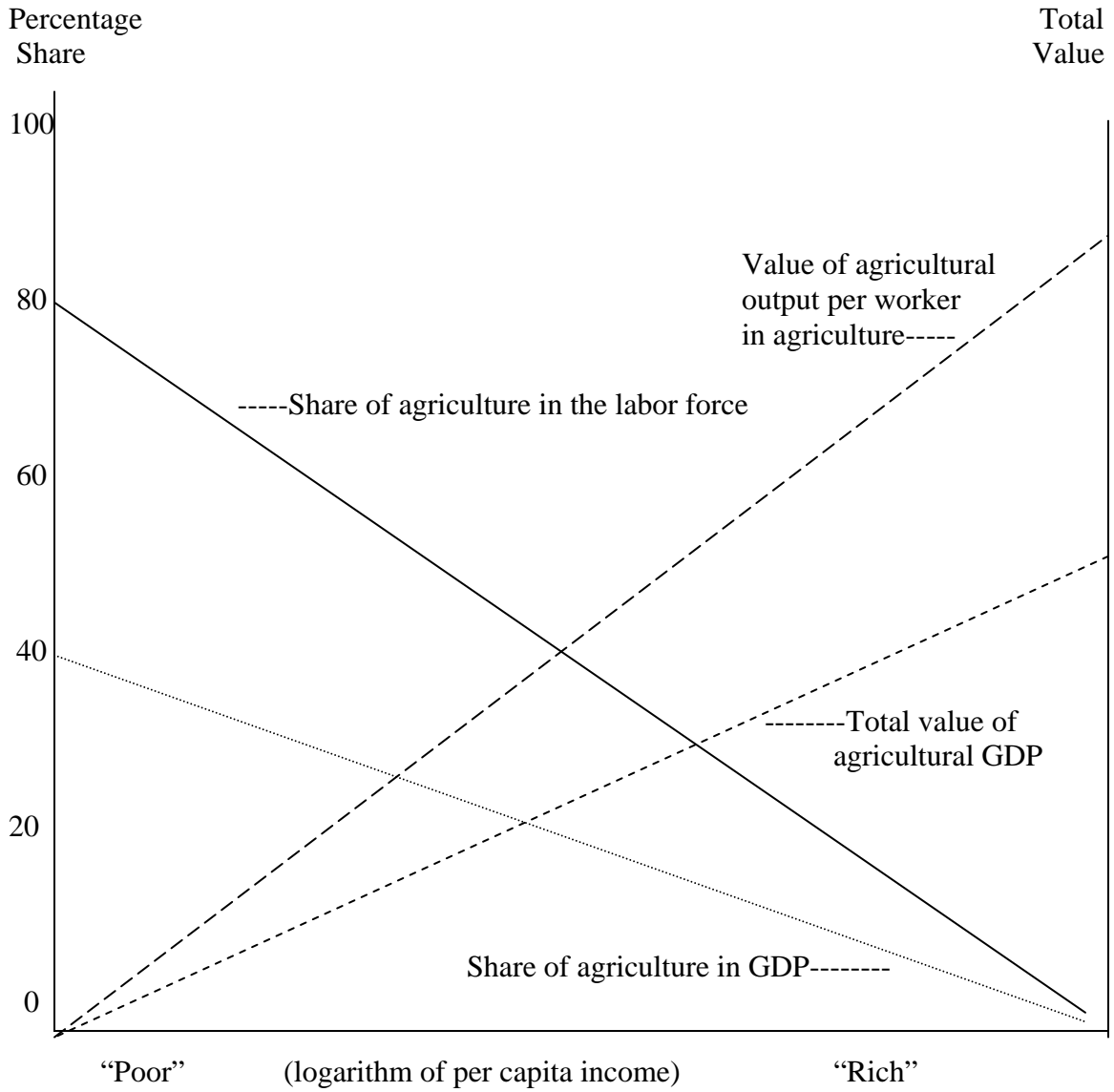"Poor"   (logarithm of per capita income)   "Rich"

Table 1.--The Simple (but Implacable) Mathematics of the Structural Transformation

Start (Year 0)	Industry	Services	Agriculture	GDP
Output	20	30	50	100
Share of GDP	20	30	50	100
Number of workers[5]	7	15	50	72
Labor productivity	3	2	1	1.4
Share of workers in total	9.7	20.8	69.5	100
Sectoral growth rates (%/year)	7.5	5.0	3.0	4.5
Contribution to growth in year 1	1.5	1.5	1.5	4.5

End (Year 20)	Industry	Services	Agriculture	GDP
Output	85	80	90	255
Share of GDP	33.3	31.4	35.3	100
Number of workers[6]				
Path A	28	40	39	107
Path B	14	24	69	107
Path C	7	15	85	107
Labor productivity				
Path A	3	2	2.32	2.4
Path B	6.3	3.3	1.31	2.4
Path C	12.7	5.3	1.06	2.4
Share of workers in total				
Path A	26.2	37.4	36.4	100
Path B	13.1	22.4	64.5	100
Path C	6.5	14.0	79.5	100
Contribution to growth in year 20	2.5	1.6	1.1	5.2

Ratio of labor productivity (wages or income) in the top quintile of workers relative to the bottom quintile

Start	2.55
Path A	1.50
Path B	4.02
Path C	7.2

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[5] The active labor force will grow by 2.0 percent per year.

[6] Path A assumes that labor productivity in industry and services remains *constant* as the two sectors absorb new laborers at the same rate as output expansion (the classic Lewis assumption). Agricultural employment remains the residual, with changes there consistent with general equilibrium. In Path B, labor productivity in industry and services increases at half the rate of output. In Path C, labor productivity in the industrial and services sectors increases at the same rate as sectoral output, so no new labor is hired. Note that Paths A and C are extremes that are somewhat outside historical experience.

III. The empirical record from 1965 to 2000

The empirics of the structural transformation have been a research topic for some time.

> Modern analyses of sectoral transformation originated with Fisher (1935, 1939) and Clark (1940), and dealt with sectoral shifts in the composition of the labor force. As in most areas in economics one can find precursors of their ideas in earlier writings [Sir William Petty and Friedrich List]. However, they were probably the first to deal with the process of reallocation during the epoch of modern economic growth, and to use the form of sectoral division (primary-secondary-tertiary) which, in one way or another, is still with us today (Syrquin, 1988, p. 212).

Kuznets (1966) provided the historical empirics and conceptual framework for modern analysis of the structural transformation, although he used no econometric techniques himself. The first quantitative analyses of patterns in the transformation process were by Chenery (1960) and his collaborators (Chenery and Taylor, 1968; Chenery and Syrquin, 1975). The first systematic effort to study the evolution of the structural gap between labor productivity in agriculture and the rest of the economy is in van der Meer and Yamada (1990), in their analysis of productivity differences in Dutch and Japanese agriculture.

Much effort has gone into finding "patterns of growth," especially for various typologies of countries. The earliest was the classification by Chenery and Taylor (1968) of their sample of countries into (1) large, (2) small-primary oriented, and (3) small-industry oriented. The goal has been to translate growth patterns in different typologies into strategies for development, but the uniqueness of country circumstances, especially in terms of political economy, has largely thwarted that effort. This paper explicitly revives that search, but this time by bringing the pressures on political economy from the structural transformation itself directly into the analysis.

A. What do the global patterns show?

For the sample analyzed here, 86 countries are followed from 1965 to 2000 (see Annex Table 1 for a list of countries included and their representative data. All the countries have populations greater than 3 million in 2000). Empirically, most countries lie close to the average paths for the three variables of interest when year-specific and country-specific dummy variables are included along with the "standard" explanatory variables: logarithm of GDP per capita (lnGDPpc), lnGDPpc squared, and the agricultural to non-agricultural terms of trade (AgToT) (see Figure 1 and Table 2). That is, all countries follow a variant of the structural transformation if their economies are growing. The three variables to be explained are:
(1) the share of agricultural employment in total employment (AgEMPshr)
     (Regression A-4 adjusted R squared = 0.9862);
(2) the share of agricultural GDP in total GDP (AgGDPshr)
     (Regression B-4 adjusted R squared = 0.9335); and
(3) the difference between these two shares (AgGDPshr minus AgEMPshr = AgGAPshr)
     (Regression C-4 adjusted R squared = 0.9166).

Employment share. Even the simplest specification for testing the relationship between share of agricultural employment in total employment, regression A-1 in Table 2, explains 87 percent of the variance in the full sample of data. The quadratic equation has the expected shape, with the linear term negative and the quadratic term positive. However, the "turning point" in this relationship, when the employment share would reach zero, is $5.9 million (US$2000).[7] Adding Year and Country coefficients (regression A-3) sharply reduces the size and significance of both income terms and the turning point falls to $19,009. Finally, adding the agricultural to non-agricultural terms of trade, calculated from national income accounts data as an index equal to one for all countries in 2000, further reduces the size and significance of both income terms—the quadratic term is no longer significant. Importantly, with this "full specification" there is virtually no convergence of the agricultural employment share toward zero because the quadratic term is so small and insignificant—the implied turning point in regression A-4 is $8.9 billion!

The Year and Country effects are extracted and shown in Annex Table 2.[8] The Year coefficients are closely linked to, but are not identical with, a simple time trend. In regression A-3, the Year effect provides a smooth and large annual reduction in the share of employment in agriculture—one percent per year. There is a slight but significant quadratic term that gradually offsets this negative trend in the employment share. This negative time trend provides an exogenous source of convergence towards zero in the employment share, independently of any relationship with per capita incomes, and suggests that technical change is an important driver of the structural transformation in addition to the impact from Engel's Law, which is driven by per capita incomes.

A further implication is that, on average, this negative time effect causes labor productivity in agriculture to rise faster than labor productivity in other sectors because the reallocation is taking place while per capita incomes are held constant. As noted in the discussion of the structural transformation as a general equilibrium process, this feature of differential productivity growth is a normal feature of the structural transformation, despite widespread policy concerns about lagging incomes in the agricultural sector.

The Country effects from regression A-3 also exhibit a regular pattern—they are significantly and negatively related to the country's per capita income in 2000. This relationship suggests that, as they get richer, countries find a way to reduce the share of workers in agriculture independently of the structural reduction from the growth process itself. Political mechanisms would seem to be necessary to see such a pattern, driven by the rising income inequality

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[7] The "turning point" in all the relationships reported here is calculated by taking the first derivative of the quadratic function in lnGDPpc and setting it equal to zero. This provides meaningful estimates, of course, only when both terms of the quadratic function are significant and of opposite signs. David Roodman points out that including both lnGDPpc and its squared term as separate explanatory variables often causes problems of multi-collinearity and downward-biased coefficients. The problem seems not to be severe for the sample we investigate in this Working Paper.

[8] Details of the econometric results are shown in Annex Tables 2 to 4. Each Annex also extracts the Year and Country coefficients for each Agshr variable and reports statistical and graphical results.

between the agricultural and non-agricultural sectors seen so regularly during the structural transformation.[9]

GDP share. The share of agriculture in GDP follows a similar pattern as employment, but the statistical results are always more significant and the coefficients become larger rather than smaller as additional controls are added. The decline in the GDP share for agriculture is clearly much more regular and powerful than the decline in employment share, thus setting up the obvious potential for a mismatch between the two trends. Indeed, the "turning point" for the share of agriculture in a country's economy is always well defined, whichever regression specification is used, and it is as low as $9102 in regression B-4, which includes full Year and Country effects as well as the terms of trade. Recall that in regression A-4 the turning point for the share of employment in agriculture was not reached until per capita incomes were $8.9 billion. It is no wonder that countries seek other mechanisms to equilibrate the employment and GDP shares.

The Year coefficients yield a smaller and less smooth trend decline in the share of agriculture in GDP than in employment, with the decline roughly two-thirds as fast as in the employment share regression. Thus, holding all other variables constant, the gap between employment share and GDP share should be expected to narrow over time for exogenous, and presumably political, reasons.

There is no parallel to the regular relationship with per capita incomes for the Country coefficients in the GDP regression (B-3)—the coefficient on lnGDPpc(2000) is insignificant (see Annex Table 3). Perhaps the surprise is that countries do not succeed in making the relationship positive. Regression B-3 does not include the terms of trade variable so any such efforts should be identified in the regression. Regression B-4 does show the highly significant and positive effect of the terms of trade on the share of agriculture in GDP, but this is controlling mostly for short-run movements in agricultural prices that are not a part of the long-run structural transformation. The net effect in regression B-4 is to make the structural transformation variables larger and more significant, just the reverse of the impact in regression A-4 on employment share. Although controlling mostly for short-run price movements, the terms of trade (AgToT) variable is interesting and important on its own, and is discussed in detail in a later section.

GAP share.   Most empirical analysis of the structural transformation has focused on these two variables—agriculture's share in employment and in GDP. The gap between the two has often been recognized, but it has received little of the systematic analysis that the two "basic" variables have received. The analysis in van der Meer and Yamada (1990) is an important exception. This paper reverses that pattern. Most of the following analysis is focused directly on the "gap" variable, defined as the difference between the share of agriculture in GDP and its

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[9] Part of the effect may be definitional, in the sense that the majority source of income can switch quickly with only modest changes in actual sources of income. For example, farm workers who earn 55 percent of their income from agricultural sources (a majority) in one census year and just 45 percent (a minority) in the next, will be re-classified from the agricultural to the non-agricultural labor force even though there has been only a small change in the source of their income. Such re-classifications tend to be based on census data and occur roughly every decade.

share in employment. The definition consciously causes this gap to be negative for virtually all observations, a visual advantage in Figure 1, which shows the gap approaching zero from below.[10]

One advantage of using the difference in shares rather than their relative values is that the gap variable then translates easily into a "sectoral Gini coefficient" that indicates the inequality of incomes (labor productivity) between the two sectors.[11] The negative of the GAP variable is equal to the Gini coefficient for agricultural GDP per worker compared with non-agricultural GDP per worker. This "sectoral Gini coefficient" accounts for 20-30 percent of the variation in the overall Gini coefficient for this sample of countries. The rural-urban income gap is a significant part of a country's income inequality.

A worrisome aspect of this rural-urban income gap is that it actually gets larger during the early stages of economic growth. The turning point in the relationship for AgGAPshr only occurs at per capita levels of GDP above $9255 in regression C-3 (where the terms of trade variable is not included). For comparison, per capita GDP in 2000 was $5940 in Mexico, $6185 in Uruguay, $7700 in Argentina, $10,300 in Greece, and $10,940 in South Korea. This result alone is likely to explain much of the political difficulty faced during a rapid structural transformation.

Interestingly, the turning point is at a lower per capita income when the terms of trade variable is included. In regression C-4, the turning point is just $5063, well below the value for Mexico. To the extent that individual countries can use agricultural price policy to influence their domestic terms of trade (and, on average, only about 20 percent of the overall variance in the terms of trade is common to all countries on a year to year basis), this instrument seems to be effective in making the growth process a more effective integrator of agricultural labor into the rest of the economy, at least in terms of relative productivity. This potential use of the AgToT to cushion the distributional pressures from rapid structural transformation is discussed in detail in Section VI.

There are also exogenous forces at work to close the gap in labor productivity, as would be indicated by the results for the Year and Country coefficients in the employment and GDP regressions. In the GAP share regression, the Year coefficients reflect a convergence of roughly 1.4 percent per year, although the negative quadratic term gradually offsets this trend. For example, in the year 2000, the exogenous decline in the Gap share as estimated from the regression on the Year coefficients is just 0.8 percent per year. The Country effects are also strongly and positively associated with per capita GDP, indicating that richer countries take measures to close this gap above and beyond the impact from the economic growth process itself. Again, only political mechanisms can explain the use of these measures, although they are closely linked to the wealth of a country.

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[10] Michael Clemens has pointed out simply having the gap approach zero is not a test of our hypothesis that labor productivity in the two sectors is converging to equality. This test requires testing the ratio of labor productivity in the two sectors, which we do below. In fact, for the sample examined here, labor productivity does converge as measured by the ratio and the gap analysis we pursue for other reasons is valid.

[11] See Annex Table 6 for details and an algebraic proof of this relationship. (This table shows the relationship between Sectoral Gini and the GAP variable)

B. Using the ratio of labor productivity rather than the gap to test convergence

The difference between labor share and GDP share (GAP) does not permit a direct test of convergence in labor productivity. Convergence can only be tested by examining the pathway of the ratio of labor share to GDP share. To see this, imagine the following: Suppose that at all levels of GDP/capita, agriculture's labor share were exactly double its GDP share. What would Figure 1 look like? It would look exactly the same as it does, because both agriculture's labor share and GDP share decline as GDP/capita rises, so therefore the difference between them must fall towards zero, even if the ratio of labor share to GDP share were fixed at two (or three, or whatever). The negative coefficients in Table 2, Equations C-1 to C-4 would look exactly the same as they do. But if the ratio of labor share to GDP share remains fixed at two, then it is simply not the case that labor in agriculture is claiming a share of GDP that looks more and more like other sectors.[12]

The regressions in Table 2, D-1 to D-4 test whether the gap variable is measuring the same convergence process as the ratio variable. For the D regressions, we replace the AgGAPshr dependent variable with the ratio of AgEMPshr to AgGDPshr. As expected, with this new specification the ratio converges to one (whereas the gap, or difference, variable converges to zero). As higher incomes are approached, both specifications tell the same (empirical) story. Obviously, if the two "basic" regressions in employment share and GDP share (regressions A and B in Table 2) are accurately capturing the behavior of those variables, the difference between the two will converge to zero and the ratio will converge to one. In some sense, it is not even necessary to estimate regression C, because those results are driven directly by regressions A and B. Figure 1a shows the ratio variable superimposed on the GDP and EMP share variables and confirms that the slope is positive, headed toward a value of one.

So why use the gap specification instead of the ratio specification. First, it is mathematically much simpler to take the difference between A and B than to take the ratio (because multiple terms are involved in each equation. Second, the gap can be directly interpreted in welfare terms--the negative of the gap coefficient is the sectoral Gini coefficient. Although in principal the Gini coefficient is not an ideal measure of income inequality, it is widely used in the literature and that connection is important to the themes of this Working Paper.

Third, the ratio variable is measured with much more error because the denominator approaches zero at higher incomes. This is readily apparent in Figure 1a. Finally, and most important, the gap is the *right* variable to use for understanding the political economy of the structural transformation and policy responses to the tensions created by the rising inequality between the two sectors. The ratio variable is not nearly as sensitive to this inequality as the gap variable. The empirics bear this out. The key coefficients in the C regressions flip from being positive (C-1 and C-2) to negative as the country fixed effects and AgToT are added (C-3 and C-4). The worsening of the gap depends on these results. In the D regressions, the turning point in the relationship occurs around $1200 before controlling for country and AgToT, but becomes very large in the fuller specifications.

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[12] This argument was made directly to the authors by Michael Clemens.

Table 2. Summary of regressions to explain the structural transformation, 1965-2000

Regression Number[13]	Dependent variable: Share of agricultural employment in total			
	A-1	A-2	A-3	A-4
Constant	2.227 (47.9)	2.351 (51.4)	0.962 (18.6)	0.745 (13.5)
lnGDPpc	-0.321 (25.2)	-0.342 (28.2)	-0.107 (8.0)	-0.0368 (2.5)
(lnGDPpc)sq.	0.0103 (12.3)	0.0118 (14.7)	0.00543 (5.9)	0.000617 (0.6)
Terms of Trade				-0.000128 (7.1)
Year?	N	Y	Y	Y
Country?	N	N	Y	Y
Adj. Rsq	0.8694	0.8830	0.9851	0.9862
Turning point				
LnGDPpc	15.582	14.492	9.853	29.822
GDPpc ($2000)	$5.9M	$2.0M	$19009	$8.9B (!)

Regression of country effects from Regression A-3 on lnGDPpc2000

     1.048   -0.130 * lnGDPpc2000   Adj. Rsq   0.8463
    (22.6)   (21.5)

Regression of year effects from Regression A-3 on "Year"[14] and "Year squared"

     0.532   -0.0100 * "Year" + 0.0000294 * "Year"sq   Adj. Rsq   0.9996
    (39.6)   (30.8)   (15.0)

Source: Annex Table2

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[13] *t*- statistics in parentheses.
[14] "Year" = Actual year minus 1900.

Regression Number	Dependent variable: Share of agricultural GDP in total GDP			
	B-1	B-2	B-3	B-4
Constant	1.485 (45.5)	1.571 (47.2)	1.519 (20.9)	1.756 (26.9)
lnGDPpc	-0.273 (30.4)	-0.286 (32.8)	-0.292 (15.3)	-0.392 (22.5)
(lnGDPpc)sq.	0.0129 (21.7)	0.0138 (23.9)	0.0142 (10.7)	0.0215 (17.7)
Terms of Trade				0.000648 (30.6)
Year?	N	Y	Y	Y
Country?	N	N	Y	Y
Adj. Rsq	0.7643	0.7795	0.9079	0.9335
Turning point				
LnGDPpc	10.581	10.362	10.282	9.116
GDPpc ($2000)	$39395	$31644	$29193	$ 9102

Regression of country effects from Regression B-3 on lnGDPpc2000

$$0.0759 \quad -0.0006 * \text{lnGDPpc2000} \qquad \text{Adj. Rsq} \quad 0.0004$$
$$(3.0) \qquad (0.2)$$

Regression of year effects from Regression B-3 on "Year" and "Year squared"

$$0.315 \quad -0.00677 * \text{"Year"} + 0.0000292 * \text{"Year"sq} \qquad \text{Adj Rsq} \quad 0.9375$$
$$(4.9) \qquad (4.3) \qquad (3.1)$$

Source: Annex Table 3

Regression Number	Dependent variable: AgGDP share minus AgEMP share equals "GAP"			
	C-1	C-2	C-3	C-4
Constant	-0.812 (15.1)	-0.907 (16.4)	1.0224 (10.3)	1.318 (15.2)
lnGDPpc	0.0637 (4.3)	0.0771 (5.3)	-0.316 (12.4)	-0.4316 (18.5)
(lnGDPpc)sq.	0.00161 (1.7)	0.000665 (0.7)	0.0173 (9.9)	0.02530 (15.4)
Terms of Trade				0.0008327 (29.1)
Year?	N	Y	Y	Y
Country?	N	N	Y	Y
Adj. Rsq	0.5817	0.5944	0.8718	0.9166
Turning point				
LnGDPpc	---	---	9.133	8.530
GDPpc ($2000)	---	---	$9255	$5063

Regression of country effects from Regression C-3 on lnGDPpc2000
$$-1.033 + 0.1331 * \text{lnGDPpc2000} \qquad \text{Adj. Rsq} \quad 0.8260$$
$$(20.2) \qquad (20.0)$$

Regression of year effects from Regression C-3 on "Year" and "Year squared"
$$-0.6288 + 0.0136 * \text{"Year"} - 0.0000584 * \text{"Year"sq} \qquad \text{Adj Rsq} \quad 0.9573$$
$$(5.9) \qquad (5.2) \qquad (5.9)$$

Source: Annex Table 4

Regression Number	Dependent variable: Agricultural GDPshare and Empl. Share Ratio			
	D-1	D-2	D-3	D-4
Constant	1.441229	1.449252	1.854898	2.552514
	(18.5)	(17.7)	(11.2)	(17.2)
lnGDPpc	-0.284816	-0.287076	-0.2748101	-0.5361013
	(13.3)	(13.3)	(6.3)	(13.6)
(lnGDPpc)sq.	0.020171	0.0202952	0.0075667	0.0255197
	(14.3)	(14.3)	(2.5)	(9.3)
Terms of Trade				0.0015191
				(31.7)
Year?	N	Y	Y	Y
Country?	N	N	Y	Y
Adj. Rsq.	0.0968	0.0911	0.6671	0.7612
Turning point				
LnGDPpc	7.060	7.073	18.151	10.504
GDPpc ($2000)	$1164	$1179	$76 billion	$36, 444

Source: Annex Table 5

Figure 1a – Looking for convergence using the Agricultural GDPshare-EMPshare Ratio:
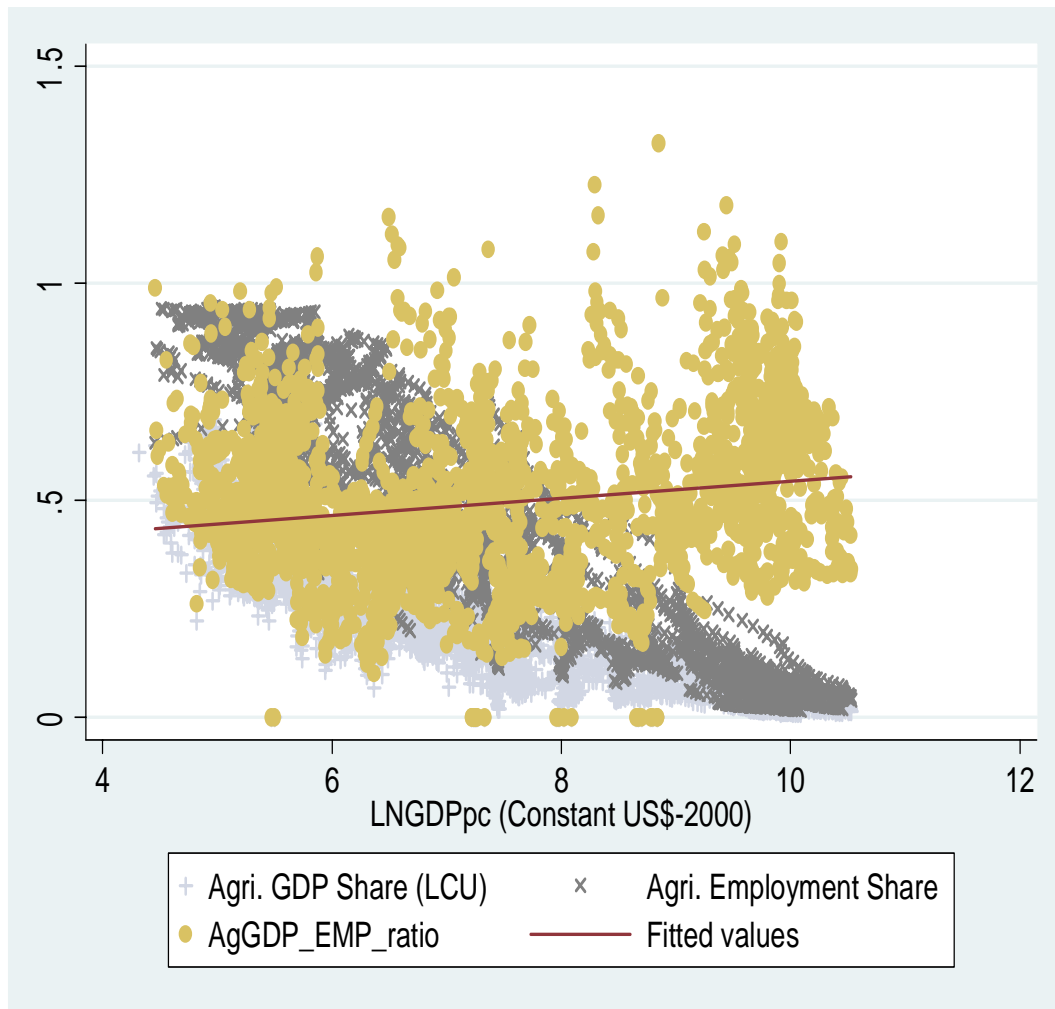
IV. Are the patterns changing over time?

An important question about the structural transformation is whether it has been a uniform process over time, or whether the very nature of economic growth, and its ability to integrate surplus agricultural workers into the non-agricultural sector, has been changing in identifiable ways. There are two ways to address the issue. The first is to examine the short-run record of growth using the current sample of countries, with data from 1965 to 2000. That is the task of this section. The second, pursued in the next section, is to examine the long-run record of the early developers to see how their patterns of structural transformation might vary from the modern record.

A. The short run

There are a number of ways to slice the modern record of structural transformation into smaller segments than was reported above for the entire period from 1965 to 2000. Tables 3a and 3b show two useful alternatives. Table 3a reports the results of estimating the AgGAPshr regression for the four time periods 1965-74, 1975-84, 1985-94, and 1995-2000. For each separate time period the turning point is calculated for regressions that first exclude and then include the terms of trade variable. Next, the slope of the gap relationship is calculated for a variety of relevant values of lnGDPpc (from 6 to 11, or from $403 to $59874 in US$2000).

The goal is to see if there are any systematic patterns over time in either the turning points or the slopes. The answer is yes. The clearest pattern occurs for the turning points in the gap relationship when the regression includes the terms of trade variable. These turning points are as follows:

        1965-74: $ 1109
        1975-84: $ 6379
        1985-94: $ 7880
        1995-2000: $15484

Clearly, the turning point for the gap in labor productivity between the agricultural and non-agricultural sectors has been steadily rising since the mid-1960s. That is to say, the economic growth process as manifested in the structural transformation has become progressively less successful at integrating low-productivity agricultural labor into the rest of the economy. Complaints that the agricultural economies of poor countries are not as well integrated into the growth of the rest of their economy are justified. The reasons for this still need to be understood, but the facts that need to be explained are clear.

It is possible, of course, that these results stem from a serendipitous choice of time periods rather some deep change in the structural transformation itself. Table 3b investigates this possibility by breaking the data into just three time periods instead of four: 1965-79, 1980-90 and 1991-2000. These three time periods correspond to the early period of "classical" economic growth, the decade of experience with structural adjustment, and the decade when forces of globalization are thought to have taken hold. The turning points in the gap relationship for these three time periods are as follows:

```
1965-79:        $    1043
1980-90         $  19300
1991-2000.      $223044
```

These results are even stronger than those for the four-period analysis and are strongly suggestive of a failure of modern economic growth processes to integrate the agricultural sector of poor countries into the rest of their economy despite relatively successful aggregate growth records. This increasing difficulty in integrating the two sectors also helps explain the relative stagnation in rural poverty over the past two decades in a number of countries (Ravallion, Chen and Sangraula, 2007).

The analysis of the slopes of the gap relationship at various income levels merely confirms this rather pessimistic result. For example, at nearly all per capita income levels in the 1965-79 era the slope was positive, as labor productivity in agriculture was converging with labor productivity in the non-agricultural sector in nearly all countries. But in the most recent era, 1991-2000, the slopes are negative for all income levels, even the highest. It is no wonder that most countries are seeking mechanisms to integrate their agricultural economies into their overall economy that go beyond the economic growth process, and the structural transformation, itself.

Perhaps the most striking evidence that the turning point is becoming harder to reach is presented in Figure 3, which shows a nine-year moving average of the calculated turning points for each sub-sample, starting with 1965-1973 and ending with 1992-2000. Although there are ups and downs that seem to be associated with broad trends in the global economy, the upward movement is striking. Indeed, by the latter years in the sample, even rich countries were no longer guaranteed to be on the converging side of the GAP relationship.

A worsening sectoral income gap—a deteriorating Gini coefficient between urban and rural areas—spells political trouble. Policy makers feel compelled to address the problem, and the most visible way is to provide more income to agricultural producers. The long-run way to do this is to raise their labor productivity and encourage agricultural labor to migrate to urban jobs, but the short-run approach—inevitable in most political environments—is to use trade policy to affect domestic agricultural prices (Olson, 1965; Lindert, 1991). It is no wonder that most countries are seeking mechanisms to integrate their agricultural economies into their overall economy that go beyond the economic growth process, and the structural transformation, itself.

Agricultural protection is a child of growing income inequality between the sectors during the structural transformation. The empirical relationship is explored in Section VI.

Table 3a. The turning point in the GAP relationship for four different time periods: When does agricultural productivity begin to converge with non-agricultural productivity (for labor)?

|	1965/74		1975/84		1985/94		1995/00	
	w/o ToT	ToT	w/o ToT	ToT	w/o ToT	ToT	w/o ToT	ToT
Coefficient on...								
lnGDPpc	-0.2528	-0.2454	-0.1067	-0.2453	-0.5387	-0.5150	-0.3469	-0.4380
	(2.6)	(3.4)	(1.5)	(3.9)	(7.4)	(10.6)	(3.6)	(7.2)
(lnGDPpc)sq	0.0230	0.0175	0.0041	0.0140	0.0303	0.0287	0.0140	0.0227
	(3.6)	(3.5)	(0.8)	(3.1)	(5.8)	(8.2)	(2.2)	(5.5)
ToT		0.000653		0.000614		0.000768		0.001146
		(9.7)		(15.3)		(16.8)		(17.0)
Nobs	780	620	818	777	848	811	516	503
Turning point								
lnGDPpc	5.496	7.011	13.012	8.761	8.889	8.972	12.389	9.648
GDPpc ($2000)	$245	$1109	$447842	$6379	$7255	$7880	$240214	$15484
Slope at lnGDPpc of...								
6 = $403	0.023	-0.035	-0.058	-0.077	-0.175	-0.171	-0.179	-0.166
7 = $1097	0.069	-0.000	-0.049	-0.049	-0.115	-0.113	-0.151	-0.120
8 = $2981	0.115	0.035	-0.041	-0.021	-0.054	-0.056	-0.123	-0.075
9 = $8103	0.161	0.070	-0.033	0.007	0.007	0.002	-0.095	-0.029
10 = $22026	0.207	0.105	-0.025	0.035	0.067	0.059	-0.067	0.016
11 = $59874	0.253	0.140	-0.017	0.063	0.128	0.116	-0.139	0.061

[Note: All regressions have Year and Country coefficients included. *t*-statistics in parentheses]

Table 3b. The turning point in the GAP relationship for three different time periods: When does agricultural productivity begin to converge with non-agricultural productivity (for labor)?

	1965/79		1980/90		1991/00	
	w/o ToT	ToT	w/o ToT	ToT	w/o ToT	ToT
Coefficient on...						
lnGDPpc	-0.2830	-0.2627	-0.2196	-0.2763	-0.1632	-0.2931
	(4.2)	(4.6)	(3.0)	(4.8)	(2.7)	(7.8)
(lnGDPpc)	0.0229	0.0189	0.0087	0.0140	0.0020	0.0119
	(5.0)	(4.7)	(1.7)	(3.5)	(0.5)	(4.3)
ToT		0.000628		0.000864		0.000972
		(13.5)		(14.9)		(22.0)
Nobs	1189	961	919	872	858	831
Turning point						
lnGDPpc	6.179	6.950	12.621	9.868	40.800	12.315
GDPpc, $2000	$483	$1043	$302758	$19300	Very large	$223044
Slope at lnGDPpc of...						
6 = $403	-0.008	-0.036	-0.115	-0.108	-0.139	-0.150
7 = $1097	0.038	0.002	-0.098	-0.080	-0.135	-0.127
8 = $2981	0.083	0.040	-0.080	-0.052	-0.1311	-0.103
9 = $8103	0.129	0.078	-0.063	-0.024	-0.127	-0.079
10 = $22026	0.175	0.115	-0.046	0.004	-0.123	-0.055
11 = $59874	0.221	0.153	-0.028	0.032	-0.119	-0.031

[Note: All regressions have Year and Country coefficients included. *t*-statistics in parentheses]

Figure 3. Nine-year moving average of turning points in GAP convergence, compared with economic growth experience of Kenya, Thailand , Mexico and France
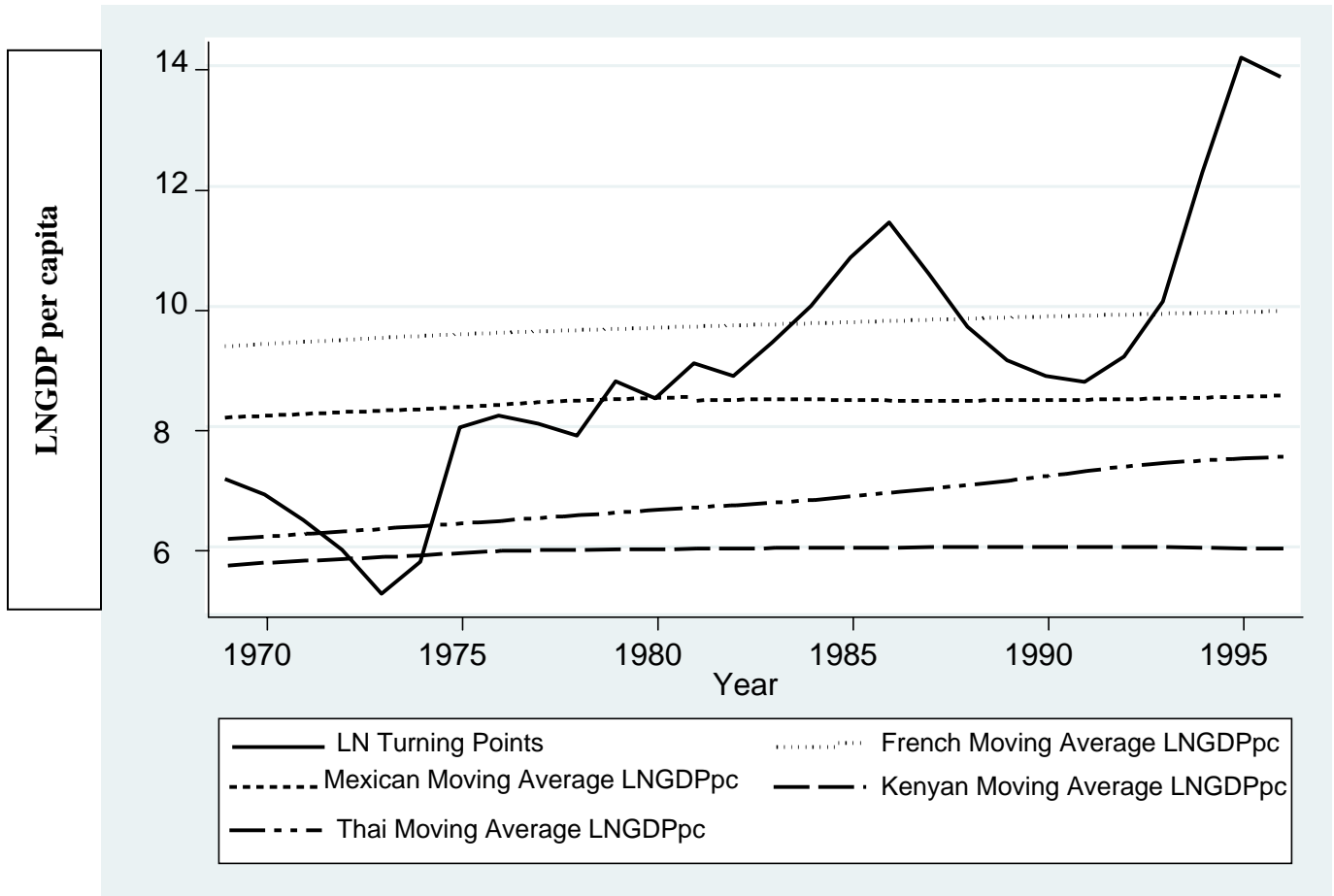
B. What lessons from the early developers? Long-run patterns from 1820-1985

Concerns about the distributional impact of globalization are not new. The world economy experienced an earlier round of globalization from 1870 to World War I, and there may be lessons from that experience from the currently developed countries. Their economies were experiencing rapid economic growth (by the standards of the time) and facing challenges from the growing integration of labor and capital markets across countries (Williamson, 2002). Thanks to the dedicated work of modern economic historians, it is possible to examine the nature of these challenges empirically. The results are shown in Table 4.

Perhaps the most striking result in Table 4 is that the patterns from the early developers seem remarkably similar to those for the full sample of countries from 1965 to 2000. Although the small sample size (9 countries with just four observations for each except the United Kingdom, for which an observation for 1820 is available in addition to an observation for the mid-to-late 19th century, 1939, 1960 and 1985) means the coefficients are measured with considerable error, they are still significant by most standards, with the same pattern of signs and magnitudes as for the full sample (see Table 4).

In particular, the tendency for the gap share variable to widen in the early stages of development does not seem to be a feature of just late-developing countries. Instead, and importantly, the pattern seems equally strong in the early developers, with the negative linear term larger and the positive quadratic term (that brings convergence) also larger. Both coefficients are significant when separate country intercept terms are included. However, the turning point is in the range of $1000 (US$2000), suggesting that the early experience for these advanced countries was much more similar to the growth patterns of the 1960s and 1970s than to the most recent era.

Still, the powerful tendency of the gap in labor productivity to widen in the early stages of development, even in the late 19th and early 20th centuries, is likely to be important in explaining the common pattern of agricultural protection seen since the mid-1930s in most developed countries, and increasingly in developing countries since the 1980s.

Further investigation is needed to explain the magnitude and significance of the country effects, to see the impact of any systematic divergences from these powerful overall patterns of structural transformation. That is the purpose of the next section.

Table 4. Summary of regressions to explain the structural transformation in early developers, 1820-1985*

Regression Number	Constant		lnGDPpc		(lnGDPpc)sq.		Country?	Adj Rsq	
Emp-1 hist	4.738 (4.2)		-0.858 (3.2)		0.0387 (2.5)		N	0.8647	
Emp-2 hist	4.103 (5.4)		-0.706 (4.0)		0.0294 (2.8)		Y	0.9453	
*	*	*	*	*	*	*	*	*	*
GDP-1 hist	6.039 (7.2)		-1.281 (6.5)		0.0684 (5.9)		N	0.8306	
GDP-2 hist	5.597 (6.8)		-1.174 (6.1)		0.0633 (5.5)		Y	0.8539	

Note: no individual country dummy was significant by itself

*	*	*	*	*	*	*	*	*	*
GAP-1 hist	1.059 (1.2)		-0.371 (1.7)		0.0269 (2.1)		N	0.6435	

The turning point for this equation is $lnGDPpc = 6.896 = US\$ 988$ (USD2000)

GAP-2 hist	1.397 (1.8)		-0.447 (2.5)		0.0316 (3.0)		Y	0.7709	

The turning point for this equation is $lnGDPpc = 7.073 = US\$ 1179$ (USD2000)

* The countries included in this panel of early developers include Japan (1885), Netherlands (1850), Sweden (1870), Denmark (1850), Germany (1850), France (1856), United Kingdom (1820, 1861), United States (1889), Australia (1861). In addition to the earliest year shown, data for 1939, 1960 and 1985 were included, for a total of 37 observations. Per capita GDP data are from Maddison (1995) and are in 1990 Geary-Khamis dollars.

V. What lessons from divergent paths?

There are two ways to think about individual country experience in the context of the regular patterns of the structural transformation. First, all countries might be "unique" in a statistically significant way, so only the aggregate of countries actually displays a pattern of transformation over time or across incomes. In this case the structural transformation would be a long-run phenomenon (over 50 to 100 years), but not very applicable in the short run (during intervals of just 5 to 10 years). Second, most countries might follow the regular pattern over time, with just a handful of "outliers" that deviate significantly from that pattern. Then the structural transformation would have both short-run and long-run implications for most countries.

Both the *level* of a country's relationship of its agricultural sector to the rest of the economy, and the *slope* of that relationship with respect to per capita income, can vary significantly from the sample-wide patterns. Country effects, which measure the level of the relationship, are large in the employment share regression. Adding the Country effects to regression A-3 in Table 2, for example, increases the variance explained by 10 percentage points (the adjusted R-squared increases from 0.8830 to 0.9851). Only 6 of the 85 Country effects are *not* statistically significant (see Annex Table 2), and they are themselves closely related to per capita GDP. The lnGDPpc variable alone explains 85 percent of the variance in the individual country coefficients. Relatively little additional country variance remains to be explained in the employment share relationship.

The Country effects are also large in the GDP share regression (see Annex Table 3). The R-squared increases from 0.7795 in regression B-2 to 0.9079 in regression B-3. Only 10 of the 85 Country effect coefficients are not significant, although the relative size and significance of the coefficients are much smaller for the GDP regressions than for the Employment regressions, reflecting perhaps the greater degrees of freedom politically to affect labor markets than the structure of the economy.

Importantly, however, the Country coefficients in the GDP relationship are not related at all to per capita GDP. Explaining the country coefficients in this regression remains an important research task. Likely candidates include movement in the agricultural to non-agricultural terms of trade, movement in the external terms of trade, openness to foreign trade, composition of exports, and oil importing/exporting status. It is also possible that institutional changes will be significant, although these are slow to change even over a 35 year horizon, and thus difficult to measure empirically.

When explaining the GAP share variable directly, the employment share results dominate. Only 6 of the 85 Country effect coefficients are insignificant, and both the size and significance of the coefficients are large. These large Country effects are largely explained by per capita GDP--83 percent of the variance. Further explanations for variations in the GAP share variable are likely to emerge from factors that also explain the Country effects for changes in GDP shares. One route to these explanations is examination of the full patterns for individual countries in relation to the overall patterns of the structural transformation. Of course, it is only possible to examine the paths of a few countries in the sample. First, a

comparison of Asian experience with that of all other countries is quite revealing as an exercise to motivate the analysis of individual countries.

A. The contrast between Asia and the rest of the world

At first glance, the 13 Asian countries included in the sample seem to have a similar pattern of structural transformation between 1965 and 2000 as the 73 non-Asian countries (see Figure 4). Since the Asian sample includes some of the fastest growing countries during that time period (Japan, Korea, Malaysia, Thailand, and Indonesia), the visual evidence is reassuring that there is in fact a common, long-run pattern of structural transformation.

Statistical analysis, however, confirms that there are important differences in the patterns. Annex Tables 7 to 9 reproduce the same basic results for the Asian/non-Asian samples separately that Table 2 reported for the entire sample. The commonalities are perhaps most obvious, but the differences are important as well. In particular, Asian countries have a very different pattern of agricultural employment changes with respect to per capita incomes from non-Asian countries.

The differences are revealed most clearly in column A-4 in Annex Table 7. For Asian countries the linear term in lnGDPpc is positive and the quadratic term is negative, just the opposite of the non-Asia sample. More importantly, the coefficient on the agricultural terms of trade is *positive* and significant for the Asian sample, whereas it is *negative* and significant for the non-Asian sample. In this, the Asian pattern contrasts with the overall sample as well.

The impact is fairly clear—Asian countries were able to use the agricultural terms of trade as a policy instrument for keeping labor employed in agriculture, a pattern not seen in the rest of the countries in the sample. Average economic growth in the Asian sample was faster than in the rest of the countries, and the rapid decline in the share of GDP from agriculture reflects this. Although the pattern of signs in the agGDPshr regressions is the same for both samples, the coefficient on the agricultural terms of trade is three times larger in the Asian sample than in the non-Asian sample (see column B-4 in Annex Table 8).

The implication is that Asian countries provided more price incentives to their agricultural sectors over this time period as a way to prevent the movement of labor out of agriculture from being "too fast." Certainly the pattern of movements in the agricultural terms of trade for the two sets of countries is strikingly different, with Asian countries seeing a long-run decline at half the pace of the non-Asian countries (see Figure 5). The political economy of these choices is explored in Section VI, where the agricultural terms of trade are split into two components, one dependent on world prices for agricultural commodities and energy, the second being the residual that reflects domestic factors in the formation of the agricultural terms of trade.

The net effect of these forces on the gap between labor productivity in the two sectors is shown in the regression results for agGAPshr (see Annex Table 9). For the fully specified model in column C-4 the results reflect the combined differences in the agEMPshr and agGDPshr regressions shown in Annex Tables 7 and 8. It is useful to calculate the turning points for the agGAPshr model in this fully specified model, and these are also shown in column C-4.

When the agricultural terms of trade is included in the regression for both the Asian and non-Asian samples, the coefficient is larger in the Asian sample. Furthermore, the turning point in the GAP relationship (after which labor productivity in agriculture begins to converge with labor productivity in non-agriculture) is sharply lower in the Asian sample. The turning point for the Asian countries is just $1,663, whereas it is $11,329 for the non-Asian countries. This difference reflects two features of the Asian economies—their more rapid growth and their greater focus on stimulating agricultural productivity as a source of that growth (Timmer, 2005b).

The reasons for these differences have been the source of considerable debate. An explanation that resonates with the empirical results reported here is that Asian countries were more concerned about providing "macro" food security in urban markets and "micro" food security to rural households because of large and dense populations farming on very limited agricultural resources. Political stability, and with it the foundation for modern economic growth, grew out of the provision of food security that connected poor households to improved opportunities. (Timmer, 2004a, 2005a).

Figure 4. The Structural transformation for Asian and non-Asian Countries separately

13 Asian Countries – *Bangladesh, China, India, Indonesia, Japan, Korea, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, and Thailand*
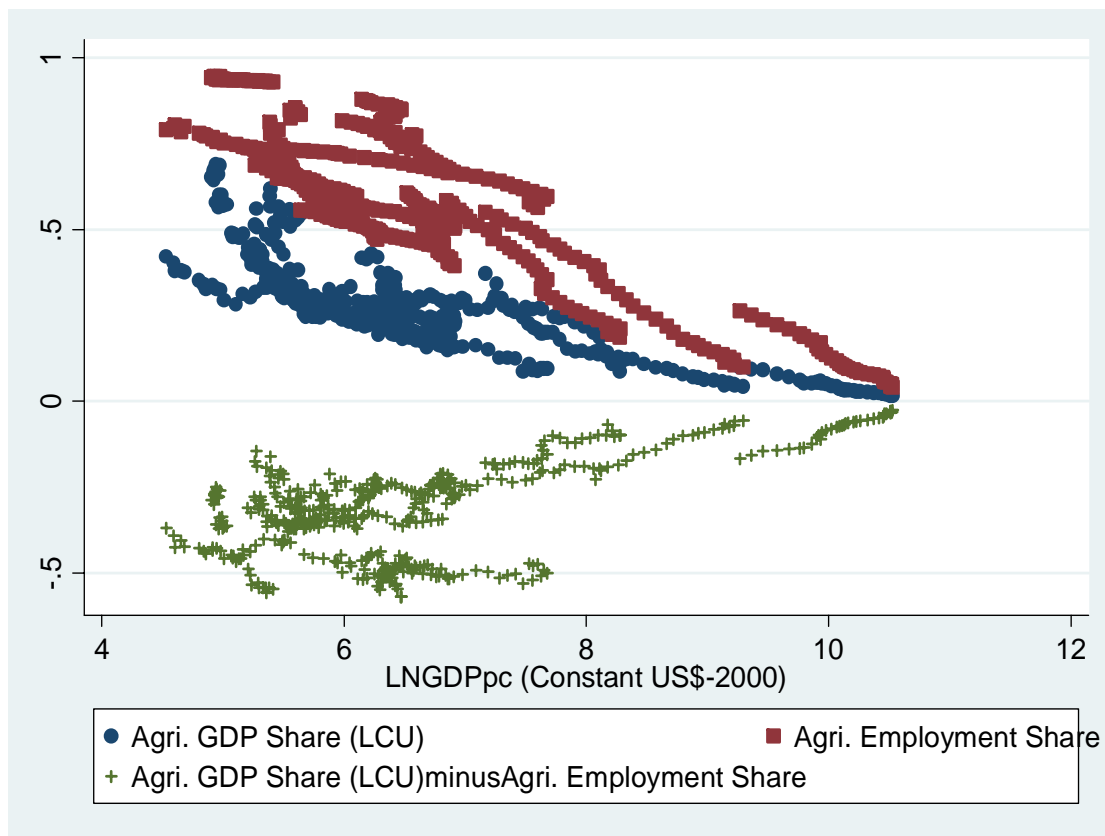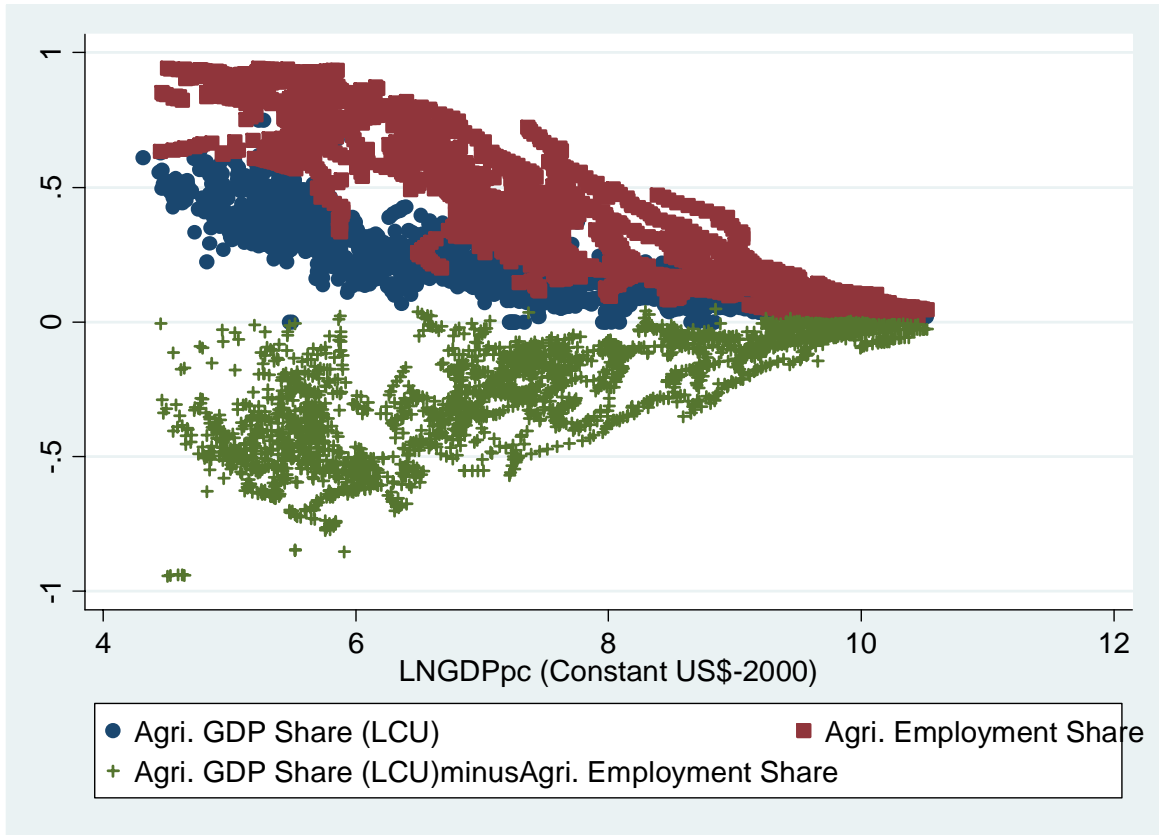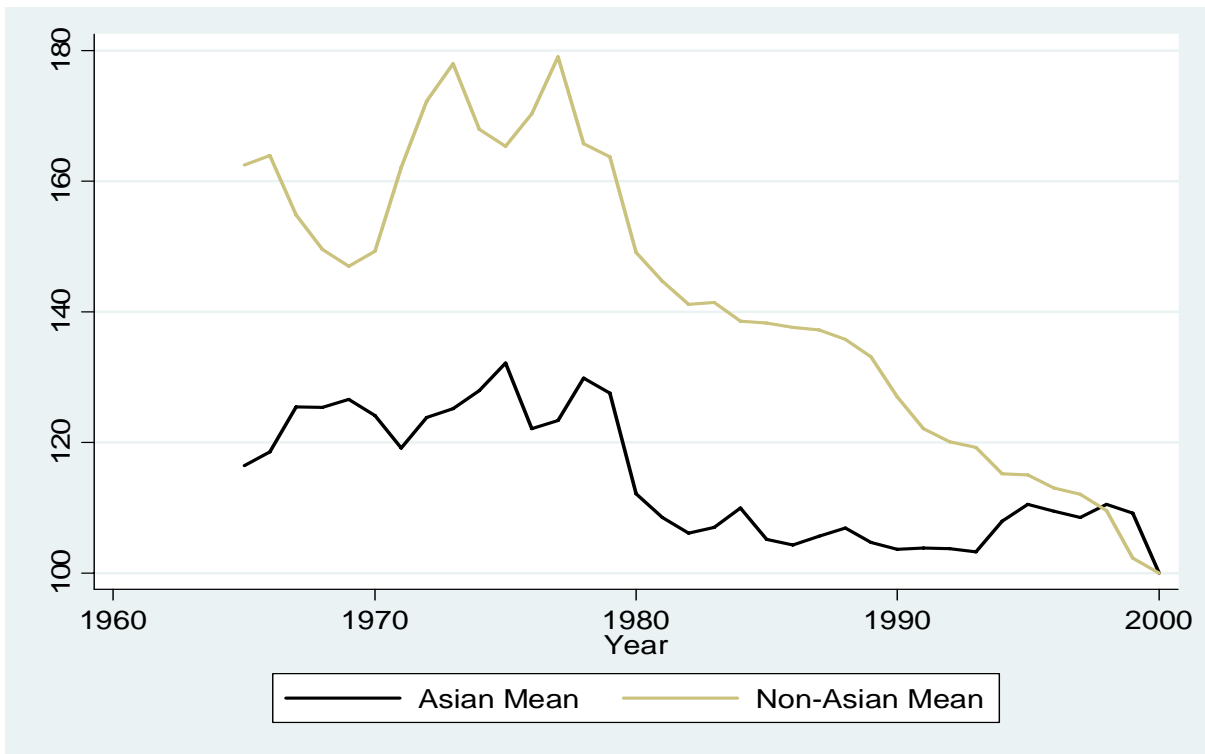
73 Non-Asian Countries

Figure 5. Asian / Non-Asian Mean AgTOT Change:

B. Understanding divergent country paths?

Testing for different country slopes with respect to per capita GDP, for any of the three regression models, is a time-intensive activity requiring careful visual study of actual country time paths. The individual country coefficients give important clues on where to look, and the high explanatory power of the three structural equations suggests that the paths for most countries fit the general pattern (see Table 2).

At one level the high explanatory power of these equations is no surprise. Despite the wide variance in the cross section-time series data for the 86 countries, the fixed effects coefficients for individual years and countries assure that *average* deviations for individual countries are accounted for, so countries with good agricultural resources are shifted onto the general path along with average countries and countries with poor agricultural resources.

Still, countries may experience significantly different *pathways* of structural transformation even after their intercept term has been moved onto the general pathway. The slopes of the paths may be different. To test for this, slope modifiers are introduced for the lnGDPpc and (lnGDPpc)sq terms for several countries of interest. In particular, modified pathways are tested for a number of large countries--China, India, United States, Indonesia, Brazil, and Nigeria, because visual inspection suggested that some of these countries' pathways might be outliers. Then the countries being studied by the RuralStruc Program in the World Bank are also examined in the same fashion to see if the patterns for a set of smaller countries are any different.[15]

It is difficult to present the results from examining individual country paths in a simple manner. Table 5 shows the results for one country, Indonesia, when this country alone is allowed to have a separate intercept and country-specific slope coefficients for both lnGDPpc and (lnGDPpc)sq. It is necessary to show the common coefficients for the rest of the countries, as these change slightly for each country examined individually. The changes are significant only when China is the country being examined, presumably because China's growth has been so rapid, so atypical, and hence such a large contributor to the overall variance in the sample, that effectively pulling it out of the sample changes the overall coefficients somewhat.

The results for other large countries are quite interesting, as the structural patterns diverge significantly for several of them. Brazil has had significant economic reversals since the 1980s and the economic recovery in the past decade has involved an increase in the share of agriculture in GDP, as large-scale commercial farming, especially for soybeans using GM technology, expanded rapidly to meet export demand, especially from China. This was not a labor-intensive farming system, however, and the share of employment in agriculture

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[15] Of course, the role of country size in the process of economic growth has been a topic of research for some time. Kuznets (1955) observed early on that large countries had lower ratios of foreign trade to GDP than did smaller countries, and this observation led Chenery to organize his research program on economic structure and growth around that fact (Chenery, 1960; Chenery and Taylor, 1968; Chenery and Syrquin, 1975). Perkins and Syrquin (1988) directly examine the impact of size in the economic growth of large countries. The RuralStruc research project, co-funded by the French government and the World Bank and directed by Bruno Losch, is investigating the impact of liberalization and globalization on the structure of rural economies in Mexico, Nicaragua, Morocco, Mali, Senegal, Madagascar, and Kenya.

continued to fall. Thus Brazil's long-run pattern for share of agriculture in GDP does not differ significantly from the overall pattern, but the share of agriculture in employment follows an inverted quadratic pattern that is sharply different from the overall pattern. Accordingly, the agGAPshr pathway also follows an inverted quadratic pattern that is statistically (and visually) different from the overall pattern, where the gap first widens, and then narrows progressively.

China is unique because it is the fastest growing economy in the sample. Labor migration was strictly regulated under the Maoist regime, so there was a large backlog of underemployed labor in rural areas when economic reforms began in 1978. Thus the decline in the share of agriculture in employment has been slower than would be predicted by the overall pattern. Indeed, the quadratic pattern for China is very flat in the relevant range and actually has a negative coefficient for (lnGDPpc)sq, indicating that the negative path began to accelerate in the mid-1990s (see Annex Figure 3-c). China's path with respect to agricultural share of GDP is similarly inverted, but both the net linear and quadratic terms are negative, so the downward path in GDP share is slowly accelerating. The net effect on agGAPshr, however, is compensating, and China's change in the gap between agriculture's share in employment and its share in GDP is not significantly different from the overall pattern. That is, China is unique in its rapid growth and in the structural patterns that growth has induced in employment and GDP. But China is not unique in the distributional consequences of its growth. Here, it faces the same pressures as other countries, although the fast pace of growth may be accelerating those pressures. If taken literally, the Chinese coefficients for the agGAPshr regression suggest that the gap between labor productivity in agriculture and non-agriculture will not begin to narrow until income levels are above $16,000!

Even a quick glance at the graph for Nigeria (Annex Figure 3-j) suggests that its pattern of structural change is very unusual. This is only partly because of the major reversals in economic growth. Indeed, the pattern of agricultural GDP is not significantly different from the overall pattern, although this is over a narrow range of incomes. What is apparent is that the economic reversal did not reverse previous moves out of agriculture, so there are two levels of agricultural employment over a significant range of Nigeria's income path—a "high" level of employment when the country first reached an income level, and then a "low" level of agricultural employment when the country's income fell back to that level again. Thus the GDP component of the structural transformation is more flexible than the employment component, especially in the face of economic reversals (at least in Nigeria). The net result for the evolution of the gap is in some sense the opposite of that in Brazil, at least for the shape of the quadratic function. In Nigeria, the quadratic term is large and significantly *negative*, indicating that the GAP is widening rapidly at current levels of per capita income.

As expected from the visual evidence, Indonesia does not deviate a lot from the overall pathways of structural change (see Annex Figure 3-e). The share of agriculture in GDP did decline significantly faster than the overall pattern in the early stages of Indonesia's development, but this was largely due to the rapid expansion of the petroleum exporting sector in the 1970s. As the economy has diversified (and growth came to a screeching halt during the financial crisis in 1998) the pattern of agricultural GDP share has also returned to normal. This effect is captured statistically by the larger positive quadratic term in the GDP regression. The

other two regressions show that Indonesia fits the general pattern, as none of the coefficients are significant when slope modifiers are included.

The small countries that are part of the RuralStruc project exhibit no strong divergences from the general patterns (see Table 6). Part of the reason is simple—a number of the countries have shown little growth in the 1965-2000 period and so there is little from which to diverge. But it also seems likely that small countries have fewer degrees of freedom with respect to the structural path they follow, if economic growth is driving that path. For small countries to grow, they must be open to the global economy. And that openness seems to enforce a common pattern of structural transformation.

All in all, the general structural patterns reported here are quite robust. All countries have unique histories and patterns, of course, and many are actually failing to undergo a significant structural transformation. But that is a failure of growth, not of the patterns. When growth is established, the future pathways for nearly all countries are likely to look like those in Figure 1 or, statistically, like the common patterns in Table 2.

Table 5. **Regression results for individual countries: Indonesia**

Independent Variable	Dependent variable		
	agGDPshr	agEMPshr	agGAPshr
Intercept	1.7070	0.7729	1.2621
(t)	(25.3)	(13.6)	(14.1)
lnGDPpc	-0.3799	-0.04333	-0.4180
(t)	(21.3)	(2.9)	(17.5)
(lnGDPpc)sq	0.02078	0.0009925	0.02450
(t)	(16.8)	(0.9)	(14.7)
Terms of trade	0.0006436	-0.0001282	0.0008291
(t)	(30.4)	(7.0)	(28.9)
Country intercept			
Without slope modifiers	0.04935	0.1611	-0.1350
(t)	(4.0)	(16.9)	(7.4)
With slope modifiers	3.1218	0.7338	2.0110
(t)	(2.3)	(0.6)	(1.1)
lnGDPpc * Country	-0.9718	-0.2168	-0.6550
(t)	(2.2)	(0.6)	(1.1)
(lnGDPpc)sq * Country	0.07655	0.02014	0.04958
(t)	(2.1)	(0.6)	(1.0)
Adjusted R squared	0.9338	0.9863	0.9168

Table 6. Summary of coefficients in agGAPshr regressions when country intercepts and slope modifiers are included (*t*-statistics in parentheses)

Country (Population, in millions)	Intercept[16]		lnGDPpc*Cty	(lnGDPpc)sq * Cty
	Without	With		
China	-0.3482	-0.5104	0.06992	-0.006197
(1314.0)	(17.2)	(0.8)	(0.3)	(0.3)
India	-0.2274	9.1711	-3.2201	0.2754
(1095.4)	(11.4)	(2.0)	(1.9)	(1.9)
United States	0.3025	17.6672	-3.4144	0.1664
(298.4)	(10.8)	(0.5)	(0.5)	(0.5)
Indonesia	-0.1350	2.0110	-0.6550	0.04958
(245.5)	(7.4)	(1.1)	(1.1)	(1.0)
Brazil	0.01758	46.4877	-12.4180	0.8260
(188.1)	(1.1)	(4.9)	(5.1)	(5.2)
Nigeria	-0.03639	-29.8189	10.3596	-0.9000
(131.9)	(1.9)	(2.9)	(2.9)	(2.9)
Mexico	0.06744	20.2729	-4.9534	0.3028
(107.4)	(3.8)	(0.9)	(0.9)	(0.9)
Kenya	-0.3620	-24.9784	8.5651	-0.7426
(34.7)	(19.7)	(1.4)	(1.4)	(1.4)
Morocco	-0.1058	18.3168	-5.6307	0.4303
(33.2)	(6.4)	(1.8)	(1.8)	(1.9)
Madagascar	-0.4097	-13.9023	4.5729	-0.3863
(18.6)	(21.2)	(1.3)	(1.2)	(1.1)
Senegal	-0.4061	75.4063	-25.9275	2.2149
(12.0)	(22.4)	(0.9)	(0.9)	(0.9)
Mali	-0.3364	-13.4095	4.7013	-0.4224
(11.7)	(15.6)	(0.3)	(0.3)	(0.3)
Nicaragua	0.06663	13.6844	-3.6660	0.2447
(5.6)	(4.1)	(2.0)	(1.9)	(1.7)

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[16] "Without" and "With" refers to whether slope modifiers are present in the regression. The coefficients for "without" are taken from Annex Table 4, whose "overall" coefficients are summarized in Table 2.

VI. The scope for countries to alter the path of structural transformation

The uniqueness of some country paths of structural transformation and the distinct patterns seen for Asia suggest that country-specific policies have the potential to alter not just the rate of economic growth, a result that is well known, but also the structural character of that growth. That potential has sparked a flurry of interest in the determinants of "pro-poor growth," defined to mean rapid economic growth that reaches the poor in at least proportionate terms (Besley and Cord, 2007).

This Working Paper is no place to review this entire debate, but it is possible to examine the impact on the structural transformation of policy choices in one especially important area—agricultural prices. The key role of the agricultural terms of trade (AgToT) in conditioning the path of structural change has already been discussed at some length. But these are the *actual* terms of trade reflected in an economy, not necessarily those desired by policy makers. It is possible to go a step further to examine those policy desires, what drives them, and their impact.

A. A new approach to understanding agricultural price policy

In an ideal world, most economists think that optimal price policy for agricultural commodities is no policy at all, that is, free trade and no subsidies. No country actually manages such a hands-off policy for all agricultural products, not even Singapore or New Zealand, so either the world is not ideal or policy makers routinely ignore economists' insights. The two possibilities are linked and this paper uses the insights from modern political economy to understand why and how the linkage influences actual agricultural price policy. Because most agricultural price policy is implemented through border interventions, it is appropriate that modern treatment of political economy has its roots in explaining the perverse patterns of agricultural trade policy during the process of structural transformation (Olson, 1965; Anderson, 1986; Lindert; 1991; Timmer, 1993).

As part of the structural transformation, there is evidence of a pattern of growing agricultural protection as the share of agriculture in the economy declines (Anderson, 1986; Lindert, 1991), but both the phenomenon and any explanation remain controversial (Timmer, 1993). Part of the controversy is over the appropriate analytical framework to use to understand price policy. An alternative to the political economy approach is a quite separate literature that treats the issue of agricultural price policy within the framework of optimal tax theory (Sah and Stiglitz, 1992). The general equilibrium models used in this approach are more "operational" than those used to explain the structural transformation, and require many simplifying assumptions (or highly detailed understanding of empirical behavior by households and firms if the computable general equilibrium models are to be relevant). Still, these general equilibrium models do emphasize the importance of addressing agricultural price policy from an economy-wide perspective. This Working Paper attempts to integrate the political economy perspective with the general equilibrium perspective, in the context of the process of structural transformation. The value of doing so is suggested by the summary Sah and Stiglitz provide of their findings:

Among the policy prescriptions often associated with the modern theory of public finance are the following: taxes should not be imposed on imported goods because such taxes interfere with production efficiency; different goods should be taxed at different rates in the urban sector to reflect differences in elasticities of demand (in accordance with the principles of efficient taxation set out by Ramsey 1927); in particular, food in the urban sector should not be subsidized, except possibly as a second-best way of redistributing money to the urban poor (in which case the food subsidies should be focused on those foods consumed by the very poor, for example millet rather than rice); and shadow wages should be considerably below market wages to reflect the pervasiveness of unemployment, but above zero to reflect the fact that investment is more valuable than consumption, and to reflect that increasing the wage bill diverts resources away from investment.

Each of these conclusions is suspect (Sah and Stiglitz, 1992, p. 10).

These two very different perspectives on how agricultural price policy "should" be set are bound to be confusing to policy makers. At one level, political pressures to cope with the tensions of a rapid structural transformation push policy makers toward providing higher prices to their farmers, usually through some form of border intervention and agricultural protection. At another level, pressures from the budget and forces arguing for efficient resource allocation to stimulate economic growth lead to less intervention. How should policy makers respond? The answer obviously depends on what they are trying to achieve.

In policy makers' eyes, agricultural price policy has the capacity to change both the quantity of a commodity traded—imported or exported--as well as its domestic price. Economists understand that the changes in quantities and prices in domestic markets are connected by the supply and demand functions for the commodity, but policy makers persist in promulgating trade policies that seek to do both independently. For example, Indonesia's desire to restrict rice imports, support farm prices and lower consumer prices all at the same time is a common feature of many agricultural trade policies in developing countries, and the multiple objectives are almost never met with a single policy instrument (Timmer, 1986).

We stand back from such complexity in this Working Paper. The goal here is broader and longer run than understanding the realities of actual agricultural trade policies—as designed and implemented. For that, the update of the classic Krueger, Schiff, and Valdez (1991) study of agricultural price distortions being led by Kym Anderson is providing much valuable information (Masters, 2007; Anderson, forthcoming). Instead, this paper examines how agricultural price policy evolves over the long-run process of structural transformation.

In this analysis, the agricultural to non-agricultural terms of trade (AgToT) is used as a quantifiable proxy for desired agricultural trade policy. The AgToT can be calculated easily as the ratio between the GDP deflator for agricultural value added in national income accounts and the GDP deflator for value added in the rest of the economy (see Figure 6). As a result, the analysis focuses exclusively on the price effects of agricultural trade policy and does not analyze quantity effects separately. Thus the emphasis is on understanding desired domestic

agricultural price policy and its quantifiable impact, with the mechanics of implementation largely ignored. [17]

Of course, agricultural price *policies* are only one of the many variables that influence the domestic AgToT. However, many of the influencing variables are beyond the direct influence of policy makers, such as the real exchange rate, international commodity prices, and the changing structure of the economy during economic development (Timmer, 1984). Agricultural trade policies are, by design, things policy makers can change according to their priorities. When we control for the exogenous factors over the process of development, the changing level and impact of agricultural price policies can be identified. That is the approach taken here.

The story that follows is complicated. The next section reviews the empirical evidence on how AgToT evolves during the course of economic development, and its impact on the structural transformation. Then the question is reversed to address what pressures are created from the structural transformation and how these are then manifested in policy responses involving AgToT. It is necessary to "purge" the AgToT as measured empirically from the influence of external factors, and this is done country by country. The results are worth the effort, however, as it is possible to show for the first time that a macro-measure of policy-induced agricultural incentives is highly responsive to changes in sectoral income inequality that are manifested during the structural transformation

B. The agricultural terms of trade: Patterns and impact

What is the role of government in stimulating growth in agricultural productivity and reaping the benefits of all the positive linkages to overall economic growth and poverty reduction noted in the general literature on agricultural development (Timmer, 1988, 2002)? Clearly, there is a set of economic (and political) basics that provide the foundation for such growth—macroeconomic stability, public sector investments in public goods (especially rural infrastructure and facilities for household investments in human capital), and effective institutions that provide property rights and a societal capacity to innovate. The narrower question here is the nature of incentives needed to stimulate growth in agricultural productivity, and the role of price and trade policy in putting those incentives in place.

In the broadest, economy-wide perspective, incentives to raise agricultural productivity are reflected in the terms of trade between agriculture and the rest of the economy. As noted, the agricultural terms of trade can be calculated easily as the ratio between the GDP deflator for agricultural value added in national income accounts and the GDP deflator for value added in the rest of the economy. This variable is an index, based on whatever year is used as the base for the GDP deflator in these accounts. As a practical matter, the *World Development Indicators* published by the World Bank use a common year for all countries, so the variable used in the following analysis is equal to 100 for all countries in the year 2000. Thus the

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[17] Quantity effects that impact food consumption are often more important for food security and nutritional well-being than price effects that are measured in markets. Such effects are not the main focus of this paper. See Timmer (2005) for treatment of the food security dimensions.

AgToT variable only captures *relative* movements in time across countries, but not any initial differences in relative price incentives at a given point in time. Figure 6 shows the average value of the AgToT variable annually from 1965 to 2000 for the 86 countries included in this analysis. All countries have a value of 100 in 2000, but the inclusion of country fixed effects in the analysis is a partial substitute for not having country-specific levels for the AgToT.

Still, the AgToT variable is very important in explaining agricultural performance across countries and over time. Even when controlling for country and year fixed-effects in regressions seeking to explain the structural transformation as a quadratic function of the logarithm of real GDP per capita in purchasing power parity terms, the domestic terms of trade between the agricultural sector and the rest of the economy is always a highly significant variable. Whether the dependent variable is the share of agriculture in GDP (AgGDPshr), the share of agriculture in total employment (AgEMPshr), the gap between these two variables (AgGAPshr), or their ratio, the AgToT variable contributes substantially to explaining the variance in these share variables (see Table 1).

Figure 6. The average AgToT from 1965 to 2000 for 86 countries:
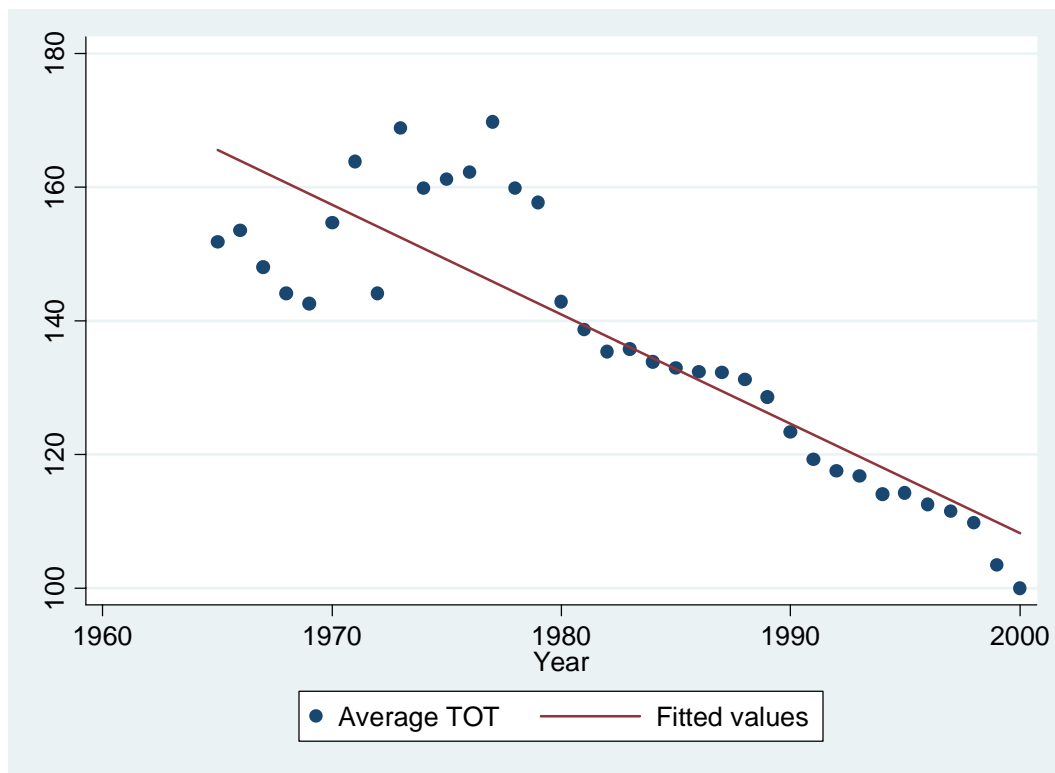
In these regressions that capture the regularity of the structural transformation, the AgToT variable is controlling mostly for short-run price movements, and the signs for the coefficient reflect that—positive and highly significant for AgGDPshr. The negative and somewhat less significant coefficient for AgEMPshr is perhaps more interesting as there are no price terms in the dependent variable. Higher agricultural prices are associated with a *lower* share of agricultural employment in total employment, after controlling for real per capita GDP (a

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statistical and not necessarily causal relationship), which suggests a policy motive in using AgToT to cushion the labor adjustment process during the structural transformation. Investigating this possibility is the main empirical contribution of this paper.

In addition, the terms of trade variable is important and interesting on its own. Annex Table 10 shows that AgToT has a significant negative trend over time, after controlling for a slight tendency to increase with lnGDPpc (Figure 6 shows a similar negative trend for the raw AgToT variable). The Year coefficients for AgToT, which reflect the "global" market forces at work on domestic economies, account for just 20 percent of the variance in the overall AgToT variable. But of this variance, 80 percent is accounted for by indices of world food prices, world non-food agricultural prices, and energy prices (see Annex Table 10. So although world markets are an important determinant of the domestic terms of trade between agriculture and non-agriculture, most of the variance is due to specific domestic economic and policy factors. Understanding the extent to which domestic policy uses instruments to influence the terms of trade between the two sectors is key to understanding the political economy of the structural transformation.

A worsening sectoral income gap—a deteriorating Gini coefficient between urban and rural areas—spells political trouble. Policy makers feel compelled to address the problem, and the most visible way is to provide more income to agricultural producers. The long-run way to do this is to raise their labor productivity and encourage agricultural labor to migrate to urban jobs, but the short-run approach—inevitable in most political environments—is to use trade policy to affect domestic agricultural prices. Agricultural protection is a child of growing income inequality between the sectors during the structural transformation. And it is possible to see this child develop in the empirical record.

C. Agricultural price policy during the structural transformation: Is there a link?

Three steps are required to establish empirically that a link exists between political pressures generated by the structural transformation and the response of policymakers in the form of agricultural price interventions. First, in order to create a price variable that reflects intentions of policy makers, the AgToT series for each country needs to be "purged" of impact from prices in world markets, over which individual countries have little or no control. As was noted above, the Year coefficients in the overall AgToT regression explain just 20 percent of total variance in the AgToT variable, but this assumes all countries have the same relationship with world prices. Thus the first step is to relax that assumption and generate a new AgToT series that is net of those prices, a variable that is termed the "domestic policy agricultural terms of trade," or DPAgToT for short.

The second step is to explain the variance in this new domestic price policy variable. The hypothesis is that widening sectoral income inequality is a major driver of domestic policy formation, and this is tested by making DPAgToT a function of agGAPshr (equal to the negative of the sectoral Gini coefficient). An obvious concern is that domestic agricultural prices appear in some form on both sides of this regression, which should cause a positive bias in the estimated coefficient. But the hypothesis calls for a *negative* coefficient (because of how

agGAPshr is defined). Fortunately, the full fixed effect model has a large and significantly *negative* coefficient, so this concern is alleviated.

Still, a third step is appropriate, one that investigates lag structures in the policy-GAP relationship to avoid the specification problem. These results are somewhat complicated to interpret but have similar implications as the simple specification.

Creating DPAgToT.—Annex Table 10 shows that the annual average terms of trade variable is significantly related to three key price series from world markets—a food price index, an index of agricultural non-food raw materials, and real crude oil prices—with a +,-,- pattern to the signs. Varying economic structures and levels of development, however, would suggest that not all countries will follow this pattern. Since the interest here is in country-specific policy initiatives to cope with the pressures of changing income distribution during the structural transformation, it is necessary to let each country have its own response to this set of world prices.

The results are, predictably, complex and heterogeneous. Instead of just 20 percent of the variance in domestic AgToT being explained by common world prices (see Annex Table 10), the *median* R-squared for the 84 countries run separately is about 0.59. The most common pattern of response to these three world prices remains +,-,- and 29 countries have three significant coefficients with this pattern.[18]

There are 20 countries with just two significant coefficients and 19 countries with just one significant coefficient, with no visible pattern as to which variable is consistently more significant. Interestingly, there are 12 countries with no significant price coefficients at all, with the implication that their domestic agricultural prices have no links to world prices.[19]

The distribution of *t*-values for the three coefficients for the 84 countries in the analysis (Ireland is excluded to avoid an identity matrix) shows the tendency for a +,-,- pattern of coefficients, but also substantial diversity around this pattern:

Variable	Median *t*-Value	Number of Significant Coefficients	
Food prices	2.0	42 +	5 -
Agric. Non-food prices	-4.1	13 +	52 -
Crude oil prices	-1.7	6 +	38 -

With these statistical results in hand, it is possible to generate a predicted value of each country's agricultural terms of trade for each year. From this new series two alternative versions of a variable reflecting just the domestic policy influence on the terms of trade are

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[18] An additional three countries (Burkina Faso, China and Pakistan) have three significant coefficients with a -,+,+ pattern, and Costa Rica has three significant coefficients with a +,-,+ pattern.

[19] These are Algeria, Cote d'Ivoire, Ethiopia, Guatemala, Iran, Malawi, Nicaragua, Nigeria, Senegal, Tunisia, Zambia, and Zimbabwe. The dominance of African countries in this set is striking.

created, as follows (resAgToT is the residual when the actual AgToT is subtracted from the predicted value):

DPAgToT(difference) = resAgToT + 100

DPAgToT(ratio) = (predicted ToT / actual ToT) x 100

Both series are roughly centered on 100 (see Annex Figures 1-a and 1-b) and neither has a distinguishable time trend, which was captured by the strong time trends in all three world price series. For simplicity, the following discussion uses the DPAgTot(ratio) variable, but the results from DPAgToT(difference) are similar (and even more significant).

One additional result from this process is worth noting. As expected, there is a reasonably close relationship between the explanatory power of each country's regression on the three world prices (R-squared) and the combined significance of the three coefficients. But the rank orders are not always the same, and for some countries the divergence is substantial.

For example, when "R-square rank minus Sum|t| rank" is calculated, seven countries have a positive difference of 15 rank points or higher.[20] At the other end of the spectrum, ten countries have a negative difference of 15 rank points or higher.[21] Do these extremes tell us anything about factors influencing the domestic agricultural terms of trade in these countries?

It is tempting to argue that countries with highly significant coefficients on world prices, but relatively low explanatory power in explaining the overall domestic terms of trade (i.e. the countries listed in footnote 10) have open commodity markets but a number of other policy instruments, including subsidies and *ad valorem* tariffs (that permit variations in world prices to be transmitted, although levels are different). This is speculative, of course, and the presence of South Korea and Japan on the list, with their tight controls over many agricultural imports, suggests other factors may be at work as well.

Explaining the formation of DPAgToT(ratio).--It has taken many steps, both logically and statistically, to reach this stage. But the results are worth the effort. In its simplest specification, the question is whether domestic policy makers are influenced by changing sectoral income distribution during the structural transformation, and whether this influence can be seen in the formation of the "domestic policy" agricultural terms of trade.

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[20] In increasing order of disparity, the countries are Benin (18), Venezuela (20), Papua New Guinea (25), Sri Lanka (25), Rwanda (27), Indonesia (32) and Syria (50). Papua New Guinea has only one significant coefficient; the rest have two.

[21] These countries are Norway (-16), Turkey (-16), South Korea (-17), Paraguay (-18), Brazil (-20), Pakistan (-22), Philippines (-22), Japan (-27), Thailand (-27), and Dominican Republic (-31). All of these countries have three significant coefficients with +,-,- pattern, except for Norway, where the third coefficient is only marginally significant (and negative), and Pakistan, which has a significant -,+,+ pattern.

The most persuasive result is the simplest:

DPAgTot(ratio) = Year effect + Country effect + a X agGAPshr.

As Annex Table 11 shows in detail, 21 of the year coefficients are significant, 45 of the country coefficients are significant, and the coefficient on agGAPshr is -51.512 with a *t*-statistic of 11.4. This is equivalent to an elasticity of about 0.25 at mean values of DPAgToT(ratio) and agGAPshr. *This full fixed effects model shows a highly significant response of domestic policy makers to changes in the sectoral distribution of income, after controlling for year and country effects.*

The adjusted R-squared is only 0.17, but substantial "noise" in this variable is to be expected given the way in which it was constructed, as a residual from the regression of year- and country-specific agricultural terms of trade on world prices for food, agricultural non-food raw materials, and oil.

The year and country coefficients exhibit significant patterns with respect to time (for the year coefficients) and with respect to real per capita incomes in 2000 (for the country coefficients). In both cases, the relationship is positive (see Annex Figure 2-a and Annex Figure 2-b). Thus DPAgToT(ratio) is increasing over time, independently of what is happening to the sectoral distribution of income. But Figure 3 has also shown that the turning point in the GAP relationship with respect to real per capita incomes is rising rapidly (thus sectoral income distribution is deteriorating), so domestic policy formation is stimulated by both factors.

In addition, Annex Figure 2-b shows that richer countries do more to protect their agricultural sectors, in the form of higher values of DPAgToT(ratio), than poorer countries, even after controlling for the time effect and the pressures from the sectoral Gini itself. The overall pattern has been well-known for some time (Lindert, 1991), but disaggregating it into these three sources of policy motivation is new.

From this more disaggregated perspective, agricultural protection can be seen to be a modest economic "necessity," as the income elasticity implied in Annex Figure 2-b is positive but less than one. For the countries in this sample, this income elasticity is about 0.035 (calculated from Annex Figure 2-b). This is a small, but significant, income elasticity for this "pure" form of agricultural protection (i.e. controlling for pressures from the structural transformation itself).

Lag structures in the formation of DPAgToT(ratio).--All of these results have been reported from the simplest econometric specification to test the relationship between DPAgToT(ratio) and agGAPshr, a fixed effect model with no lags in the relationship. Introducing lags complicates the story, although the net effect is similar to the simple story told above. Annex Table 12 shows the detailed results of four separate lag specifications (without the values of year and country coefficients in each case).

These results are summarized below (all regressions have year and country effects included. The dependent variable is DPAgToT(ratio) and the independent variables are agGAPshr with annual lags varying from zero to three years):

Coefficient (*t*-value) (from Annex Table 12)				Sum of coefficients
GAP(0)	**GAP(-1)**	**GAP(-2)**	**GAP(-3)**	
-51.512				-51.512
(11.4)				
	-18.758			-18.758
	(4.2)			
	-53.449	40.108		-13.341
	(6.4)	(5.0)		
	-58.843	22.820	23.853	-12.170
	(6.8)	(2.3)	(2.9)	
-135.996	30.932	42.342	25.347	-37,375
(15.8)	(3.1)	(4.4)	(3.2)	

The net result of introducing these lag specifications is to lower the overall size of the response to agGAPshr. It is not immediately clear why the lags cause the coefficients to behave in this manner, and the pattern is deserving of further study.

D. Is the Asian experience different with respect to agricultural price policy?

Somewhat ironically, the response of Asian countries to the growing gap in labor productivity between the agricultural and non-agricultural sectors is less sensitive than in non-Asian countries (see Annex Tables 13a and 13b). For comparison, results are shown for both DPAgToT(ratio) and DPAgToT(difference). As noted earlier, the results are actually stronger for the difference form of the variable, but all the results are consistent and significant.

The irony, of course, is that Asian countries have used agricultural price policy very aggressively to protect their farmers, especially in the rapidly growing countries of East Asia (Anderson, 1986). Their agricultural terms of trade declined at only half the rate as for non-Asian countries, despite being subject to the same global market forces (see Figure 5). But the very speed of the Asian transformation, and the greater concentration on raising productivity of small farmers, means that the actual coefficient of policy response to the agGAPshr variable (the sectoral Gini) is smaller.

Recall that the turning point for the agGAPshr regression for Asian countries was just $1,663 compared with a turning point of $11,329 for non-Asian countries (see column C-4 in Annex Table 9). Asian countries devoted greater policy attention to agriculture across the board, and had the advantage of more equal landholdings than in most other countries. As a result, Asian countries were able to generate a far more rapid and equitable pattern of economic growth (there are several exceptions, the Philippines being perhaps the most obvious). The sheer pace of growth created great political pressures to assist agriculture during the transformation

process, but in comparative terms non-Asian countries had to resort to price policy interventions more heavily in response to rapidly worsening income distribution from less rapidly growing economies. That is, the economies of Asian countries responded more flexibly to movements in their agricultural terms of trade, which somewhat paradoxically meant that Asian policy makers could respond somewhat less aggressively to a growing gap in sectoral incomes. They had kept the gap from growing too fast in the first place.

This effect can be seen even more clearly when both components of the agricultural terms of trade are included separately in the standard structural transformation regressions, for Asia and non-Asia (see Annex Table 14 and Table 15). That is, the "world price" component (Predicted AgToT) and the domestic policy component (DPAgToT(dif)) are included separately to see their impact on agEMPshr and agGDPshr. The difference in the coefficients between these two regressions is then calculated as agGAPshr to see the net effect on the structural Gini coefficient.

The results are not surprising in view of what has already been reported, but they are powerful nonetheless. In Asia, the Predicted AgToT has a positive and significant impact on *both* agEMPshr and agGDPshr, with a net coefficient of 0.001336 for agGAPshr. Because agGAPshr is defined in a way that it is negative for nearly all observations, the net impact of higher world agricultural and energy prices in Asian countries (through their impact on the overall domestic agricultural terms of trade) is to *reduce* the level of income inequality.

In sharp contrast, the impact of DPAgToT is negative, although the coefficient on agEMPshr is not significant. Reverse causation seems to be the only plausible explanation for such an impact, with worsening sectoral income distribution actually causing domestic agricultural policy to respond with greater price incentives. This, as was seen in the overall results above, is precisely what seems to be happening.

As before, the non-Asian countries have a reversed pattern of signs from Asia for the agEMPshr regression, and the same signs but smaller coefficients for the agGDPshr regression. The net effect on agGAPshr is for both coefficients to be about half the magnitude as in Asia. Thus, when price effects are disaggregated into their global and domestic components, Asian countries are seen to be more responsive than non-Asian countries to both.

The broader role of agriculture revealed in these patterns extends well beyond agricultural price policy, and it clearly is powerful enough to influence the basic patterns of structural transformation.

Table 7. The separate impacts of the predicted agricultural terms of trade based on world prices, and the residual domestic agricultural terms of trade that reflect policy preferences, for Asia and non-Asia separately

Asia

Impact of the specified agricultural terms of trade on...

	AgEMPshr	**AgGDPshr**	**AgGAPshr**
Predicted AgToT	0.000590	0.001926	0.001336
(*t*)	(7.1)	(30.2)	
DPAgToT(dif)	-0.000138	-0.001563	-0.001425
(*t*)	(1.2)	(17.7)	
Adj R sq	0.9854	0.9772	

Non-Asia

Predicted AgToT	-0.000163	0.000604	0.000767
(*t*)	(7.4)	(21.9)	
DPAgToT(dif)	0.0000521	-0.000663	-0.000715
(*t*)	(1.8)	(18.7)	
Adj R sq	0.9886	0.9341	

Note: All regressions also included lnGDPpc and (lnGPDpc)squared, as well as Year and Country fixed effects. The agGAPshr coefficient is calculated as the difference between the agGDPshr and agEMPshr coefficients.

Source: Annex Tables 14 and 15.

VII. What happens in rich countries at the "end of the structural transformation"?

It is clear that for many decades rich countries have sought mechanisms to place a higher value on their agricultural sectors than market prices would indicate. Under pressure from a number of agricultural exporting countries, including the United States, these mechanisms have increasingly tried to break the link between policy support for farmers and the additional production of commodities (and surpluses) that were historically forthcoming. The various ways of de-linking have generated an entire language and sub-profession of its own (Elliott, 2004; 2006).

Not all of the arguments for paying farmers more than the market would pay are without merit, although the most vociferous voices, especially from Japan, France and South Korea, inevitably sound narrowly protectionist. Still, at least three rationales for supporting agriculture in rich countries at taxpayer and consumer expense are increasingly accepted by mainstream policy analysts as reflecting appropriate public action in the face of market failures. These are support for the multiple functions that agriculture performs, beyond the commodity production that is offered for sale; support for "local" food systems that might offer reduced carbon footprints for most food consumers and possibly even fresher and healthier food; and support for bio-fuel production as a mechanism to break dependence on imported fossil fuels and slow emissions of greenhouse gases.

A. Multi-functionality

Bucolic landscapes, green buffers to urban density, preservation and development of rural societies, domestic food security, and flood alleviation through proper land management all have economic value even if there is no market price for their "production." The basic argument for the multi-functionality of agriculture as a basis for policy support to farmers is that these non-commodity outputs, although essential to economic, environmental and social well-being, are unpaid by-products of commodity production (Losch, 2004). If farmers are paid only the market price for their commodities, the by-products will not be produced in optimal amounts, and may be lost altogether if farmers are forced out of business because of international competitive pressures.

A major theme of this Working Paper is that many countries have undervalued their agricultural sectors in terms of contribution to economic growth and reductions in poverty. Large countries rightly see a link between the level of domestic food production and the degree of food security, although even China, India and Indonesia can improve the efficiency of their food security policies through international trade. The rural economy broadly and farm households in particular offer a buffer to macro economic shocks that can provide a safety net of last resort. Successful rural development can slow the flow of migrants to urban slums, and perhaps stabilize both rural and urban societies. These are all reasons why poor countries need to think carefully about how to provide adequate incentives to their farmers.

These are not reasons for rich countries to protect and subsidize their farmers. At a minimum, the multi-functional by-products of agricultural commodity production in rich countries need to be investigated for more efficient mechanisms of production that are less distorting than direct

protection and subsidies. The Economic Research Service of the United States Department of Agriculture (USDA) provides several examples (see Table 9).

Table 9. Comparison of policies according to their market effects

Nonfood output	**Minimal market effects**	**Large distortion**
Environmental:		
Rural landscape	Purchase or transfer of land development rights	Production subsidies that raise profitability of agriculture relative to other land uses
Rural development:		
Viable rural communities	Rural infrastructure to support creation of agriculture and non-agriculture jobs	Agricultural policies linked to production that raises output in both wealthy and marginal rural areas
Food security:		
Assure availability of food supply	Public food stocks	Production subsidies to achieve domestic self-sufficiency

Source: Bohman, et al., 1999.

Obviously, not every non-commodity output associated with agricultural production can be produced in ways that are de-linked from commodity production. Country and regional circumstances will differ and matter, as population densities in much of rural Asia, for example, make investments in infrastructure more socially profitable than they might be in sparsely settled rural Africa. How can rural development be promoted in Africa, without some additional stimulus to farm profitability?

Still, this is the way to address the question. Efforts to value in economic terms the flow of multiple services from natural ecosystems, including agriculture, need far more analytical research and empirical testing (Tallis, et al., forthcoming). With better valuation will come better designed initiatives to conserve the natural resources and better mechanisms to pay the provider of these services, including farmers. Simply paying farmers to do more of what they do anyway cannot be an efficient use of fiscal or natural resources. Agriculture performs multiple functions, but finding ways for the market to value, and pay for, these functions will be essential to sustainable production.

B. Local food systems

Buying food that is produced "locally" is the current agenda for two related causes: the anti-globalization movement and the sustainability movement (Feenstra, 2002). The anti-globalization movement has its roots in a clear sense of lost control over something as deeply felt as where the food on our tables comes from. Modern supply chains seem impervious to consumer desires to control what they eat. The sustainability movement has its roots in the broader environmental movement that now links to climate change as the key challenge to quality of life in rich and poor countries alike. Can transporting food thousands of miles, often on jet freighters, possibly be a sustainable way of eating? Will buying and consuming foods produced locally make any difference to either of these agendas?

Economic efficiency has a hard time entering these debates. Both the anti-globalization and sustainability movements specifically reject market prices as the basis for evaluating decisions about what consumers should consume, because these prices have too many subsidies and distortions to reflect real opportunity costs in terms of natural resources used. There is some merit to these arguments. In rich countries, for certain, a vast array of public expenditures helps multi-national agribusinesses keep local food systems from being competitive. The question is, should the "local food movement" receive more policy support?

It should be obvious that any effort to support the purchase and consumption of foods grown locally, however that is defined, is inherently anti-trade. New Zealand is fully aware of this threat, and researchers at Lincoln University have issued a study confronting the environmental challenges to long-distance agricultural trade:

> New Zealand has greater production efficiency in many food commodities compared to the UK. For example New Zealand agriculture tends to apply less fertilizers (which require large amounts of energy to produce and cause significant CO2 emissions) and animals are able to graze year round outside eating grass instead of large quantities of brought-in feed such as concentrates. In the case of dairy and sheep meat production NZ is by far more energy efficient even including the transport cost than the UK, twice as efficient in the case of dairy, and four times as efficient in case of sheep meat. In the case of apples NZ is more energy efficient even though the energy embodied in capital items and other inputs data was not available for the UK (Saunders, Barber, and Taylor, 2006).

Measuring environmental impact of food production is not simple. Any measure that pretends otherwise is flawed. Whether it is the energy consumption per food calorie delivered to consumers, or average distance traveled of the food consumed, many other intervening variables confound any welfare significance of such simple ratios.

Still, there is clear appeal to consumers, especially wealthy consumers, to knowing where their food comes from and buying from producers they know. The rapid growth of farmers' markets, of organic food, and of "local food" sections in supermarkets is testimony to this basic desire. There may be positive health consequences from consuming local foods, as they may be more nutritious, and there is little doubt that local varieties and produce are tastier. But the

local food movement is not yet a serious threat to the globalization of food chains, and may in the end even be consistent with it, if supply chains are able to "localize" their suppliers of Kenyan green beans or Costa Rican shade-grown coffee. But the trend bears watching, because it is the ultimate form of agricultural protection. Expanded trade has been the basis of much economic growth, and restricting it could have serious and unforeseen consequences.

C. Bio-fuels and the potential to reverse the structural transformation

Bio-fuels are not new. Although coal was known in China in pre-historic times, and was traded in England as early as the 13th century, it was not used widely for industrial purposes until the 17th century. Until then, bio-fuels were virtually the only source of energy for human economic activities, and for many poor people they remain so today. But the widespread use of fossil fuels since the Industrial Revolution has provided a huge subsidy to these activities—because coal and later petroleum were so cheap--a subsidy which seems to be nearing an end.

What will be the role of bio-fuels going forward, and what will be the impact on agriculture? In the extreme, the demand for bio-fuels in rich countries to power their automobiles has the potential to raise the price of basic agricultural commodities to such a level that the entire structural transformation could be reversed. If so, the growing use of bio-fuels has two alternative futures: it could spell impoverishment for much of the world's population because of the resulting high food prices, or it could spell dynamism for rural economies and the eventual end of rural poverty. Which future turns out to be the case depends fundamentally on the technology, economics, and politics of bio-fuel production (Peskett, et al., 2007).

The potential devastating effects of bio-fuels are easy to conceptualize. The income elasticity of demand for starchy staples (cereals and root crops for direct human consumption) is less than 0.2 on average, and falling with higher incomes. Adding in the indirect demand from grain-fed livestock products brings the average income elasticity to about 0.5, and this is holding steady in the face of rapid economic growth in India and China. Potential supply growth seems capable of managing this growth in demand (Naylor, et al., 2007).

But the demand for bio-fuels is almost insatiable in relation to the base of production of staple foods. The income elasticity of demand for liquid fuels for automobile and truck fleets, not to mention power generation, is greater than one in developing countries. The average for the world is rising as middle class consumers in China, India and beyond seek to graduate from bicycles to motorbikes to automobiles. One simple calculation shows the dimension of the problem: if all the corn produced in the United States were used for ethanol to fuel automobiles, it would replace just 15 percent of current gasoline consumption in the US. Something has to give.

If this were a market-driven process, it is easy to see what will give. High grain prices will make ethanol production uneconomic, driving down the demand (and returns on investments in ethanol processing plants). Greater profitability of grain production will stimulate a supply response, although this may take several years if improved technologies are needed. Grain prices will reach a new equilibrium, with demand from the bio-fuel industry having only a modest impact.

This is not the scenario most analysts see. Instead, political mandates to expand bio-fuel production in many countries will continue to drive investments in processing facilities and the need to keep these profitable in the face of high raw material prices will require large public subsidies. Rich countries will be able to afford these more easily than poor countries, so a combination of inelastic demand for fuel and a willingness to pay large subsidies will keep grain prices very high.

If this scenario plays out, what are the consequences for economic growth and poverty reductions in developing countries? Not surprisingly, the answer depends on the role of agriculture in individual countries, the pattern of commodity production and the distribution of rural assets, especially land. It is certainly possible to see circumstances where small farmers respond to higher grain prices by increasing output and reaping higher incomes. These incomes might be spent in the local, rural non-farm economy, stimulating investments and raising wages for non-farm workers. In such environments, higher grain prices could stimulate an upward spiral of prosperity.

An alternative scenario seems more likely however, partly because the role of small farmers has been under so much pressure in the past several decades. If only large farmers are able to reap the benefits of higher grain prices, and their profits do not stimulate a dynamic rural economy, a downward spiral can start for the poor. High food prices cut their food intake, children are sent to work instead of school and an intergenerational poverty trap develops. If the poor are numerous enough, the entire economy is threatened, and the structural transformation comes to a halt. The share of agriculture in both employment and GDP starts to rise, and this reversal condemns future generations to lower living standards.

A reversal of the structural transformation as the regular path to economic development and reduced poverty will be a historical event, countering the patterns generated by market forces over the past several centuries. Such an event is likely to have stark political consequences, as populations do not face the sustained prospect of lower living standards with equanimity. It is possible, of course, that new technologies will come on-stream and lower energy costs across the board and thus allow the bio-fuel dilemma to disappear quietly. But it looks like a rocky couple of decades before that happens.

VIII. So what? The relevance of historical experience

At one level it is easy to dismiss these results in terms of providing guidance to policy makers in developing countries or to donor agencies seeking to help these countries. After all, the results are based on historical data, some of which are more than four decades old. The statistical manipulations needed to generate the results were convoluted and required close attention to the logic of the model. The model itself is not particularly novel, based as it is on observations in the political economy literature that have been around for decades (Olsen, 1965; Anderson, 1986).

Still, the specific results reported here are new to the economics profession. They confirm statistically what most policy makers know intuitively, that political pressures arising from deteriorating income distribution between rural and urban areas during a successful structural transformation are nearly irresistible. The pervasiveness of agricultural protection, its increasingly early onset, and its multiple sources of causation, are all identified and quantified in the analysis here. The result is to provide new confidence to policy analysts and policy makers alike that they understand this powerful phenomenon.

There are broader implications as well, stemming from the basic analysis of the structural transformation. Three main implications are worth noting. They focus on how agricultural trade policy changes during the structural transformation, at least from the perspective of the role of agriculture in poverty reduction for contemporary developing countries:

1. For poor countries, growth in agricultural productivity is the main driver of poverty reduction in the short to medium term (5-20 years). The type of investments needed to raise agricultural productivity varies by country and even agro-ecological zone within countries, but these investments are not small. The payoff to these investments in narrow financial terms may not be large even at current commodity prices (inflated by the boom in bio-fuels), and valuing such non-market payoffs as differential impact on poverty reduction, role as macro economic safety nets for the urban poor, and contributions to a sustainable carbon economy may be necessary to pass financial thresholds dictated by standard benefit-cost analysis (World Bank, 2007).

2. Connecting rural economies to dynamic urban economies is the long-run solution to rural poverty, and this involves a process of structural transformation that lasts for generations. But the convergence of rural labor productivity with urban labor productivity, the ultimate welfare manifestation of the structural transformation, has become increasingly difficult over the past three decades. Active government policies will be needed to connect small farmers and rural landless workers to the economic growth process, and these policies are likely to include interventions to affect commodity prices at the border. It is important to understand, however, that these policies will be highly country specific and will depend on domestic political processes that donors understand poorly (Timmer, 2002, 2008).

3. The international market environment for agricultural development is severely hampered by protection of domestic farmers in OECD countries and by the complexity of food standards for international trade. The dominance of large integrated supply chains in managing this trade is

a challenge to the participation of small farmers. More importantly, the reach of these modern supply chains into the food retail systems of developing countries threatens access by small farmers to their own domestic markets (Reardon and Timmer, 2007). There is an active debate underway as to whether appropriate remedial or preventive actions should be taken at the nation or international level, that is, whether agricultural trade policies will be effective instruments in linking small farmers into domestic supply chains (Maxwell, 2004).

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