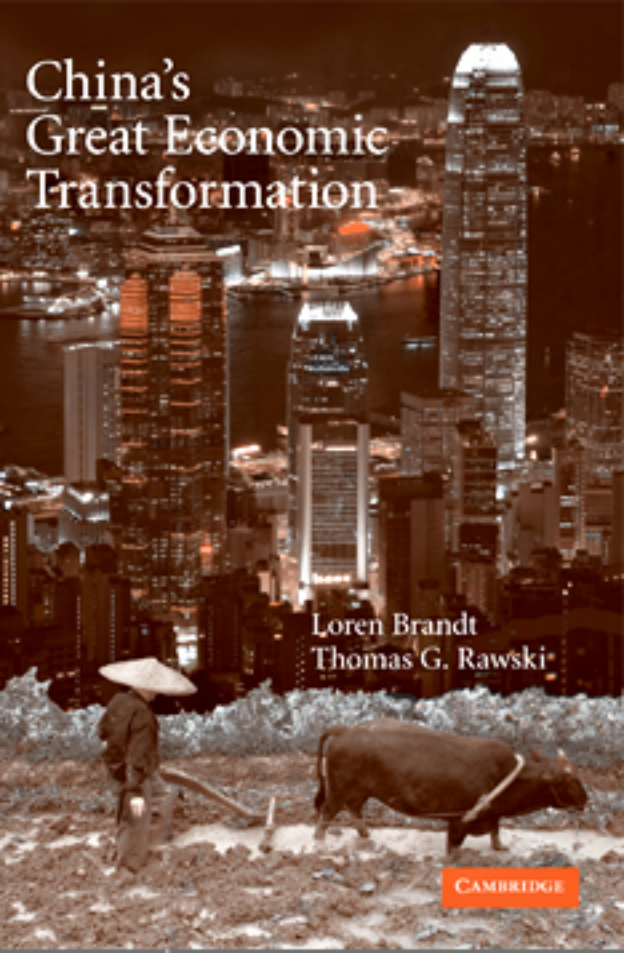
China's Great Economic Transformation



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Growth and Structural Transformation in China

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INTRODUCTION

Between 1978 and 2004 China's real GDP per capita grew at a rate of 8.16 percent per year. Some of this growth can be attributed to increases in labor force participation.[1] On a per worker basis, GDP still increased at a real rate of 6.96 percent, implying a doubling of aggregate labor productivity every ten years and a quadrupling every twenty years. This impressive growth performance accompanied two important structural transformations.

The first, a fundamental feature of the economic development process, entailed large-scale reallocation of labor from agriculture to manufacturing and services, which pushed agriculture's share of total employment from 69 to 32 percent between 1978 and 2004. The second, unique to the transition process in former socialist economies, involves the reallocation of labor and other resources from state-owned enterprises (SOEs) to enterprises outside the state sector: over the same period, the state sector's share of nonagricultural employment fell from 52 percent to only 13 percent.

The primary objective of this chapter is to quantify the contributions of these two transformations and of productivity growth within each sector to China's overall growth and to systematically examine the forces driving each of these momentous changes. As will quickly become evident, this approach delivers a substantial payoff in the form of unexpected outcomes and a new perspective on the interaction among structural change, transition from socialism, and productivity growth during the course of China's long boom.

The first surprise comes from information on the annual growth of real output per worker during 1978–2004. Our data show that labor productivity in China's nonagricultural sector grew only 4.65 percent per annum compared to 6.75 percent in agriculture and 6.96 percent in the aggregate. The distinctly superior growth of

[1] Between 1978 and 2004, labor force participation rates, defined here as the ratio of the total number of individuals working to the total population, increased from 48.7 to 57.9 percent. This increase largely reflected changes in the demographic composition of the population.

farm labor productivity suggests that agriculture may have played a significant role in China's growth. Indeed, Young (2003) observes, "Despite the popular academic emphasis on industry and exports, a deeper understanding of the success of the world's most rapidly growing economies may lie in the most fundamental of development topics: agriculture, land and the peasant."

Agriculture contributed to Chinese growth both directly, through rapid expansion of productivity, and indirectly, through the release of labor into the nonagricultural sector. China's economic reform followed nearly two decades of urban-oriented policies that concentrated investment in urban industry, tied rural households to the land, and generated a 6:1 gap in output per worker between the nonagricultural and the farm sector. With 70 percent of the labor force in agriculture in 1978, we can see the potential for cross-sector labor reallocation to accelerate aggregate growth.[2]

To understand China's immense post-1978 economic gains, we must also examine the other important structural transformation: the reallocation of labor and other resources from the state-owned nonagricultural sector to the nonstate sector.[3] In principle, the two transformations, from agriculture to nonagriculture and from state to nonstate within nonagriculture,[4] may be linked, for example, through the effect of the state sector's initial size and subsequent growth on relative productivity between agriculture and nonagriculture.

At the outset of reform, the state sector dominated nonagricultural activity, accounting for 80 percent of urban employment, 76 percent of industrial output, and nearly two-thirds of construction output in 1978. The balance of ownership is crucial because labor productivity growth in the nonstate sector ran far ahead of state-sector achievements. Furthermore, the growth of output per worker in the state sector relied heavily on capital accumulation – largely financed through loans from China's state-dominated banking system – implying an even larger shortfall in the growth of total factor productivity (TFP) within the state sector.[5]

[2] Hayashi and Prescott (2006) argue that this transfer played an important role in the post–World War II growth acceleration of one of China's Asian neighbors, Japan.

[3] We should be clear at the outset that "nonstate" activity includes but is not limited to the private sector. Through the first decade and a half of the reform, the nonstate sector consisted mainly of urban collectives and mostly of collective township and village enterprises. Over time, through relaxation of restrictions on ownership, privatization of both collectively owned and state-owned firms, foreign direct investment, and so on, private ownership has come to occupy an increasingly prominent position within the nonstate sector.

[4] In what follows, we employ the terms "state" and "nonstate" to indicate the decomposition of the nonagricultural sector along ownership lines. This allows us to avoid clumsy terminology, such as "nonstate nonagricultural sector." Our discussion ignores China's state farms, which are too small to influence the outcome of this analysis.

[5] We define TFP growth to be the increase in output that cannot be attributed to increases in factor use, namely, labor and capital. In our empirical work, TFP also includes the contribution of increases due to the accumulation of human capital. In ongoing work, we examine human capital separately.

Our effort to disentangle these complexities focuses on a series of specific questions. With respect to agriculture, we want to know the following:

- How important was increased agricultural productivity to aggregate output growth?
- How much of the growth in aggregate output per worker can be attributed to the reallocation of labor from agriculture to nonagriculture?
- What factors were most important in determining the speed with which labor was transferred out of agriculture?

Outside agriculture we are motivated by a related set of issues:

- How much did productivity change in the nonstate sector contribute to overall growth?
- What is the role of capital accumulation in the growth of the nonagricultural sector?
- What is the contribution of the reallocation of labor and capital from the state to nonstate sectors?

We address these questions first through the use of simple growth accounting. However, unraveling the complex interactions among capital accumulation, sectoral productivity change, and the reallocation of labor and capital reallocation across sectors requires a more complex analysis than conventional growth accounting can offer. To address these issues more fully, we have pursued the following research agenda:

1. Compile time series of key variables, including output, employment, capital stock, and, for the nonfarm sector, nominal and total labor compensation, over the period 1978–2004 for three segments of the economy – agriculture, state sector, and nonstate sector both nationally and for ten provinces.[6]
2. Develop a dynamic three-sector model that encompasses key features of China's economic evolution, particularly the TFP differences across sectors and the shift of resources from farming and the state sector.
3. Use aggregate data to calibrate the model, which allows us to verify the broad consistency between the model's performance (i.e., predicted outcomes) and actual developments.
4. Use the calibrated model to conduct a series of counterfactual experiments intended to estimate the contributions of specific elements to overall growth. For example, the difference between observed aggregate growth and aggregate growth in a censored version of the model in which the growth of agricultural TFP is arbitrarily fixed at zero provides an estimate of the contribution of increased TFP in agriculture to aggregate growth.

[6] The provinces include Shanxi, Jilin, Jiangsu, Zhejiang, Anhui, Henan, Hunan, Guangdong, Sichuan (and Chongqing), and Gansu.

5. Use the provincial data for further experimentation that confirms the initial results.

We leave the details of our dynamic three-sector model to Appendix B, in which we show that the model is able to replicate the broad features of China's economic development during the years 1978–2004. This structural model, while unavoidably complex, allows us to pursue issues that lie beyond the reach of conventional growth accounting and other forms of decomposition; our results also reveal the capacity of these simpler methods to produce erroneous results. Our analysis suggests that the traditional structural transformation, that is, from agriculture to nonagriculture, plays a smaller role than Young (and we) anticipated. Far more important is productivity growth in the nonstate sector and the transfer of labor from the state to the nonstate sectors.

Indeed, neglect of the important heterogeneity within the nonagricultural sector cutting across ownership lines bypasses what our analysis highlights as perhaps the most important determinant of China's rapid growth: TFP growth in the nonstate sector. Careful attention to the separate trajectory of the state and nonstate sectors also directs our attention to other processes such as those described in the chapters on industrial development (see Chapter 15) and on China's participation in the international economy (see Chapter 16) that contributed to productivity growth outside agriculture. Finally, our analysis suggests that cross-provincial differences in the state sector's initial position significantly influenced provincial growth trajectories.

By way of summary, we list our major findings as follows:

1. Productivity growth in agriculture and the relaxation of restrictions on rural labor mobility and use were the two most important factors driving the transfer of labor out of agriculture.
2. Although productivity growth in agriculture was important to the reallocation of labor from agriculture to nonagriculture, it contributed only modestly to aggregate labor productivity growth.[7] Between 1978 and 2004, agriculture's direct contribution to annual output growth was 0.43 percentage points. The reallocation of labor from low-productivity agriculture to higher-productivity activities in nonagriculture was the source of 1.02 percentage points, implying a total contribution of 1.45 percentage points, or 20.83 percent of total growth.
3. Reductions in barriers to labor reallocation, including those between agriculture and nonagriculture and between state and nonstate, were important for both structural transformations. However, it is only the relaxation of the latter set of distortions that had significant effects on growth. The total contribution of barrier reductions to growth is 2.29 percentage points, or close

[7] TFP in agriculture, however, contributed significantly more to growth in welfare than it did to output growth. We discuss this briefly in footnote 28 in section "Growth Accounting."

to one-third. Out of this 2.29 percentage point contribution, the reduction in labor market barriers between the state and nonstate sector accounts for 1.77 percentage points, while the reduction in barriers between agriculture and nonagriculture accounts for only 0.52 percentage points.

4. TFP growth in the nonstate sector, which attained an average annual rate of 4.33 percent during 1978–2004, is the most important source of growth between 1978 and 2004. It contributed to 2.83 percentage points, or 40 percent of the overall growth. Looking at the nonagricultural sector in the aggregate conceals this important feature of the growth process. This impressive growth coincided with near-tenfold employment growth in the nonstate sector, from 48.9 million in 1978 to 446 million in 2004.
5. The state sector emerges as a major impediment to growth. With low-TFP growth averaging only a third of that in the nonstate sector, the state sector maintained a substantial position in China's economy only as the beneficiary of large-scale capital-market distortions. The resulting misallocation of capital favoring the state sector at the expense of more productive nonstate outlets slowed the pace of growth, resource transfer, and productivity change. Reforms in the 1990s that reduced both the size of the state sector and the wage premiums enjoyed by its employees contributed significantly to the growth of aggregate labor productivity.
6. Cross-provincial data confirm the significant negative impact of the state sector on growth. Provinces with larger state sectors (measured by the state employment share) in 1978 experienced a slower pace of structural transformation and had a larger percentage of investment going to the state sector during the period. As a result, both the aggregate and nonagricultural labor productivity growth rates were lower in these provinces.

The rest of the chapter is organized as follows. "Some Basic Facts" lays out a set of first-order facts relating to China's economic transformation between 1978 and 2004. "A Simple Decomposition Exercise" presents the results of a simple growth accounting decomposition of the sort commonly used to look at the returns to reallocation of labor across sectors. Drawing on a model laid out in Appendix B, "A Heuristic Model of Structural Transformation and Growth" sketches out the potential forces driving the reallocation of labor out of agriculture, followed in "Accounting for Labor Reallocation from Agriculture to Nonagriculture" by an accounting of the contribution of each of these factors. "Growth Accounting," in turn, undertakes a similar accounting of the contribution of resource reallocation, capital accumulation, and productivity growth to China's rapid expansion. All of the analysis through the section on "Growth Accounting" is at the national level. In the section on "Regional Variations," we look to provincial-level data and differences in their growth trajectories for footprints of the causal factors we identified at the aggregate level. Finally, the last section concludes.

SOME BASIC FACTS

We begin by documenting a number of first-order facts relating to sector-level growth, the structure of employment, and the behavior of TFP. These observations will serve as the basis for our quantitative analysis. Sector-level time-series data on nominal and real GDP, employment, wages, investment, and the real capital stock are critical here. There are important issues surrounding the construction of each of these series, especially employment levels in the agricultural and nonagricultural sectors and price deflators linking nominal and real GDP. We leave most of this discussion to a separate data appendix and limit the present discussion to highlighting key facts.[8]

Employment and Employment Share by Sectors

We start with employment because it provides the basis for constructing estimates of labor productivity. China's National Bureau of Statistics (NBS) provides an estimate of total employment and a breakdown by sector: primary, secondary (manufacturing plus construction, mining, and utilities), and tertiary (services). Between 1978 and 2004, the NBS measure of total employment increased from 401.52 million to 752.00 million. The NBS data also show a decline in the percentage of the labor force in the primary sector from 70.5 percent in 1978 to 50.1 percent in 2000, and then to 46.9 percent in 2004.

We find two difficulties with the official data. There is a major discontinuity in the employment data beginning in 1990. This "break" reflects a major upward adjustment to the NBS employment series based on new information from China's population censuses of 1990 and 2000.[9] These adjustments did not extend to years before 1990, leading to a big jump in the NBS employment measure during 1989–1990.

A second issue concerns the possibility that NBS data underestimate the rate of decline in the primary-sector labor force (Chen, 1992; Rawski and Mead, 1998). Critics point to several potential sources of this bias: the exclusion of employment in private and cooperative enterprises owned by households prior to 1984 (Wong, 1988, p. 14), incomplete tabulation of self-employment and part-time work outside agriculture by individuals who derived the bulk of their incomes from farming, and erroneous inclusion of out-migrants in the farm labor force.

Following Holz (2006), we use information from the 1982 Census to adjust the pre-1990 data on total employment in a way analogous to the adjustments made for 1990 and after. We also construct an alternative estimate of "primary"

[8] This appendix can be accessed at http://www.economics.utoronto.ca/brandt/China's Great Economic Transformation/Chapter 17/Data Appendix.

[9] Following the revisions, for example, total employment in 1990 increased from 567.40 million to 647.49 million, or an increase of 14.1 percent. In percentage terms, the adjustment in each of the three sectors, primary, secondary, and tertiary, was comparable.

sector employment by utilizing detailed labor supply data for rural households disaggregated by activity collected by the Research Centre for Rural Economy as part of their annual rural household survey.[10]

Table 17.1 lays out our revised estimates of total employment and employment disaggregated between the primary and nonprimary sectors. For the nonprimary sector, we also report employment in the state and nonstate sectors. At the beginning of the reforms, total employment was 468 million, with nearly 70 percent in agriculture. The state sector occupied over half of all employment outside the primary sector in 1978. The remainder of the nonagricultural workforce was divided among urban collective enterprises and rural firms operated by rural townships and villages (commune and brigade level enterprises).

Between 1978 and 2004, total employment grew at an annual rate of 1.82 percent, reaching a terminal figure of 752 million (Table 17.1). Important changes in the composition of employment accompanied this growth. First, primary-sector employment declined by nearly 100 million, and its share of total employment dropped by more than half, from 69.3 to 31.8 percent.[11] Over the same period, employment outside agriculture increased at an annual rate of nearly 5 percent, rising from 144 million to 513 million, with its share in the total expanding from 30.7 to 68.2 percent.

Within the nonagricultural sector, employment in the state sector increased by more than 50 percent, from 74.5 million to 112.6 million workers, between 1978 and 1995, before dropping sharply. By 2004, reflecting a combination of massive layoffs and major restructuring in the state sector, including privatization of many small- and medium-sized firms, employment fell to 67.1 million, occupying only 13.1 percent of nonagricultural employment in 2004. At the same time, employment in China's nonstate sector jumped from 69.5 million to 446.0 million between 1978 and 2004, an increase of 640 percent.

Labor Productivity Levels and Growth by Sectors and Periods

We combine data on output and employment to derive time series for aggregate and sectoral labor productivity in terms of 1978 prices. Results appear in Figure 17.1. Our estimates of real output begin with the most recent revision of the standard NBS data on nominal GDP at the aggregate and sectoral levels. We apply a new set of sector-level price deflators that imply slightly higher (lower) inflation in the secondary and tertiary (primary) sectors than the implicit price indicators

[10] By agreement with Research Center on the Rural Economy, we have data for the ten provinces identified in footnote 6.

[11] By way of comparison, our revised estimates actually show a smaller reduction than alternative estimates by Rawski and Mead (1998), using a different methodology. Their estimates, which terminate in 1993, imply a drop of a third in the absolute number working in agriculture, and a reduction in the share of the labor force in primary-sector activity from 70 to 35 percent between 1979 and 1988, before a slight rise the next few years.

Table 17.1. *Revised employment data: 1978–2004*

Year	Total employment (millions)	Primary sector		Nonprimary sector		
		Total (millions)	Percentage of total	Total (millions)	State-owned units (SOU) (millions)	Non-SOU (millions)
1978	468.43	324.45	69.26	143.98	74.51	69.47
1979	479.67	314.16	65.50	165.51	76.93	88.58
1980	493.97	305.93	61.93	188.04	80.19	107.85
1981	510.39	298.90	58.56	211.49	83.72	127.77
1982	526.18	291.38	55.38	234.80	86.30	148.50
1983	541.17	283.38	52.36	257.79	87.71	170.08
1984	558.10	276.34	49.51	281.76	86.37	195.39
1985	575.51	269.46	46.82	306.05	89.90	216.15
1986	591.51	277.04	46.84	314.47	93.33	221.14
1987	607.44	277.26	45.64	330.18	96.54	233.64
1988	622.40	282.32	45.36	340.08	99.84	240.24
1989	635.61	299.13	47.06	336.48	101.08	235.40
1990	647.49	301.07	46.50	346.42	103.46	242.96
1991	654.91	300.44	45.88	354.47	106.64	247.83
1992	661.52	299.43	45.26	362.09	108.89	253.20
1993	668.08	292.19	43.74	375.89	109.20	266.69
1994	674.55	281.55	41.74	393.00	112.14	280.86
1995	680.65	277.59	40.78	403.06	112.61	290.45
1996	689.50	268.27	38.91	421.23	112.44	308.79
1997	698.20	267.34	38.29	430.86	110.44	320.42
1998	706.37	266.25	37.69	440.12	90.58	349.54
1999	713.94	259.91	36.41	454.03	85.72	368.31
2000	720.85	254.46	35.30	466.39	81.02	385.37
2001	730.25	255.02	34.92	475.23	76.40	398.83
2002	737.40	250.40	33.96	487.00	71.63	415.37
2003	744.32	243.96	32.78	500.36	68.76	431.60
2004	752.00	238.88	31.77	513.12	67.10	446.02

embedded in the NBS data. As a result, our measure of real GDP growth is roughly 1 percentage point below the official figure for the entire period 1978–2004.

At the beginning of the reform, real labor productivity in the nonagricultural sector was nearly six times higher than that in agriculture (RMB18,000 per man-year vs. RMB3,100 per man-year). This "gap" gradually declined by nearly half as a result of differential growth in labor productivity favoring agriculture. Between 1978 and 2004, average labor productivity in agriculture increased at an annual rate of 6.76 percent compared to only 4.65 percent for the nonprimary sector. Most of this partial convergence occurred very early in the reform process. We attribute this to the large "one-time" gains in agricultural output that followed the introduction of the household responsibility system, the early reform of marketing and pricing,

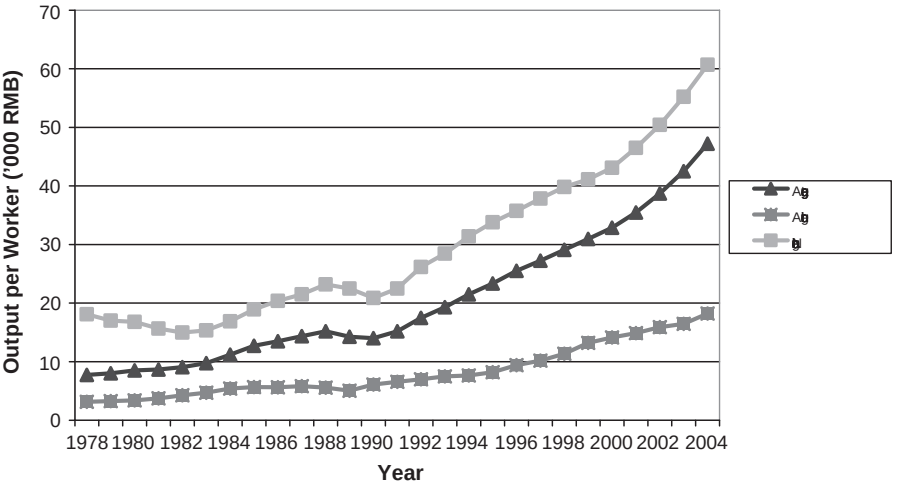

Figure 17.1. Real labor productivity, 1978–2004 (RMB1,000) (See text.)

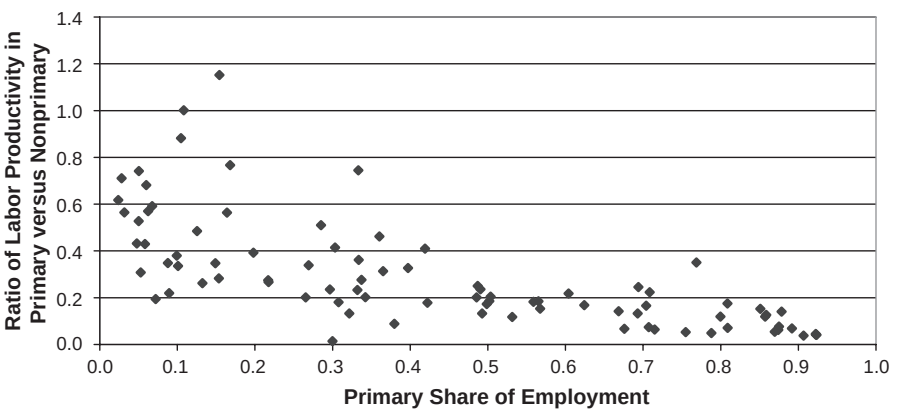

Figure 17.2. Relative labor productivity versus primary share of employment, eighty-five countries

and the ensuing exodus of labor out of agriculture (see McMillan, Whalley and Zhu, 1989; Lin, 1992; see Chapter 13).

Figure 17.2 helps put China's 1978 intersectoral productivity gap into comparative perspective by graphing the ratio of primary-sector to nonprimary-sector labor productivity (vertical axis) against the primary sector's employment share (horizontal axis) for a cross section of eighty-five countries that spans all regions and levels of development. The data are for 1985 for all countries except China, for which we use 1978 data.

Many empirical studies document the universal decline in agriculture's share of employment (and also GDP) as per capita incomes rise. Thus, in Figure 17.2,

observations associated with high-income nations congregate near the vertical axis (because they have low shares of primary-sector employment), with China among the low-income nations on the right-hand segment of the graph. Figure 17.2 shows that the ratio of primary to nonprimary labor productivity rises substantially as we move from right to left, that is, from lower to higher levels of per capita income. China, with its gap of 1:6 between agricultural and nonagricultural productivity, does not stand out among low-income countries with most of their labor force employed in the farm sector. This leads us to conclude that, despite the unusual features of China's rural organization in 1978, China was not alone among low-income nations in suffering institutional constraints that impeded efficient allocation of resources across sectors. Indeed, Figure 17.2 suggests that such obstacles appear to be endemic among low-income countries.[12]

What about differences in labor productivity between the state and nonstate sectors? While the NBS data decompose industrial output and value added into state and nonstate components, they provide no similar breakdown for the entire secondary and tertiary sectors. This forces us to rely on wage data for the state and nonstate sectors to approximate such a division for the entire nonagricultural economy.

To do this, we assume that wages are proportional to average value products and that labor shares in the two sectors are the same. Information on wages in the state and nonstate sector, the latter including urban collective, foreign-owned, private, and township and village enterprises (TVEs), suggest that wages outside the state sector were between 60 and 70 percent of state-sector wages between 1978 and 1995, rose to nearly 85 percent by 2000, and then fell slightly thereafter.

These data conceal an important complication: they include only cash compensation and neglect the value of subsidies and in-kind wages enjoyed by workers in the state sector, the largest component of which was probably housing. Rawski (1982), Bannister (2005), and Benjamin et al. (see Chapter 18) offer estimates of the magnitude of these benefits for various years. There is a clear consensus that the relative importance of such noncash benefits has declined markedly over time, with estimates suggesting that they have fallen from rough equality with cash wages in the late 1970s, to half of cash wages by the early 1990s, to perhaps a quarter of cash wages today. These figures imply that total compensation in the nonstate sector almost doubled relative to compensation in the state sector between 1978 and 2004. Although these estimates of overall compensation are unavoidably crude, we note that the implied doubling of relative earnings paid to nonstate workers parallels our estimates of relative labor productivity between state and nonstate industry, which make up the bulk of the secondary sector.[13]

[12] See Restuccia, Yang, and Zhu (forthcoming) for a cross-country quantitative analysis of these obstacles to labor reallocation.

[13] In 2004, for example, GDP in industry was equal to 86.6 percent of GDP produced in the secondary sector, which is made up of industry, mining, utilities, and construction (see *Zhongguo tongji nianjian*, 2005, p. 51).

Investment and Capital Accumulation by Sectors

Capital accumulation surely contributed to the rapid growth of labor productivity. Fixed investment increased from 23 percent of GDP in 1978 to 45 percent in 2004. As a result, the capital–labor ratio in the economy grew from RMB14,000 in 1978 to RMB59,000 in 2004. However, fixed investment and the increase in the capital–labor ratio were not uniform across sectors. Between 1978 and 2004, the average annual growth rate of the capital–labor ratio amounted to 5.13, 2.51, and 6.43 percent for the agricultural, nonstate, and state sectors, respectively. For agriculture, the rapid rise in the ratio is partly due to falling employment. The rapid growth of the capital–labor ratio in the state sector, however, is largely a product of huge infusions of investment arising from sizable credit market distortions designed to channel funds to state-sector investment projects.

China's financial system has played an important role in intermediating the economy's growing pool of savings. The annual flow of new savings directed to firms, enterprises, and government through either banks or emerging bond and equity markets has averaged more than 20 percent of GDP since the mid-1980s. China's financial system, however, remains strongly oriented toward serving state-sector firms, which receive the largest portion of these funds (Lardy, 1998; Brandt and Zhu, 2000). Even with recent banking reforms and significant downsizing of the state enterprise sector, more than 60 percent of all new loans were directed to state-owned or state-controlled firms between 1998 and 2003 (Brandt and Zhu, 2007). This is only marginally lower than estimates for earlier years. In addition, funds raised through initial public offerings continue to flow primarily to state-controlled firms.

By contrast, nonstate-sector firms, especially domestically owned enterprises (rather than either joint ventures or wholly owned subsidiaries), have often experienced significant difficulty in raising funds. Discrimination against small- and medium-size private firms has been well documented (see Chapter 14; Brandt and Li, 2003). This bias in the financial system helps explain why investment in the state sector has consistently hovered in the vicinity of 17 percent of GDP despite the state sector's rapidly declining contribution to aggregate GDP and employment.

TFP Levels and Growth by Sectors

The presence of substantial differences in the capital–labor ratio across sectors makes labor productivity a potentially misleading measure of production efficiency. For example, output per worker in the state sector has consistently been higher than labor productivity in the nonstate sector, but this may reflect the state sector's easy access to capital and higher capital–output ratio rather than any superior effectiveness of resource utilization. To measure differences in production efficiency across sectors, we need to control for differences in

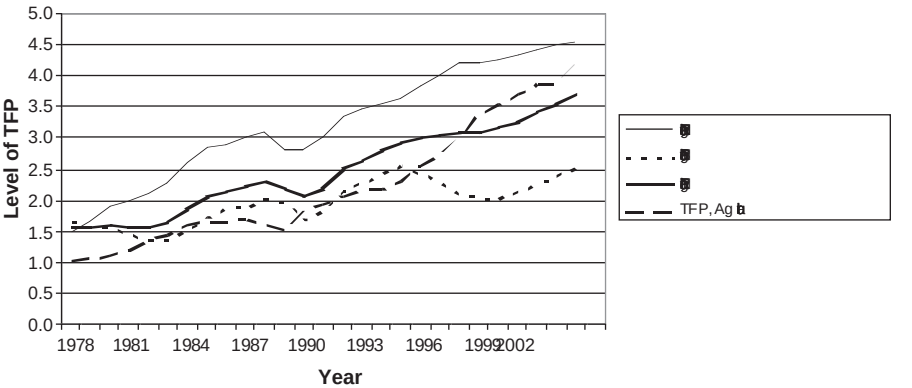

Figure 17.3. Sector TFP, 1978–2004 (see text)

the capital–labor ratio. We do this by estimating the TFP levels for each sector.[14]

Figure 17.3 plots the TFP levels for each of the three sectors. There has been significant growth of TFP in the agricultural and the nonstate nonagricultural sector, which increased at annual rates of 5.38 and 4.33 percent, respectively. By comparison, TFP growth in the state sector has been relatively sluggish, increasing only at the rate of 1.66 percent per annum. In terms of levels, in 1978 TFP in the nonstate nonagricultural sector was nearly the same as that in the state sector. Due to the more rapid growth in the nonstate sector, TFP levels diverge over time so that by 2004 the level of TFP in the nonagricultural sector was 80 percent higher than that in the state sector. This huge gap in TFP levels supports the claim that high rates of capital accumulation in the state sector have been instrumental to maintaining high levels of output per worker.

Labor Market Barriers

There are many institutional and policy constraints that restrict movement of labor from agriculture. Although difficult to measure directly, they generally have the effect of depressing the returns to labor in agriculture relative to those in nonagriculture. Thus, the gap in returns to labor between agriculture and nonagriculture can be used as an implicit measure of the barriers to labor reallocation between the two sectors. We do not have direct data on the average returns to labor in the agricultural and nonagricultural sectors. However, we do have data on the average value product of labor (or nominal output per worker) for the two sectors. Under the assumption that labor shares of income are the same in the two sectors, the gap in the average value product of labor equals the gap in average returns to labor and therefore can be used as a measure of labor market barriers.

[14] We discuss briefly the calculation of TFP in Appendix A.

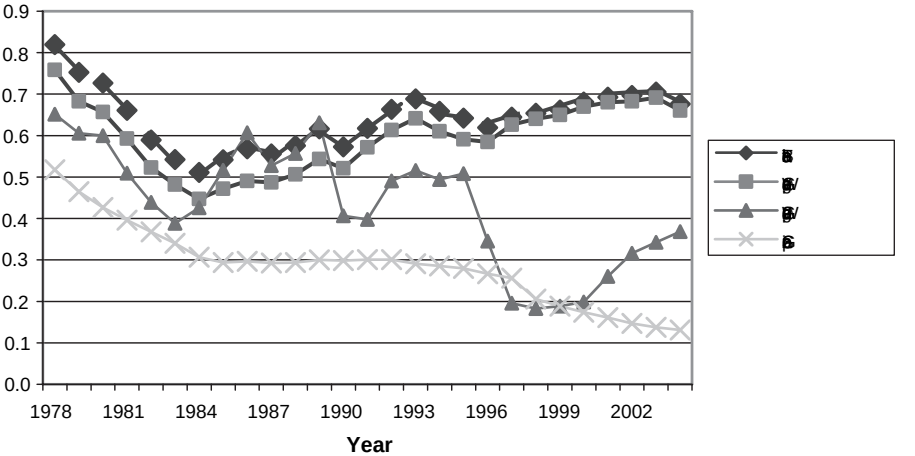

Figure 17.4. Labor market barriers (see text and Appendix B)

Figure 17.4 plots this measure of labor market barriers. Between 1978 and 1984, the gap in average returns to labor between agriculture and nonagriculture declined sharply, from 82 to 51 percent. Subsequently, the gap widened and in 2004, was equal to 68 percent. The gap in average returns to labor can be further decomposed into three sources: the wage gap between the agricultural and the nonstate nonagricultural sector (wage gap 1), the gap in wages between the nonstate and the state sector or the state sector's wage premium (wage gap 2), and the size of the state sector measured by the share of the state sector's share of nonagricultural employment (size gap). Figure 17.4 also plots these three components of barriers separately. While the first component behaves very similarly to the overall gap, the second and the third component decline steadily over time.

A SIMPLE DECOMPOSITION EXERCISE

Differences in the levels and rates of growth of labor productivity between sectors (see the section on "Labor Productivity Levels and Growth by Sectors and Periods") suggest that labor reallocation contributed to aggregate labor productivity growth. Many authors have investigated such possibilities using simple decompositions that begin by noting that aggregate labor productivity can be expressed as the weighted average of productivities in the two sectors:

$$y_t = y_{at} l_{at} + y_{nt}(1 - l_{at})$$

Here, y_t, y_{at}, and y_{nt} are labor productivities in the aggregate, agriculture, and nonagriculture, respectively, in year t, and l_{at} is agriculture's share of total employment in year t. Aggregate labor productivity growth, then, can be expressed as follows:

$$\mathrm{d}\ln y_t = [(y_{at} l_{at})/y_t]\mathrm{d}\ln y_{at} + [(y_{nt}(1 - l_{at})/y_t]\mathrm{d}\ln y_{nt} + [(y_{nt} - y_{at})/y_t]\mathrm{d}\, l_{at},$$

Table 17.2. *Growth rates of output per worker by sector*

	1978–2004	1978–1988	1988–2004
Aggregate	6.96	6.74	7.09
Agriculture	6.76	5.70	7.43
Nonagriculture	4.65	2.47	6.02
State owned	4.87	3.30	5.86
Nonstate owned	5.59	3.89	6.67
Simple growth decomposition: contribution of each source to growth			
Aggregate	100.00	100.00	100.00
Output per worker in agriculture	27.30	23.80	19.40
Output per worker in nonagriculture	48.10	26.40	69.20
Reallocation	24.60	49.90	11.40

Source: See text.

where d denotes the rate of change and ln represents logs. We decompose aggregate labor productivity growth into three sources: labor productivity growth in both sectors and labor reallocation. In the absence of labor movement between the two sectors, that is, with $dl_{at} = 0$, the growth rate of aggregate labor productivity simply equals the weighted average of the growth rates of labor productivity in the two sectors, with the weights equal to the respective GDP shares of the two sectors.

Table 17.2 uses this popular approach to decompose aggregate labor productivity growth into these three components.[15] For the entire period, growth in output per worker in agriculture and nonagriculture contributed 27.3 and 48.1 percent, respectively, to total labor productivity growth. Although output per worker in agriculture actually grew more rapidly during reform, its contribution to overall growth was dampened by the primary sector's relatively small size – slightly more than a quarter of GDP at the beginning of reform. These estimates imply that about a quarter of the growth in labor productivity, that is, 100 – 27.3 – 48.1, can be attributed to the reallocation of labor from agriculture to nonagriculture. Recall that over this period, the share of labor in the primary sector fell by more than half, from roughly 70 percent in 1978 to 32 percent in 2004.

Decompositions for the two subperiods, 1978–1988 and 1988–2004, reveal that the contribution of labor reallocation from agriculture to nonagriculture to overall growth occurred mainly near the start of China's reform process. During the first decade of reform, the transfer of labor to the higher-productivity nonagricultural

[15] See, for example, OECD (2005, p. 32), which performs similar calculations in the context of a three-sector model for 1983–2003. They find that a fifth or so of the overall growth was due to sectoral reallocations of labor and suggest that the contribution could have been even larger in light of differences in the marginal (as opposed to average) products of labor.

sector was the source of almost half (49.9 percent) of all growth, with productivity growth in the two sectors contributing equally to the remaining half. This behavior is in line with the timing of the reduction in agriculture's share of employment, a significant portion of which occurs very early in the reforms. By comparison, reallocation contributed only 11.4 percent to the growth since 1988. For the period since 1988, growth of labor productivity outside agriculture provides the largest contribution to overall GDP growth.

These simple decompositions tell us that reallocation across sectors is positively associated with growth, but we expect that the estimated magnitude of the reallocation effect resulting from this analysis is likely to be biased. There are two primary reasons for believing that this is the case.[16] First, the reallocation of labor may be a result of the growth in TFP in the two sectors. If that is the case, the decomposition may overestimate the role of the reallocation and underestimate the role of labor productivity growth within sectors.[17] Second, labor productivity growth within each of the two sectors will depend on labor reallocation. Because of diminishing returns, all else equal, the gap in productivities between the two sectors will narrow, as labor is reallocated from agriculture to nonagriculture. Simple decompositions ignore all these potentially important considerations surrounding intersectoral productivity and labor flows. They provide no more than an upper bound for the actual contribution of labor reallocation out of agriculture to overall growth during China's reform period.

To convincingly analyze the impact of labor reallocation on economic growth, we need a structural model that explicitly captures all the interactions between labor productivity and labor flows.[18]

A HEURISTIC MODEL OF STRUCTURAL TRANSFORMATION AND GROWTH

We begin by sketching a simple heuristic model of the traditional structural transformation that moves resources out of agriculture. Appendix B provides a more

[16] There is also a third potential bias. The decompositions implicitly assume that the "gaps" in average and marginal productivities of labor between sectors are the same. The returns to reallocation depend on differences in marginal productivity; however, the decompositions are based on information on averages. If the underlying production technology is Cobb–Douglas and labor shares in the two sectors are the same, the ratio of average and marginal productivity between sectors will be the same, but this does not hold true for other functional forms. It is an empirical matter as to how sensitive the returns to reallocation are to alternative assumptions about the underlying technology. Based on sensitivity analysis we carried out, this is not an important consideration here.

[17] This bias generally exists in standard growth accounting in which the contribution of capital accumulation is overestimated and that of TFP is underestimated.

[18] The problems of using these simple decomposition methods are also revealed in trying to estimate the returns to reallocation of labor between the state and nonstate sectors. At the beginning of reform, average labor productivity in the state sector was actually higher than that in the nonstate. This would imply negative returns to the reallocation. However, differences in TFP between the two sectors offset this.

formal treatment. In this section, we focus on the forces potentially driving the shift of labor out of agriculture. Subsequently, we disentangle the contribution of the reallocation, productivity growth, and capital formation to overall growth.

A Simple Two-Sector Model

Consider a simple two-sector, two-good economy, with three factors of production: labor, capital, and land. Food is produced in the agricultural sector and manufactured goods and services outside. Land is a "fixed" factor that is important for agriculture but less important elsewhere. In a frictionless world, resources flow to their highest valued uses, and returns are equalized on the margins.

Here, we focus on two important qualifications to this ideal outcome. Since land is a fixed factor, there are diminishing returns to labor in agriculture. This means that removing labor from agriculture increases the marginal productivity of the remaining farmworkers, which makes it unlikely that all workers will leave agriculture. Furthermore, since the two sectors produce different outputs, unless the demand for agricultural output vanishes, some resources must remain in agriculture to satisfy this demand, even if TFP in agriculture is very low.[19]

Previous studies of structural transformation during the development process identify four factors that may drive the reallocation of resources toward the nonagricultural sector: (1) increases in agricultural productivity that relax a subsistence food consumption constraint, (2) faster TFP growth in agriculture than in nonagriculture, (3) a reduction in barriers to labor mobility between sectors, and (4) increases in capital formation. We examine each in turn and then discuss their potential relevance in the Chinese context.

Subsistence Food Consumption Constraint and the Rise of Agricultural Productivity

Engel's law reminds us of a universal tendency for the proportion of income that is spent on food to decline as incomes rise. This means that the income elasticity of food demand is less than 1. A simple way to capture this relationship is to assume that each individual must consume a minimum amount of food. When income is low, expenditure is concentrated on satisfying this subsistence requirement, so that the share of food in total expenditure is high. As income rises, more income becomes available for consumption of other goods, and the share of food expenditure declines. The implication of this minimum food consumption constraint is that when agricultural labor productivity is low (and assuming a closed economy), a large amount of labor is needed in agricultural production to satisfy the subsistence food consumption demands. As agricultural productivity improves,

[19] For reasons explained later, we implicitly assume that the economy remains closed to international trade.

less labor will be needed for this purpose, thereby allowing the share of labor in agriculture to decline.[20]

Relative Productivity Growth in Agriculture

In a small open economy, world markets determine the relative price of the two goods. Since production levels in a small economy will not affect these prices, higher relative productivity growth in agriculture means higher returns to labor in agriculture and will attract more labor into farming. This "small economy" result is clearly inconsistent with the development experience of large advanced countries, such as the United States, in which differential productivity growth favoring agriculture has coincided with large outflows of labor from the farm sector, evidently because large increases in farm output exerted downward pressure on agricultural prices. As a result, most studies of structural transformation concentrate on closed economy models.

We follow this standard and confine ourselves to a no-trade, closed economy model.[21] This approach fits particularly well with the initial fifteen years of China's transition experience, when global market forces still played only a modest role in determining the domestic terms of exchange between farm and nonfarm products.

In a closed economy with no possibility for labor to move between sectors, faster productivity growth in agriculture has two effects: supply grows faster in that sector, which causes the relative price of agricultural goods to decline, and the decline in relative price will act to increase relative demand for agricultural goods.

If we now permit labor to move freely between sectors, the net effect of accelerated agricultural productivity growth on labor allocation depends on the elasticity of substitution between the two goods. If the elasticity of substitution between agricultural and nonagricultural goods is less than 1, the increase in the demand for agricultural goods will be less than the increase in supply. This will depress prices and wages in the farm sector and encourage labor to shift to the nonfarm sector. If the elasticity of substitution is greater than 1, the logic is reversed, so that labor will flow into, rather than out of, the farm sector. Finally, if the elasticity of substitution equals 1, the relative supply of and demand for agricultural goods increase at the

[20] The importance of this subsistence food consumption constraint was pointed out long ago by T.W. Schultz as *the food problem* and is an integral part of more recent models of structural transformation. See, for example, Caselli and Coleman (2001), Kongsamut, Rebelo, and Xie (2001), Hansen and Prescott (2002), Gollin, Parente and Rogerson (2003), Restuccia, Yang, and Zhu (forthcoming), Yang and Zhu (2004), Duarte and Restuccia (2006), and Hayashi and Prescott (2006).

[21] Clearly, food is not completely nontradable. The source of the inconsistency between the implications of the open economy model and the experience of countries such as the United States is beyond the scope of our chapter. As a matter of fact, food imports into China have been a relatively small percentage of domestic agricultural output.

same rate and there will be no reallocation due to the relative productivity growth in agriculture.[22]

Reduction in Labor Market Barriers and Distortions

Barriers and distortions in various forms tend to keep farmers from leaving the land. These may include restrictions on labor mobility or on the kinds of activities that are open to rural labor. Low levels of human capital in the primary sector may also constrain movement into the nonagricultural sector. An important effect of these barriers is to suppress the wages (or the marginal product of labor of households farming their own land) received by workers in agriculture and drive a wedge between the returns earned by laborers working in the two sectors. Thus, the gap in wages between agriculture and nonagriculture is an implicit indicator of the severity of barriers to labor mobility. A reduction in barriers will lead to a reduction in the share of employment in agriculture and convergence of wages in the two sectors.[23]

Increases in the Investment Rate

Capital formation is frequently ignored in this context, but deserves attention as a potentially important influence on the pace and extent of labor reallocation across sectors. Because capital is produced in the nonagricultural sector, an increase in the rate of fixed investment leads to an increase in the demand for nonagricultural goods, which raises the share of employment in the nonagricultural sector.

Driving Forces in the Chinese Context

Which of these forces seem likely to figure prominently in the analysis of Chinese labor mobility? Our analysis of aggregate data suggests that the elasticity of substitution between farm products and nonagricultural goods is close to unity, so we expect that labor allocation is unaffected by changes in relative prices and, therefore, by shifts in relative productivity growth. We therefore focus on the remaining items: subsistence food constraints, labor market barriers, and increases in the rate of fixed capital formation.

Binding Subsistence Constraints at the Beginning of Reform

In 1977, per capita grain availability in China was slightly more than 190 kilograms per capita. Piazza (1983) estimates that total per capita nutrient availability

[22] Ngai and Pissaridis (2007) have emphasized this source of labor reallocation. In the U.S. data, the relative productivity in agriculture has increased, while agriculture's share of labor has declined, which suggests that the elasticity of substitution is less than 1. Quantitatively, however, it is not clear how important this effect is in accounting for the labor reallocation.

[23] Recent studies that emphasize the importance of labor market barriers in labor allocation include Caselli and Coleman (2001), Restuccia, Yang, and Zhu (forthcoming), and Hayashi and Prescott (2006).

was 2,247 calories, 95 percent of which was from cereals and vegetables. Piazza places protein availability at 30.6 grams per day. These figures are 4.1 and 23.4 percent above estimated "safe" limits of energy and protein intake, with the margin on total energy intake especially low. These nationwide estimates ignore differences in per capita consumption between urban and rural China. They also ignore regional differences. Additional information on the rural–urban diet gap and the size of urban and rural populations implies that rural calorie adequacy in 1977 was 4 percent below safe levels. In fact, rural calorie consumption was below adequacy levels every year between 1959 and 1977 (Rawski, 2002), and during this period it was lower than consumption levels in the 1930s.

With nearly 70 percent of the labor force in agriculture, labor force participation rates just slightly below 50 percent in the late 1970s, and negative net exports, these levels of consumption, which Riskin (1987, p. 263) terms "spartan," clearly indicate the low level of labor productivity in pre-reform Chinese agriculture. On average, each farmworker produced enough food to support only 2.67 individuals, or even fewer if we convert the population into adult equivalents. Inadequate nutrition and low productivity that trapped most of the workforce in farming highlight the enormous costs of the weak incentives associated with collectivized agriculture, restrictions on rural marketing, unfavorable terms of trade for agriculture, and policies mandating local self-sufficiency in grain. These costs swamped any benefits from ongoing technological progress in agriculture (see Chapter 13 in this volume; Lardy, 1983). Without significant increases in agricultural productivity (or relaxation of constraints on food imports), low farm productivity forced most workers to cluster in the agricultural sector, imposing a low ceiling on the size of China's nonagricultural labor force and population. Indeed, between 1962 and 1977, the percentage of the Chinese population living in the cities failed to grow, holding steady at slightly more than 17 percent.

Barriers

Barriers impeding the movement of labor from agriculture were a pervasive feature of the China's pre-reform economy. These restraints helped to sustain higher returns to labor outside of agriculture. Prior to reform, tight restrictions limited the entry of rural workers into nonagricultural activities; their primary intent was to prevent the diversion of labor from collective agriculture (Lardy, 1983). Additional restrictions limited the sectors open to enterprises run by rural communes and production brigades. In principle, these enterprises were to serve agriculture and infrastructure investment (mainly, water-control projects) in their home localities. These limits were embedded in a broader system that severely isolated the countryside from the cities.

The early rural reforms began to relax some of these constraints on both households and enterprises. Self-employment in transport, crafts, and miscellaneous commercial activity, previously forbidden, expanded rapidly after 1978 (Riskin, 1987). Reforms allowed "specialized households" to enter a host of nonagricultural

activities under the principle of "*litu bulixiang*" (leave the land but not the township). At the same time, Central Committee pronouncements on rural development strategy in 1978 and 1984 encouraged fresh expansion of rural industry (Chen et. al., 1994). A relaxation of restrictions of state procurement of agricultural goods, for example, allowed rural factories to enter the business of processing farm products, formerly reserved for urban firms (Naughton, 1992).

More generally, the 1984 introduction of the dual-track pricing system for industrial goods allowed rural enterprises to gain access to key intermediate goods, raw materials, and goods. The share of all producer (agricultural) goods transacted through the market rose from 0 (6) percent in 1978 to 46 (58) percent in 1991. By 1993, these percentages increased to 86 and 83 percent, respectively.[24] The new availability of subcontracting relationships with urban state enterprises facilitated rapid expansion of rural enterprises, which also benefited from unprecedented opportunities to enter into markets not served by SOEs. Key emerging sectors among rural industry included building materials, machinery and metal fabrication, and textiles and apparel (Byrd and Gelb, 1990).

Despite these improvements, which particularly facilitated resource mobility within individual townships (formerly communes), long-standing barriers to mobility continued to obstruct the access of rural households to potential opportunities outside their home townships and contributed to gaps in nonagricultural wages between a burgeoning TVE sector and wages paid in urban-based SOEs. The *hukou* system continued to serve as a de facto internal passport system (Chan, forthcoming). It imposed control on the ability of individuals and households to move between cities, but especially between rural and urban areas, by severely limiting access to housing, education, and other important social services for migrants. These restrictions, combined with preferential government policies supporting workers in the state sector, helped to sustain a gap in wages between the state and nonstate sectors.

A number of forces, however, helped to facilitate more informal labor flows. In the mid-1980s, for example, localities began to issue migration employment registration cards, which facilitated and probably lowered the costs of obtaining administrative permission for out-migration. Beginning in the late 1990s, smaller cities and towns began to facilitate permanent settlement by individuals and households arriving from rural villages.

Efforts to measure the volume of migration must contend with alternative definitions based on final destination, duration, as well as the presence or absence of change in *hukou* status (Chan, forthcoming). *Hukou* migration (i.e., the migrant is officially registered as a resident of the destination community), which can include rural–urban, rural–rural, urban–rural, as well as urban–urban, measured as a flow, has remained relatively constant in the last twenty to twenty-five years at slightly less than 20 million per year. Informal migration is much harder to measure. There

[24] See OECD (2005, p. 29).

are estimates based on a number of alternative definitions typically tied to lengths of stay, for example, three days versus six months. This migration includes rural–urban, as well as the other three kinds of migration.

Despite these complications, which interject significant uncertainty into our estimates, we observe several noteworthy trends. The period from the early 1980s to mid-1990s witnessed a significant increase in informal migration, followed by a leveling off in the last half of the 1990s and a further increase after 2000.[25] The rural–urban migration flow totals as much as 100 million. The proportion of migrants moving across county and provincial boundaries has risen during the past decade, creating a very different picture from earlier periods, in which migrants typically moved to cities within their home county or province (see de Brauw et al., 2002; Chan, forthcoming). Coastal provinces, especially Guangdong, have become the largest recipients of these long-distance migratory flows, with the largest labor flows originating in the central provinces (see Chapter 19, Figure 19.3, showing the thirty largest migratory flows).

Investment Rates

Between 1978 and 2004 fixed investment as a percentage of GDP increased from 23 to 45 percent. With most capital goods produced domestically, this rise in the investment rate increases the demand for labor in manufacturing and therefore contributes to the rise of nonagriculture's share of total employment.

ACCOUNTING FOR LABOR REALLOCATION FROM AGRICULTURE TO NONAGRICULTURE

We now evaluate the quantitative importance of the three factors underpinning the shift of labor out of agriculture: TFP growth in agriculture, a reduction in labor market barriers/distortions, and increases in the rate of fixed investment. To do this, we begin with our calibrated dynamic model that, as explained in Appendix B, produces results that closely track the historical statistics of labor reallocation. We then conduct a series of counterfactual exercises, each of which removes one of the factors driving labor reallocation. In each case, the difference between observed labor reallocation and the (smaller) result arising from the corresponding counterfactual trial becomes our measure of that particular factor's contribution to observed reallocation of labor.[26] Table 17.3 summarizes the results of these calculations. Figure 17.5 provides additional detail by tracking the trajectory for the share of labor in agriculture under the alternative scenarios.

[25] The tightening restrictions in the late 1990s appear related to a slowdown in growth accompanying the Asian Financial Crisis and accelerated SOE layoffs. Beijing is a good example of these kinds of policies, as are a number of northeastern cities (Chan, forthcoming).

[26] Since the three factors influence the labor reallocation nonlinearly, their effect on reallocation may not be independent of each other. Thus, the contributions of the three factors do not necessarily add up to the actual total reallocation.

Table 17.3. *Driving forces of labor reallocation*

	Labor reallocation reduction of share in agriculture (L_a/L)	
	1978–2004	1978–1988
Data	38	24
Benchmark model	38	28
Counterfactuals:		
No TFP growth in agriculture	10	13
No reduction in barriers	25	10
No reduction in agricultural nonstate barriers	30	13
No reduction in state employment share	35	26
No reduction in state wage premium	37	27
No TFP growth in NSOEs	38	28
No TFP growth in SOEs	38	28
No reallocation between agriculture and nonagriculture	0	0
No reallocation at all	0	0
No increase in saving rate	30	24

Source: See text. Values are in percent.

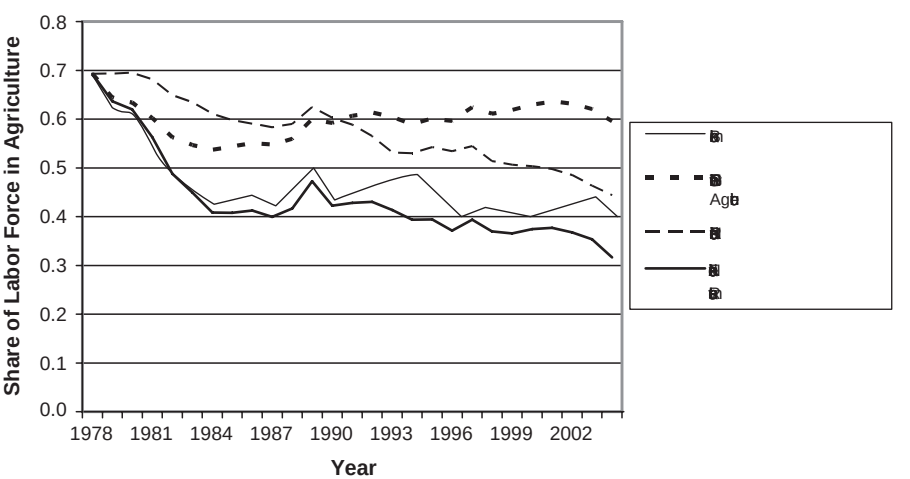

Figure 17.5. Driving forces of labor reallocation (see text)

TFP Growth in Agriculture

Our historic data show that agriculture's share of total employment fell from 69.3 percent in 1978 to 31.8 percent in 2004, a reduction of nearly 38 percentage points. How much of this decline can we attribute to rising agricultural TFP and its role in relaxing a binding subsistence food constraint? To estimate this magnitude,

we conduct a trial of our model with the added specification of no change in agricultural TFP throughout 1978–2004. Under the assumption of zero TFP growth in agriculture, the farm sector's terminal employment share in 2004 stands at 59 percent, only 10 percentage points below the 1978 figure. We conclude that growth of TFP in agriculture was responsible for a reduction of 28 (38 − 10) percentage points in agriculture's overall employment share between 1978 and 2004. This implies that by relaxing a binding food constraint facing the economy, TFP growth in agriculture allowed slightly more than a quarter of China's entire labor force to leave the land in search of nonfarm employment. This result pinpoints improvements in agricultural productivity as the most important driver of the transfer of labor out of agriculture. Our calculations attribute $100 \times 28/38$ or 73.6 percent of the historic decline in agriculture's labor force share during 1978–2004 to the growth of TFP in agriculture.

Reduction in Labor Market Barriers

Our second-trial calculation begins with the assumption that barriers to labor mobility remained at their original 1978 level throughout the period of analysis. When we run a version of our model that eliminates the relaxation of restrictions on nonfarm employment opportunities for rural workers, the terminal employment share of agriculture in 2004 comes to 44 percent (as opposed to the actual share of 31 percent). These results allow us to attribute roughly one-third (13/38) of the total reduction in agriculture's employment share to the relaxation of barriers to the mobility of rural labor.

Most of this contribution occurred fairly early in the reform process. Between 1978 and 1988, agriculture's actual employment share decreased from 69 to 45 percent. In our simulation that excludes the effects of reduced barriers in facilitating movement of labor off the land, the 1988 share would have been 59 percent, or nearly a third higher. This implies that the reduction in barriers was the source of more than half (14/24) of the total reduction in agriculture's employment share during the first ten years of reform. By comparison, TFP growth in agriculture contributed 11 percent of the 24 percent total reduction in agriculture's labor share during the same decade.

As we discussed in the section "Driving Forces in the Chinese Context," these barriers limited the ability of rural labor to enter a host of "local" nonagricultural activities, for example, family run business, TVEs, and so on, as well as restricting movement from village to city and between the state and nonstate components of the nonfarm sector. In our modeling and empirical work, we capture these barriers through three components: the wage premium enjoyed by workers in the state sector, the size of the state sector (as measured by its share of nonagricultural employment), and the wage gap between agriculture and the nonstate sector.

The results of multiple simulations with our dynamic model show that reduction in the last component of these barriers, the wage gap between farmwork and nonfarm employment outside the state sector, provided the largest spur to the reallocation between agriculture and nonagriculture. The impact of the other two

components on the speed of the transfer of labor out of agriculture is relatively small. This highlights the important role that relaxation on restrictions on household nonagricultural activity, entry by township and village-level firms, and so on, had in increasing *local* nonagricultural opportunities for rural labor, as opposed to those that could be accessed only through migration to the cities and whose growth was impeded by preferential policies favoring state-sector workers.

Increases in the Rate of Fixed Investment

Like other East Asian economies at comparable development stages, China's ratio of fixed investment to GDP increased significantly between 1978 and 2004. In 1978, the fixed investment rate was a modest 23 percent. By 2004, it has almost doubled to 44 percent. This rise in investment raised the demand for capital goods, which come mostly from the nonagricultural sector. (The actual share of imports is surprisingly small.) As a result, rising investment rates increased the nonagricultural sector's share of total employment. As before, we can estimate the magnitude of this effect using a version of our dynamic model, in which the ratio of investment to GDP is arbitrarily fixed at 23 percent throughout the period 1978–2004. The outcome shows that with no rise in the investment rate, agriculture's employment share in 2004 would have been modestly higher, namely, 39 percent compared to the 31 percent we observe in the data.

In summary, three factors, TFP growth in agriculture, a reduction in labor market barriers, and the increase in the investment rate, have contributed to the reallocation of labor from agriculture to nonagriculture. If we focus on the entire post-1978 period, the TFP growth in agriculture is clearly the most important factor. In absolute terms, its contribution was more than two times larger than that arising from the reduction in barriers, and three and a half times larger than the increase in investment proportions. However, during the critical first decade of reforms, the reduction in local barriers to labor mobility played the largest role.

GROWTH ACCOUNTING

Growth accounting is a popular form of analysis that seeks to attribute changes in output or productivity to particular "sources of growth." The objective is to decompose the overall outcome into a series of "contributions." Here, we use our three-sector framework, which includes the agricultural, the state, and nonstate sectors, to investigate changes in nationwide or aggregate labor productivity growth, which can come from three sources[27]:

- TFP growth within each of the three sectors,
- capital accumulation, and
- intersectoral reallocation of labor and capital from low-TFP sectors to high-TFP sectors.

[27] Because we are analyzing contributions to labor productivity (output per worker), there is no need to account separately for the growth of the labor force.

The first two are standard items that are emphasized in many studies of growth accounting. In the Chinese case, the presence of substantial structural transformation and the large cross-sector differences in TFP demands careful attention to the third possible source of aggregate growth in labor productivity: more efficient allocation of labor and capital across sectors, agriculture versus nonagriculture, and state versus nonstate. In particular, we will investigate the extent to which reductions in barriers have contributed to more efficient resource allocation across sectors and, therefore, to economywide increases in aggregate TFP in the economy and in output per worker. As we have emphasized throughout, we must consider two types of barriers: obstacles to reallocation of resources between agriculture and nonagriculture and also within nonagriculture, between the state and the nonstate sectors.

From a growth perspective, it is important to see how the latter barriers may impact the economy. As market competition intensified, many (but by no means all) state enterprises emerged as weak players. In a pure market system, competition would force the exit of such firms through bankruptcy, closure, or acquisition by stronger rivals. Rather than allowing market forces to inflict such outcomes on SOEs, the Chinese government first offered cash subsidies to troubled state enterprises and then used its control over the state-dominated banking system to direct "soft" loans to such firms ("soft" meaning that the borrowers would not qualify for such loans under normal commercial criteria). These credit flows allowed SOE beneficiaries to sustain employment and wages at levels higher than firm-level productivity and profitability would have independently supported.

This arrangement links labor market distortions (SOEs employ more workers and maintain higher wage scales than would occur under normal market conditions) to distortions in the credit market (the state sector receives more loans – leaving fewer loans available to other sectors – than would occur under normal market conditions). Without government support via the banks, wages, employment, and the number of firms in the state sector would all have declined. Directing credit to floundering SOEs affected the economy's overall rate of growth in two important ways. Favoritism toward weak SOEs in the allocation of capital denied capital to stronger firms that could have put the funds to better use, resulting in a reduction of overall growth. Furthermore, this reduction in growth lowered the supply of saving available to fund future investments, inflicting damage on future as well as current growth prospects.

Once again, we construct specially modified versions of our dynamic model to simulate the quantitative contribution of each of these factors: as before, we estimate the contribution of each prospective source of growth by eliminating its influence from the model and then comparing the resulting outcome with the actual historical series. For example, to investigate how much TFP growth in the agricultural sector contributed to overall growth, we conduct a counterfactual experiment that imposes constant agricultural TFP throughout 1978–2004 and then let our model determine the path and rate of growth of aggregate labor productivity. We then take the difference between this hypothetical growth rate

Table 17.4. *Historical and counterfactual estimates of average annual labor productivity growth*

	Labor productivity growth				
	Agriculture	NSOEs	SOEs	Nonagriculture	Aggregate
Data and counterfactuals for 1978–2004					
Historical data	6.76	5.59	4.87	4.65	6.96
Benchmark model	6.77	5.48	4.76	4.54	6.84
Counterfactuals:					
No TFP growth in agriculture	−0.62	6.50	5.78	5.57	5.51
No reduction in barriers	6.12	2.49	2.49	2.49	4.67
No reduction in agricultural nonstate barriers	6.38	5.37	4.65	4.44	6.44
No reduction in state employment share	6.62	3.41	2.69	2.97	5.42
No reduction in state wage premium	6.73	4.83	4.83	4.03	6.37
No TFP growth in NSOEs	6.77	n.a.	0.96	0.96	4.13
No TFP growth in SOEs	6.77	3.98	3.26	3.04	5.57
No reallocation between agriculture and nonagriculture	5.27	7.12	6.40	6.19	5.94
No reallocation at all	5.27	4.92	4.20	4.48	4.72
No increase in saving rate	5.70	4.52	3.80	3.58	5.70
Labor productivity growth					
Data and counterfactuals for 1978–1988					
Historical data	5.52	3.89	3.30	2.29	6.56
Benchmark model	6.13	3.21	2.62	1.81	6.62
Counterfactuals:					
No TFP growth in agriculture	−0.35	4.72	4.14	3.33	4.99
No reduction in barriers	4.39	0.16	0.16	0.16	2.97
No reduction in agricultural nonstate barriers	4.64	3.82	3.23	2.43	5.11
No reduction in state employment share	5.90	−0.24	−0.83	−0.61	4.42
No reduction in state wage premium	6.07	2.97	2.97	1.81	6.57
No TFP growth in NSOEs	6.13	n.a.	−3.22	−3.22	2.88
No reallocation between two sectors	3.58	6.82	6.24	5.43	5.93
No reallocation at all	3.58	3.08	2.49	2.71	2.97
No increase in saving rate	5.93	2.86	2.28	1.47	5.93

Note: Values are in percent.

Source: See text.

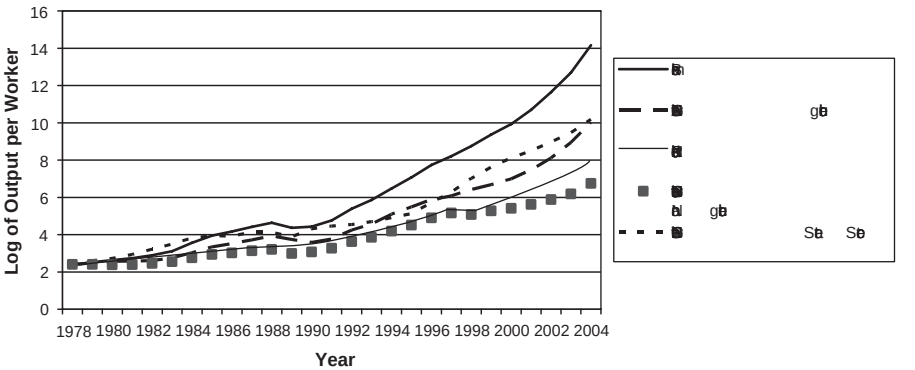

Figure 17.6. Sources of growth (see text)

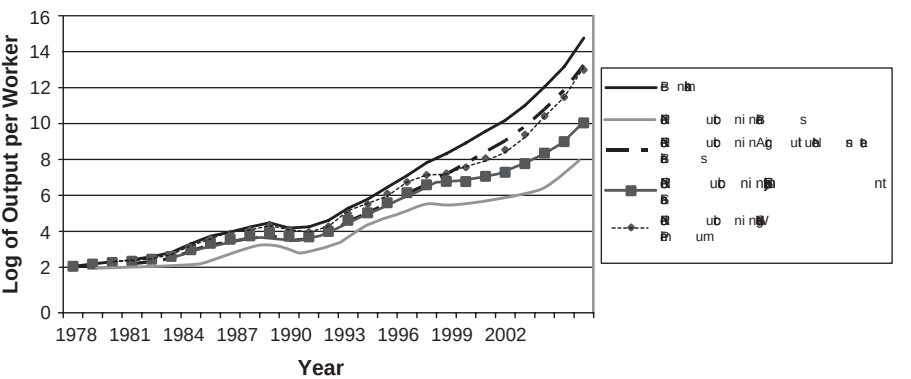

Figure 17.7. Role of barriers (see text)

and the actual rate as our estimate of the contribution of the change in agricultural TFP to overall growth. Table 17.4 provides the results from these counterfactuals. Figures 17.6 and 17.7 add further detail by showing graphic representations of the trajectory of the most important counterfactuals over the entire period of analysis.

TFP Growth in Agriculture

We are interested in the effect of agricultural TFP growth on output per worker both in agriculture and in the entire economy. In agriculture, where land is essentially fixed and the quantity of capital remains modest, the impact of TFP growth on labor productivity in agriculture is enormous: without it, labor productivity in agriculture would have actually declined at an annual rate of −0.62 percent, compared to the 6.76 percent annual growth that we observe in the data. TFP growth in farming also contributed to the reallocation of labor out of agriculture.

However, the total contribution of TFP growth in agriculture to aggregate labor productivity – including the direct effect through labor productivity growth within agriculture and indirect effect through reallocation of labor – is relatively modest. Assuming no TFP growth in agriculture, aggregate labor productivity would have still grown at a robust rate of 5.51, implying that the contribution of TFP growth in agriculture is about 1.45 percentage points, that is, 6.96–5.51, or slightly more than 20 percent of the growth in labor productivity between 1978 and 2004. An important reason for this modest contribution is that agriculture's share of GDP was already below 30 percent in 1978. By 2004, it fell to half of this. As a result, growth in that sector exercised only weak influence on the path of economywide labor productivity.[28]

TFP Growth in the Nonstate Sector

Employment in the nonstate sector grew by nearly 400 million, and its share of total employment jumped from 14.8 to 59.3 percent between 1978 and 2004. Despite this rapid increase, labor productivity grew at an impressive 5.48 percent annual rate. Because the nonstate sector has limited access to capital, labor productivity and TFP, which shows annual growth of 4.33 percent during 1978–2004, are closely linked. We conduct two counterfactual exercises to help quantify the importance of TFP growth in the nonstate sector to aggregate output growth.

First, suppose that there had been no TFP growth in the nonstate sector, but that employment in the sector had experienced the same growth as we observe in the data. In this case, the rapid increase in employment would drive labor productivity growth rates below zero for both the nonstate sector and the nonagricultural sector as a whole. It also implies a much lower aggregate labor productivity growth rate of 2.91 percent.

Alternatively, Figure 17.3 shows that at the beginning of the reform, the level of TFP in the nonstate sector was slightly lower than that in the state sector. Without

[28] There is an important caveat to our analysis here: aggregate labor productivity growth does not necessarily capture the true improvement in average living standards or welfare. Given the importance of subsistence demand for the agricultural good, growth of agricultural output has a much larger impact on the household's welfare. Without TFP growth in agriculture, the relative price of food would have increased dramatically, significantly increasing the cost of living and, as a result, households' welfare would have grown much slower. The aggregate labor productivity that we calculated is based on a measure of real GDP that uses the initial relative price as the weight for agriculture and therefore does not capture this price and welfare effect. A better measure would be GDP measured using a chain-weighted index, which captures the change in relative prices. The GDP growth rate measured this way is 6.77 percent per annum, only modestly less than the 6.96 percent per annum obtained using fixed weights. The actual growth rate is not affected much by the difference in the method of aggregation, because the relative price of agricultural goods has not changed much during the period. For the counterfactual, however, there is a large difference. When measured using the chain-weighted index rather than the fixed-weight index, the growth rate of aggregate GDP per worker is 3.95 percent. In other words, TFP growth has been the source of 2.82 percentage points of the growth in average living standard, or 40.5 percent of the total growth.

the TFP growth in the nonstate sector, an efficiency-enhancing growth path would channel all workers moving out of agriculture into the state sector. This would have reduced the nonagricultural sector's labor productivity growth rate to only 0.96 percent and aggregate labor productivity growth to 4.13 percent. In other words, without a nonstate sector with rapidly rising TFP to absorb the growth of nonagricultural employment, the annual growth of aggregate labor productivity in the economy would have been cut by 2.83 percentage points, or 40 percent.

TFP Growth in the State Sector

Consistent with extensive empirical work on the experience in industry (Groves, Hong, McMillan, and Naughton, 1994; Jefferson and Rawski, 1994), we find only modest growth of TFP in the state sector. Although it is significantly lower than that in the nonstate sector, this growth in TFP is moderately important. If TFP in the state sector had not grown, the drag of the state sector on overall growth would have been even larger, as state enterprises would have absorbed an even larger portion of China's capital formation to maintain their employment and wage premiums. Overall, stagnation of state-sector TFP would have reduced nonagricultural labor productivity growth to 3.04 percent and pushed aggregate labor productivity growth down to 5.57 percent, a reduction of roughly one-sixth.

The Role of Capital Accumulation and Increases in the Rate of Fixed Investment

As a result of the reallocation of labor from agriculture to nonagriculture and general increases in total employment, employment in the nonagricultural sector grew rapidly. Although the investment rate has generally moved upward, the increased rate of capital accumulation did not catch up with the rapid employment growth in the nonagricultural sector until the last ten years or so. Before 1995, the capital–labor ratio in the nonfarm sector actually remained below its 1978 level, as nonfarm employment grew faster than the corresponding capital stock. So, capital accumulation played a relatively minor role in the first sixteen years. In the last decade, however, the rate of investment increased dramatically, which led to a doubling in the capital–labor ratio in the nonagricultural sector.

To quantify the impact of this increase in the capital–labor ratio arising from an increase of the rate of investment, we conduct a counterfactual experiment that assumes that investment remained at 23 percent of GDP throughout the twenty-six–year period. For the first fifteen years, the growth rate in labor productivity would have been lowered slightly, falling from 5.97 to 5.21 percent. In the last ten years, however, the growth rate would have been reduced significantly from 7.84 to 6.18 percent.

The Reallocation of Labor from Agriculture to Nonagriculture

As we have seen, three factors influenced the reallocation of labor from agriculture: TFP growth in agriculture, a reduction in labor market barriers and distortions,

and increases in investment. In addition to promoting labor reallocation, each of these factors also has a direct effect on growth. To isolate the pure impact of labor reallocation from agriculture to nonagriculture, we design a counterfactual exercise with the following characteristics: we retain the historical measures of investment rates and of TFP in all sectors. We also retain historic measures of two components of the barriers to labor mobility: the intersector wage differentials and the division of nonfarm employment between state and nonstate enterprises. Recognizing that higher wages in the nonagricultural sector will limit the demand for labor, we raise these wages to a level that pushes the absorption of village migrants into nonagricultural employment to zero. This arrangement simulates the consequences of eliminating the reallocation of labor between agriculture and nonagriculture. Note that this component of the barrier affects growth only through its impact on labor reallocation and has no other direct effect. So the reduction in growth that results can be viewed as the contribution of labor reallocation between agriculture and nonagriculture.

In this counterfactual exercise, the growth rate of agricultural labor productivity falls to 5.27 percent compared to 6.76 percent, leaving agriculture to absorb more labor under conditions of sharply diminishing returns (i.e., adding more workers to the farm sector depresses labor productivity). The absence of labor inflows from the farm sector would actually increase the growth rate of labor productivity in the nonagricultural sector from 4.54 to 6.19 percent. There is a third effect related to the elimination of labor reallocation: economywide average labor productivity is now lower because a larger percentage of employment is allocated to the sector with lower productivity.

Taking these three effects into account, eliminating the transfer of labor across sectors would reduce the annual growth rate of aggregate labor productivity from 6.96 to 5.94 percent, a modest reduction of 1.02 percentage points per year. So, this experiment with our dynamic model shows that the reallocation of labor from agriculture to nonagriculture had three impacts on growth: higher labor productivity growth in agriculture, lower labor productivity growth in nonagriculture, and more efficient labor allocation across sectors. Overall, they translate into an increase of 1.02 percentage points in the growth rate of aggregate labor productivity.

The contribution of labor reallocation to growth obtained from counterfactual simulations based on our dynamic three-sector model is significantly less than the estimate from the "naïve" simple decomposition we carried out earlier. The difference points to the shortcomings of the simple decomposition approach and the need to consider both the role of TFP growth and the general equilibrium effects. The difference is even larger for the first ten years of the reform, when nearly half of the transfer occurred. Our counterfactual simulations suggest that contribution of labor reallocation to overall labor productivity growth is 1.63 percentage points, while the simple decomposition implies a contribution that is two times as large, 3.36 percentage points.

The Reallocation of Labor from the State to the Nonstate Sector

To quantify the contribution of the second structural transformation, that is, the reallocation of labor from the state to the nonstate sector, we do a counterfactual simulation that is identical to the one we described earlier, but with one difference: we let the state sector's share of nonagricultural employment to remain at its 1978 level. Thus, in this simulation, employment in all three sectors grows at the same rate and there is no labor reallocation across sectors. In other words, this is a counterfactual simulation under the assumption that there is no structural transformation. Under this scenario, growth of aggregate labor productivity falls to 4.72 percent a year, or 2.24 percentage points lower than the 6.96 percent growth rate observed in the data. Recall that the first structural transformation, namely, the reallocation of labor from agriculture to nonagriculture, contributed 1.02 percentage points to growth. Thus, this counterfactual simulation implies that the contribution of the second structural transformation is 1.22 percentage points (2.24 – 1.02). Combined, the two structural transformations are responsible for close to one-third of overall growth (2.24 out 6.96).

Reduction in Barriers to Intersectoral Resource Mobility

Systematic barriers to the intersectoral movement of labor and capital constitute an important aspect of China's economic structure during the reform era. There are three components of barriers that we can measure either explicitly or implicitly: the wedge in wages between the agricultural and the nonstate sectors, the state sector's wage premium, and the state sector's share of nonagricultural employment. We examine the impact of each of these three components separately later.

The Wedge between Agricultural and Nonstate Nonagricultural Wages. This component of the barriers affects growth through labor reallocation between the agricultural and the nonstate sector. Much of this reallocation is associated with the growth of TVEs and nonagricultural sidelines in the countryside. If the gap in wages had remained at the same level as in 1978, agriculture's share of total employment would have fallen by 30 percentage points (from 69 to 39 percent) rather than 38 percentage points. The growth impact of this reduction in labor reallocation, however, is fairly small: with the wage gap held constant at the 1978 level, labor productivity growth in the agricultural and nonagricultural sectors would be 6.38 percent and 4.44 percent, respectively, during 1978–2004. The aggregate labor productivity growth rate would be 6.44 percent, only one-half percent lower than the actual growth rate.

The Reduction in the State Sector's Wage Premium. Within the nonfarm sector, state-sector workers receive higher wages than workers outside the state sector; as shown earlier in Figure 17.4, this premium declined. Without this reduction in the wage premium paid to state-sector workers, more capital would have been needed to

support the state sector, implying even less capital for the nonstate sector. However, the quantitative effect is not large. A counterfactual experiment in which the wage premium paid to state-sector workers remains fixed at the 1978 level throughout the entire period of analysis would reduce the rate of labor productivity growth in nonagriculture from 4.54 to 4.03 percent and the aggregate labor productivity growth rate from 6.96 to 6.37 percent.

The Reduction in the State Sector's Share of Nonagricultural Employment. Because of the low TFP levels in the state sector, maintaining a large share of employment in the sector becomes very costly. The state sector requires a large injection of capital into its inefficient operations to raise the marginal productivity of labor sufficiently to support the high wages paid to state-sector workers. The higher the state sector's employment share, the more capital it absorbs and the less capital is available for the much more efficient nonstate sector. As a result, raising the share of state-sector employment reduces the growth of the nonagricultural sector. Furthermore, slower growth in the nonagricultural sector would also decrease the growth of aggregate income, thereby reducing the future rate of capital accumulation and economywide growth. Quantitatively, the reduction in the state sector's share of nonagricultural employment is significant. If the share had remained constant, the overall growth rate would have fallen from 6.96 to 5.42 percent.

REGIONAL VARIATIONS

Between 1978 and 2004, we observe significant differences across provinces in the growth rates of labor productivity. Our analysis in the section "Growth Accounting" highlights the important role at the national level played by the relaxation of barriers that allowed labor and other resources to move more freely from the state to the nonstate sector. In this environment of gradual reduction in mobility barriers, differences in the size of the state sector exert direct and indirect effects on the trajectory of provincial economies. In the following discussion, we use detailed time-series data on ten provinces to demonstrate the important contribution of these differences to the heterogeneity of province-level economic performance since 1978.

In Figure 17.8, we graph the relationship between the size of the state sector at the beginning of the reform and the rate of growth of provincial aggregate labor productivity between 1978 and 2004. The size of the state sector here is captured by its share of nonagricultural employment. For consistency reasons, we limit ourselves to the ten provinces for which we have alternative data on the size of the labor force in agriculture (see the section "Some Basic Facts"). The provinces are highly representative geographically. The mean rate of growth of provincial aggregate labor productivity over the twenty-six–year period was 6.86 percent, but the difference in the rate of growth between the fastest and slowest growing provinces was on the order of 2:1. We observe a similar spread with respect to the

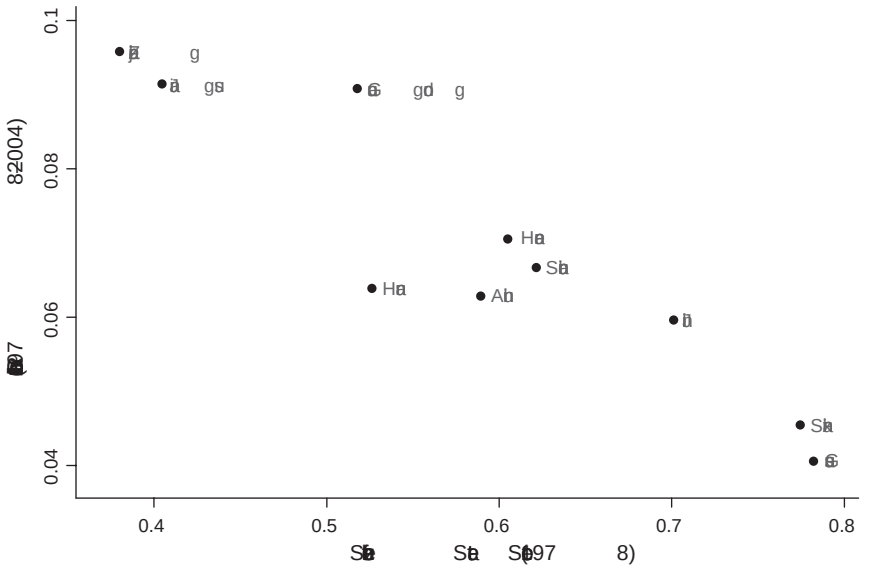

Figure 17.8. Growth of labor productivity versus size of the state sector

size of the state sector in 1978. The relationship between the rate of growth and the initial size of the state sector is clearly negative.

In our modeling and empirical work, the size of the state sector affects growth directly through its influence on credit allocation. Because of the lower rate of growth of TFP in the state sector, higher rates of capital accumulation are required to maintain a commitment to jobs and higher wages in the sector. Since the late 1970s, China's financial institutions have been the primary conduit through which needed funds reach the state sector. Applying the same logic across provinces, and assuming persistence in the size of the state sector (which the data justify), we expect the initial size of the state sector to be positively associated with the severity of the distortions in credit allocation and fixed investment over the entire period.

Figure 17.9, which shows the relationship between the size of the state sector in 1978 and the share of fixed investment going to the state sector between 1978 and 1994, is highly suggestive: the relationship is clearly positive. Over this sixteen-year period, provinces that began the reforms with larger state sectors directed a much higher percentage of fixed investment to the state sector than provinces that began with smaller state sectors. The simple ordinary least squares regression shows that a 10 percentage point increase in the initial share of the state sector is associated with a nearly equal (9.3 percentage point) increase in the share of fixed capital going to the sector over this sixteen-year period. The same relationship holds true over the entire period 1978–2004, although in 2004 the link between the state sector's initial size and the subsequent investment share is weaker (see Figure 17.10).

Distortions in credit allocation provide a direct link between the size of the state sector and the growth in the nonagricultural sector (see Figure 17.11). In all

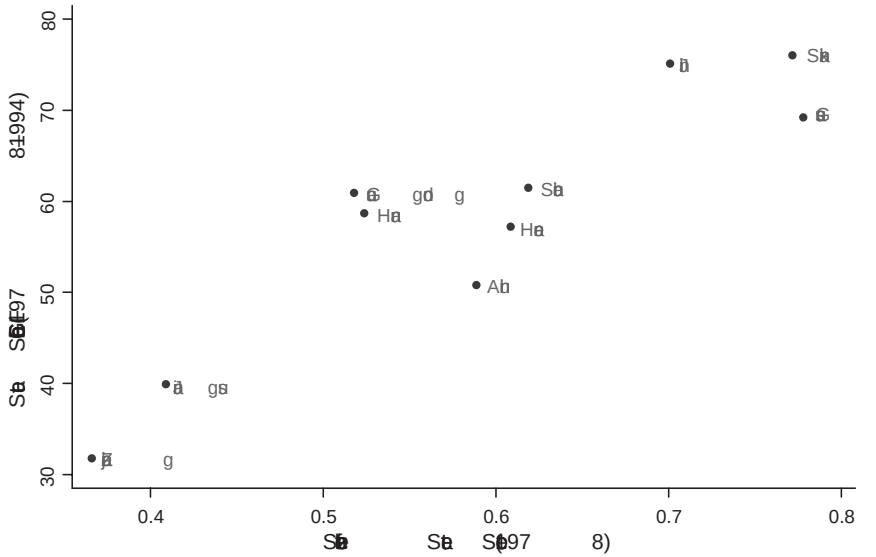

Figure 17.9. State share GFCF, 1978–1994 vs. size of the state sector in 1978

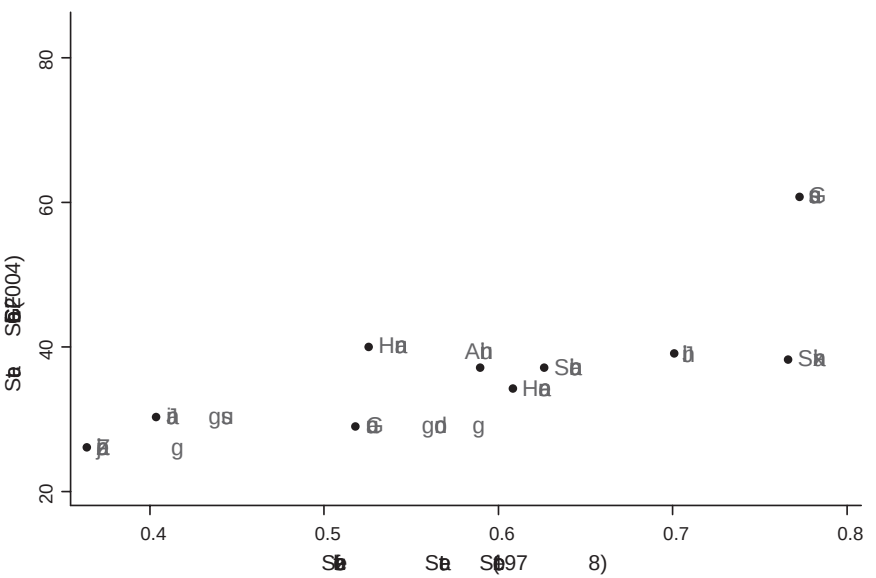

Figure 17.10. State share GFCF, 2004 versus size of the state sector in 2004

likelihood, the effect of the state sector was much more pervasive and operated through more channels than those specified in our modeling. For example, our 1997 interviews with local officials in Jilin and Jiangsu confirm the expectation that provinces with larger state sectors may have acted to protect state-sector interests, by emphasizing restrictive policies that limited nonstate firms in areas such as rights

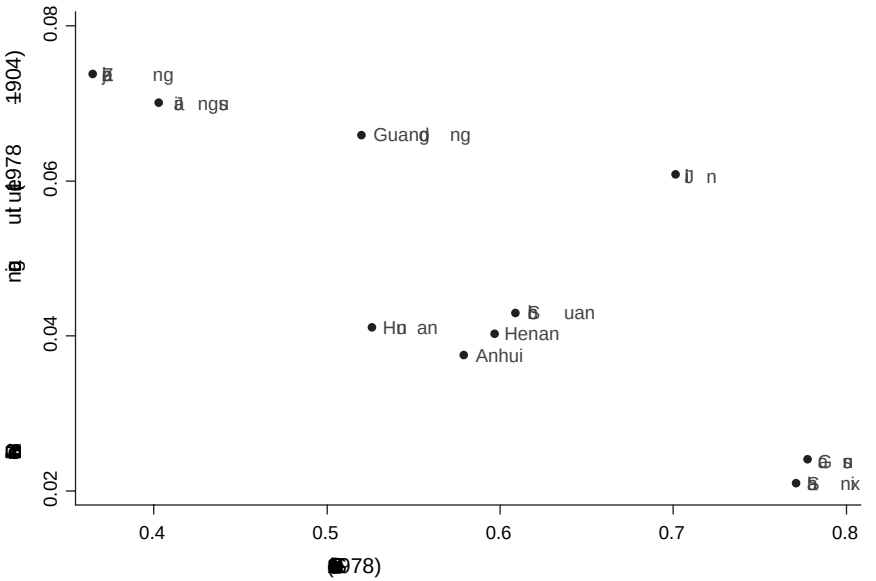

Figure 17.11. Nonagricultural growth versus size of state sector

of entry and access to land, raw materials, and intermediate goods. Such behavior could have reduced TFP growth in the nonstate sector, thus reinforcing the negative relationship between the size of the state sector and the growth in aggregate labor productivity. Weaker competition from local nonstate firms or higher barriers on goods from other provinces may have similarly reduced TFP in state firms.

Efforts to protect the state sector appear to have limited inflows of foreign investment. Working with provincial data, both Branstetter and Feenstra (2002) and Amiti and Jovorcik (2005) find a negative correlation between the level of foreign direct investment and the size of the state sector, which they attribute to local protectionist policies in support of state firms.

The same provincial data confirm our expectation that provinces with relatively large state sectors at the start of reform are likely to experience relatively slow growth of labor productivity in agriculture as well as relatively slow reallocation of labor between agriculture and nonagriculture. Higher initial barriers to mobility in provinces with larger state sectors would clearly slow the pace of labor transfer. Although we lack detailed information on the intensity of migration restrictions in different areas during the late 1970s, we do know that later in the reform process, municipalities and provinces with large state sectors (e.g., Beijing, Liaoning, and Jilin) imposed tighter restrictions on urban opportunities for migrant labor than other regions. Figures 17.12 and 17.13 graph the relationship between the initial size of the state sector and the rate of growth of labor productivity in agriculture (Figure 17.12) and the speed of transfer of labor out of agriculture (Figure 17.13). Both relationships are strongly negative, which helps to identify the

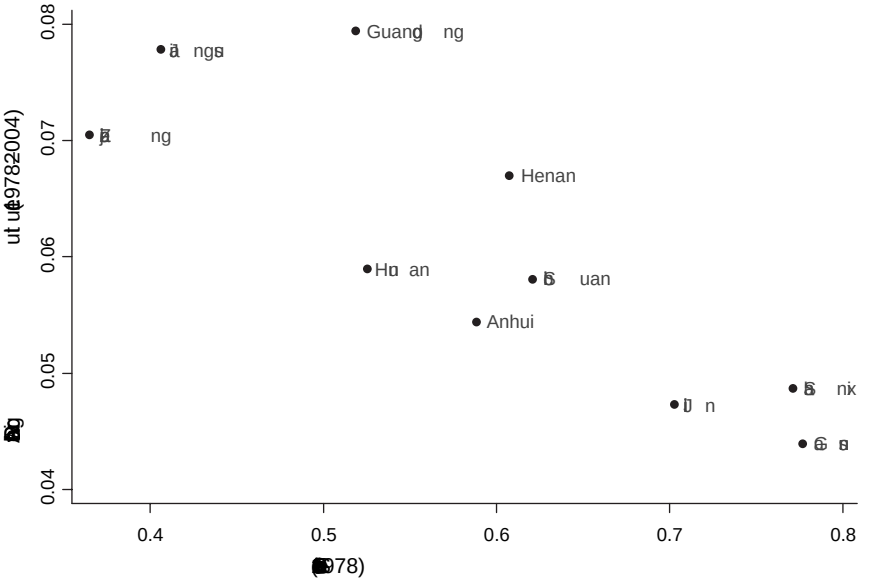

Figure 17.12. Agricultural growth versus size of state sector

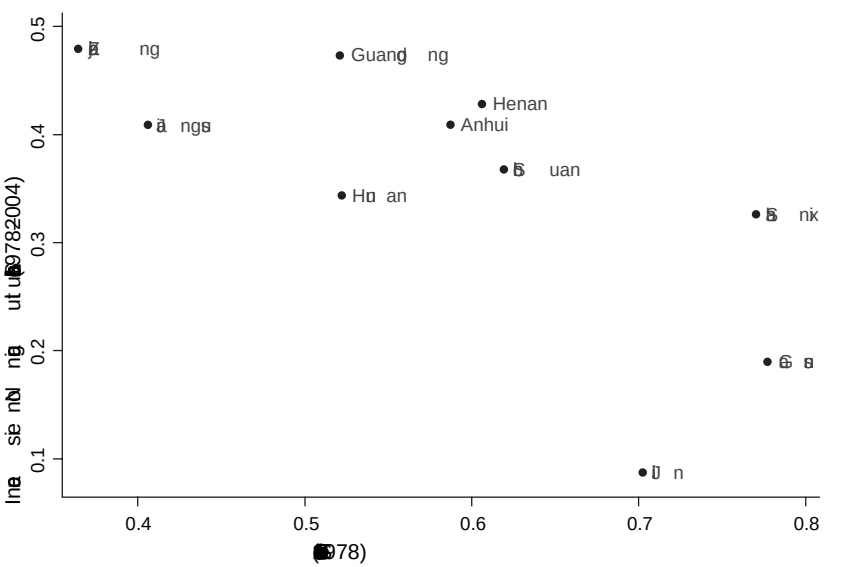

Figure 17.13. Increase in nonagricultural labor share versus size of state sector

state sector as a drag on growth through its influence on local political economy and policymaking.

China may have succeeded in "growing out of the plan" by the end of 1980s (Naughton, 1995), but the process of growing out of the state sector has proved much harder. Even as its share of output and employment declines, the legacy of the state sector survives through the continuation of its preferential access to credit flows. The failure of China's reform to resize the state sector's investment share has delayed the process of institutional reform, retarded investment efficiency and structural change, and lowered the growth of output, employment, and productivity in the nonstate sector and in the economy as a whole. More generally, the size of the state sector mattered for the entire trajectory of economic and institutional reform at the provincial level.

Discussions of regional development often emphasize the "natural" advantages that the coastal provinces enjoyed during China's economic reform. Without denying these circumstances, we would emphasize that the coastal provinces also benefited from the limited expansion of state-sector activity prior to 1978. Guangdong, Fujian, Shandong, and Zhejiang ranked eleventh, fourteenth, seventeenth, and twenty-third in terms of per capita GDP in 1978. Jiangsu ranked a much more respectable sixth. In 2004, these five provinces were ranked fourth to eighth, behind only the three provincial-level municipalities of Shanghai, Beijing, and Tianjin in GDP per capita.

Whereas the weak pre-reform development of the state sector seems to have accelerated reform-era progress in China's coastal regions, the huge levels of investment related to the development of the Third Front in the 1960s and 1970s strengthened the state sector in interior provinces, which influenced, in turn, resource allocation, policy, and growth since 1978. Unfortunately, recent central government initiatives to develop the same western region under the slogan *Xibu dakaifa* may be doing the same through funneling massive investments through the same state institutions.

CONCLUSION

The last three decades, GDP per worker in China has grown at about 7 percent a year. A number of alternative approaches have been taken to explain this achievement, for example, provincial growth regressions that follow in the tradition of cross-country investigations. While studies along these lines, for example, Jian, Sachs, and Warner (1996) and Tao and Zou (1998), are helpful in identifying the factors that are significantly correlated with growth, they are not able to provide quantitative measures of the importance of the contributing factors.

An alternative and complementary method to growth regression is growth accounting, which quantitatively decomposes the overall growth into various sources. A standard growth accounting decomposes the aggregate GDP growth into three sources: capital accumulation, employment growth, and TFP growth. One limitation of this method is that many potential sources of growth are lumped into TFP growth, which then becomes a black box. This includes both intra- and

intersectoral improvements in resource allocation, as well as other sources of productivity growth within individual sectors.

In this chapter, we try to go one step deeper than the standard growth accounting by examining the impact of within-sector productivity growth and cross-sector allocations on the overall growth. Admittedly, we are not the first to try to examine the sectoral contributions to overall growth. OECD (2005) and Bosworth and Collins (2007), for example, have also attempted to quantify the contributions of sectoral growth and reallocation across sectors to overall growth. However, these studies use a simple decomposition method that does not take into account the interactions between sectoral productivity growth and reallocations. Our analysis in this chapter goes beyond the simple decomposition by using a three-sector structural model that explicitly takes into account the interactions. Using the three-sector structural model to do growth accounting, we are able to identify and quantify some important sectoral factors that are crucial to China's growth, which we summarize as follows:

1. During the last three decades, China's nonstate nonagricultural sector has been the key driver of economic growth. Underlying this important contribution has been the rapid TFP growth in the sector. Looking at the nonagricultural sector as a whole tends to conceal this important source of growth.
2. At the beginning of the reforms, China's economy suffered under the weight of huge sectoral distortions and barriers that prevented the flow of resources into this emerging dynamic sector. China's reforms have been extremely important in reducing these barriers and thus allowing resources to flow into the sector that experienced the highest TFP growth.
3. Barriers to labor mobility both from agriculture to nonagriculture and from state to nonstate sectors have declined. While the reduction in both types of barriers has contributed to overall growth, it is the reduction of barriers to labor mobility from state to nonstate that has been a more important source of growth.
4. Despite reductions, barriers persist in credit and labor markets, especially in the credit market. Substantial potential gains remain from reducing credit market distortions.

In future work, we intend to build on this framework. Human capital accumulation, for example, needs to be explicitly included in the analysis. The analysis carried out at the national level can also be extended more rigorously to the provincial level. Finally, our analysis highlights the returns to future research into the sources of TFP growth within both agriculture and the nonstate nonagricultural sectors. Moreover, our findings regarding the importance of intersectoral reallocation to aggregate productivity suggest that intrasectoral reallocation may be important to sectoral TFP as well.

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APPENDIX A: ESTIMATING TFP FOR THE THREE SECTORS

We assume Cobb–Douglas production technologies in all three sectors (agricultural, nonstate nonagricultural, and state sectors). Under this assumption, the TFP in sector i (i = a – agriculture, ns – nonstate nonagriculture, and s – state) can be calculated using the following formula:

$$\text{TFP}_i = \frac{Y_i}{L_i^{\alpha} K_i^{\beta_i}}.$$

Here, Y_i is sector i's GDP, L_i employment, and K_i capital stock, respectively. α and β are labor and capital shares in sector i.

The NBS data report GDPs for the agricultural and nonagricultural sectors, but do not provide a separate breakdown of nonagricultural GDP into the state and nonstate sectors. To generate GDPs for the state and nonstate sectors, we use information on relative wages between the two sectors. Let y_{n} be the aggregate output per worker in the nonagricultural sector, and y_{ns} and y_{s} be the output per worker in the nonstate and state sectors, respectively. Then, we have

$$y_{\text{n}} = y_{\text{ns}}(1 - \varphi_{\text{s}}) + y_{\text{s}}\varphi_{\text{s}} = y_{\text{ns}}[1 - \varphi_{\text{s}} + (y_{\text{s}}/y_{\text{ns}})\varphi_{\text{s}}].$$

Here φ_{s} is the state sector's share of nonagricultural employment. Under the assumption that both sectors use Cobb–Douglas technology with the same factor shares, the ratio of wages in the two sectors equals the ratio of average labor productivities in the two sectors; that is, $y_{\text{s}}/y_{\text{ns}} = w_{\text{s}}/w_{\text{ns}}$. So, given data on the aggregate labor productivities in the nonagricultural sector, the relative wages between the state and the nonstate sectors and the state sector's shares of nonagricultural employment, we can use the equation given earlier to back out the average labor productivities in the nonstate sector. The state sector's average labor productivities can then be calculated by multiplying the relative wages to the average productivities in the nonstate sector. Finally, GDPs in the state and nonstate sectors are obtained by simply multiplying average labor productivities by employment in the respective sectors.

On the basis of the national income accounts for China and the national input–output tables constructed by the NBS, the labor share in nonagriculture has remained roughly 0.5. These accounts put the labor share α for the entire economy at 0.58–0.60, which implies a share for agriculture of nearly 0.7. Moreover, the falling contribution of agriculture in GDP since 1978 means that the share of labor in agriculture has been rising over time. The high and rising share of labor in agriculture is inconsistent with estimates made on the basis of household data, which suggest a labor share in the vicinity of 0.50. For both sectors, then, we assume that the labor share has been roughly constant, around 0.50. Under the assumption of constant returns to scale, the capital share β is simply one minus the labor share, or 0.5 percent.

In agricultural production, land is a major component of the capital stock. We treat the land as a fixed factor and estimate the value of land as the present discounted value of current and future rental incomes from land.

Note that when we calculate TFPs we do not control for the levels of human capital. Thus, the TFP differences over time and across sectors may also reflect differences in human capital.

APPENDIX B: FULL MODEL

For our quantitative exercises, we consider a three-sector model: agriculture, nonstate nonagriculture, and state nonagriculture.

Technology. We assume that all three sectors employ Cobb–Douglas production technologies. Land, physical capital, and labor are the three production inputs. For simplicity, we assume that land is used only in agriculture and physical capital is used only in nonagriculture. We keep the labor share at 0.5 in all sectors. Enterprise-level data suggest that the parameter values in the nonstate and state sectors are the same. For agriculture, since we abstract from physical capital here, the land share in the model is 0.5.

Preferences. The household's demand for agricultural and nonagricultural goods is given by a simple Stone–Geary utility function:

$$U(c_{at}, c_{nt}) = a \log(c_{at} - \bar{a}) + (1 - a)\log(c_{nt}).$$

Here c_{it} is household's consumption of good i ($i = a, n$), $\bar{a}$ is the subsistence demand for the agricultural good, and a is the weight on the agricultural good. Without the subsistence demand $\bar{a}$, households would allocate their expenditures to the two consumption goods according to the preference weights, a and $1 - a$. For $\bar{a} > 0$, however, the agriculture good's expenditure share is greater than a and declines with income.

Frictions in labor market. Let w_{it} be the wage in sector i. We assume that

$$w_{at} = (1 - \mu_t) w_{nst},$$
$$w_{st} = (1 + \xi_t) w_{nst}.$$

Here, μ_t is a wedge between wages in the agricultural sector and the nonstate nonagricultural sector. The existence of this wedge may be due to barriers to labor mobility between the two sectors. ξ_t is the wage premium that the state sector enjoys over the nonstate sector. Let $\varphi_{st} = L_{st}/L_{nt}$ be the state sector's share of nonagricultural employment, which we assume is an exogenous variable that is set by the government.

The average wage in the nonagricultural sector is given by

$$w_{nt} = w_{st}\varphi_{st} + w_{nt}(1 - \varphi_{st}) = (1 + \xi_t\varphi_t)w_{nst}.$$

Using the fact that $w_{at} = (1 - \mu_t)w_{nst}$, we have

$$w_{at} = \frac{1 - \mu_t}{1 + \xi_t\varphi_t} w_{nt},$$

or

$$w_{at} = (1 - \theta_t)w_{nt},$$

where

$$\theta_t = \frac{1 - \mu_t}{1 + \xi_t\varphi_t}.$$

θ_t is a measure of the barriers to labor mobility between agriculture and nonagriculture and is made up of three components: (1) the labor mobility barrier between agriculture and nonstate nonagriculture, μ_t; (2) the state sector's wage premium over the nonstate sector, ξ_t; and (3) the state sector's share of nonagricultural employment, φ_{st}.

We have direct measures of θ_t and φ_t in the data, but no direct measures of μ_t. However, the values of μ_t can be inferred from the last equation.

Figure 17.4 shows the evolution of θ_t, μ_t, ξ_t, and φ_t.

Model Implied Employment Share in Agriculture

Given TFP and barriers, in equilibrium agriculture's share of employment is given by the solution to the following equation:

$$l_{at} = \frac{(1 - a)(1 - \theta_t)}{1 - \theta_t + a(1 - i_t)\theta_t} \frac{\bar{c}}{\tilde{A}_{at}} \iota_{at}^{1-a} + \frac{a(1 - i_t)}{1 - \theta_t + a(1 - i_t)\theta_t}.$$

Here i_t is the investment rate (fixed investment–output ratio) in the economy and

$$\tilde{A}_{at} = A_{at}(Z/L_t)^{1-\alpha}.$$

A_{at} is the TFP in agriculture, Z is the total amount of land, and L_t is total employment in the economy.

The predicted share of the labor force in agriculture is independent of the relative prices. It is a function of productivity in agriculture $\tilde{A}_{at}$, the wedge in wages between the two sectors θ_t, and the investment rate i_t.

Figure 17.3 shows the rise of agricultural TFP. The change in the barriers to labor reallocation is captured by Figure 17.4. The barriers declined sharply in the early years, but reversed trend and increased in the later years. One explanation is that the early decline is mainly a result of the relaxation of restrictions on rural households from engaging in nonagricultural activities; during that period, most of the reallocation is rural to rural (from farm to TVEs) and *within* townships and

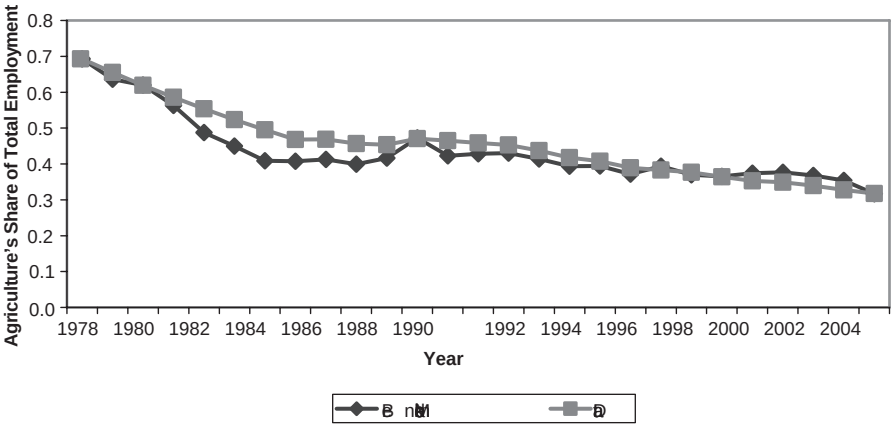

Figure 17B.1. Agriculture's share of total employment (actual vs. benchmark)

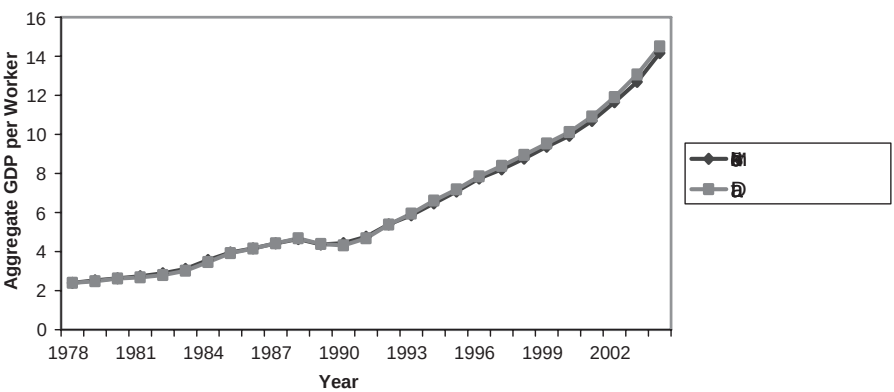

Figure 17B.2. Aggregate GDP per worker (actual vs. benchmark)

counties. In the later years, rural–urban migration becomes a more important way of reallocation and restrictions on migration become binding constraints. Human capital may also figure in.

Accumulation and Allocation of Capital

We take the fixed investment rate as exogenous. The allocation of capital between the state and the nonstate sector is determined by the employment share and wage premium of the state sector. Given the TFP differences between the state and the nonstate sectors, the larger the employment share and the higher the wage premium, the larger the portion of total capital that will be allocated to the state sector.

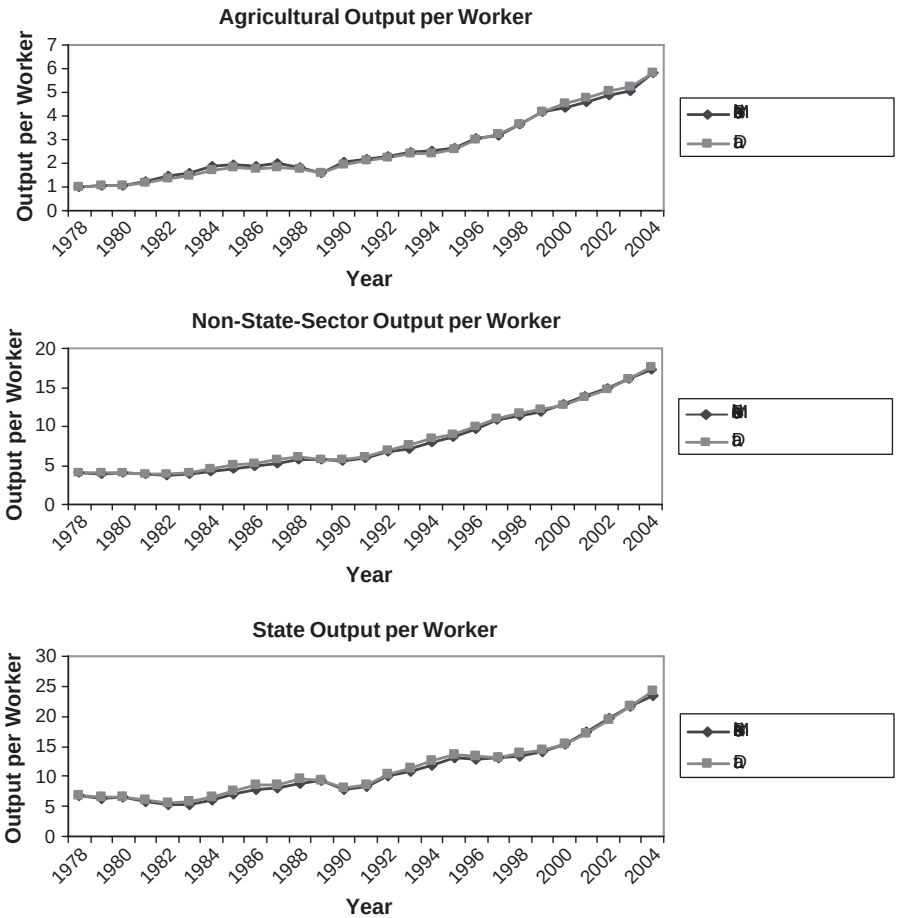

Figure 17B.3. Labor productivity (actual vs. benchmark)

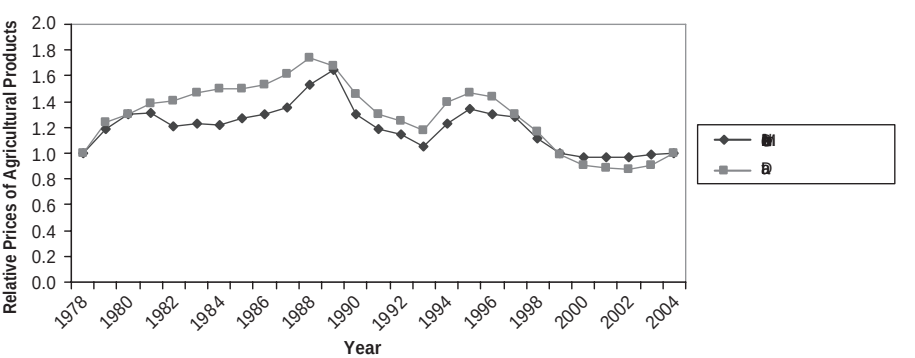

Figure 17B.4. Relative prices of agricultural products (actual vs. benchmark)

Calibration

For our quantitative exercises, we need to choose the values for the parameters in the model. As explained in Appendix A, for production technologies, we let the labor share be 0.5 in all three sectors. There are two parameters in the utility function: the weight on the agricultural good, a, and the subsistence consumption of agricultural good, $\bar{a}$. Both of these parameters have a direct influence on labor allocation between agriculture and nonagriculture. Parameter a determines the agricultural good's expenditure share in the long run and therefore influences the long-run employment share of agriculture. The parameter $\bar{a}$ determines how much labor is needed in agriculture in the short run to satisfy the subsistence food constraint. We choose the values of these two parameters so that the model's predicted share for agricultural employment in 1978 and 2004 match the data exactly. The weight a is equal to 0.235, and $\bar{a}$ is equal to 0.42, which implies that minimum consumption was equal to 42 percent of output per worker in agriculture. Alternatively, each worker in agriculture was producing food to support roughly two and a half individuals.

Given the calibrated parameters and the variables that we take as exogenous, that is, TFPs in the three sectors, the gap in wages between the three sectors, the investment rate, and the relative price of capital, we can calculate the model-implied values for the following variables:

- employment shares of agriculture,
- labor productivities in the three sectors, nonagriculture, and the aggregate, and
- relative price of agriculture to nonagriculture.

In Figures 17B.1 through Figure 17B.4 we compare the model-implied values for agriculture's share of employment, aggregate labor productivity, sector-level labor productivity, and relative prices with the actual data. In general, the model-implied values match the data reasonably well. Thus, the model can be used as a basis for our counterfactual quantitative exercises.