CT Forecasting China's Economic Growth to 2025

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Why attempt to forecast China's economic growth? Most importantly, the impact of China on the rest of the world and on the standard of living of its own people depends mainly on whether the nation continues to double the size of its gross domestic product (GDP) every seven to ten years or whether that growth slows markedly or even halts. China already influences the world economy through its booming exports, its demand for natural resources, its influence on global warming, and much else. A GDP four times the current level will multiply China's worldwide impact.

But there is another reason why forecasting Chinese growth is desirable in a volume dedicated to understanding China's present and past economic performance.

The ability to forecast is one important test of whether the analysis has gotten the story right. There are many ways to forecast the future, some of which, like simple projections of recent trends, tell us little about the present and not much about the future.

But analytical forecasts based on a model that attempts to sort out the main influences that are likely to shape that future can deepen our understanding of the mechanisms driving Chinese growth. Even if the forecasts are a bit off the mark or downright wrong, a good model allows analysts to review a forecast's strengths and limitations and to identify specific shortcomings that contributed to the gap between predictions and ultimate outcomes. Put differently, the effort to forecast necessitates explicit judgments about which economic forces matter and which do not. If the forecast turns out to be wrong, future analysts and readers are in a position to understand why the forecast was wrong and what changes could have improved it.

The forecasting model used in this chapter is extremely simple. We start with the supply side growth accounting equation. We use data from the past half century to determine how much of GDP growth can be attributed to larger inputs of capital, human capital, and labor and how much is due to a rise in total factor productivity (TFP) or output per unit of these inputs. This approach has an important advantage in that it is possible to make informed quantitative judgments about the likely growth of labor, capital, and education over the next two decades.

The primary reason for starting with the growth accounting equation, however, is that it provides a basis for separating out the contribution of TFP and capital to China's economic growth. If rapid growth arises primarily from high rates of capital formation, then the forecasting agenda boils down to determining whether high rates of investment will continue. This in turn depends on whether personal savings of the Chinese population will remain high, whether Chinese corporations continue to be an independent source of high savings, and whether the Chinese government will run large fiscal surpluses or large fiscal deficits.

If growth is driven instead by TFP, the considerations critical to any long-term forecast are very different. Rising rates of savings and investment may contribute little to growth. What matters is whether investments deliver high rates of return. But what contributes to a high rate of return? Can a country achieve a high rate of return with a weak financial system? Was China's growth during the 1980s and 1990s the result of reforms that created a one-time rise in the level of TFP? Or, have these reforms created conditions that will promote sustained TFP growth over the coming decades?

The sources of TFP growth are inherently difficult to quantify. Determining the impact of financial reform or greater outward orientation is more complex than measuring an increase in the size of the labor force or in the number of college graduates. Still, we have far more knowledge than existed several decades ago about what kinds of reforms promote accelerated growth. In East Asia, in particular, we

have the experience of South Korean and Taiwanese economic reforms in the 1960s through the 1980s and of Vietnamese reforms in the 1990s. We also have the econometric estimates of the "new growth economics" that give us some guidance as to what works and what does not in the relationship between policy, institutional reform, and growth.

There is a fundamental difference between forecasting growth over a twenty-year period, which is the focus of this essay, and short-run predictions targeting the next year or two. Because short-term outcomes depend on a host of economic variables and can be strongly influenced by external shocks, short-run forecasting requires a model that captures how the many different sources of change in the economy impact overall performance. The model thus will depend on a large number of equations. Given that we have few estimates of such equations in the Chinese context, short-term forecasts call for a wide variety of assumptions about the parameters of such equations. Such assumptions invariably involve high error margins. Utilizing short-term models to project longer-term growth is particularly dangerous because rapid shifts in economic structure – such as changes in income distribution or in the relative size of the state and private sectors – seem likely to shift the underlying structure embedded in short-term forecasting models.[2]

Long-term growth, by contrast, is largely independent of sudden shocks or short-term changes in consumption behavior. It is mainly driven by the growth rate of productivity, which in turn is heavily influenced by research and development

expenditures, the availability of capital to turn the discoveries of research and development (R&D) into final demand products, and the growth of the labor force.

Long-term growth in developing countries is both a bit simpler and a bit more complicated. It is simpler because efforts to develop and commercialize new technologies typically contribute little to economic growth in poor nations. China may be an exception as the scale of domestic R&D spending increases (see Chapter 9 in this volume) and as multinational firms transfer a growing array of research activity to the People's Republic. Productivity growth in developing countries, however, depends mainly on how fast these countries can adapt the technology and management practices of higher-income economies to their particular situations.

Because developing countries are not, for the most part, in the business of pushing out the frontiers of knowledge, they can avoid the dead ends that technological leaders inevitably encounter. Developing nations may also benefit from opportunities to avoid expensive and time-consuming investments, for example, by building cell-phone networks rather than connecting telephone wires to customers' homes or shops. These advantages give developing countries the potential to grow much faster than high-income nations, at least for a time.

A half century of international development experience demonstrates that low-income nations can capture this unique opportunity for accelerated growth only if they orient their economic systems to take full advantage of being followers. Since we know something about the structures that generate productivity growth, we can

compare what China has accomplished in this regard with what has worked elsewhere. Comparisons of this sort do not lead to precise quantitative estimates of the contribution of reform to growth, but they do provide a benchmark for comparing Chinese economic institutions and policies with circumstances in countries that have succeeded in building extended periods of high-speed growth into their economies.

A-Head STRUCTURE OF THIS CHAPTER

We begin by measuring the supply side sources of growth between 1952 and 2005 with as much rigor as is possible given the limitations of Chinese data. Making the measurements is a straightforward if time-consuming task. Interpreting the results is quite another matter. Most analysts select a time period, compile the data, determine whether the contribution to growth of capital is greater than that of TFP or vice versa, and leave it at that. In our view, this approach is inadequate because it fails to examine the dynamic interaction between productivity and accumulation. In China and other nations that experience major economic or institutional reforms, the growth of capital is itself in part the result of acceleration in TFP growth. We see China's recent development as first and foremost a story about productivity growth supported by the growth of factor inputs, notably, capital. From this perspective, China's ability to sustain high rates of GDP growth in the future will depend critically on the capacity to generate continuing growth in TFP.

TFP growth, however, is far from the whole story of either China's past or its future. The next section of this chapter, therefore, looks at the likely future growth of factor inputs. Will the savings rate remain high and will high savings continue to be translated into high rates of investment and capital stock growth? We can be reasonably precise about labor force growth, but considerably less precise about what share of that labor force will end up in high-productivity industrial and service-sector employment as contrasted to low-productivity agriculture or failing state enterprises.

The analysis of Chinese productivity dynamics will begin with a brief review of what our growth accounting equation and our knowledge of Chinese reforms since 1978 can tell us about what drove productivity growth over the past quarter century. Many of the reforms that led to high productivity growth in the past, however, are not likely to continue to provide a comparable stimulus to growth in the future.

The effort to understand where future reforms might impact productivity growth is unavoidably speculative. It begins with a brief look at cross-country econometric growth equations to see what guidance they give us about China's likely growth path over the next two decades. We then focus on key economic institutions, policies, and social issues that are likely to affect future growth.

Finally, we will turn from our supply side approach to look briefly at demand-side issues. Foremost among these is the question of whether and for how long China can continue to expand the share of domestic output exported to its trading partners. If demand-side limits oblige China to rein in export growth, which seems inevitable,

will the domestic market suffice to push the economy ahead without losing momentum?

This chapter cannot encompass the multiple forces that could shape China's GDP growth over the coming two decades. We concentrate on economic factors and make only passing reference to political events that could fundamentally alter the country's growth prospects. Will rising incomes and education lead to pressure for fundamental political change, for example, and might the ensuing political changes result in protracted instability? Will war in the Taiwan Straits upset China's growing economic integration with the rest of the world?

Nor can we explore the implications of the GDP growth rates that we project for agriculture and other economic sectors, for China's environment, or for energy demand. Answering those kinds of questions is a very different kind of exercise involving other kinds of models and analysis.

A-Head MEASURING SUPPLY SIDE SOURCES OF GROWTH

To measure the sources of growth from the supply side during 1952–2005, we begin with a conventional production function,

$$Y = f(K, H, t), \tag{20.1}$$

where "Y" is GDP, "K" is the stock of fixed capital, "H" is the education-enhanced

labor force, which is measured in a way that includes the increase in quality of labor

due to the rise in human capital, and "t" represents shifts over time in the production

function or changes in the productivity of the factor inputs. To get this equation into a

measurable form, we differentiate with respect to t and rearrange terms to arrive at

the following standard growth accounting equation,

$$g_y = s_k * g_k + s_l * g_h + a, \qquad\qquad (20.2)$$

where "g_y" is the growth rate of GDP, "g_k" is the growth rate of the capital stock,

"g_h" is the growth rate of the education-enhanced labor force, and "a" is the increase

in TFP. The parameters "s_k" and "s_l" are, in the calculation we shall make, the shares

of capital and labor in total national income. To construct the equation in this way,

one must assume constant returns to scale. We could avoid this assumption by

estimating "s_k" and "s_l" directly, but we do not believe that currently available

Chinese aggregate data can support reliable econometric estimates of these

parameters.[3]

The main challenge in estimating the sources of growth for China during

1952–2005 is to obtain reliable time series for the key variables. Any large, low-

income nation faces unavoidable obstacles to the accumulation of comprehensive and

accurate statistical information. In China, the use of Soviet-inspired accounting

methods, the subsequent shift to conventional national accounts, and episodes of

widespread data manipulation add to the difficulties surrounding national economic statistics. As a result, the data that we use to measure output, capital, labor, and schooling are beset by issues of reliability as well as a variety of conceptual or theoretical problems. We defer detailed discussion of these issues to an appendix.[4] Here, we summarize the choices we have made in assembling key statistics and briefly explain how our data series differ from standard official statistics and from estimates by other researchers.

Official measurements of the level and growth of China's total output have attracted a steady stream of criticism from Chinese and international analysts who argue that distortions inherent in the methods of compiling official data may lead to an overstatement of output growth.[5] There is evidence, for example, that output data for township and village enterprises may mix current and constant prices, imparting an upward bias to growth measures for inflationary years during the early and mid-1990s.

The disruption of regular economic reporting during the Great Leap Forward (1958–1960) and the early years of the Cultural Revolution calls for the application of large error margins for data in those years. More recently, some analysts have argued that political pressures may have elevated China's official growth rates in the aftermath of the Asian financial crisis of 1997–1998.[6]

Although most studies emphasize possible overstatement of Chinese growth, there is good reason to suspect substantial downward bias in official growth

measures. Despite multiple adjustments, the complete elimination of long-standing

undermeasurement of China's service sector may require further revision. The

coincidence of rapid output growth, rising product quality, and falling prices visible

in many manufacturing sectors (e.g., autos, home appliances, and electronics) raises

the possibility that quality adjustments could produce sharp increases in measured

output growth.[7] Work by Klein and others indicates that international pricing

conventions such as those currently used by China underestimate quality

improvements and hence overstate price increases used to deflate data in current

prices.[8]

Despite these strictures, some of which we regard as well founded, we regard

standard official data, including revisions announced by China's National Bureau of

Statistics (NBS) during 2005--2006, as the best available benchmark for appraising

the long-term evolution of China's economy.[9] We therefore take the most recent

NBS measures of nominal and real output and growth as the starting point for

studying the sources of growth in China's economy. We do, however, make one

important adjustment to official growth measures in order to remove distortions

arising from the peculiar structure of relative prices during China's socialist plan

period. Following Soviet example, China's government assigned high values to

industrial goods and set low prices for agricultural and resource products soon after

the 1949 creation of the People's Republic. This price arrangement generated

monopoly profits for industry, which provided the main source of government revenue, typically exceeding 20 percent of GDP.

These arrangements, while intended to create a mechanism for financing government investments under successive five-year plans, had an accidental effect on GDP growth. With industry growing more rapidly than agriculture, the use of official prices that artificially exaggerated the relative price of fast-growing manufactures distorts both the overall growth rate of GDP and the GDP share of investment spending (much of which goes to purchase equipment and other overpriced manufactures).

Meaningful analysis of the sources of growth requires that we remove the effect of these price distortions. As Branstetter and Lardy explain in their contribution to this volume (Chapter 16), the dismantling of trade restrictions during the 1990s initiated a broad convergence of Chinese commodity prices to international norms. This steep reduction in domestic distortions allows us to use prices of the year 2000 to recalculate both the GDP and the capital series.

Recalculating Chinese GDP item by item in 2000 prices is well beyond our capacity and would be a major task even for China's NBS. Starting with official series for nominal value added in the primary, secondary, and tertiary sectors, we use the implicit price indexes derived from nominal and real growth rates in each sector to derive series of sector output valued in 2000 prices and combine the resulting sector data to form a new series of aggregate output valued in 2000 prices.

The resulting GDP series provides the output data used in our decomposition of growth into input and productivity components. This procedure does not eliminate all price distortion in the GDP growth estimates: official regulation, for example, continues to hold domestic energy prices below world market levels. However this revision does eliminate the implausibly high relative prices for manufactures that we see as the most important source of distortion in China's official GDP statistics.

Our approach to the measurement of inputs focuses on the available supply of capital and labor. We seek to measure the stock of fixed assets and the nonstudent population between the ages of 16 and 65. These input measures make no adjustment for changes in utilization rates, unemployment levels, or the standard retirement age. Our series of annual TFP observations simply record trends in output value per combined unit of capital and labor. The results incorporate the combined impact of changes in output per unit of employed resources and variations in the utilization of both capital and labor.

Chinese capital stock data are built up by adding new investment valued at current prices to the undeflated sum of past investments, with or without deductions for depreciation, major repairs, and scrap. The resulting figures combine amounts valued in prices of many years and are therefore unsuitable for productivity analysis. Beginning with Chen et al. (1988), analysts routinely apply the perpetual inventory method to build capital stock estimates from standard data on annual investment outlays.

We adopt the same approach, but apply a new deflator for fixed investment that uses the shares of construction and equipment in investment spending to combine separate indexes of construction costs and equipment prices. The new deflator parallels the NBS index of investment costs for 1992–2005; however, it improves on the crude improvisations that various researchers have used to estimate trends in investment costs prior to 1992.

The perpetual inventory method also requires information about depreciation rates and about the initial stock of fixed assets. Available data indicate that until very recently, depreciation rates used by Chinese accountants reflected the physical rather than the economic service lives of buildings and equipment (Gao, 1985, pp. 70–71; Yearbook, 1994, p. 29). We derive capital stock measures using two depreciation rates: 9.6 percent, a figure derived by Zhang, Wu, and Zhang (2004, p. 39) from an earlier study of service lives and an alternate rate of 7 percent to facilitate sensitivity analysis.

We actually have a figure for the national total of fixed assets in 1952, the initial year of our study. Since this figure is known to be incomplete (Ishikawa, 1965, pp. 109–110), we assume that the initial value of the fixed capital stock in 1952 is either the same as 1952 GDP (a 1:1 capital output ratio) or is double the size of 1952 GDP (a 2:1 capital output ratio). Which initial capital stock assumption is used has little influence on the growth rate of the capital stock in the post-1978 reform period,

but a major influence on the capital stock growth rate in the 1950s and, to a lesser

degree, the 1960s.

We measure annual labor input as the nonstudent working-age population,

meaning persons aged 16–65. We decompose the annual labor totals into five

categories based on educational attainment: no diploma (L_1), primary school (L_2),

junior high school (*chuzhong* (L_3)), high school (L_4), and college (L_5).[10] Standard

Chinese sources provide these data only in connection with the population censuses

of 1982, 1990, and 2000. Interpolation between the census results is not feasible

because of major inconsistencies in the education component of successive census

compilations.

Results from the 1990 census show substantially higher education levels than

what we derive by combining the 1982 census outcome with subsequent graduation

figures. The 2000 census also reveals a wider expansion of educational attainment

than what is implied by the 1990 census findings and subsequent graduation rates.

These inconsistencies arise from two factors: China's expanding array of

nontraditional training programs and a thriving trade in forged credentials. In

addition, official labor totals appear to incorporate definitional changes that introduce

an enormous jump in the employed population between 1989 and 1990.[11]

Faced with these difficulties involving both numbers of workers and the

growth of educational attainment, we have chosen to construct new time-series

measures of the working-age population and the dispersion of education. We begin

with the 1982 census totals and use information on births, age-specific mortality rates and annual numbers of graduates to obtain totals for earlier and subsequent years. The appendix explains the details of this procedure.

In addition to deriving time-series estimates of China's nonstudent working-age population, we use information about education-linked wage differentials in 2000 shown in Table 20.1 to construct a new measure of "education-enhanced" labor. We assume that wage differentials reflect differences in productivity. The analysis of wage data, for example, shows that junior high school graduates earned 34.6 percent more on average than primary graduates with similar demographic characteristics in 2000. We attribute this difference to education-linked productivity variation and record each junior high graduate as equivalent to 1.346 primary graduates in tabulating the education-enhanced work force H.[12] In formal terms,

$$L = L_1 + L_2 + L_3 + L_4 + L_5 \tag{20.3}$$

$$H = w_1 L_1 + w_2 L_2 + w_3 L_3 + w_4 L_4 + w_5 L_5 \tag{20.4}$$

In equation (20.4), the w coefficients are the "Mincer coefficients" or education-linked wage differentials shown in Table 20.1, with w_2, the coefficient for primary graduates, set equal to unity.

Insert Table 20.1 here

Table 20.1 summarizes the outcome of our labor analysis. Our measure of working-age nonstudents aged 16–65, denoted by *L*, has grown substantially, but at declining rates. The new labor force series *L* eliminates the implausible bulge in the official totals for 1989--1990. Our measure of the working-age nonstudent population *L* grows at an annual rate of 2.52 percent during 1978–1995 and rises by 2.09 percent in 1989--1990 in comparison with officially measured employment, which rises at an average rate of 3.15 percent during 1978–1995 and by an implausible 17.03 percent during 1989--1990.

The ratio *H*/*L* measures the average educational attainment of the working-age population included in the headcount total *L*. The initial 1952 figure of 0.90 indicates that the average educational level of Chinese workers was below the primary school level. The ratio *H*/*L* attained a value of close to 1.0 (actually 0.98) in 1965, indicating that the average worker at that time still had only a primary school level of education. By 2005, *H/L* had increased to 1.31, nearly equivalent to the junior high school level (for which the same ratio would equal 1.346). By recognizing only the diplomas issued by traditional educational institutions, our calculation understates the growth of human capital since the reform period began because we ignore the impact of nontraditional training programs, some of which no doubt increased the subsequent productivity of the trainees.[13]

Although we expect that education is negatively related to mortality, our calculations apply age-specific mortality rates without regard to educational

attainment level, adding a further downward bias to our estimates of human capital growth. We conclude that our estimates understate the growth of human capital. We believe that the extent of this bias remains modest.[14]

A-Head THE HISTORICAL GROWTH ACCOUNTING RESULTS

The results of our efforts to estimate the sources of Chinese GDP growth during 1952–2005 appear in Table 20.2 and Figure 20.1. The results from our reconstructed input and output series broadly resemble the findings of previous studies built on simpler methods.[15] Careful analysis of the new results, however, clarifies the dynamics of China's post-reform growth spurt.

Insert Table 20.2 and Figure 20.1 here

Beginning with the period that covers the first Chinese five-year plan (1953–1957), GDP grew rapidly, in large part due to an increase in TFP, which accounts for nearly three-quarters of measured GDP growth. Our estimate of GDP growth in this period (6.5 percent) is well below the official Chinese figure (9.2 percent), but close to the T.C. Liu--K.C. Yeh reconstruction of official estimates made years ago, using prices from 1933, when China approximated a fully-open market system.[16] This agreement between our estimate of GDP growth and the Liu--Yeh result based on 1933 prices enhances our confidence that the 2000 prices underlying our data more

closely approximate the relative scarcities of industrial and agricultural products during the 1950s than do the official prices of the time.

Since the assumption about the initial 1952 level of capital stock heavily influences the capital stock growth rate in this early period, the appendix provides alternative calculations, using different assumptions about the initial capital stock. A high initial capital stock estimate for 1952 lowers the contribution of capital and raises the impact of TFP in accounting for GDP growth, and vice versa. Only a detailed analysis of China's capital stock in the early 1950s, building on the work of Shigeru Ishikawa (1960, 1965), can determine which of these estimates best reflects the reality in China at that time. The calculations presented here report only the results based on assuming that the initial capital stock was twice GDP in 1952, with a depreciation rate of 9.6 percent per year.[17]

China achieved impressive growth of TFP during the First Five-Year Plan period despite undertaking the collectivization of agriculture (1955–1956) and the state takeover of virtually all industry. Offsetting the disruptive impact of these political movements was in part the high rate of capital formation that had risen from very low levels prior to 1949 when total investment probably did little more than cover depreciation if that. Productivity growth mainly reflected continued recovery from the long-term impact of the war with Japan (1937–1945) and the final phase of China's civil war (1945–1949) between the Kuomintang and the victorious Communists.

Recovery from war typically unleashes a quick productivity surge due to the reactivation of capital and labor idled by military strife and the associated chaos. Under these circumstances, simple measures such as restoring electricity and reopening transport routes can deliver major jumps in output. In China, the new government's swift restoration of monetary stability following a decade-long hyperinflation provided a further push toward higher productivity by stimulating the resumption of cultivation and trade in cotton and other commercial farm products (Perkins, 1966).

From 1958 to the eve of the reform period that officially began in December 1978, China's growth slowed markedly. The average GDP growth rate in year 2000 prices fell to 2.41 percent from 1957 through 1965 and then rose to 4.87 percent from 1965 through 1978, producing an average growth rate over the entire period of 3.92 percent (as contrasted to an official growth rate mainly in 1957 prices of 5.4 percent for the whole period[18]).

It would have been remarkable if China had actually maintained a growth rate of over 5 percent a year between 1957 and 1978. This period began with the Great Leap Forward (1958–1960) that left much of industry in shambles and caused a steep decline in agricultural output that led directly or indirectly to excess deaths amounting to tens of millions in the resulting famine of 1959–1961. Compounding these punishing reversals, the Soviet Union withdrew its technical assistance in 1960. Together with China's prohibition of foreign direct investment, political hostility

from the far left toward foreign technology in general, and the U.S.-led trade

embargo, China effectively was left on its own with only the most limited access to

far superior technologies available in the outside world. Despite some modifications

in the early 1970s, China's costly economic isolation hardly changed until after the

death of Mao Zedong in 1976.

Finally, there was the Great Proletarian Cultural Revolution that reached a

peak of disruption in 1967–1968, but which continued to paralyze economic decision

making throughout its formal existence from 1966 to 1976. As the data in Table 20.2

indicate, the disruption to the economy caused by the Cultural Revolution, while

considerable, was substantially less than what occurred during the Great Leap

Forward.

Given this long and formidable list of setbacks, the real question about the

1958–1978 period is how GDP grew at all. The answer is that the growth was

primarily made possible by high and rising rates of capital accumulation, which

replaced productivity enhancement as the dominant contributor to GDP growth (see

Table 20.2 and Figure 20.1). The share of gross investment in GDP (measured in

current prices) rose from 17.5 percent in 1957 to 29.5 percent in 1978. Data in Table

20.2 show that capital formation dominated the growth picture during the two

decades following 1957, accounting for 93 percent of GDP growth during 1957–1965

and 68 percent of GDP expansion during 1965–1978. TFP, not surprisingly, declined,

making a sharply negative contribution to overall growth during the years that encompassed the Great Leap Forward.

The growth that did occur in this period did not provide much help to China's population, which grew at an annual rate of 1.9 percent during 1957–1978 in spite of the famine in 1959–1961. If we subtract capital formation from output growth, we find that real per capita consumption during 1957–1978 rose slightly more than 2 percent per year in 2000 prices.[19] Most of that increase occurred in the urban areas or was eaten up by government consumption. As a result, our calculations confirm work by Lardy (1984), Bramall (1989), and others indicating that China's rural majority experienced little or no improvement in living standards during the two decades prior to the start of economic reforms.

The dramatic change after 1978 is the story that is most relevant to our interest in the future performance of China's economy. Instead of the trendless swings in annual TFP changes typical of 1952–1978, the data underlying Figure 20.1 show annual TFP turning upward in 1976--1978, dipping briefly in 1978/1980, and then rising in each year beginning with 1981/1982. Following negligible growth averaging 0.5 per year during the 1952–1978 plan era, including an actual decline during 1957–1978 (Table 20.2), TFP grows at an annual rate of 3.8 percent during 1978–2005 and accounts for 40 percent of overall growth during this interval of nearly three decades. The size and persistence of this productivity surge is

unprecedented in Chinese history. Although TFP growth did average 4.7 percent during 1952–1957, this spurt covered only five years and, as noted earlier, is partly attributable to recovery from the ravages of war and hyperinflation.

The rise in the contribution of capital did not occur independently of the rise in productivity. The rate of capital accumulation in China did not rise after 1978 as a result of efforts by government and the private sector to shift a higher share of resources away from consumption and toward investment. The rate of capital accumulation in current prices as a share of GDP actually declined slightly in the early 1980s and again in the late 1980s before rising again later on (Figure 20.2). The higher growth rate of the capital stock (and hence of the contribution of capital to growth) resulted from the same savings and investment effort being applied to a higher growth rate of GDP. Thus, it was the jump in productivity growth leading to a higher GDP growth rate that made possible the greater contribution of capital. Put differently, the story of the 1979–2005 period in China is a story of reforms generating high TFP growth that in turn led to a higher level of capital formation growth than would otherwise have been the case.

Insert Figure 20.2 here

This pattern recalls the experience of Japan during its twenty-year growth spurt from the early 1950s. Calculations by Denison and Chung (covering 1953–1971) and by Shinohara (covering 1960–1970), for example, show that TFP accounted for just over half of Japan's 9 plus percent rate of GDP growth in this

period.[20] The GDP share of gross fixed capital formation averaged 20.1 percent in the early 1950s, then rose to 24.5 percent in the latter half of the 1950s, and finally to over 30 percent of GDP during the 1960s,[21] where it remained throughout the 1970s even though the Japanese GDP growth rate slowed markedly. Thus in Japan, as in China, it was TFP growth that drove accelerated growth of GDP, leading to a rise in the rate of capital formation. In Japan in the 1970s and into the 1980s, it was a deceleration in TFP, not a decline in the rate of gross fixed capital formation that accounted for most of the initial slowdown in growth in that period.

The Chinese and Japanese data on the contribution of TFP to GDP growth are similar to the data for South Korea and Taiwan. Reform in all four cases led to a jump in productivity that in turn led to a rise in the growth rate of the capital stock. This close connection between reforms that led to high TFP followed by high growth and hence higher rates of growth of capital has been missed in some earlier studies because of the way the data were presented. There were two major economic reform periods in both South Korea and Taiwan, the turn outward to promote manufactured exports in the early 1960s and the major effort at economic liberalization (reduction in the role of government in limitations on imports and much else) beginning in the mid- to late 1980s. In both reform periods in both countries, the growth accounting data indicate that there was a burst in TFP followed by a rising rate of growth of the capital stock (Perkins and Sabin, 2001).

The picture for China as shown in the yearly growth accounting data in Figure 20.1 is most like the story for South Korea and Taiwan. The pace of institutional reform in China in qualitative terms breaks down into four major periods. The first period, 1979–1984, was the period of the opening up of foreign trade, the return to household agriculture, and the freeing up of rural and many consumer markets. The second period of reform followed closely on the first in 1985 through 1988 and involved the freeing up of industrial inputs for sale on the open market that led in turn to the boom in township and village enterprises that sustained high growth until the hiatus in June 1989 and conservative backlash to reform in the latter part of that year and in 1990. The third phase of reform came after Deng Xiaoping's trip to China's south in 1992 and his call for more not less reform. The fourth phase of fundamental institutional and policy changes came in the mid- to late 1990s with the rapid rise in foreign direct investment, China's decision to do whatever was necessary to join the World Trade Organization (WTO), and the government's disguised but clear decision to reduce sharply its role in the ownership and control of the industrial sector.   .

The primary question addressed in this essay, however, is not about the past, but about whether China's high growth will continue into the future. Will China continue to enjoy major spurts in TFP followed by accelerated growth in the capital stock or will a new pattern of capital and TFP growth emerge, perhaps one that is still robust but perhaps less volatile than in the past? Previous interludes of reform and

accelerated TFP growth were a product of the return of household farming, the shift from plan to market, the removal of most restrictions on domestic and international trade, and other fundamental changes that accompany the transition from a central planning to a market economy. That transition, while not complete, has moved China far toward the market economy end of the economic systems spectrum. Future reforms of this sort will not have the same impact as the freeing up of industrial inputs for sale on the market or the large increase in foreign direct investment. Future agricultural reforms in particular are not likely to have much of an impact on GDP growth, because that sector now accounts for less than 15 percent of GDP. The shift of labor out of agriculture and into industry and services will continue to be important, but only so long as the secondary and tertiary sectors create new jobs.

Thus, future productivity and GDP growth in China over the coming two decades depends primarily on what happens to growth in output and productivity in industry and services. One suspects that these new sources of reform and productivity growth in industry and services are likely to come in a continuing stream of important but smaller and less volatile steps that raise efficiency and upgrade technology year after year. What some of those changes might be is the subject of the discussion that follows. We begin, however, with a discussion of some of the future sources of growth that are a bit easier to predict than the pace of innovation and productivity growth.

A-Head CHINA'S GROWTH PROSPECTS

B-Head Will the Savings and Investment Rate Remain High?

Even if productivity is the main driving force behind high GDP growth, sustained growth at the levels attained during the past quarter century will require the continued expansion of China's stock of fixed capital at something approximating the 9 percent annual growth that has prevailed since the reform period began. This is because it is difficult to conceive of sustained productivity growth in the absence of the large investments needed to introduce new technologies. In a market system, it is equally improbable to expect investment to remain at high levels if productivity is not growing rapidly. Productivity growth is a central component in the large number of profitable investment opportunities needed to keep investors willing to invest.

In China, the continuing role of official actors in investment choice complicates the relation between growth of investment and productivity. Because of China's consistent record of poor investment decisions, a subject to which we shall return, a decline in the expenditure share devoted to fixed investment could improve the quality of project selection and execution and contribute to a higher rate of TFP growth.

Even though China has become a magnet for overseas investment, annual increments to the capital stock come mostly from domestic sources of investment,

which in turn are largely financed by domestic savings.[22] Assuming robust investment opportunities, it is therefore the level of domestic savings over the coming two decades that will largely determine the pace of investment in China and the growth rate of the capital stock.

Savings in China come from three sources: household saving that accounts for a little over half of total savings, enterprise saving that accounts for roughly one-third of the total, and government saving that has averaged around 15 percent of the total since the 1990s (Yu, 2005). Among these three components, only the household segment is amenable to systematic analysis and forecasting.

Chinese households have recorded high savings levels throughout the reform era. In recent years, both rural and urban households save roughly one-quarter of disposable income, with household savings amounting to about one-sixth of GDP (Kuijs, 2006). There are several reasons for high household savings during the past two decades, not all of which will continue with the same force into the future. One current motivation is to accumulate funds that can be used to purchase expensive durable goods including, for a small but growing part of the population, automobiles. The recent privatization of urban housing has provided an even greater reason for urban households to save. These motivations for saving will continue, but their impact could decline over the coming decades if financial institutions continue to expand the availability of home mortgages, auto loans, and other forms of consumer credit. Since slow growth of aggregate demand has prompted Beijing to strenuous

efforts to raise consumer spending during the past decade, policy restrictions are unlikely to slow the expansion of consumer loans and mortgages.

The main motivation for high household savings in China, however, is to save for retirement and to meet the rapidly rising costs of health care and education. None of these factors acted as important determinants of household saving during the plan era. Urban workers expected to receive generous pensions provided by their work units. Rural households were unable to accumulate substantial savings; their retirement incomes depended on whatever reserves their collective farms could accumulate and whatever income their children could share with them. Access to education and medical care was largely determined by nonmonetary considerations.

China's reforms changed all this. Mass layoffs and privatization introduced new uncertainty into urban pension arrangements, while the demise of collectives eliminated the collective reserves on which elderly villagers had depended. Ability to pay became increasingly prominent in the allocation of education and especially health care. Following these changes, multiple studies have shown that Chinese household behavior now fits the life cycle model of savings behavior that economists routinely apply to market economies.[23] This approach postulates an inverse relationship between dependency and savings: children and retirees consume more than they earn, while adults in the prime working ages accumulate savings to benefit their children and finance their own retirement.

China's government lacks the financial resources to establish a public retirement or social security system that will provide ample pension income to more than a small segment of the population.[24] This circumstance is unlikely to change dramatically during the next two decades. This means that most households must depend primarily on their own resources for retirement income. The same story applies to health care: most Chinese must expect to pay the bulk of their medical expenses. Given these realities, what then does the life cycle savings model tell us about the likely level of household savings over the next decade or two?

Table 20.3 provides data and projections for China's population and divides the demographic total into two categories: working-age persons (between 16 and 65 years of age) and dependents. One immediate observation from these data is that the dependency ratio, meaning the share of persons above or below working age, is very low.

Insert Table 20.3 here

China's low dependency ratio follows from recent demographic history. The one-child-family policy instituted in the early 1970s led to a marked decline in the number and proportion of young people, and the earlier baby boom that began in the 1950s is only now beginning to approach retirement age (see Chapter 5).

Although the age structure of China's population ensures rapid future
increases in the proportion of retirees (Howe and Jackson, 2004), the projections in
Table 20.3 show the dependency ratio declining to 2015, whether or not working-age
high school and college students are counted as dependents. Although the
dependency ratio begins a steep ascent of about 3 percentage points per decade from
2015, it is only after 2025 that this ratio climbs above the low figures observed
during 1990–2005. The predictions of the life cycle model, which associates low
dependency with robust household savings, therefore indicate that household saving
in China is likely to remain high throughout the two decades to 2025.

It is difficult to say much about the future savings of business and
government, the other major sources of domestic saving in China. Prior to the reform
period, the primary source of saving was enterprise profit that was generated by
monopoly pricing of consumer manufactures. The state collected these profits in the
form of turnover and profit taxes and used the revenues to fund virtually all
investment other than that done by the rural communes. Under the reform, the
expansion of entry and price flexibility eliminated this system. Enterprise profits fell
sharply (see Naughton's Figure 4.1 in Chapter 4) and then recovered to some extent.
Industrial profits remain highly concentrated. In 2003 just five sectors (out of a total
of 39) accounted for half of all industrial profits; in 2005, the same five sectors – oil
and gas, ferrous metallurgy, electric power, electronics, and transport equipment,
earned 42 percent of total industrial profits.[25] Although we may speculate that

concentration of profits is conducive to high savings, any detailed forecast of business savings requires predictions about profit trends in these and the other thirty-four industrial sectors, as well as construction, commerce, finance, construction, transport, communications, and other branches of economic activity, a task far beyond our competence. In thinking about the future, all we can say is that we see no reason to expect enterprise profits and savings to fall substantially as a share of GDP. If investment opportunities remain robust, enterprises will make substantial profits and will plow a large portion of those profits back into investment.

Forecasting the level of government savings mainly involves reaching a judgment about the likely path of government revenue and, more importantly, how that revenue will be used. The recent shift in government policy toward greater efforts to ameliorate the distributional consequences of rapid growth could boost subsidies for the poor and other welfare expenditures at the expense of government savings. We think it more likely that increased effort to reduce poverty is likely to concentrate on raising investment in education and rural infrastructure rather than subsidizing consumption. Our best guess is that government will continue as a substantial contributor to domestic saving.

In summary, therefore, there is every reason to believe that China's rate of saving and investment will remain high for the next two decades. Inadequate saving is unlikely to constrain China's economic growth between now and 2025.

B-Head Future Growth of the Labor Force and Human Capital

Since infants born in 2005 will enter the work force in 2021, forecasting China's working-age population to 2025 is not difficult. To accomplish this, we assume that the annual number of births remains constant during 2005–2009 and apply age-specific mortality rates for 2005 to the ensuing two decades. Results appear in Table 20.4. They show that China's workforce, which we define to include nonstudents aged 16–65, will continue to grow slowly until about 2015, and then begin to decline, resulting in a terminal 2025 figure that matches the projected total for 2010.

Insert Table 20.4 here

Our focus, however, is not on total numbers, but rather on the portion of the labor force that is employed outside agriculture and particularly on the changing educational attainments of Chinese workers. We consider these issues in turn.

The growth accounting results summarized in Table 20.2 indicate that a rising workforce has contributed 1 percentage point and often more, to overall growth ever since the 1950s. Should we be concerned that the stagnation and, after 2015, decline in numbers might detract from future growth? We think not, and for two reasons.

To begin, China's long history of labor market segmentation, which dates to the 1950s, institutionalized a large productivity gap between urban and rural workers (see Chapters 6, 17, and 19). Survey data for 2000, for example, show that wages of urban primary school graduates were more than double the earnings of rural workers

with similar educational qualifications.[26] Assuming that this wage gap reflects differences in the marginal labor productivity of rural and urban workers, we may anticipate that the transfer of workers from rural to urban occupations, which accounted for a substantial share of output growth during 1978–2005 (see Chapter 17), will continue to spur future growth. The presence of urban scale economies (see Chapter 19, Table 19.9) means that shifting workers from rural to urban occupations can increase the productivity of existing urban workers as well as that of the migrants themselves.

Economists analyze rural--urban migration from the perspective of the Harris--Todaro model, which assumes that migration is an increasing function of the gap between urban and rural incomes and of the migrants' probability of obtaining urban employment. The migration of villagers to China's cities and towns, which Chinese sources describe as a "tide of workers" (*mingongchao*), is already the largest in human history.

Government initiatives to remove barriers limiting migration – for example, by abolishing the administrative distinction between "urban" and "rural" residents, allowing trade unions to assist migrants' efforts to claim unpaid wages, and providing medical benefits for migrant workers – promise to improve pay and working conditions, which should increase the flow of migrants (Zheng, Wu, and Guo, 2005; Chen, 2006; Zhu, 2006).

China's recent declining rate of job creation obliges us to hesitate before concluding that the continued transfer of large numbers of workers from rural to urban occupations seems likely to offset the drag on the economy arising from the near-term slow labor force growth and eventual decline in the overall labor force. Employment growth in China's secondary and tertiary sectors dropped sharply during the past decade. One study found that annual creation of formal employment during 1995--2004 was no more than half as much as during 1990--1995 (Rawski, 2006).

Slow employment growth is partly due to restrictions on the inflow of rural migrants, however. The main difficulty is an array of policies, including official support for capital-intensive projects and sectors, low interest rates for favored borrowers, and policy discrimination against private business, which have the effect of tilting investment spending in directions that limit employment growth (Chapter 6, section "Causes of Unemployment and Slow Job Creation"). These policies, each with its own rationale, are "formulated without consideration of their effects on aggregate employment" (ibid.) and have the unintended consequence of restricting the growth of employment.

Given the importance that China's present administration has placed on efforts to accelerate the growth of employment, we anticipate that, despite the legacy of migration restrictions and of policies and institutional arrangements that constrain job creation, continued migration out of China's countryside will deliver sufficient

productivity increases to offset the negative impact of slow growth and eventual shrinkage of the labor force on overall economic expansion. In terms of our growth accounting equation, this productivity boost shows up in TFP because lack of sufficient data makes it difficult to separate the labor force in our equation into its rural and urban components.

How does the addition of human capital change this picture? Over the next two decades, growing numbers of high school and college graduates will reshape China's labor force. Our projections assume that the expansion of Chinese high school and college enrollments during 2005–2025 will parallel Japanese enrollment patterns during the two decades from 1955, when Japan's share of agriculture in its national labor force approximated China's 2005 share. The details are left to the appendix, but we assume that the proportion of high school (*gaozhong*) graduates among successive cohorts of 18-year-olds will rise from the 2005 figure of 42 percent to 82 percent by 2005 and that the proportion of successive cohorts earning tertiary diplomas will rise from 16.0 to 44.5 percent between 2005 and 2025.

Our labor force projections, summarized in Table 20.4, show that junior high school graduates will continue to constitute the largest segment of Chinese workers, accounting for a steady proportion slightly above one-third of the total. But the distribution of educational attainment among the remainder of the workforce will shift dramatically between 2005 and 2025, with the share of high school and college

graduates doubling from 18.4 to 37.9 percent, while the proportion with primary school diplomas or less drops from nearly half to only one-fourth.

As more students earn higher-level diplomas, their subsequent contribution to GDP will rise. Our projections show the annual numbers of high school and university graduates rising from 11.4 million in 2005 to 17.8 million in 2015 and 19.4 million in 2025, with new university graduates exceeding 6 million in both 2020 and 2025 (Table 20.4).

Table 20.5, which summarizes the results of our projections, shows that, under plausible assumptions about demographic and educational change, the education-enhanced workforce will continue to contribute positively to overall growth between 2005 and 2025 even as the number of workers reaches a peak and begins to decline. This is because the anticipated productivity benefits from the continuing spread of education outweigh the slow growth and subsequent decline in the actual number of working age adults.

Insert Table 20.5 here

B-Head Future Growth of Total Factor Productivity

As the earlier discussion indicates, it is possible to base forecasts of trends in factor inputs at least in part on solid information about demographics, school enrollment, savings potential, and investment behavior. No comparably solid foundation exists for estimates of the likely future path of TFP. Since TFP growth accounted for two-

fifths of China's overall GDP increase between 1978 and 2005, this poses a major difficulty for our effort to derive a reasonable forecast for economic performance over the coming decades. In order to create the firmest possible foundation for our predictions, we adopt the following step-by-step approach:

<BL>

- Use our projections of capital and labor input to examine the productivity implications of assumed 6 and 9 percent annual GDP growth during 2005–2025.

- Review the findings of cross-national studies of economic growth for possible relevance to China's economic future.

- Examine the likely future productivity impact – both positive and negative -- of specific dimensions of China's economy: further market-oriented reform, research and development, the financial and legal systems, and health and environmental degradation.

- Supplement our discussion of these supply side issues with a brief excursion into the implications of China's expenditure accounts for future growth prospects.</BL>

We then conclude by reviewing China's prospects for sustained productivity growth.

~~B-Head~~ Productivity Implications of Expected Growth of Capital, Labor, and Education

We begin with a series of calculations that investigate the productivity implications of combining specific assumptions about the growth of GDP and fixed capital with the labor force projections summarized in Table 20.4. Table 20.5 presents both assumptions and results.

To make the calculations underlying Table 20.5, we assumed annual GDP growth of 9 percent (versions 1 and 2) or 6 percent (versions 3 and 4) throughout 2005–2025. These are not predictions, but simply the starting point for our analysis. We project fixed capital using the perpetual inventory method with annual depreciation of 9.6 percent. Our capital stock projections assume that the GDP share of fixed investment declines linearly from the 2005 figure of 42.3 percent to a terminal 2025 level of 35 percent (versions 1 and 3) or 25 percent (versions 2 and 4).

Together with our projected labor force outcome (Table 20.4), these assumptions produce four growth scenarios, corresponding to various combinations of assumed growth rates (9 or 6 percent) and capital formation paths (fixed investment shrinking to 35 or 25 percent of GDP).

The first thing to note about these projections is that, despite the anticipated expansion of education, the contribution of labor and human capital to projected growth during 2005–2025 is only 0.8 percent annually, well below the 1.5 percent

figure derived for 1978–2005 in Table 20.2. Excluding rural--urban migration that shows up in TFP in our calculations, without the increase in high school and university enrollments, the contribution of labor and human capital growth over the coming two decades would be close to zero.

A second observation is that under widely varying assumptions about the growth of GDP and investment, the average annual contribution of fixed capital to overall GDP growth during 2005–2025 varies only between 2.4 and 3.9 percent. Put differently, if China has to rely entirely on inputs of labor (including education) and fixed capital for growth over the next two decades, the nation's GDP growth rate cannot exceed 4.7 percent per year – a figure that is only half the 9.5 percent rate attained during 1978–2005 (Table 20.2).

The central issue in forecasting China's future rate of growth, therefore, involves projecting the likely rate of growth of TFP. That will be the focus of the discussion that follows. One conclusion emerges from these projections alone. To sustain a growth rate of 9 percent per year for another two decades, China would have to push the annual growth of TFP growth above 4 percent – higher than the 3.8 percent growth attained during 1978–2005 and far above the 3.1–3.2 percent rate recorded during 1995–2005. We think such an increase in TFP growth is unlikely. Nor do we think that China can substitute a rapidly rising (as contrasted to our assumption of a falling) rate of capital formation to fill this gap. Our initial conclusion, therefore, is that China's GDP is not likely to grow by 9 percent a year

for the coming two decades. Simply maintaining the TFP growth rates of the recent

past will be an enormous challenge, and, as is evident from the four different

projections in Table 20.5, those rates will produce a GDP growth rate in the range of

6 to well under 9 percent a year.

When the projections for the two decades (2006–2015 and 2016–2025) are

separated out, it is clear that China will have much more difficulty achieving a rate of

growth above 6 percent in the second of these two decades. All of these projections,

the reader should recall, assume that China's economy enjoys a peaceful environment

both externally and internally. Assuming a peaceful environment, our belief is that

Chinese GDP will grow at a rate of from 6 to 8 percent per year for the next decade

and sometime in the second decade the economy will slow to a rate of GDP growth

that could be as low as 5 percent to a rate as high as 7 percent per year. In the second

decade the rate of growth will depend not only on the level of TFP achieved, but also

on the rate of growth in the first decade. A slower rate of growth in the first decade

will make possible a somewhat higher growth rate in the second.[27]

Would this level of economic performance for China be unprecedented or is

there experience elsewhere that would lend credence to these forecasts? An approach

that provides some guidance as to how long China can sustain high growth is one that

looks at other nations with similar economies that earlier experienced a sustained

(several decades or more) rate of GDP growth comparable to that achieved by China

over the past twenty-seven years. There are many economies that have achieved high

growth rates for a decade or less starting at low levels of per capita income and a few

that have grown at 7--9 percent per year for longer, but only three can be said to have

economies similar to that of China.[28] Those three are Japan, the Republic of Korea,

and Taiwan. In all three of the economies, growth proceeded for either two decades

(Japan) or three decades (Korea and Taiwan) at rates that averaged more than 8

percent per year. But all three eventually slowed down never to grow at rates that

high again. In Japan this accelerated growth began in the 1950s when full recovery

from World War II was achieved and continued until 1971 when the growth rate

dropped precipitously never to recover to "miracle" levels. In South Korea and

Taiwan the slowdown was not quite so sudden or sharp, but was pronounced

nonetheless and began in 1990 for Taiwan and 1992 for Korea.

As the data in Table 20.6 indicate, this slowdown came at a similar level of

per capita income, remarkably similar when GDP per capita is calculated in

purchasing-power parity (PPP) terms and converted into prices of a comparable year

(2005 prices in the case of this table). When these three economies' per capita GDP

passed U.S.$13,000 in PPP terms, the GDP growth rate in the years that followed

dropped and did not recover to the levels of the previous decades for even one year.

According to the World Bank (World Bank, 2007, p. 288), Chinese PPP GDP per

capita in 2005 was $6,600 and the Penn World Tables figure for 2004 updated to

2005 would be about $6,300. Because China does not participate in the United

Nations project that calculates PPP GDP figures, these Chinese estimates are subject

to more than the usual margin for error. Nevertheless, given that China's GDP per capita in U.S. dollars using the official exchange rate was U.S.$1,717, given that the Chinese currency is widely accepted to be significantly undervalued, and given that developing countries at this level of income typically have a PPP GDP per capita that is two or three times their per capita GDP calculated using the official exchange rate, these Penn and World Bank estimates are plausible.

Insert Table 20.6 here

If one accepts the Chinese estimates of PPP per capita GDP and our GDP growth rate forecasts of 6--8 percent or something over 5.4--7.4 percent per capita per year,[29] then China would reach the slowdown point within ten years (at 7 percent) or 14 years (at just over 5 percent per year). Thus, these international comparisons reinforce our view that China should be able to achieve 6--8 percent GDP growth for another decade (if reforms proceed at a determined pace) but it will be unprecedented for the growth rate to proceed at that pace for another full decade.

Being unprecedented does not mean it cannot happen, but we have no basis for believing that China will outdo the performance of Japan, South Korea, or Taiwan. This international comparison, therefore, reinforces what we have said based on our growth accounting estimates. Given a continued effort comparable to that achieved by Japan, South Korea, and Taiwan, China's economy has the potential to grow at a high rate, as high as 8 percent, for another decade and perhaps a bit longer. But when China's GDP reaches PPP $13,000 (in 2005 prices) a decade or a bit more

from now, it is likely that the GDP growth rate will begin to decline on a sustained basis. Whether it will come down sharply, as in the case of Japan, or more gradually as in the case of South Korea, remains an open question.

None of these projections will be realized, however, unless China is able to maintain a high rate of growth of TFP. What kind of evidence can we bring to bear on the question of whether Chinese TFP over the coming two decades will continue at its recent pace or whether it will begin to slow down or even disappear altogether? Our approach to this question is first to look at what we can learn from the various econometric efforts that use an array of variables to study the determinants of economic growth in large numbers of nations. We will concentrate on those variables that might have something to do with TFP. Second, we will then turn to a brief review of well-known sources of inefficiency in specific Chinese sectors and institutions, inefficiency whose elimination could help sustain TFP growth. Some of these latter issues are also discussed at greater length in other chapters in this volume.

B-Head Econometric Estimates of the Sources of Growth

A number of researchers have used data from many economies to conduct statistical studies that attempt to pinpoint factors that can be associated with higher or lower rates of long-term growth. The resulting econometric growth equations are not ideal for our purposes, because they typically relate various explanatory variables to the growth rate of GDP rather than to the growth rate of TFP. Furthermore, these

equations do not include a variable for capital formation, because the level of capital formation is endogenous and hence the estimates of its relationship to growth will be biased when estimated econometrically. Thus, the explanatory variables used could work as much through capital as through TFP to raise the growth rate of GDP. Variables such as the working population and the total population, for example, are an indirect way of measuring the dependency ratio and hence the likely level of savings and investment.

Despite these difficulties, econometric studies of growth do provide plausible links to productivity growth. Comparing these links with Chinese circumstances reinforces the perception of China as an economy with strong growth prospects.

Jeffrey Sachs and Andrew Warner find a strong positive association between economic openness and growth (Sachs and Warner, 1995). Openness is clearly tied more closely to productivity than to capital formation. In Chapter 16 on China's international economic relations, Branstetter and Lardy show that the dramatic opening of China's economy predates Beijing's 2001 entry into the WTO. Looking ahead, both domestic policy (e.g., the "Go Global" (*zou chuqu*) program that promotes overseas investments by Chinese firms) and China's WTO obligations, which call for further liberalization of trade in services as well as commodities, point to future increases in China's participation in many forms of cross-national exchange.

China earns high marks for openness in terms of the specific criteria employed by Sachs and Warner. In their analysis, "open" economies have tariff rates

below 40 percent (China's weighted average tariff rate was 12 percent in 2001),

subject no more than 40 percent of imports to quotas and licensing (China applied

such measures to only 21.6 percent of imports in 2001), [30] maintain moderate export

taxes (China has few taxes on exports), and keep the black market premium for

foreign exchange below 20 percent (with China's *renminbi* widely seen as

undervalued, there is no black market premium).

Sachs and Warner also find links between geography and growth.

Specifically, their work associates slow growth with states that are landlocked, have

short coastlines, and/or are located in the tropics. China avoids each of these potential

obstacles. The reasons underlying the superior economic performance of nations

located outside the tropics and endowed with long coastlines are not entirely clear.

Chinese experience suggests that the negative impact of isolation has more to do with

the attitudes of people and their governments than with physical limitations. Many

chapters in this volume, particularly the studies of trade, industry, and science,

demonstrate that China's dramatic shift from isolation (imposed by politics rather

than geography) to growing openness contributed to the economic boom of the last

three decades.

Development economists find a negative association between large resource

exports and growth, apparently because of management difficulties associated with

dominant natural resource exports whose revenues experience wide price

fluctuations. From this perspective, China's growth prospects benefit from its

growing dependence on imports rather than exports of crude oil, iron ore, and a variety of other resource products: one study finds that "by 2020, China's domestic resources will fully supply only 9 of 45 mineral varieties" (You and Qi, 2004, p. 13).

Robert Barro finds that high levels of government consumption (as a share of GDP) tend to retard economic growth (Barro, 1997). Collection of taxes to fund public consumption, including excessive levels of subsidies and welfare outlays, could divert funds from investment. As Wong and Bird note in Chapter 12 on the fiscal system, China's formal tax system "remains weak," with budgetary revenue and extrabudgetary funds each amounting to roughly 20 percent of GDP. Despite recent increases in defense budgets, China's public spending avoids excessive consumption outlays, perhaps because, as Wong and Bird emphasize, responsibility for most social expenditures rests with poorly funded local administrations. Data for 2005 show that the combined budgetary expenditures of central and local governments amounted to 18.5 percent of GDP, of which roughly one-third may be classified as investment related.[31]

Most cross-national studies include a variable for education. Because growth promotes school enrollment, so that the causation between education and growth runs in both directions, analysts typically make use of education levels at the start of the period being considered. China's 2000 census found that the average adult had received 8.28 years of education or 2.28 years of secondary schooling (Census Research, 2005, p. 1649). The China Health and Nutrition Survey reports a 75

percent secondary school enrollment rate in 2000 among youths aged 12–18, much higher than the 53 percent sample average among ninety-eight countries in Barro's cross-national study (see Chapter 7, Table 7.7; Barro, 1991, p. 438). At the beginning of the twenty-first century, China had a high level of schooling given its per capita income. With educational attainments expected to rise further, these growth equations lead us to anticipate that high and growing levels of educational attainment should add momentum to future Chinese growth.

Alesina and others find that cross-national data reveal a positive link between political stability and economic growth (Alesina and Perotti, 1994; Alesina et al., 1996). Chinese experience confirms this observation. Political turmoil slowed China's economy at many points during the century prior to the establishment of the People's Republic of China in 1949 and again during the chaos of the Great Leap Forward and the Cultural Revolution (1958–1976).

During the reform era, China's economy has clearly benefited from a combination of relative political stability (notwithstanding the uncertainty surrounding the Tiananmen incident of June 1989) and policy focus on economic growth. While this chapter avoids engaging with political issues, we see the continued presence of a stable, growth-oriented political environment as an essential support for the continuation of sustained productivity growth.

Table 20.7 summarizes our reading of China's current position with respect to variables commonly employed in cross-national regression studies intended to

pinpoint the determinants of economic growth. In general, these observations show that China is well situated to continue the strong economic performance of the recent past.

Insert Table 20.7 here

Cross-national growth studies typically also include dummy variables for different regions of the world; the estimated coefficient for East Asia is invariably positive, meaning that, after controlling for the other explanatory variables, East Asian performance turns out to be unexpectedly strong. Exceptional growth in East Asia during the 1960s and 1970s provided important motivation for China's reform effort: "no sooner had the Chinese opened their eyes to the outside world after the Cultural Revolution than they exclaimed how far China had lagged behind" (Hua, Zhang and Luo, 1993, p. 27).[32] Now, such studies identify China itself as exceptional in the same fashion: Bekaert, Harvey, and Lundblad find that "standard growth regressions substantially under-predict ... Chinese growth .... China is a huge outlier with the bulk of its past growth unaccounted for by the standard variables" (2006, pp. 22, 34).

Table 20.7 points to institutions as the single area in which Chinese circumstances fail to provide the conditions that cross-national studies associate with rapid economic growth. To examine the adequacy of Chinese institutions and policies to support sustained growth of productivity over the coming decades, one must get beyond these econometric estimates and focus on the specific situations facing China

along a number of dimensions. To do that, we draw in part on a few general trends in the development of market-related institutions in China and in part on studies by others of such growth-related issues as the cost of dealing with environmental problems.

Can Chinese Institutions Support Continued Rapid Growth?

The Role of the State

Although the experiences of Singapore and a few enterprises in Korea (POSCO), the United States (Tennessee Valley Authority), and elsewhere demonstrate that state ownership and management can coexist with economic success, recent Chinese experience supports the view that a higher degree of state involvement in ownership and direct management of economic activity is likely to reduce the future increase of TFP. Chapter 17 in this volume and many other studies associate state intervention and especially public ownership with low growth of output, employment, and productivity, slow progress toward the transfer of labor out of farming and other aspects of structural change, low investment returns, and large seasonal fluctuations in economic activity.

At the outset of China's reforms in 1978, the state controlled virtually all aspects of the economy. Markets governed only the allocation of a few consumer

goods and rural sidelines, and even then, prices were set by the state. Private activity was essentially limited to the household plots of farmer families, which occupied about 5 percent of China's cultivated acreage.

Since that time, a long sequence of reforms has pushed market forces to the fore in determining the prices of virtually all goods and most services. Among factors of production, wages and urban land prices have moved into the market orbit, while official preferences still exert strong control over the price of capital and especially the price of foreign exchange (see Chapter 14 in this volume).

Ownership of resources has experienced substantial, though less dramatic, change. Early reform initiatives included the dismantling of collective farms and the restoration of family farming, which effectively privatized farm equipment and livestock, while ownership of land (including mineral deposits) remained in the hands of the state.

Ownership in the secondary and tertiary sectors is more complex, but the trend toward private control is clear (Garnaut et al., 2005). Virtually all retail commerce and much wholesale commerce are in private hands. Even nominally state-owned department stores mainly rent space to individual traders. Although the state has maintained its control over the finance and utility sectors, as well as railway, airline, and telecommunications networks, privatization has begun to infiltrate these activities, although its extent remains modest.

Industry provides a well-documented illustration of the shift away from state control. Table 20.8 tracks the output shares of different ownership forms between 1980 and 2005. Despite shifts in category definitions and in the scope of industrial output, the trend toward private ownership is clearly evident. The output share of state-owned enterprises plunges from 81 percent in 1980 to 15 percent in 2005.

Insert Table 20.8 here

Even if we assume effective state control of all corporations, the combined share of state-owned and corporate firms in 2005, at 41 percent, is only half the size of the 1980 starting point. While state influence permeates the operations of many corporations, the assumption of across-the-board state control is excessive: China's 2004 economic census found that the sources of capital for shareholding entities included a state share of 52 percent, but for limited liability corporations, the state's capital share (36.2 percent) was considerably less than the share of private Chinese stakeholders (47.2 percent) (State Council Economic Census Group, 2005, table 8).

Even when state ownership is substantial, industrial companies show a growing tendency to pursue commercial interests, as when petroleum refiners, squeezed between rising costs for imported crude oil and controlled domestic prices of gasoline, reduced their production and domestic sales of gasoline, thus creating regional gasoline shortages in order to draw attention to the negative impact of price controls on their finances.[33]

Equally impressive is the growing scale of privately controlled industrial activity. The 2005 data in Table 20.8 show 52 percent of industrial output coming from domestic private firms and from firms with partial or full foreign (including Overseas Chinese) ownership. With the 2004 Economic Census listing the combined share of private and foreign capital as 97.8 percent for domestic private firms, 85.9 percent for firms with investment from Hong Kong, Macao, or Taiwan, and 88.1 percent for firms with other foreign ownership, these enterprises surely fall into the category of private ownership despite pockets of official influence (State Council Economic Census Group, 2005, table 8).

Recent developments demonstrate a continuing shift away from state ownership. The 2004 Economic Census reported that the number of state enterprises in the entire economy dropped by 177,700, while the number of collectives fell by 402,000 between 2001 and 2004, indicating declines of over 45 percent in each of the two most prominent forms of public ownership. At the same time, the entry of 658,000 private enterprises employing eight or more persons pushed the balance of ownership further away from the public sector (State Council Economic Census Group, 2005).

We anticipate further declines both in the number of state firms, especially at the provincial and local levels, and in the state sector's output share. In addition, the proliferation of public offerings and the conversion of nontradable corporate shares

held by state-sector entities into tradable shares will further dilute public ownership of corporate firms.

As the share of public ownership shrinks, the issue of state intervention in the operation of the economy, rather than direct state ownership, comes to the fore. The chapters in this volume identify many areas of China's economy in which official intervention is no more intrusive than in many leading market economies. The planning, financing, and implementation of capital formation, which absorbs over 40 percent of aggregate expenditure, represents the biggest exception to this observation. The institutions surrounding investment behavior pose a considerable threat to China's forward momentum. At the same time, weaknesses in these institutions create opportunities for improvements that can stimulate future productivity growth.

The disproportionate role of the state sector in investment spending is widely understood. Despite their declining output share and consistently low profitability (Table 20.8), state-owned units absorbed one-third of investment funds in 2005 (Yearbook, 2006, p. 187). As Allen, Qian, and Qian point out in Chapter 14, bank loans, share offerings, and bond issues flow mainly to state-controlled entities. The unfortunate consequences of extensive official involvement in investment decisions are well documented. Even after twenty-five years of reform, Table 20.9 shows that investment spending displays Soviet-style seasonality, with low activity during the first quarter, minipeaks in June and September, and a fourth-quarter rush. Chinese sources provide a flood of anecdotes chronicling poor investment decisions. Zhang

Hanya, secretary general of the China Investment Association, reports a failure rate
of 42 percent for medium- and large-scale projects during the Eighth Five-Year Plan
period (1991–1995) (Gao, Shi, and Zhou, 2004). Failed investment efforts often arise
because "local governments and officials ... invest in 'image projects'... to enhance
their performance record" (GDP, 2004).

Insert Table 20.9 here

Recent studies deploy firm-level industrial data to explore the
macroeconomic consequences of China's largely unreformed investment system.
Using data from more than 100,000 enterprises, Hsieh and Klenow (2006) find that
equalizing the marginal product of labor and capital across enterprises within specific
four-digit industries could raise output by approximately 100 percent.

Dollar and Wei (2006) employ a smaller data set, but focus precisely on the
link between ownership and returns to capital. Preliminary results show that "the
average return to capital is more than 50 percent higher for private firms [and also for
foreign-invested enterprises] than for wholly state-owned firms .... [These results]
suggest that state-ownership is systematically associated with lower returns to
capital."

It is evident that reductions in state ownership and official intervention in the
economy, particularly in the realm of investment decisions, have the potential to
propel substantial productivity gains over the coming decades. The benefits of an
improved investment mechanism extend far beyond reducing the number of failed

projects and the scale of bad debt. Policies that channel investment funds to state-sector projects and artificially reduce interest rates to improve the profitability of state-sector borrowers are largely responsible for the slow pace of job creation visible since 1995 (Rawski, 2006).[34]

Despite these difficulties, important steps have moved China's economy toward greater commercialization of investment, by which we mean a structure in which decisions governing investment outlays rest primarily in the hands of decision makers whose choices reflect the costs and likely returns to alternative allocations of funds. Substantial privatization has placed increasing shares of assets and profits under the control of profit-seeking entrepreneurs and managers. Removing restrictions on the sale of formerly nontradable corporate shares, while still incomplete, represents another important advance. Ongoing expansion of the market for corporate ownership rights is also highly significant. Business mergers and acquisitions, which increasingly cut across sector, provincial, and national boundaries, can activate assets formerly trapped in low-yielding circumstances.

The emerging agenda for China's State Asset Supervision and Administration Commission (SASAC), established in 2003, represents another significant development. SASAC's objective is to represent the state's interest as the owner and investor in over 150 centrally controlled state enterprises, including China's large "petroleum, petrochemical, electricity, automobile, and telecom enterprises, as well as those that evolved from the old military industry ministries, Chinese government

conglomerates based in Hong Kong, the big state-trading and import-export companies, specialized construction companies and research institutes, and quite a few high-tech enterprises including Great Wall Computer and Alcatel Shanghai Bell" (Naughton, 2003, p. 3). Provincial and local commissions will perform similar functions at lower levels of government. This initiative may eliminate long-standing difficulties arising from the absence of any effective agent to implement ownership of state enterprises by "all the people." SASAC, which "formulates its agenda in terms that a Wall Street investment banker would understand," aspires to collect dividends from profitable state enterprises, channel these funds into a capital management budget, and gradually shift the management of state ownership interests into the hands of public companies operated by investment specialists (Naughton, 2005, p. 7; 2006).

Recent initiatives at both the central and local levels illustrate the potential productivity benefits of implementing these ambitious plans. In addition to managing the government's interest in centrally controlled state firms, the national SASAC has systematized procedures for management buyouts at provincial and local state enterprises, enhanced the marketability of shares in state firms, expanded listings of state-controlled enterprises, announced plans to accelerate bankruptcies, and supported M&A activity involving centrally controlled firms in the energy and electronics sectors, among others (Li, 2005; Naughton, 2005, 2006; Wang Ying, 2005, 2006a,b). At the local level, Shenyang's municipal SASAC "plans to sell a 49

per cent stake in China's top machine tool manufacturer, Shenyang Machine Tool Group "... to diversify the company's ownership and improve its competitiveness" (Wu, 2006).

Reforming the Financial Sector

Along with the actions of SASAC and other official agencies, the progress of reform efforts in China's financial and legal systems is likely to exert a powerful influence on the outcome of efforts to improve the quality of day-to-day economic decision making.

We see three levels at which fundamental change in China's financial sector can improve the prospects for sustained productivity growth: cleaning up bank balance sheets, promoting entry and reform to increase the range and quality of financial services offered to Chinese firms and households, and removing politics from the allocation of financial resources.

Chapter 14 by Allen, Qian, and Qian chronicles the recent decline in the share of nonperforming loans in the banking system. Whatever the exact level of bad loans, preventing the future accumulation of nonperforming debt is a key reform objective. Japan's recent experience illustrates the danger associated with high levels of bad loans. Japan's floundering banks sought to protect their weak balance sheets by propping up heavily indebted clients with additional loans while denying credit to potentially dynamic start-up companies. The result was a decade and a half of near

stagnation for Japan's economy. With state firms, including many weaklings, absorbing huge amounts of capital and private companies pushed to the margins of the formal financial system (see Chapter 14 in this volume), China's economy could drift into comparable difficulties. To avoid such dangers, China needs to commercialize its financial markets by dismantling long-standing arrangements that favor state firms with preferential access to bank loans and preferential opportunities to tap domestic and international stock and bond markets. The productivity and employment benefits associated with these reforms (and the cost of inaction) will increase as the economy becomes more complex.

Improving the scope and quality of financial services by expanding entry and upgrading existing institutions can provide important support for raising productivity growth during the coming decades. Two key measures have opened the door to long-term development of China's weak financial sector. China's entry into the WTO included a promise to offer national treatment to foreign banks, investment firms, and insurance companies. China's subsequent decision to sell equity stakes in key financial institutions to international firms ensures the implementation of this promise by installing global leaders of international finance within the core of China's financial sector. By selling equity stakes in China's largest banks and insurance companies, China's leaders have implicitly acknowledged both the central importance of commercializing the financial sector and the inadequacy of their own prior reform efforts.

The injection of global financial heavyweights and offshore reporting requirements into key banks and insurance firms should increase pressures to control the fraud and embezzlement that have plagued China's financial sector. Even more important than curbing criminality is the effort to install business rather than politics as the foundation for allocating funds. This will entail rolling back long-standing arrangements under which offices of the Communist Party selected the officers of financial institutions, government quota systems controlled access to stock market listings, "high-risk financial projects ... ended up getting bank loans, usually under orders from government departments," and local bank offices, "with little choice, frequently ignored routine risk calculations and limits on the size of loans ... at the behest of party and government officials" (Sender, 2004; Gao, 2005).

Past efforts to improve China's financial system "have done enough *not* to slow down the growth of the economy" (see Chapter 14, section "Summary and Concluding Remarks"). Looking forward, this minimal standard is unlikely to suffice. China's financial system falls far short of arrangements that can offer positive support to (rather than merely permitting) sustained growth of output and TFP.

Recent changes have pushed China's financial system in the right direction. The weak starting point provides ample opportunities for productivity-enhancing improvements in performance. To underwrite continued growth and productivity increase, China needs to raise its financial sector to the level currently operating in

Korea and Taiwan. This is not a high standard. Achievement of this outcome – or better yet, one that matches the considerably more effective financial mechanisms currently operating in Hong Kong and Singapore – depends most of all on China's success in wringing politics out of lending and investment decisions.

B-Head Strengthening the Legal System

Chapter 11 on law recounts many flaws in China's legal, judicial, and enforcement regimes. The question of how China's economy developed so fast in the face of these weaknesses remains open. Perhaps economists overstate the importance of having governments enforce property rights and uphold contract provisions. Perhaps flaws in China's legal system are less costly than they appear from outside. Perhaps, as both the law and finance papers suggest, Chinese participants have developed alternative mechanisms that partially replace what theorists regard as essential institutional arrangements. The extensive participation of China-based firms in cross-national networks of manufacturing, finance, research, and design demonstrates that, whatever its shortcomings, China's legal system has not decisively blocked national development to date, nor has it prevented Chinese firms from joining in increasingly complex webs of transactions. At the same time, we cannot doubt that weaknesses of the legal system, beginning with such elementary matters as employers (including government-run firms) refusing to pay wages or electricity purchase agreements being "scrapped because local governments felt that the original contracts were too

expensive," impose very large costs on China's economy (Xie, 2005; Defaulting, 2006).

Two areas, intellectual property rights (IPR) and disposition of business property, stand out as particularly important for China's long-term growth prospects. Although the active involvement of official agencies makes the extent of Chinese technological piracy quite unusual,[35] developing nations, including the United States, have typically ignored IPR enforcement at early stages of their growth. The reason is obvious: for nations with little in the way of intellectual property, the benefits of piracy outweigh the cost to domestic innovators.

The rapid expansion of domestic R&D spending described in Chapter 9 on science and technology, together with China's growing success in attracting R&D operations from foreign companies, means that the value of domestic intellectual property, and therefore the potential cost of weak IPR protection, has entered a steep upward trajectory. As more and more Chinese firms join the "battle against pirates and counterfeiters" and Chinese innovators focus on "strengthening ... defenses ... [against] other enterprises ... copying ... technology ... without paying any royalties," the future course of public policy seems clear (Liu Weiling, 2005a,b).

Rapid intensification of official efforts to curb IPR violations appears to have begun. Official regulations have outlawed the installation of pirated software in government offices and, most recently, in newly manufactured computers (Poon, 2006). IPR enforcement is emerging as a new dimension of competition among

localities. Beijing's municipal government has ordered enterprises to use authentic computer software and plans to establish a hotline to receive IPR complaints, while Guangdong plans to "redouble efforts to improve the system for technological innovations while improving measures to protect intellectual property rights" (Guan, 2006; Zhan, 2006a). Initial results impress often critical foreign media, which note that "China Moves From Piracy to Patents" and that "China Makes Genuine Progress Against Sellers of Fakes" (Ortolani, 2005; Dickie and Minder, 2006).

The disposition of assets for firms undergoing bankruptcy or restructuring is equally important, especially because these categories encompass large numbers of firms and large amounts of assets. The emergence of national and regional SASAC agendas for the management of state-owned assets represents an important advance, as does the expansion of mergers and acquisitions based on commercial criteria rather than official decisions. Despite these gains, the commercialization of firms now trapped in bureaucratically controlled enterprise groups (*jituan*) holds the prospect of considerable gains in productivity.[36]

It is too early to tell whether China's new bankruptcy law, which took effect in June 2007, will establish a system in which legal precepts rather than official preferences govern the timing of bankruptcy declarations and the disposition of assets held by bankrupt firms. In North America and the European Union, these decisions are made by the firms involved subject to rules set down by the legislature and enforced by an independent and competent judicial system or by independent

regulatory bodies. In China, as in much of East and Southeast Asia, these decisions are often made by the executive branch of the government. The courts lack the independence, competence, and authority to determine and enforce the resolution of issues surrounding bankruptcies, mergers, or acquisitions.

The central point here is that the absence of competent and effective judicial or regulatory processes pushes such decisions into the hands of government or party administrators in spite of the high costs associated with official intervention in business decisions. As Perkins (2004) argues, efforts to establish an independent judiciary as the chief arbiter of issues surrounding the disposition of business property will hasten the improvement of corporate governance and the protection of minority shareholder interests, both of which can contribute to future productivity growth.

DO SOCIAL ISSUES POSE MAJOR OBSTACLES TO CHINA'S DEVELOPMENT?

In addition to possible political instability, numerous observers suggest that social issues could pose major obstructions to China's future growth (e.g., Wolf et al., 2003; Pei, 2006). We focus successively on public health and environment.

Public Health

The SARS scare of 2002–2003 and the longer-term issues surrounding AIDS/HIV

have drawn international attention to the limitations of China's public health system.

Despite many shortcomings, China's response to both SARS and AIDS/HIV suggests

that health authorities have sufficient administrative and financial resources to

prevent threats to public health from inflicting severe damage on China's economic

prospects.

In the case of SARS, crude but effective official and community action

rapidly defused a potentially dangerous situation by curtailing interaction between

suspected disease carriers and the general public. Following the collapse of initial

efforts to deny the spread of this disease, the official response shifted to "massive,

swift, and concentrated action from the center. Strong quarantine measures were

introduced, and SARS 'bounties' were paid to help in contact and case finding. The

Health Minister was sacked and epidemic monitoring systems tightened up" (Ma et

al., 2006, p. 289). Economic damage, though substantial, was confined to the first

half of 2003, after which rapid growth resumed (Rawski, 2005).

The official Chinese response to HIV/AIDS followed the same sequence of

denial followed by strong action to limit the spread of disease. Recent policy

measures include steeply rising appropriations for combating HIV/AIDS; efforts to

expand the availability and reduce the cost of medications; investigation and

regulation of blood collection networks; imposition of compulsory premarital health

checks in Yunnan, the province most seriously affected; and limited offers of free

testing and treatment (Ma, 2005; Wu and Sullivan, 2005; Ma et al., 2006; Yunnan, 2006; Zhang, 2006).

Specialists agree that this disease could spread to as many as "10 million infected over the next decade *in the absence of effective measures*" (Ma et al., 2006, p. 289; italics in original). They also report that in 2002 "the Chinese government succeeded in reducing the cost of annual antiretroviral treatment ... to US$4000–5000 ... with significant price reductions ... since 2003" (Ma et al., 2006, p. 293).

We can crudely reckon the direct cost of treating HIV/AIDS under worst-case assumptions: 10 million HIV/AIDS victims with the government bearing the full annual treatment costs of U.S.$5,000 per person. At RMB7.5 per dollar, the annual cost becomes RMB375 billion. Although spending of this magnitude would impose substantial pressure on official budgets, China's government, which increased its revenues by RMB525 billion during 2004--2005 alone, is fully capable of mobilizing funds on this scale without major economic disruption.

We conclude that public health issues, barring some worldwide health catastrophe on the model of the 1918 pandemic or worse, are unlikely to impose major obstacles to the growth of China's economy during the coming decades.

B-Head Environment

Environmental issues are widely seen as possible barriers to future growth. The questions that matter for our forecast of the future are whether cleaning up the

undoubtedly widespread environmental degradation will cost so much that it will cut

significantly into investment in new production or whether that degradation will

reduce the health of the labor force enough to materially influence the labor force's

contribution to growth. We focus on issues surrounding air quality and water supply.

Focusing on urban air quality, Roumasset, Burnett, and Wang find declining

levels of particulates and sulfur dioxide and conclude that "the statistical picture of

pollution trends contrasts starkly with bleak qualitative reports" (see Chapter 8).

Rawski and Sheng (2007) provide evidence that concentrations of dust and soot

outside major cities reached a peak around 2000 and subsequently began to decline,

suggesting a general trend toward improved air quality.

International comparison of trends in urban concentrations of particulates and

sulfur dioxide can provide historical perspective on Chinese air quality. Figure 20.3

compares trends in concentrations of sulfur dioxide in major Chinese cities with

circumstances in the United States, Japan, and Korea. The average for Chinese major

cities consistently falls below the readings for Tokyo in 1968, for Seoul in 1990, and

in recent years, for New York in 1972. The Chinese average for 1984 matches the

1984 reading for Pittsburgh, which was named "America's most livable city" in the

following year. Even the worst of major Chinese cities now reports lower

concentrations of SO_2 than Tokyo in 1965 or Seoul in 1990. These observations

demonstrate that air quality in major Chinese cities, although well below current

standards in today's rich nations, can hardly pose unprecedented hazards to human health or economic growth.

Insert Figure 20.3 here

Cross-national data for total suspended particulates (TSP) reinforce the observation that the magnitude of Chinese urban air pollution is not unusual. Figure 20.4 plots primary-sector labor force shares for China, Japan, and Korea against urban TSP concentration for Tokyo, Kitakyushu, and Seoul and compares these observations with the arithmetic average of readings for approximately thirty major Chinese cities. The share of the primary sector (mainly agriculture) in the national labor force is a standard development indicator that declines with rising levels of per capita income.

Each series shows a declining trend in atmospheric concentration of particulates. In Japan, the decline begins when the primary-sector labor force share stands in the range of 20–30 percent. In Korea, the decline starts with primary labor share in the 25 percent range. In China, by contrast, ambient concentrations of TSP begin their downward march much earlier in the development process, when the share of primary-sector workers in the national labor force is approximately 50 percent.[37] These data indicate that the spread of new technologies and especially of awareness about the damaging effects of pollution have prompted China to move toward abatement of urban air pollution at an earlier stage of the development process than occurred in Japan or Korea.

Insert Figure 20.4 here

While air quality appears to be improving, China's greatest difficulties with water lie in the future. Elizabeth Economy notes that "[f]or many regions in China, diminishing water supplies pose today's greatest social, economic, and political challenges ... the Ministry of Water Resources predicts a 'serious water crisis' in 2030, when ... China's per capita water resources are estimated to decline to the World Bank's scarcity level" of 2,000 cubic meters per capita per year from the 2005 level of roughly 2,150 (Economy, 2004, pp. 67–68; Yearbook, 2006, p. 412). With water tables falling, 400 of 660 cities reporting water shortages, and over 100, including the capital, reporting "very severe" supply problems, it is evident that current arrangements are not sustainable (Water, 2005).

China's water resources are unevenly distributed, with available supplies concentrated in the south, while northern regions cope with extreme supply limitations. One study indicates that 1993 levels of per capita water resources are at 225–356 cubic meters per person for North China's major river basins (Wolf et al., 2003, p. 78). Although these figures may be too low, data for 2005 show ten province-level units with per capita water resources less than 1,000 cubic meters. These water-short regions, which include the two most populous provinces, Henan and Shandong, as well as Beijing, Tianjin, and Shanghai, account for 34.8 percent of China's population (Yearbook, 2006, pp. 101, 412). With urbanization and

industrialization generating higher levels of waterborne effluents, the water-short areas confront growing difficulty with the quality as well as the quantity of water.

Statistics on water usage show a steep tilt toward agriculture. In 2004, the farm sector absorbed 65 percent of total water consumption.[38]

Price increases, structural change, and regulatory controls can help save water. Nationwide data show the average price of water rising from RMB1.63 to RMB3.61 per cubic meter between 1993 and 2001 for agricultural use and from RMB8.2–8.7 to RMB22.8–24 for household and industrial use between 1994 and 2001 (Liu Wei, 2005, p. 217). In Beijing, "the current price is 3.7 yuan ... more than 30 times the price in 1991" (Xin, 2006). With the Minister of Water Resources insisting that water prices "must be used as a major way" to promote efficient usage, further increases seem inevitable.

Water usage declined from 537 to 465 tons per RMB10,000 of GDP between 2002 and 2003, but these figures are "about four times the global average" (Zhao, 2004; Liang, 2005). This decline may persist as development shifts output and employment toward services and away from farming and water-intensive manufacturing industries. Policymakers have also imposed "Norms of Water Intake" to "mandate rational and efficient use of water" in seven water-intensive industries (Zhao, 2004).

Each of these measures promises important benefits. However, the dominant share of agriculture in water consumption and the difficulty of collecting water fees

from farm operators[39] mean that an effective response to growing water shortages will almost certainly include substantial reductions in farmland and agricultural employment, particularly in North China. Compulsory shrinkage of farm activity has also begun: Chicheng county, Hebei, which "provides almost half the water for Miyun Reservoir" in nearby Beijing, shifted cultivated acreage from rice to corn and "dropped sheep grazing ... to ... only a quarter" of the 2001 figure "in a bid to provide abundant water resources for Beijing" (Yang, 2006).

In environmental matters, as in the health sector, cost is not a major issue. News that anticipated costs for the initial phase of "China's massive south-north water diversion scheme" would rise "by around 80 per cent ... to a total 225 billion yuan," with "the entire project ... expected to cost 500 billion yuan ... before 2050" appeared as a routine announcement that reflected no sign of alarm (Diversion, 2006). A figure of 500 billion yuan spread out over one decade would amount to roughly 0.4 percent of average annual gross capital formation each year and spread over two decades would be less than 0.2 percent of gross capital formation each year.[40]

Table 20.10 shows that annual investment in remediation and prevention of pollution, which does not include expenditures on water diversion projects, has jumped from under 1 percent of GDP in the early and mid-1990s to 1.1–1.3 percent in 2004--2005, figures that approach comparable totals for the United States, Japan, and Germany around 1990, when annual spending on environmental protection and

pollution control ranged from 1.3 to 1.8 percent of GDP (O'Connor, 1994, pp. 177–

178). For China, these outlays amount to no more than 3 percent of annual

investment spending. Although these are sizable figures, high levels of current and

projected future saving and investment mean that China's economy can easily

support a much larger burden of expenditure on environmental remediation without

endangering its prospects for rapid growth of output and productivity.

Insert Table 20.10 here

What of the possible impact of global warming on China's development

prospects? When and if global warming leads to a major rise in the sea level, China,

along with many other nations, will face large expenditures to move people out of

flooded areas, notably in the lower reaches of the Yangzi River, or to build dikes to

protect low-lying coastal cities. Of greater relevance to the next two decades, the

challenge for China, and for other nations, is to restrict CO_2 emissions so that the

worst effects of global warming do not occur. Success in this regard will eliminate

the need for remedial investments to control coastal flooding. Efforts to limit CO_2

emissions mainly involve improving the efficiency of energy use, an area in which

China lags far behind international best practice. Japan's successful efforts to raise

energy efficiency did not damage its economic prospects. We see no reason to expect

similar conservation efforts to undermine Chinese economic growth.

We conclude that issues surrounding public health and environment, while

confronting China's policymakers with a broad array of complex and difficult

problems, seem unlikely to pose fundamental obstacles leading to downward revision of China's prospects for economic growth between now and 2025.

B-Head The Demand Side of the Sources of Growth

Most of the discussion in this chapter has approached the question of future growth from the supply side of the issue. But there are also elements on the demand side that will determine whether or not China will be able to sustain rapid growth over the next one to two decades. The contributions of the main expenditure categories to annual growth in China since 1979 are presented in Figures 20.5 and 20.6. There are two trends worthy of note in these figures. The first is that household consumption as a share of GDP declined steadily over time and came to just under 40 percent GDP in 2004 and 2005. The change in household consumption as a share of the change in GDP also fluctuated around a declining trend line and fell to a very small level below 30 percent of the increment to GDP in the years after 2001. The change in government consumption as a share of the change in GDP fluctuated year to year as well, peaking in the late 1990s when, as discussed earlier in this chapter, the Chinese government pump primed in an effort to keep the financial crisis of those years from depressing the growth rate of GDP.

Insert Figures 20.5 and 20.6 here

The most notable trend in these charts, however, is that the annual change in exports accounted for a rising share of incremental expenditure on GDP and in the years 2003–2005 accounted for over half of that change in GDP. Put differently, without the extraordinarily rapid growth of exports in recent years, China very likely would have experienced a shortage of aggregate demand, and, unless the government had taken steps to prime the pump as in 1997–1999, the growth rate of GDP would have fallen markedly because of inadequate aggregate demand.

This contribution of the annual rise in exports to GDP was achieved thanks to a growth rate of exports over the past decade that averaged 17.7 percent per year (2005/1995) and averaged 29.9 percent per year over the last five years (2005/2000). There is a large import component to these exports, so the net impact on aggregate demand is moderated, but the point remains – Chinese growth in recent years has been highly dependent on an unusually high export growth rate.

It is highly unlikely that an export rate of growth of this magnitude can be sustained for even one more decade let alone two decades. Exports in 2005 reached U.S.$762 billion. At a growth rate of 15 percent per year, lower than the average of the past ten years, exports in 2015 would reach U.S.$3 trillion and would by then be growing at U.S.$450 billion per year. China's factories could probably produce this many toys, shoes, textiles, computers, cars, and television sets per year, but where would they find the markets for these goods? And if they could find the markets, would the importing countries tolerate for long the rapid adjustment that

accommodating this massive import surge would require? This seems highly unlikely.

If China needs to sustain high export growth rates for exports to continue to be a main source of growth in GDP from the demand side, how high would that export growth rate have to be? If one assumes that GDP continues to grow at 9 percent a year over the next decade (or in current prices 12 percent per year with inflation at 3 percent annually), then a growth rate of exports (in current prices) at 12 percent a year would produce an annual increment to aggregate demand equal to around a quarter of Chinese GDP in the year 2014.[41] An export growth rate of 7 percent a year (in current prices), in contrast, would contribute only about one-tenth of the increment to GDP in the year 2014. For exports to be a major element in sustaining aggregate demand, therefore, they will have to grow at something like 9 percent per year in real terms or 12 percent annually in nominal terms. Total exports at that rate would reach nearly U.S.$2 trillion by the year 2015, for an average annual increase of more than U.S.$200 billion. Achieving even this lower figure will be a major challenge.

China, therefore, is probably going to have to find a way to stimulate domestic demand as the export share of increments to aggregate demand declines. How it achieves this shift inward in demand, however, could have a major impact on whether the country will be able to sustain a high GDP rate of growth over the next one to two decades. If demand has to be supported as it was in 1997–1999 by

government running a fiscal deficit in order to fund expanded government consumption plus state investment in road and airport construction across the country, sustained productivity growth at high rates seems unlikely. High productivity growth is more likely to come from a higher growth rate (and a higher share of GDP) of consumer spending that in turn stimulates a higher or at least high growth rate in private investment. This chapter is not the place to outline the policies required to stimulate this increase in consumer demand, but it is an achievable goal.

A-Head CONCLUSION

Our objective in this chapter has been to forecast the broad outlines of Chinese economic growth to the year 2025. The central ingredients in our forecast are analyses of the likely path of factor inputs (labor, human capital, and physical capital) and, of most importance, TFP.

We began by reviewing the performance of China's economy between 1952 and 2005. During China's plan era (roughly, 1952–1978), GDP growth was sustained almost entirely by increases in capital and labor inputs with TFP actually at negative levels during the two decades 1957–1978. Beginning in the late 1970s, China's turn to economic reform brought dramatic change, with productivity emerging as a key driver of accelerated growth, both directly and, through its stimulus to the acceleration of capital formation, indirectly. TFP recorded average annual growth of

3.8 percent between 1978 and 2005, with the pace slackening somewhat during the final decade.

We then used straightforward and, we believe, uncontroversial assumptions to project the growth of fixed capital, labor, and education to 2025. These projections show that the growth of labor, capital, and education alone can propel China's GDP growth at a maximum rate of less than 5 percent during 2005–2025, well below the average rate of 9.5 percent recorded during 1978–2005.

We then focus on productivity, beginning with the TFP implications underlying assumed annual GDP growth of 6 or 9 percent between 2005 and 2025. Because the productivity expansion required to support 9 percent annual growth seems unrealistically high (it is higher than what was achieved during 1978–2005), we focus on the likelihood that China can attain sufficient TFP growth to drive the economy forward at an average annual rate in the neighborhood of 6--8 percent during the two decades ending in 2025. That range does seem feasible over the next decade to 2015, but the upper end of this range appears to be unrealistically high for the entirety of the second decade from 2016 to 2025.

There are two reasons for our conclusion that the likely range of growth rates in this second decade falls between 5 and 7 percent per year. First, the rate of TFP required to sustain a growth rate of 8 percent is higher than the TFP rate sustained by China during 1978–2005 and much higher than TFP growth during 1995–2005. Second, the three economies that in earlier times were most like China's economy

today (Japan, South Korea, and Taiwan) each sustained a growth rate for several decades similar to that achieved by China from 1979 through 2005, but each saw the rate of GDP growth rate fall sharply when per capita GDP rose above $13,000 measured in 2005 prices, using the PPP method. China's current per capita GDP in PPP terms is roughly $6,600 and, at a per capita growth rate of 6--7 percent a year, will surpass $13,000 in ten to twelve years.

These projections assume that China continues to enjoy a stable domestic and international political environment over these next two decades. But even if the political environment is stable, growth rates in the 6--8 percent range in 2006–2015 and in the 5--7 percent range in 2016–2025 are not a sure thing. These rates, even the lower end of the ranges, assume that China will continue to pursue economic reform and will maintain a high rate of savings and investment throughout these two decades. That China will sustain a high rate of investment or capital formation will not be seen as controversial by most economists who study the Chinese economy. Our belief that Chinese TFP will continue to grow at a high rate is likely to be more controversial.

In addition to dividing the sources of growth between factor inputs and TFP, one can also look at future growth prospects in terms of moving to the production possibility frontier and moving that frontier outward. Capital formation moves the frontier outward by expanding old industries and starting new ones. R&D expenditures also move the frontier outward and protection of IPRs is one way of

ensuring that innovators have the incentive to develop new products and new ways of

producing old products. Protecting IPRs in turn requires a legal system that is

equitable, efficient, and can enforce its judgments - conditions that do not exist

today. As we have shown above, however, China is clearly taking strides to raise

R&D, protect IPRs, and strengthen the legal system, but there is a long way for China

to travel before it has a system that compares in these areas with the more advanced

industrial and postindustrial economies. Having a long way to go means that the

expansion outward of the production frontier would slow in the absence of vigorous

pursuit of reform in these areas, but it also means that the frontier will keep moving

outward if China continues to strengthen its R&D together with steady improvement

in the incentives for innovation and the capacity of the legal system to enforce those

incentives.

Many of China's potential sources for continued productivity growth come

not from moving the production frontier outward, but through moving toward the

existing frontier from its current position that is well inside that frontier. Certain

reforms discussed in this chapter and in other chapters in this book will play a central

role in this regard. The two that we have emphasized in this chapter are the reform of

ownership and finance.

China's productivity prospects will benefit from further reforms aimed at

getting the state out of direct ownership and management of industrial and service

sector enterprises. State ownership and management is clearly associated with lower

rates of return than private ownership and management. China has made a great deal of progress in this regard, but, as in other areas, there is still a long way to go. Furthermore, even where private ownership and management exist, state administrative intervention remains necessary to manage efficiently such critical areas as bankruptcy and mergers and acquisitions. Reducing state administrative intervention, however, requires finding a substitute for administrative regulation in these and other areas, and that brings us back to the need to create and strengthen an independent, fair, and technically competent legal or regulatory system.

Moving toward the frontier depends critically on improving China's financial system. The waste connected with a system of investment allocation that is heavily influenced by politics and rent seeking is enormous. Again China has made progress in this area, but decisions particularly by the state owned banking system are still heavily influenced by politicians.

Other areas discussed briefly in this chapter that involve approaching the frontier include reallocation of labor from low-productivity activities in the rural areas to much more productive work in industry and urban services. We have also looked briefly at the challenge China faces in shifting a larger portion of aggregate demand from dependence on exports to a greater dependence on domestic demand.

Finally, in this chapter, we have looked at shocks to the economic system that could derail economic growth. A period of political instability is in this regard probably the greatest danger to China's continued growth, but the conditions that

could bring this about are outside the scope of this book. We do, however, consider other potential shocks to the system, such as a major health crisis prompted by a pandemic, such as what might occur with SARS or H5N1 Avian Flu or if HIV/AIDS becomes more prevalent in the population. Some have suggested that China's current environmental situation could be a shock to the system that derails growth, but to do so the cost of cleaning up the environment would have to cut deeply into total capital formation and in China, as we have shown, this is unlikely to be the case. Even the severe water problems of North China and the cost of transferring large amounts of water from the Yangzi River north are well within China's financial capacity.

Our overall belief, therefore, is that China's economy will continue along a path of rapid growth over the next two decades. Our forecast envisions annual growth averaging 6--8 percent in real terms. While considerably below the 9.5 percent real growth recorded during 1978–2005, two decades of expansion at rates between 6 and 8 percent will deliver large increases in the absolute and relative scale of China's economy and in the standard of living available to China's nearly 1.5 billion citizens.

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[2] While these more elaborate models are an unreliable basis for forecasting long-term GDP growth, they can be very useful in sorting out the impact of various levels of growth on sector demand and much else.

[3] We ignore the numerous controversies surrounding this widely utilized method of analysis. Our calculations follow Robert Solow's (1957) original exposition of this approach measuring the sources of growth.

[4] The appendix, which describes the sources and methods used to obtain data for our calculations and analysis, is posted at

http://post.economics.harvard.edu/faculty/perkins/papers.html.

[5] Perkins (1980) and Ren (1997, chapter 2) review early controversies. Recent contributions include Maddison (1998), Meng and Wang (2000), Young (2003), and Holz (2003, 2006).

[6] Rawski (2001); Lardy (2002) provides an opposing view.

[7] Following adjustments for quality change to price indexes, "the real growth rates for both semiconductor output and intermediate inputs were revised up substantially" in the United States national accounts (Grimm, 1998).

[8] Lawrence Klein and his coauthors, for example, use a technique developed for a related purpose during the Second World War to show that the official Chinese price indexes tend to overstate the increase in price (Klein, Gao, and Tao, 2005). Reiitsu Kojima (2002) anticipated some of the revisions undertaken by the NBS, with analysis showing that underreporting of the service sector remained even after attempts were made to better account for output in this sector.

[9] As we were preparing this chapter, China's NBS revised its GDP estimates from 2004 back to 1993, mainly by increasing the size and share of the services sector. This service-sector adjustment accounted for 93 percent (or RMB2.1 trillion) of the total upward adjustment in GDP of RMB2.34 trillion in 2004 (Xu, 2005, p. 1). These adjustments respond to well-known gaps in official data (see Keidel, 1992). The

revisions considerably alter the share of the various producing sectors in GDP, but do not substantially affect the shares of consumption, investment, and net exports on the expenditure side of China's national accounts.

[10] We group graduates of specialized (*zhongdeng zhuanye xuexiao*) and vocational (*zhiye zhongxue*) secondary schools together with recipients of regular high school (*gaozhong*) diplomas.

[11] The reported level of year-end employment (*congye renyuan*) rises by 54.6 million during 1985–1989 and by 40.38 million during 1990–1995, but jumps by 85.8 million during the single year of 1989--1990 (Labor Yearbook, 2001, p. 9).

[12] The wage differentials in Table 20.1 are based on analysis of rural wages by deBrauw and Rozelle (2004) and of urban wages by Junsen Zhang et al. (2005). Alan deBrauw, Xiaoqing Song, and Yaohui Zhao generously provided unpublished data and answers to many questions.

[13] Many did not increase trainee productivity. Hsi-sheng Ch'i, for example, finds that efforts to expand training programs outside the regular school system "greatly increased the number of cadres with impressive academic degrees or certificates without meaningful improvement of their educational levels" (1991, p. 107).

[14] An alternate measure of education-enhanced human capital incorporating the education stock reported in the 1990 and 2000 population censuses exceeds the measure shown in Table 20.1 by 4.7 percent in 1990, 11.1 percent in 2001, and 7.4 percent in 2005. Insertion of the new index in our TFP calculations reduces the

estimated rate of annual TFP growth during 1982–2005 by 0.1--0.2 percentage

points, raises the share of GDP growth attributable to labor and human capital from

12.5 to 14.4 percent, and reduces the share attributable to productivity growth from

45–46 percent to 43–44 percent. We are grateful to Albert Park for recommending

this sensitivity analysis.

[15] See Kraay (1996) and Wang and Yao (2001), among others.

[16] Liu and Yeh, it should be noted, made estimates of GDP growth for this period,

using the underlying official data but adjusting for the distortions in the 1952 prices

and that is the figure that we use here. They also had an estimate, and it was the one

that they preferred, which made adjustments in the underlying data series that

brought down the rate of growth of GDP in the 1953–1957 period in 1933 prices to

4.6 percent. These small differences are now mainly of historical interest, although

they led to heated debate at the time. Liu and Yeh (1965, p. 120) and elsewhere. Liu

and Yeh do not actually calculate the reconstructed Chinese GDP growth rate in 1933

prices, but a rough estimate can be obtained from the difference between their

adjusted estimate and the reconstructed estimate in 1952 prices.

[17] The lower initial capital stock figure (equal to GDP in 1952) produces implausibly

low TFP growth in the first five-year plan period when recovery from wartime

disruption should have, and in the estimates in the table, did enable substantial

improvements in productivity. A lower depreciation rate (we also used 7 percent in

our complete calculations in the appendix) has much less influence on the estimates.

[18] National Bureau of Statistics (1999, p. 4).

[19] This is a rough estimate obtained by subtracting gross fixed capital formation in 2000 prices in 1957 and 1978 from GDP in 2000 prices for those same years. The resulting figure for "consumption" thus includes government consumption and changes in net exports as well as household consumption.

[20] Both results reproduced in Ito (1992, pp. 48–49).

[21] These figures are from Ohkawa and Rosovsky (1973), but Ito (1992) shows an even more dramatic rise in the capital formation rate.

[22] Working with data from a cross section of nations, Feldstein (1983) observed a strong correlation between domestic saving and domestic investment. Jiang (2006) finds that foreign direct investment represents only a small fraction of China's overall capital formation, demonstrating that recent Chinese experience conforms to the same pattern.

[23] Kraay (2000), Modigliani and Cao (2004), and Yu (2005).

[24] The Chinese government is actively discussing and experimenting with a national pension system, and one will no doubt be in place sometime in the next decade or two, the time frame with which we are concerned. That said, however, the resources needed to finance this system will remain meager over this period and pensions, other than for a relatively narrow elite, are likely to remain a small part of what most families will depend on in their retirement years.

[25] Yearbook (2004, pp. 520–521); Yearbook (2006, pp. 506–507). These data exclude enterprises outside the state sector with annual sales under RMB5 million.

[26] Based on urban and rural survey results underlying Zhang et al. (2005) and deBrauw and Rozelle (2004). As explained in the chapter on labor (see Chapter 6), adjusting for differences in urban and rural prices would reduce this wage differential; adjusting for differential nonwage benefits, however, would push in the opposite direction.

[27] This statement is based on the view that a slower rate of growth will leave more early stage economic reforms and structural changes for the second decade (slower rural--urban migration in the first decade followed by faster migration than would otherwise be the case in the second decade, for example) hence making possible somewhat faster growth.

[28] A number of oil-rich countries and even a small country with diamonds (Botswana) have managed to grow rapidly for sustained periods. There are also the city states of Hong Kong and Singapore. But none of these countries is both large in terms of population, possesses at the start a large and poor agricultural sector, and has built its economic growth on manufacturing.

[29] These per capita figures assume a population growth rate that continues at the current rate of 0.6 percent per year.

[30] These tariff data are from Bhattasali, Li, and Martin (2005, pp. 214–215).

[31] Yearbook (2006, pp. 57, 286). Investment-related spending includes outlays on capital construction, innovation, science and technology promotion, prospecting, and operating funds for education, science, and health.

[32] Hua, Zhang, and Lo (1993, p. 27); see also Shirk (1993, p. 35) and Lin, Cai, and Li (2003, p. 140).

[33] "As the pump prices were not rising as fast as global crude markets, so firms responded by cutting down on domestic supplies while boosting exports" (Zhan, 2006b).

[34] A government economist finds that, on average, investment outlays per new job amount to RMB220,000 in large enterprises, RMB120,000 in medium-sized firms, but only RMB80,000 at small companies (SMEs), so that "promoting SMEs will be more cost effective in job creation" (Zhao, 2002).

[35] During the late 1980s, for example, one of the authors encountered a pirated version of an American company's virus-detection software distributed by China's Ministry of Public Security.

[36] A 2005 visit to a Chinese firm listed on the Hong Kong stock exchange revealed a passive operation completely dependent on instructions from group headquarters. This firm had no discretion over the selection of component suppliers or the disposition of its output. Despite rapidly eroding demand for its main product, the company was not permitted to develop a substitute, because the group headquarters had assigned that task to another enterprise (Interview, July 2005).

[37] The Chinese data on primary-sector labor force share in Figure 20.4 come from Chapter 17. Use of official Chinese labor data, which appear to overstate the share of primary sector workers, would accentuate the observations in the text.

[38] Li (2006). Wolf (2003, p. 78) cites data showing that agriculture absorbed 77–78 percent of overall water consumption in 1993.

[39] Liu Wei cites a 2002 report from the Ministry of Water Resources, noting that "in the past three years," presumably referring to 1999–2001, "50 of 100 water authorities collected at least 75% of fees imposed on agricultural water users, 30 attained a collection rate of 50–75 percent, and 20 collected less than half of the user fees. Among urban units, the collection rate exceeds 90 percent" (2005, p. 220).

[40] Chinese gross capital formation in 2005 was 7,956 billion yuan. If it grew at 7 percent a year for two decades, it would reach over 30,000 billion yuan in 2025. Gross capital formation throughout the period would average around 16,000 billion yuan per year. Five hundred billion yuan spread over ten years would be 50 billion per year and over twenty years 25 billion yuan per year.

[41] These calculations used the recently revised GDP figure for 2004 of RMB15,988 billion yuan (National Bureau of Statistics, 2005b).