American Enterprise Institute for Public Policy Research

AEI

No. 1 • May 2009

Development Policy Outlook

# A World without Agriculture? The Historical Paradox of Agricultural Development

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*As countries become rich, their agricultural sectors virtually disappear in relation to total economic activity. Poor countries, looking at this history of structural transformation for lessons to guide their own development, easily jump to the conclusion that "a world without agriculture" can start sooner rather than later. They neglect—and even tax—agriculture to fund state-led industrialization. The paradox, of course, is that history is equally firm in its judgment that poor countries must invest public resources to raise agricultural productivity and reduce rural poverty before a structural transformation can be sustained. Deepening the paradox is the political response to rapid structural transformation. Excess labor left on the land generates political demands for agricultural protection and subsidies. These help to close the income gap with modern industrial and service workers, but they often lead to surplus commodity production. When these surpluses are dumped on world markets in which cheap food is readily available—and often free in the form of food aid—agricultural commodity prices are further depressed. These low prices then send signals back to political leaders, donors, and private investors that poor countries should not invest in their own agricultural development, just at the time when these countries need most to invest in their farming sectors.*

The structural transformation in agriculture is a powerful historical pathway experienced by all successful developing economies. It encompasses highly important and diverse approaches to coping with the political pressures generated along that pathway and policy mechanisms available to keep the poor from falling off the pathway altogether. The 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.

At one level, the story is easy to tell because the historical picture presented is, well, telling. In their broad sweep and relevance, these are

**Key points in this *Outlook*:**

- The "structural transformation" by which societies shift from agriculture-dominated to industrialized economies has been the main pathway out of poverty for all societies, and it depends on rising productivity in both sectors.
- The process of transformation puts enormous pressure on rural societies to adjust and modernize, and these pressures produce visible and significant policy responses that alter agricultural prices.
- This lag in real earnings from agriculture is the fundamental cause of the deep political tensions generated by the structural transformation, and that lag is growing more extreme.

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very robust forces with deep historical roots. Challenging them is like challenging the tides.

At another level, the complexity of country-specific policies asserts itself in very important ways. This diversity of policies does not alter the pathways themselves, but rather their consequences for income distribution and the gap in labor productivity between urban and rural economies. We learn 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.

Policy initiatives to ameliorate the distributional consequences of rapid transformation have turned out to be a major challenge for policymakers over the past half century. There are successes and failures: the historical record helps illuminate what works and what does not. Trying to stop the structural transformation simply does not work—and it certainly does not work for the poor. Investing in the capacity of the poor to cope with (and benefit from) change, however, does seem to work. Investments in human resources—especially in education and health—are the most promising pathways here. Overall, such investment strategies can only be successful if the rest of the economy is doing well, and they typically require significant public-sector resources and policy support to enhance rural productivity. Thus, these rural investment strategies depend on political processes that are themselves conditioned by the pressures generated by the structural transformation.

## The Structural Transformation in Historical Perspective

From a historical perspective, it is impossible to imagine a world without agriculture. Just a hundred years ago, four out of five households in the world would have been engaged primarily in farming. Now, in rich countries, farmers are a tiny share of the workforce. Indeed, in the United States today, there are more lawyers than farmers, more dry-cleaning establishments than farms. The structural transformation is truly a radical force, and it is propelling the global economy toward a world without agriculture in an apparently inexorable manner. Since the middle of the past century, and well before that in the richest countries, the share of employment in agriculture and the share of agriculture in GDP have been converging to zero. Based on simple extrapolation of historical trends, the world's last farmer will sell his final crop sometime in the next century, somewhere in Africa.

In a world of ample food supplies in global markets (some of it free as food aid) and increasingly open borders for trade, what is the role of agriculture in stimulating economic growth and connecting the poor to it? The question remains relevant in the face of the highly unstable prices for staple agricultural commodities seen in world markets since 2007.[1]

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Historically, the answer to the question about the role of agriculture in economic development is clear. 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 with, that is—Singapore and Hong Kong are exceptions). The process involves a successful transition in which agriculture, through higher productivity, provides food, labor, and even savings in the process of urbanization and industrialization. A dynamic agricultural sector 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 industrial and service sectors grow more rapidly, agriculture modernizes, and rural workers migrate to urban jobs.

Table 1 illustrates 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 twenty years, with industry growing 7.5 percent per year, services 5 percent per year, and agriculture 3 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 from differential demand patterns that reflect Engel's Law (the share of

food in consumers' budgets declines as incomes rise). 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 final outcome of the structural transformation, already visible on the horizon in rich countries, is an economy and a society in which agriculture as an economic activity has no distinguishing characteristics from other sectors, at least in terms of the productivity of labor and capital.

The simple mathematics of the structural transformation show what happens to the economy and to labor productivity through twenty 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 twenty 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 percent per year during this exercise, labor productivity in the 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 critical story is at the sectoral level, at which the structural transformation becomes visible. Table 1 also shows three possible growth paths that encompass modern development experience. Path A follows the basic logic of Nobel laureate Arthur Lewis's model of economic development, which uses surplus labor in the agricultural sector to fuel labor-intensive industrialization.[2] This path 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. The "Lewis path" of industrial and service growth leads to the fastest structural transformation of the three scenarios, and it is so successful in pulling "surplus" labor out of agriculture that labor productivity in agriculture is actually higher at the end than it is 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 close. The structural transformation is extremely rapid with this path, and the absolute number of workers in agriculture is already declining after twenty years of rapid growth.

Path C looks at the opposite extreme, in which 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, 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 the 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 U.S. Department of Agriculture economist Keith O. Fuglie for Indonesia from 1961 to 2000, the years of both rapid and slow growth in productivity.[3]

But even this successful pattern of structural transformation leaves a serious problem for policymakers. As table 1 also shows, income distribution widens under this scenario, at least as measured by the ratio of labor productivity (wages) in the top quintile of laborers to those in 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 widens to 7.27. Only a pure "Lewis-style" pattern of growth narrows 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 the decline in the share of

**Table 1**
**The Mathematics of the Structural Transformation**

| | | Industry | Services | Agriculture | GDP |
|---|---|---|---|---|---|
| **Output** | | | | | |
| Start year (0) | | 20 | 30 | 50 | 100 |
| End year (20) | | 85 | 80 | 90 | 255 |
| **Share of GDP** | | | | | |
| Start | | 20 | 30 | 50 | 100 |
| End | | 33.3 | 31.4 | 35.3 | 100 |
| **Number of workers** | | | | | |
| Start[a] | | 7 | 15 | 50 | 72 |
| End[b] | Path A | 28 | 40 | 39 | 107 |
| | Path B | 14 | 24 | 69 | 107 |
| | Path C | 7 | 15 | 85 | 107 |
| **Labor productivity** | | | | | |
| Start | | 3 | 2 | 1 | 1.4 |
| End | Path A | 3 | 2 | 2.32 | 2.4 |
| | Path B | 6.3 | 3.3 | 1.31 | 2.4 |
| | Path C | 12.7 | 0.3 | 1.06 | 2.4 |
| **Share of workers in total** | | | | | |
| Start | | 9.7 | 20.8 | 69.5 | 100 |
| End | Path A | 26.2 | 37.4 | 36.4 | 100 |
| | Path B | 13.1 | 22.4 | 64.5 | 100 |
| | Path C | 6.5 | 14 | 79.5 | 100 |
| **Contribution to growth** | | | | | |
| Start | | 1.5 | 1.5 | 1.5 | 4.5 |
| End | | 2.5 | 1.6 | 1.1 | 5.2 |
| **Sectoral growth rates (percent per year)** | | | | | |
| | | 7.5 | 5 | 3 | 4.5 |

Source: Author's calculations.
Notes: a) The active labor force will grow by 2 percent per year.
b) 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. For 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.

agriculture in both the economy and the overall labor force. And the paradox is that the faster the structural transformation, the faster rural productivity—proxied by rural labor productivity—rises (as in path 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.

The structural transformation is the defining characteristic of the development process, both cause and effect of economic growth.[4] The final outcome of the structural transformation, already visible on the horizon in rich countries, is an economy and a society in which agriculture as an economic activity has no distinguishing characteristics from other sectors, at least in terms of the productivity of labor and capital. The gap in labor productivity between agricultural and nonagricultural workers approaches zero when incomes are high enough and the two sectors have been integrated by well-functioning labor and capital markets.

In the long run, the way to raise rural productivity is to raise urban productivity (or, as Mao Zedong crudely but correctly put it, "the only way out for agriculture is industry"). Unless the nonagricultural economy is growing, there is little long-run hope for agriculture. At the same time, the historical record is very clear on the key role that agriculture itself plays in stimulating the nonagricultural economy.[5]

## The Gap in Labor Productivity between Agriculture and Nonagriculture

As shown above, 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 workforce. This gap narrows with higher incomes. This convergence is also part of the structural transformation, reflecting better-integrated labor and financial markets. The role of better technology and higher productivity on farms as a way to raise incomes in agriculture is controversial. Most of the evidence suggests that gains in farm productivity have been quickly lost (to farmers) in lower prices and that income convergence between agriculture and other sectors is driven primarily by the labor market.[6]

In many countries, this structural gap actually widens during periods of rapid growth, as was evident in even the earliest-developing countries, the now-rich Organisation for Economic Co-operation and Development. 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 different processes,

after which labor productivity in the two sectors begins to converge, has also been increasing over time, requiring progressively higher per-capita incomes before the convergence process begins.

This lag inevitably presents political problems as farm incomes visibly fall behind incomes in the rest of the economy. The long-run answer, of course, is faster integration of farm labor into the nonfarm economy (including the rural nonfarm 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.[7]

This lag in real earnings from agriculture is the fundamental cause of the deep political tensions generated by the structural transformation, and that lag is growing more extreme. 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.[8] We now understand that the political economy of this process is driven by the structural transformation itself.

## The Role of Agricultural Terms of Trade

Individual countries use agricultural price policy to influence their domestic terms of trade—the relative prices of a country's agricultural products to those produced in its nonagricultural sector—and this policy instrument helps the growth process integrate agricultural labor into the rest of the economy, at least in terms of relative productivity. However, political efforts to influence the domestic terms of trade often run into powerful counterpressures from global commodity markets and thus require large subsidies or trade barriers to make them effective.

In explaining the gap in labor productivity, a comparison of the Asian experience with that of all other countries is quite revealing. In particular, Asian countries have a very different pattern of agricultural employment change with respect to per-capita incomes than non-Asian countries. Asian economies tend to employ disproportionately more farm workers in the early stages of development.

The historical record shows that 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 other countries. Average economic growth in Asia was faster than in the other countries, and the rapid decline in their share of GDP from agriculture reflects this rapid growth. Statistical analysis shows that Asian countries relied heavily on the agricultural terms of trade as a policy tool to mitigate the consequences of rapid growth: a widening gap in labor productivity between the agricultural and nonagricultural sectors.

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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 between 1965 and 2000 in the agricultural terms of trade for the two sets of countries is strikingly different, with Asian countries seeing a long-run decline at only half the pace of the non-Asian countries.

The net effect of these forces on the gap between labor productivity in the two sectors is that the turning point in the gap in labor productivity (after which labor productivity in agriculture begins to converge with labor productivity in nonagriculture) is sharply lower in Asia. This difference underscores two distinctive features of the Asian economies: their more rapid growth and the greater role of agricultural productivity in that growth.[9]

The reasons for these differences have been the source of considerable debate. One 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 an approach to the provision of food security that connected poor households to improved opportunities.[10]

The distinct patterns of Asian structural transformation suggest that country-specific policies have the potential to alter not just the tempo of economic growth (a fact long and widely recognized) but also the structural character of that growth. That dual potential has sparked a policy debate, especially with respect to the role of agriculture, over how to connect the poor to rapid economic growth.

Agricultural price policies are only one of the many variables that influence the actual domestic agricultural terms of trade. Many of the influencing variables—the

real exchange rate, international commodity prices, and the changing structure of the economy during economic development—are beyond the direct influence of policymakers.[11] Agricultural trade policies are, by design, things policymakers can change according to their priorities. When controlling for these exogenous factors influencing agricultural prices over the process of development, the changing level and impact of agricultural price policies can be identified in the statistical record.

How are agricultural prices set? I argue that there is a link between sectoral income distribution and policy response in the form of changes in the domestic policy input to the agricultural terms of trade. Political pressures caused by a rising gap between incomes in the agricultural and nonagricultural sectors lead policymakers to improve incentives for agricultural producers.

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 inclusive pattern of economic growth (there are several exceptions, the Philippines being perhaps the most obvious). The sheer pace of Asian growth created great political pressures to assist the agricultural sector during the transformation process, but, in comparative terms, non-Asian countries had to resort to price policy interventions more heavily in response to widening income distributions as a result of their 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 policymakers could respond somewhat less aggressively to a growing gap in sectoral incomes. They had kept the gap from growing too large in the first place.

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 the structural transformation. It is important, then, to understand what role agriculture actually plays on the way to its virtual disappearance as a share of the economy. It turns out that a "world without agriculture" cannot happen without first investing in the sector in financial and policy terms.

## Conclusions

I conclude with three points: First, the structural transformation has been the main pathway out of poverty for all societies, and it depends on rising productivity in both the agricultural and nonagricultural sectors (and the two are connected). Second, the process of structural transformation puts enormous pressure on rural societies to adjust and modernize, and these pressures are translated into visible and significant policy responses that alter agricultural prices. Third, despite the decline in the relative importance of the agricultural sector, leading to the world without agriculture in rich societies, the process of economic growth and structural transformation requires major investments in the agricultural sector itself. This seeming paradox has complicated (and obfuscated) planning in developing countries and donor agencies seeking to speed economic growth and connect the poor to it.

This historical process of structural transformation might seem like a distant hope for the world's poor, who are, for the most part, eking out a living day by day. There are many things governments can do to give them immediate hope, such as keeping staple foods cheap and accessible, helping connect rural laborers to urban jobs, and augmenting educational and health services in rural areas. But for poverty-reducing initiatives to be feasible over long periods of time—to be "sustainable," as current development jargon would have it—the indispensable necessity is a growing economy, especially one that successfully integrates the rural with urban sectors and stimulates higher productivity in both. The long-run success of poverty reduction hinges directly on a successful structural transformation.

It is too soon to say whether the reversal of long-run downward trends in real prices of agricultural commodities—driven by demand for biofuels 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. 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 another pathway out of rural poverty.

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*Mauro De Lorenzo is the editor of AEI's* Development Policy Outlook *series.*

## Notes

1. The causes of high food prices, especially from the demand to produce biofuels using food grains and vegetable oils are discussed in detail in C. Peter Timmer, "The Causes of High Food

Prices," in *Asian Development Oulook Update* (Manila: Asian Development Bank, 2008).

2. By modeling the flow of underemployed labor in agricultural households to more productive industrial employment and the subsequent rise of the urban industrial sector, Lewis was able to capture in a simple manner the basic elements of the structural transformation. For this and subsequent work in the field of development, he was awarded the Nobel Prize in Economics. (W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labor," *The Manchester School* 22 [1954]: 139–91.)

3. Keith O. Fuglie, "Productivity Growth in Indonesian Agriculture, 1961–2000," *Bulletin of Indonesian Economic Studies* 40, no. 2 (August 2004): 209–225.

4. Moshe Syrquin, "Structural Transformation," in *The Elgar Companion to Development Studies*, ed. David Alexander Clark (Cheltenham, England: Edward Elgar Publishers, 2006), 601–607.

5. C. Peter Timmer, "The Agricultural Transformation," in *Handbook of Development Economics*, vol. 1, ed. Hollis Chenery and T. N. Srinivasan (Amsterdam: North-Holland, 1988), 275–331; and C. Peter Timmer, "Agriculture and Economic Growth," in *Handbook of Agricultural Economics*, vol. 2A, ed. Bruce L. Gardner and Gordon Rausser (Amsterdam: North-Holland, 2002), 1,487–1,546.

6. D. G. Johnson, "Agriculture and the Wealth of Nations (Ely Lecture)," *American Economic Review* 87, no. 2 (May 1997): 1–12; and Bruce L. Gardner, *American Agriculture in the Twentieth Century: How It Flourished and What It Cost* (Cambridge, MA: Harvard University Press, 2002).

7. Bruce L. Gardner, *American Agriculture in the Twentieth Century: How It Flourished and What It Cost*.

8. Kym Anderson, "Economic Growth, Structural Change and the Political Economy of Protection," in *The Political Economy of Agricultural Protection*, ed. Kym Anderson and Yujiro Hayami (London: Allen and Unwin, 1986), 7–16; and Peter H. Lindert, "Historical Patters in Agricultural Policy," in *Agriculture and the State*, ed. C. Peter Timmer (Ithaca, NY: Cornell University Press, 1991).

9. C. Peter Timmer, "Agriculture and Pro-Poor Growth: An Asian Perspective" (Working Paper 63, Center for Global Development, Washington, DC, July 21, 2005), available at www.cgdev.org/content/publications/detail/2986 (accessed April 27, 2009).

10. C. Peter Timmer, "The Road to Pro-Poor Growth: Indonesia's Experience in Regional Perspective," *Bulletin of Indonesian Economic Studies* 40, no. 2 (August 2004): 177–207; and C. Peter Timmer, "Food Security and Economic Growth: An Asian Perspective," *Asian-Pacific Economic Literature* 19 (May 2005): 1–17.

11. C. Peter Timmer, "Energy and Structural Change in the Asia-Pacific Region: The Agricultural Sector," in *Energy and Structural Change in the Asia-Pacific Region: Papers and Proceedings of the Thirteenth Pacific Trade and Development Conference*, ed. Romeo M. Bautista and Seiji Naya (Manila: Philippine Institute for Development Studies and Asian Development Bank, 1984), 51–72.