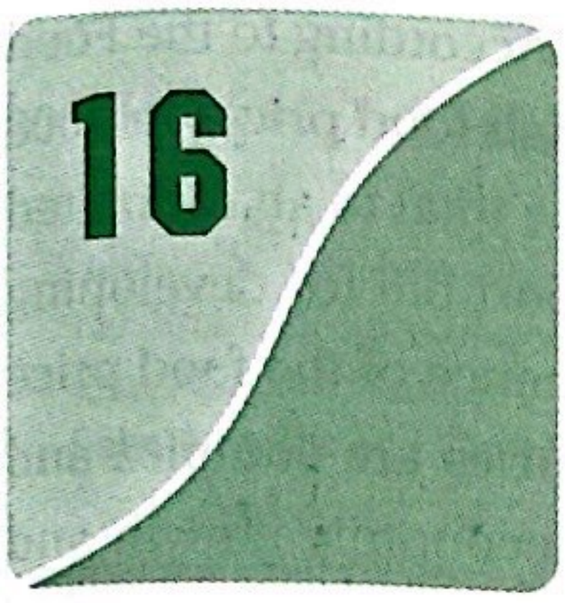

Agriculture and Development

During the years 2006 through 2008 the world experienced its worst food crisis since the early 1970s. Over that period, the price of corn on world markets nearly tripled, followed closely by the prices of other basic cereals. During the six months from October 2007 to April 2008 the world price of rice tripled, increasing from $335 to over $1,000 per ton. The results were immediate and sometimes violent. Food riots broke out in Bangladesh, Burkina Faso, Cameroon, Egypt, Haiti, Mozambique, and Senegal. A report from Cairo, Egypt, by Al Jazeera on March 13, 2008, recounted, "thousands of people have resorted to violence due to shortages of basic food commodities and rising food prices. At least 10 people have died . . . in riots that erupted at government subsidized bakeries." A few weeks later, on April 18, the *New York Times* reported from Port-au-Prince, Haiti, that, "Hunger bashed in the front gate of Haiti's presidential palace. Hunger poured onto the streets, burning tires and taking on soldiers and the police. Hunger sent the country's prime minister packing. Haiti's hunger, that burns in the belly that so many here feel, has become fiercer than ever in recent days as global food prices spiral out of reach, spiking as much as 45 percent since the end of 2006 and turning Haitian staples like beans, corn, and rice into closely guarded treasures." Grain prices fell in late 2008, but once again rose steeply in 2010–11.

When food prices rise dramatically, what does this imply for developing countries and the welfare of the poor? If many of the poor are farmers, do they benefit from the kinds of food price increases that have occurred in recent years? Some may benefit, if they produce and sell food in sufficient quantities; yet, most poor households are net consumers of food. Similarly, most poor countries are net importers

of food. Increases in world food prices may be quite harmful. According to the Food and Agricultural Organization (FAO) of the United Nations, high food prices in 2008 pushed an additional 40 million people into hunger, raising the total to an estimated 963 million. In addition, the FAO estimates that the food import bill for developing countries increased by nearly 75 percent in 2008 as a consequence of the food price shock.[1] The implications of such events for developing countries are complex and raise central questions about the role of agriculture in both economic growth and poverty alleviation.

Agriculture has substantial implications at both the macroeconomic and microeconomic levels in most developing countries. Among countries categorized by the World Bank as low income, agriculture accounted for 25 percent of the gross domestic product (GDP) in 2008, making it the largest single sector in many countries. In addition, over 70 percent of the population of these low-income countries lived in rural areas. Even though not all rural households earn their primary income through farming, the simple observation that nearly three-quarters of the population of low-income countries was sharing one-quarter of the income suggests that poverty in the poorest countries tends to be disproportionately concentrated in rural areas. The large size of the agriculture sector, both in its share of GDP and employment, along with the likely concentration of poverty in rural areas, points to the unique opportunities that agricultural development provides. This chapter addresses the role of agriculture in economic growth and poverty alleviation; Chapter 17 looks more closely at the specific policies and institutions that governments can use to maximize those contributions.

UNIQUE CHARACTERISTICS OF THE AGRICULTURAL SECTOR

Economists Peter Timmer, Walter Falcon, and Scott Pearson identified five characteristics of the agriculture sector that distinguish it from other sectors of most developing economies: the agricultural sector's share of GDP, the agricultural sector's share of the labor force, special characteristics of the agricultural production function, that much of the agricultural sector's output is directly consumed by its producers, and agriculture's role as a resource reservoir.[2]

Agriculture is a dominant sector in many of the world's poorest countries. Table 16–1a summarizes trends in the agricultural share of GDP for major areas of

[1]FAO, *Crop Prospects and Food Situation*, 2008, www.fao.org/giews/, and A. Mittal, "The 2008 Food Price Crisis: Rethinking Food Security Policies," G-24 Discussion Paper No. 56, United Nations Conference on Trade and Development (UNCTAD), Geneva, June 2009.

[2]Peter Timmer, Walter Falcon, and Scott Pearson, *Food Policy Analysis* (Baltimore, MD: Johns Hopkins University Press, for the World Bank, 1983).

TABLE 16–1 The Share of Agriculture in GDP and Rural Population Share

	1965–75	1976–85	1986–95	1996–2008
(a) Share of agriculture in GDP (%)				
East Asia and Pacific	35.3	29.3	22.8	14.4
Latin America and Caribbean	13.3	10.8	8.9	6.4
South Asia	41.3	34.0	28.9	22.3
Sub-Saharan Africa	20.4	18.8	18.5	17.1
High-income countries	5.7	4.1	2.7	1.8
(b) Rural population share (%)				
East Asia and Pacific	81.1	78.0	70.8	61.2
Latin America and Caribbean	42.5	34.8	29.1	23.8
South Asia	81.1	77.8	75.0	72.2
Sub-Saharan Africa	80.4	76.1	71.6	66.4
High-income countries	33.1	29.4	26.6	23.7

GDP, gross domestic product.

Source: World Bank, "World Development Indicators," http://databank.worldbank.org.

the developing world since 1965. While it is clear that agriculture plays an important role in generating national income, it is also clear that the magnitude of that role has trended downward over time (an observation pursued in greater depth in the following section). Nonetheless, the challenge of accelerating economic growth becomes much more difficult if a large sector such as agriculture is left to lag behind the rest of the economy.

Table 16–1b demonstrates the even greater share of each region's population that lives in rural areas. Not all rural dwellers are farmers, and many farmers earn at least some of their income outside of farming. Yet, most nonfarm rural activities depend substantially on the existence of a vibrant agricultural sector. Agriculture also plays a substantial role in the consumption side of the economy. It is common among poor households in developing countries for food expenditures to make up 50 to 70 percent of total household expenditures.

The agricultural sector is also distinguished from other sectors by both the sheer number of participants and by the degree of decentralization of those participants. A farming sector may consist of hundreds of thousands, or even millions, of individual production units, all operating independently, yet all allocating resources in response to the same broad set of incentives created by government policy.

Key characteristics of the agricultural production function are also distinctive. These features include seasonality, geographic dispersion, the sources of risk, and the sources of technical change. Agricultural production is uniquely sensitive to seasonality. Most countries have distinct growing seasons, usually defined by rainfall patterns. From an economic point of view, we can think of farmers' use of seasonality as cost minimization (for example, it is much cheaper to use natural sunlight

than to use electric grow lights). Yet, with the reliance on seasonality also comes strict requirements for the timing of operations. Late planting, for instance, might substantially reduce yields by failing to take advantage of the best natural growing conditions. Strict timing requirements imposed by seasonality may lead to labor shortages at critical times, such as planting and harvesting, despite widespread rural underemployment at other times of the year. If inputs such as seeds and fertilizer are not available at the right time, they may become useless. These considerations, plus the fact that agriculture is highly geographically dispersed due to its unique use of surface area as an input to production, underscore the need for efficient marketing of both inputs and outputs as a critical ingredient for agricultural development (a point discussed in more detail in Chapter 17).

Risk and uncertainty also affect production in ways that are unique to agriculture. The primary sources of risk for farmers are prices and weather. While it is true that all productive sectors must worry about the price of their output, agricultural prices tend to be particularly variable, both within and across seasons. Farmers are confronted with challenging forms of price risk, as they must commit resources (and potentially take on debt) at the time of planting despite not knowing the price they will receive for their output until months later, when they harvest their crops. This uncertainty about prices is related to weather being an additional source of risk that is unique to agriculture. Most poor farmers (especially outside of Asia) do not have access to modern irrigation systems and thus depend on rainfall. In sub-Saharan Africa only 4 percent of cropland is irrigated and in drought-prone regions, such as Africa's Sahel, weather-related risk is substantial. Too much rain can also be catastrophic, as the destruction of nearly one-fifth of Pakistan's cultivable area by the monsoon floods of 2010 demonstrated.

Productivity growth is essential for sustained agricultural development and is a critical component of overall economic development. In the long run, growth in agricultural productivity is driven by technical change. Creating and disseminating technical change in agriculture is a special challenge for policy makers. The diversity and complexity of agricultural production systems around the developing world make agricultural technologies highly context specific. A wheat variety that thrives in the Pakistani Punjab may fail miserably in Argentina. Thus substantial effort and resources are required not only to create agricultural technologies but also to adapt them to particular agroecological settings. The highly atomized and dispersed nature of agriculture in most countries then presents additional challenges for disseminating new technologies, the impact of which are nil if they are not widely adopted by farmers.

Agriculture is also unique in that producers in developing countries consume a large share of their own output. This highlights the complexity of decision making within agricultural households. Production and consumption decisions are inextricably linked. Households must consider the trade-offs inherent in allocating a mother's time to working in the field or to childcare or in deciding how much time to send

children to school versus putting them to work (either on the family's own farm or as hired off-farm labor). Such decisions may have large impacts on the welfare of poor households.

Finally, agriculture differs from other sectors in having traditionally been seen largely as a reservoir of inexpensive resources (principally labor and capital) available for extraction and use in modern industry and services. In many cases, this perspective justified the neglect of agriculture by policy makers, as agriculture was perceived to be a traditional, low-productivity sector with little to contribute to industrialization. Although later approaches have challenged this view of agriculture's role in economic growth, as economies grow, agriculture tends to account for a declining share of both GDP and employment. This robust empirical regularity is part of the broader concept called **structural transformation**.

STRUCTURAL TRANSFORMATION

Structural transformation refers to the systematic changes in sector proportions as economies grow. Initially, at low levels of income, agriculture dominates both as a share of GDP and as a share of employment. As economies transition toward middle levels of income per capita, agriculture accounts for a smaller share of both GDP and employment (replaced by industry and services). This pattern is a central feature of economic development and both a cause and an effect of economic growth. In advanced economies, the farming population accounts for a negligible share of the total population. As Timmer observes, "there are more lawyers in the United States than farmers, more dry cleaning establishments than farms."[3] The relative decline of agriculture and rise of industry and services that characterize structural transformation imply an additional characteristic—namely, a substantial migration of labor from the rural to the urban economy. Finally, structural transformation is also characterized by a demographic transition (discussed in Chapter 7) in which the high birth and death rates of traditional societies are replaced by low birth and death rates (as health conditions improve with income growth).

From the perspective of the demand side of the economy, this process of structural transformation is driven by **Engel's law**, the observation by nineteenth-century statistician Ernst Engel that the proportion of income spent on food declines as income rises (that is, the income elasticity of food is positive, but less than 1). This implies that income grows faster than the demand for food, resulting in the decline of agriculture as a share of national income.

[3] C. Peter Timmer, "A World without Agriculture: The Structural Transformation in Historical Perspective," Wendt Lecture, American Enterprise Institute, Washington, DC, October 30, 2007, p. 5.

Structural transformation is an empirically robust phenomenon. Figure 16–1 shows the (smoothed) patterns of rural population shares and agricultural shares of GDP by region as a function of income per capita. (The same patterns are apparent in Table 16–1, which includes the average levels of these variables by decade.) It is clear from Figure 16–1 that there is a persistent, though declining, gap between the rural population share and the share of agriculture in GDP. This gap reflects the persistent, though declining, concentration of poverty in the rural economy. However, as the gap falls, labor productivity and wages across sectors tend to converge. The data in Table 16–1 show that significant gaps remain, on average, in the major regions of the developing world. Among those regions, only Latin America has approached low levels (and convergence) of rural population share and agricultural share of GDP that characterize the advanced economies. The particular path followed by any given country will vary from these norms, depending on local circumstances. Yet, the broad pattern is remarkably robust.

We can begin to consider the potential contributions of agriculture to economic growth by looking more closely at the process of structural transformation. History reflects that structural transformations broadly consist of four distinct phases.[4] The first phase begins with an increase in agricultural output per worker (average labor

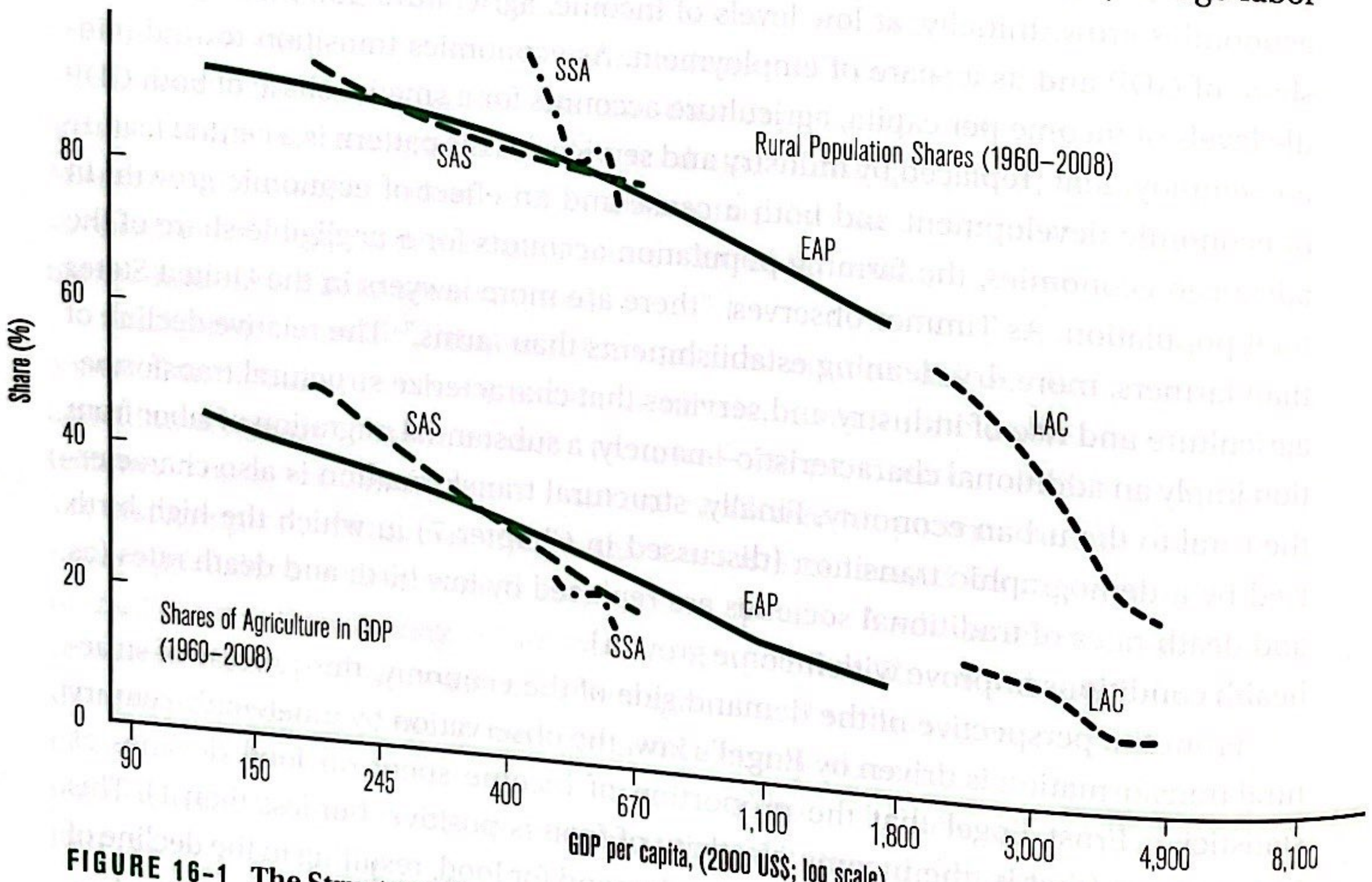

FIGURE 16–1 The Structural Transformation

EAP, East Asian and the Pacific; GDP, gross domestic product; LAC, Latin American and the Caribbean; SAS, South Asia; SSA, sub-Saharan Africa.
Source: World Bank, "World Development Indicators," http://databank.worldbank.org.

[4]C. Peter Timmer, "The Agricultural Transformation," in H. Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics*, vol. 1, (Amsterdam: Elsevier Science, 1988).

productivity). This rising level of output per worker creates a surplus in the rural economy. The second phase of the structural transformation consists of the transfer of that surplus from the agricultural to the nonagricultural sector. This transfer can be implemented either directly (through taxation) or indirectly (through other forms of government intervention). This process of resource transfer is facilitated by the increasing integration of agricultural and nonagricultural factors and product market linkages, with intersectoral trade and labor migration being supported by improved infrastructure. The progressive integration of the agricultural and nonagricultural sectors is the third phase of structural transformation. Finally, the fourth phase occurs when the agricultural sector is fully integrated into the macroeconomy, at which point much of the economic distinctiveness of agriculture will have faded. This is the situation that we currently observe in the advanced economies, where agriculture and nonagriculture operate in essentially the same labor and capital markets.

The concentration of poverty in rural areas that it is implied by the gap between rural employment shares and agriculture's share in GDP also implies that average labor productivity tends to be higher in nonagricultural sectors. Indeed, it may be reasonable to believe that poverty is concentrated in rural areas *because* the level of agricultural productivity is lower than the level of productivity in nonagriculture. Williams College economist Douglas Gollin calculated the ratio of nonagricultural output per worker to agricultural output per worker in 1999–2000 for a number of countries.[5] His results are summarized in Table 16–2. Gollin's calculations confirm that average labor productivity is substantially higher in nonagricultural sectors than in agriculture. In general, the ratio of average labor productivity in nonagriculture relative to agriculture is on the order of 2.5 to 7. Countries in this range include Brazil, Côte d'Ivoire, Ghana, Indonesia, Mexico, and Pakistan. Yet, for more than a few countries, such as Burkina Faso, Burundi, China, and Thailand, this ratio is greater than 10.

If average labor productivity is often substantially higher in nonagriculture than in agriculture, then the process of structural transformation in which labor flows from agriculture to nonagriculture creates a potentially important source of economic growth. We can think of part of the benefit of structural transformation as arising from the transfer of labor from relatively low-productivity to relatively high-productivity employment. Columns 3 to 5 of Table 16–2 present Gollin's calculation of the contributions of sectoral shifts of labor to growth in total output per worker for selected countries.[6] In China, average output per worker in nonagriculture in

[5]Douglas Gollin, "Agricultural Productivity and Economic Growth," in Prabhu Pingali and Robert Evenson, eds., *Handbook of Agricultural Economics*, vol. 4 (Amsterdam: Elsevier, 2010).

[6]Gollin calculates the contribution of sectoral reallocation of labor to growth in aggregate output per worker as a residual. This residual is the growth in output per worker that is not explained by adding the separate contributions to growth in output per worker coming from growth in agricultural and nonagricultural output per worker. Accurate accounting for these distinct sectoral contributions requires that each sectors' contribution be weighted by the share of GDP coming from each sector. If the weighted sum is different from the actual growth in aggregate output per worker for a given country, then the difference (that is, the residual) provides an estimate of the contribution of the reallocation of labor between sectors. This type of calculation is thus quite similar in its approach to the growth accounting analysis presented in Chapter 4.

TABLE 16-2 Ratio of Sectoral Labor Productivity, Agriculture, and Nonagriculture (1999–2000) and the Contribution of Sectoral Labor Shifts to Growth (1960–2000)

COUNTRY	NONAGRICULTURAL OUTPUT TO AGRICULTURAL OUTPUT*	GROWTH RATE†	GROWTH FROM		
			AGRICULTURE	NONAGRICULTURE	SECTORAL SHIFTS
Burundi	13.91	0.005	−0.011	0	0.016
Mexico	6.28	0.01	−0.001	−0.002	0.013
Burkina Faso	29.07	0.013	0.002	0.006	0.006
Côte d'Ivoire	3.03	0.014	0.004	0	0.01
Brazil	3.37	0.017	0.002	−0.005	0.021
Ghana	2.43	0.025	0.014	0.007	0.004
Indonesia	5.07	0.028	0.001	−0.001	0.027
Pakistan	2.54	0.03	0.007	0.005	0.018
Thailand	13.07	0.043	0.004	0.007	0.032
China	11.25	0.053	0.014	−0.015	0.054

*Ratio of nonagricultural output per worker to agricultural output per worker.
†Output per worker

Source: Douglas Gollin, "Agricultural Productivity and Economic Growth," in Prabhu Pingali and Robert Evenson, eds., *Handbook of Agricultural Economics*, vol. 4. (Amsterdam: Elsevier, 2010), tables 4 and 5.

1999–2000 was more than 11 times greater than average output per worker in agriculture. Output per worker from 1960 to 2000 grew at 5.3 percent per year, essentially all of which was explained by shifts of workers from agricultural to nonagricultural employment. In Thailand, the labor productivity ratio was over 13. In that case, 3.2 percent of the country's 4.3 percent growth in output per worker during the four decades was explained by sectoral shifts of labor. Intersectoral labor shifts accounted for about three-quarters of the growth of output per worker in Thailand.

Our awareness of the structural transformation comes from historical observation. Yet, the notion of economies consisting of two sectors (agricultural and nonagricultural, traditional and modern, etc.) and the understanding of development as a process centered around the transfer of labor (and capital and other resources) from agriculture to nonagriculture is firmly grounded in the theoretical tradition of two-sector (or dualistic) growth models.

TWO-SECTOR MODELS OF DEVELOPMENT

Although single-sector growth models, presented in Chapter 4, have the great advantage of simplicity, they do not explore production in different sectors such as agriculture, industry, or services (such as banking or tourism); the allocation of capital,

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COUNTRY	NONAGRICULTURAL OUTPUT TO AGRICULTURAL OUTPUT*	GROWTH RATE†	GROWTH FROM AGRICULTURE	GROWTH FROM NONAGRICULTURE	GROWTH FROM SECTORAL SHIFTS
Burundi	13.01	0.005	−0.011	0	0.016
Mexico	6.28	0.01	−0.001	−0.002	0.013
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