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Accounting for Growth: Comparing China and India

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The emergence of China and India as major forces in the global economy is one of the most significant economic developments of the past quarter century. Their continued growth is likely to dominate the course of the world economy for the next several decades. Up to now, only a small fraction of the world's population has enjoyed the fruits of economic well-being, with high-income industrial countries accounting for less than a fifth of the world's population. However, China and India together comprise over a third of the world's population; and since 1980, they have achieved remarkable rates of economic growth and poverty reduction.

The purpose of this paper is to examine sources of economic growth in the two countries and to compare and contrast their experiences over the past 25 years. In many respects, China and India seem similar. Both are geographically large countries with enormous populations that remain very poor. In 1980, roughly the beginning of our analysis, both had extremely low per capita incomes, although we note that there is some controversy in the literature about their relative income levels. [2] Since then, GDP per capita has more than doubled in India and has increased a remarkable 7-fold in China. However, the details of their economic growth are in

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[2] China has not participated in past rounds of the international comparison project, and measures of GDP at purchasing power parity are quite speculative. India last participated in 1985. Maddison (2001) shows them with nearly equal levels of income per capita of about $1000 in 1980, but he obtained those values from a 1987 comparison of China to the United States, combined with a lower rate of growth between 1980 and 1987 than indicated by the official Chinese statistics. The World Bank and the Penn World Tables show GDP per capita for China at about two thirds of the estimate for India in 1980.

fact quite different. While initially both were largely autarkic countries, isolated from the global economy, China acted more quickly and aggressively to lower trade barriers, and attract foreign direct investment inflows. In addition, as discussed more fully in later sections, China has experienced explosive growth in its industrial sector, whereas India's growth has been fueled by the expansion of service-producing industries.

In this paper, we investigate the patterns of economic growth for China and India by constructing a set of growth accounts for each that uncover the supply side sources of output change. In addition to aggregate output, the accounts are constructed for the three major economic sectors: primary (agriculture, forestry and fisheries), industry (manufacturing, mining, construction, and utilities), and services. This level of detail enables us to assess the magnitude of efficiency gains associated with the movement of workers out of agriculture, where they are frequently under-employed, into higher productivity jobs in industry and services.

Construction of the Growth Accounts

Growth accounting provides a means of allocating changes in a country's observed output into the contributions from changes in factor inputs (capital and labor) and a residual, typically called total factor productivity (TFP). The latter is best interpreted as a measure of gains in the efficiency with which inputs are used, including technical progress as well as myriad other determinants. While highlighting proximate, not fundamental causes of growth, the approach provides extremely useful benchmarks for analyzing economic performance.

As discussed in more detail in Bosworth and Collins (2003), we essentially assume a Cobb-Douglas production function with fixed factor shares:

$$Y = AK^{\alpha}(LH)^{1-\alpha}. \qquad (1)$$

Y, K, A and α are measures of output, physical capital services, TFP and capital's share, respectively. L is labor, which is adjusted for improvements in educational attainment (H) as a proxy for skills. The capital share, α, is assumed equal to 0.40 for both countries with a modest change in the case of agriculture to allow for the role of land.[3] We report our results in a form that decomposes the growth in output per worker (*y/l*) into the contributions of growth in capital per worker (*k/l*), increases in education per worker (*h*), and a residual measure of the contribution of improvements in TFP (*a*):

$$(2) \qquad y/l = \alpha(k/l) + (1-\alpha)h + a .$$

We specify that the growth of capital services is proportionate to that of the capital stock. We measure the gains in educational attainment with average years of schooling, s, assuming a constant (7%) return to each additional year:

$$(3) \qquad H = (1.07)^{s} .$$

Data Sources

Issues of data availability and quality are always of great concern in the construction of growth accounts, and the problems are often more severe for emerging markets. We provide a detailed discussion of the data sources and issues for India in a prior publication (Bosworth and others, forthcoming). Thus, the discussion of data sources here focuses on China. However, it is important to highlight that the data concerns we encounter in the two countries are quite different. India has a very large informal sector, where output and employment are concentrated

[3] It would be preferable to rely on a more general formulation of the production process and use the income shares of each factor to infer its contribution. However, the large numbers of self-employed persons in developing countries, with their mixture of income from both capital and their own labor makes it difficult to obtain meaningful measures of the income shares. As discussed in Bosworth and Collins (2003), we believe that the simplifying assumption of a constant share has minimal effects on the conclusions.

in small enterprises. Thus, construction of India's national accounts is centered around large periodic surveys of households, rather than relying on reports from major enterprises. China, in contrast, can make greater use of reports from large enterprises for the industrial sector, but must still rely on household surveys to obtain high quality information on some service-producing industries. We have a wealth of information on the methods that India uses to construct its statistical accounts, but lack important details for China.

China's transition from a command economy to one based on markets raises some additional concerns about its economic statistics. One set relates to the major problems of adjusting values for significant changes in quality. In addition, China is still in the process of converting its statistical reporting system over to one more closely aligned with international standards. In particular, the conversion from the Soviet Material Product System (MPS) to the system of Standard National Accounts (SNA) raises concerns about the comparability of the data over time. Such concerns are less relevant for India, which has had a coherent statistical system for a longer period of time, and for which a larger amount of methodological information is available in English.

Output. The national accounts of each country provide our basic source for data on output for the total economy and the three major sectors (primary, secondary, and tertiary). While India's national accounts data are used without modification, the Chinese data are often claimed to overstate the rate of real growth. The most extensive criticisms are those of Maddison (1998) who reduced the growth of China's GDP by an average of 2.4 percent per year for the 1952-95 period. However, his adjustments were severely criticized by Holz (2006a), and in contrast to the downward adjustments, the official estimates were recently revised up to correct for an underestimation of the services sector over the period of 1993-2004. However,

others continue to argue that the estimates of real growth are overstated because of an underestimate of price inflation. The real output data come from asking firms to report the change in their production based on prices of the prior year. The difficulty of making that calculation may lead many enterprises to report equal rates of nominal and real change (Woo, 1998). Thus, some researchers have sought to construct alternative price indexes that could be used to deflate the nominal values (Young, 2002, and Dekle and Vandenbrouck, 2006).

We experimented with using the price indexes suggested by Young (2002). The alternative output measure for agriculture has a very similar growth rate to that reported in the official national account statistics. Woo's argument seems most applicable to the large enterprises of the industrial sector, where the alternative price indexes do indicate substantially more rapid inflation than the implicit price deflators embedded in the official data. We find that the alternative index for the secondary (industry) sector does indicate a significantly slower rate of output growth.

Finally, the only available price indexes for services are those in the services component of the consumer price index. However, the items included in that index are far from representative of the product mix of the tertiary sector, where the major activities are transportation, communications, finance, and trade. The rate of increase for the services price index seems implausible in comparison with increases in wage rates (the primary input), and prices of industrial goods. This is probably because the consumer price index for services has been dominated by the elimination of a large array of subsidies and price controls for the services provided to households, particularly with regard to housing.

While we computed the growth accounts using both the official output measures and those based on the alternative price deflators, our preferred set uses the official output data for

the primary and tertiary sectors and the alternative only for the secondary sector. We also note that, although much of the discussion of China's data has focused on the potential understatement of inflation implying an over estimate of output growth, research on other countries has highlighted equally severe problems in the construction of price indexes that result in an overestimate of inflation. The two major problems are the failure to incorporate substitution effects and inadequate allowances for quality change, which are both likely to be of substantial importance in China. While we agree that the current estimates of output growth leave substantial room for error, the evidence for significant bias seems unproven.

Employment. For India, employment estimates are only available from the quinquennial household surveys, and values for intervening years must be interpolated. Estimates of the workforce follow international standards of including wage earners, the self-employed and unpaid family members. As a result, they include a substantial number of underemployed workers. We use a measure based on a worker's primary activity (employed, unemployed, out of the labor force) in the prior year.

The data for China have more complex origins, reflecting the results of both the population censuses and administrative reports from enterprises. However, only limited information is available on the methods used to generate these series. At the level of the three sectors, we have two alternative measures of employment. The first, derived from administrative data from the employment reporting system, extends back to 1952. The primary problem with these data is that in the years prior to 1998, they include workers who were effectively laid off (Holz, 2006b). It is difficult to judge the magnitude of the break in these data because layoffs were largely unknown prior to the 1990s. A second set of data, adjusted to be consistent with the population censuses, begins in 1990; and consistent estimates for the earlier years were obtained

from Holz (2006b). This series is conceptually most comparable to the data for India, and is significantly higher in levels than the first. However, it has also been subject to frequent revision, and little is known about the precise methods used to compute it. We use both series in computing the growth accounts and discuss their impact on the conclusions below.[4]

Capital. The data on fixed capital are taken directly from the national accounts of the two countries. India produces its own estimates of the capital stock by major sector, which we adopted. In the case of China, information from the provincial reports must be used to allocate the national data on gross fixed capital formation (GFCF) among the three major sectors (Hsueh and Li, 1999).[5] We constructed our own perpetual-inventory estimates of the capital stock assuming a geometric rate of depreciation of 0.06.

Land. Our growth accounts include land as well as capital and labor as factor inputs to produce agriculture. For India, an estimate of the volume of land used in agricultural production is available annually. We use an estimate of total cropped land that adjusts for irrigated lands, which are sown more than once per year. For China we used a measure of total sown land area.[6] These two measures of land use show a growth over the past quarter century of about 9 percent for India and 3 percent for China. In both countries, there are no available estimates of current market value of the land that would enable us to construct measures of the annual flow of capital services. Thus, we simply focus on the growth in the aggregate amount of land.

[4] Both employment series are published in the Chinese statistical yearbook. In the 2005 edition, the first series, sector totals from on establishment reports is shown in table 5-6. The series that is closer to a census concept is shown in table 5-2.

[5] In addition, the expenditure-side estimates of GDP have not yet incorporated the revisions that resulted from the last economic census and that are included in the output data. Thus, the data may be subject to revision in the near future.

[6] The data were available online from the China Data Center are included in a table entitled "Production Condition for Agriculture of China."

Educational Attainment. We constructed an index of educational attainment for each sector of the Indian economy using information from the quinquennial household surveys (Bosworth and others, forthcoming). For China, we relied on prior estimates that we had assembled from census data (Bosworth and Collins, 2003). In this case, we are unable to distinguish among the three sectors and use a common education index.

Growth Accounts

We have constructed growth accounts covering the period of 1978 to 2004 for India and China for both the aggregate economy and the three major sectors. The results confirm many of the now standard themes that have emerged from the prior literature on the economic development of the two countries. However, some new findings emerge as well.

Table 1 provides a basic summary of the results. We first report the results for the full 26-year period that corresponds to China's economic reform period. This works as well for India, which also experienced an acceleration of its rate of economic growth in the early part of this period, though the precise dating of the change is controversial. We divide the period at 1993 for three reasons: it is a benchmark year for the Indian national accounts, it avoids the 1991 economic crisis, and the second sub-period can be identified with India post-reform. The table is based on our preferred measures of output for China, in which an alternative price deflator is used to convert output of the industrial sector to constant price values. Official national data are used to measure output for the primary and tertiary sectors. This change lowers industrial sector output growth by an average of 1.3 percentage points and that of the total economy by 0.8 percentage points. In addition, the estimates reported in the table are based on the employment series most comparable to the census concept.

Aggregate Economy. Focusing first on the full period, China's extraordinary performance is clearly evident, with output growing at an average annual rate of 9.2 percent. India's rate of growth is substantially lower, at 5.4 percent, but still well above the economy's 3.4 percent growth rate of the prior two decades. Both countries show almost identical rates of employment change, but at the level of the total economy, this is largely determined by growth in the population of labor force age since unemployment is not a realistic alternative. Finally, the growth in output per worker in both countries is equally split between increased capital per worker and gains in TFP, although the values for China are twice those of India.

Second, both countries show an acceleration of the rate of economic growth between the first and second sub-periods. This is most significant for India, but because Chinese employment growth slowed substantially, the acceleration of its labor productivity growth after 1993 is very rapid. The marked slowing of employment growth in China is also evident in the estimates of the population of labor force age, and reflects the sharp decline in the birth rate during the 1970s.

Both China and India have had serious deficiencies in their educational institutions that have limited the contribution of improvements in educational attainment relative to the norm of other Asian countries. The measures of educational attainment for India and their contribution to labor quality are discussed more fully in Bosworth and others (forthcoming), which cites a number of studies of the Indian educational system. As those studies highlight, the problems are most evident in India's high continuing rate of illiteracy. In China, the process of formal education was greatly disrupted by the cultural revolution of the late 1960s and early 1970s. In later years, an unusually large number of adults took advantage of remedial programs to raise their recorded educational levels, but the value of those programs is controversial. Young (2003) provides a useful overview of Chinese statistics on educational attainment that confirm the

evidence of limited gains in educational attainment for the adult labor force. In particular, his analysis of the relationship between earnings and years of schooling finds surprising low returns. Knight and Shi (1996) also document a large divide in the educational attainment of rural and urban workers in China. In contrast to India, however, China does appear to have largely eliminated illiteracy. For example, UNESCO reports a literacy rate of 99 percent among youth aged 15-24 in China, compared with just 76 percent for India. It has also succeeded in sharply raising the educational attainment of today's youth. Equivalent improvements have not been achieved in India. In addition, our own investigation found surprisingly low returns to primary education in India, and a rising return to tertiary (presumably implying an increasing shortage of the highly educated).

In the bottom of table 1, we also report similar growth accounts for the East Asian economies, excluding China (Bosworth and Collins, 2003). Their performance is of particular interest in the present context because it has been so frequently cited as a model for remarkable economic performance. These countries are also notable for the extent to which their growth appears to have been the result of extremely rapid gains in both physical capital and educational attainment. The comparison highlights the extent to which China's growth performance has exceeded prior norms. It is also evident that China's gains are coming from both the contribution of a very high rate of capital accumulation and from gains in TFP. There are other historical examples of countries that have achieved growth rates comparable to China's growth. This short list includes Germany and Japan in their recoveries from WWII, and Taiwan and Korea more recently. However, China's rapid growth has now lasted more than a quarter century, while none of these countries were able to sustain such rapid growth for as long.

India's performance also compares favorable with that of East Asia prior to the financial crisis of 1997-98. Its strong growth is overshadowed only by the even more remarkable performance of China. However, India achieved its growth with relatively little emphasis on capital accumulation and more substantial gains in TFP. In that mix of gains, it differs from the rest of Asia, where capital accumulation was so important.

While our growth accounts for India accord closely with prior research, the results for China differ in important respects from some of the prior studies. To begin with, a number of studies have expressed concern about what they perceive to be a slowing of the rate of TFP growth in recent years.[7] They, in turn, attribute the slowdown to excessive and inefficient rates of capital accumulation that have lead to widespread waste (Zheng and others, 2006, and Kwan, 2006). Our analysis finds no such slowing. We believe that the differences can be traced to two factors.

First, several studies report a slowing of overall output growth after 1993 that falls through to the residual calculation of TFP. Our study incorporates the recent revisions in the national accounts that raised the level and growth of output in the services sector. The official GDP statistics report a 10 percent growth rate for both the 1978-93 and 1993-04 periods; but as discussed above, we used an alternative price deflator that lowered the overall rate of growth of industrial sector output for the full post-1978 period. However, it has a bigger impact on the estimate of growth in the early years and raises the rate of growth after 1993 relative to the earlier period. Thus, we show a modest acceleration of GDP growth of 0.8 percentage points after 1993, compared to a 0.7 percent deceleration, for example, in the Kuijs and Wang study.

[7] A slowing of TFP growth is reported in Kuijs and Wang (2006), OECD (2005), and Zheng and others (2006).

Second, several studies use a greater elasticity of output with respect to capital than our assumption of 0.4. In the case of India, this does not matter greatly because capital and labor inputs grow at relatively similar rates. In China, however, the rate of growth of the capital input is far in excess of that for labor, and this difference accelerates in the second sub-period. Thus, a high weight assigned to the capital input will produce an index of inputs that rises rapidly relative to output, leaving little room for improvement in TFP.[8] Our estimates, like those of Young (2003) and the IMF (2006) that also use a capital elasticity near 0.4, obtain a larger estimate of the contribution of TFP.

Finally, our preferred estimates are based on the census definition of employment (discussed above) with an adustment for the data break in 1990. If we use the alternative report-based series, it implies about the same rate of employment growth for the full 1978-2004 period, but a larger portion of the growth occurs before 1993. Thus, we find that using the census-based series reduces the average annual growth in output per worker by about 0.4 percentage points in 1978-93 and raises it by an equivalent amount over the 1993-2004 period.

We turn next to an analysis of the sources of growth in each of the three major sectors.

Primary Sector. Both China and India benefited from the Green Revolution, but improvements in the Chinese agricultural sector were also aided by major institutional reforms and the emergence of the household responsibility system. Thus, we find that the output of China's agricultural sector has grown at a very rapid pace, 4.6 percent per year since 1978,

[8] Kujis and Wang (2006) use a capital share of 0.5, Zheng and others (2006) use the three alternatives 0.4, 0.5 and 0.6, and OECD (2005) uses 0.53. Heytens and Zebreg (2003) use both 0.56 and 0.63, however their study does not include the post-1998 period in which the others find a TFP slow-down. We are surprised by the frequent assumption of a capital elasticity of 0.5 or higher in the growth accounting studies of China. Perhaps it can be traced to econometric studies, such as Chow and Li (2002), that obtain large coefficients on capital in regression estimates of an aggregate production function. A high rate of growth of output and capital relative to labor can generate a strong correlation between the first two, and a high capital elasticity without being indicative of the underlying production process. We believe that the low quality of the data makes any estimate of the aggregate production function a bit dubious.

compared to a strong but less spectacular 2.5 percent growth rate in India. Although both countries exhibit a slowing in the years after 1993, the primary sector continues to be a major contributor to growth of the aggregate economy.[9] China's growth is particularly impressive because it occurred against the backdrop of declining employment after 1993. Thus, output per worker continued to expand at a very strong 4.3 percent annual rate. China achieved its gains through both substantial increases in capital per worker and rates of TFP growth more than double those for India.

Rawski and Mead (1998) argue that the administrative employment data greatly overstate the share of China's workforce that is employed in agriculture and that as many as 100 million workers should be reclassified as actually working in nonagricultural jobs. They based their estimates on information on labor input requirements and acreage for various crops. We have not incorporated their adjustment in our measures of employment by sector. We use the alternative census-based series, and it is not clear how to adjust for workers who may be employed in both agriculture and non-agriculture. In any case, the adjustment has the greatest effect on the relative growth of the labor input in the years prior to the mid-1980s, when it would sharply raise the growth of labor productivity in agriculture and lower it for the nonagricultural sectors. However, it matters little for post-1993 growth rates.

While India's labor productivity growth is not nearly as impressive, we note that annual increases of more than one percent represent a significant improvement relative to the previous two decades in which there were little or no gains in agricultural productivity. (See Bosworth

[9] There is some evidence that the official statistics may overstate the growth of output in Chinese agriculture (Fan and Zhang , 1997), but not by an amount that would greatly alter our finding of strong productivity growth. We believe that the reliance on household surveys of food consumption to challenge the official production data is itself questionable. In other countries, household surveys are notorious for their underestimation of consumption. In addition, while Fan and Zhang are correct to point out that Laspeyres indexes overstate growth, the reliance on such indexes is not unique to China.

and others, forthcoming). What is striking for India, however, is that employment in the primary sector continued to grow, albeit at a somewhat slower rate in the second sub-period than in the first. As we shall discuss below, the primary sector continues to employ a surprisingly large share of India's labor force. We attribute this to an insufficient rate of expansion of employment opportunities in industry and services relative to India's population growth.

Industry. The industrial sector (composed of mining, manufacturing, construction and public utilities) differs dramatically in size between China and India. In China it has consistently accounted for about half of the GDP, whereas in India it has remained below 30 percent. During the 1978-93 period, the sector grew rapidly in both countries, with large increases in employment. Both also had similar rates of gain in capital per worker. However, China experienced a much faster rate of TFP improvement.

In the period since 1993, China has achieved spectacular rates of growth in industrial output per worker. Employment growth slowed to only a little more than one percent per year, while output per worker has averaged nearly 10 percent annually. This has been achieved by a doubling of the growth in both the contribution of increased capital per worker and TFP.[10] India has also witnessed an acceleration of output growth in its industrial sector, but the magnitude has been much smaller and about half of the growth is attributable to increased employment. The rate of gain in India's labor productivity has been only about one-third that for China, the contribution of increased capital per worker much smaller, and the gains in TFP have averaged a very modest one percent per year.

Services. India has attracted considerable attention for the rapid expansion of its service industries; yet, it is striking that the expansion of this sector has also been very strong in China.

[10] These gains are based on our use of the alternative price deflator suggested by Young (2003). The acceleration of output growth and TFP would be less if we used the official data. The alternative price deflator has the greatest impact on lowering the estimated growth of industrial output in the first sub-period.

As shown in table 2, China's services sector has grown as rapidly as its industrial sector, and accounts for most of the growth in employment. Furthermore, output per worker has grown at a steady 5 percent annually over the full 26-year period. Since 1993, China has also had an increase in the contribution of capital per worker in services that is as large as that for industry. Where the sector has performed less well is in its weak rate of TFP improvement.

Services is the sector in which India comes closest to matching China's performance. Output growth accelerated after 1993, and the rate of improvement in value added per worker exceeds 5 percent annually. It is also remarkable that India has achieved those gains with only a very modest contribution from increased capital per worker. Unlike for China, India's impressive performance in services is largely reflected in a rapid improvement of TFP.

Sector Shares

The top panel of table 3 shows the distributions of value-added at the beginning of each sub-period as well as for the last year in our sample. In 1978, China and India had quite different sectoral distributions of value added, and these differences have magnified in subsequent years. In 1978, agriculture and services each accounted for roughly one-quarter of China's value added, with industrial activities accounting for the remaining half. In contrast, agriculture was the largest share of India's value added, with services and industry accounting for one-third and just one-quarter respectively.

By 2004, the value added share of agriculture had declined by 20 percent in both economies. For China, this was split equally between increases in the secondary and tertiary sectors. In contrast, India has seen only a small increase in the value added share of its already relatively small industrial sector, with most of the expansion concentrated in services.

In contrast, as shown in the bottom panel of table 3, the initial sector distributions of employment for China and India were quite similar in 1978. Both reported about 70 percent of their workers as being in the agricultural sector. Since then, workers have moved out of agriculture, but the decline in the share of employment in agriculture has been much larger for China: only 47 percent are still in agriculture, compared to 57 percent for India. In addition, China now has a larger portion of its workforce in services than does India.

Are these sectoral distributions unusual relative to those for other similar economies? A recent IMF study (IMF 2006) compares actual value added and employment shares with predicted shares, using a regression analysis to control for country characteristics such as output per capita (PPP), population and geographic size. For both China and India, the authors find that agriculture's share of value added is about what one would expect, but that this sector continues to employ a surprisingly large share of the labor force. In both economies, this is offset by a significantly smaller than predicted labor force share in the service sector. For India, however, the actual value added shares for industry and services are also quite similar to predicted shares. In contrast, the industrial sector in China accounts for an unusually large share of value added, while value added in services is unexpectedly small.

Reallocation Effects

Output growth can be generated from the reallocation of resources into higher productivity activities as well as from productivity gains within sectors. Indeed, this reallocation effect is potentially a very important source of growth for economies in which a large share of labor is initially underutilized in agriculture. In the discussion below, we contrast this dimension of the sources of growth for China and India. Our first step is to examine sectoral differences in

labor productivity. We then decompose aggregate growth in output per worker into the contributions from each sector and a residual, which can be interpreted as the effects from resource reallocation.

Figure 1 shows the evolution of output per worker by sector from 1978 to 2004. We use PPP exchange rates from the World Bank and constant 2004 prices to construct indicators that are comparable for the two countries.[11] First, the chart provides an alternative look at each country's growth in output per worker, already presented in Tables 1 and 2. As shown, the level Chinese labor productivity in each sector was only about seventy percent that for India at the beginning of the period. However, by 2004, Chinese output per worker in services, primary activities and industry had risen to 110, 130 and 220 percent of the Indian levels respectively.

Second, the chart highlights the substantial and growing sectoral differences in labor productivity for both economies. In 1978 and for both India and China, output per worker was nearly identical in the secondary and tertiary sectors, and roughly three times that for the primary sector. Since then, India has experienced relatively slow productivity growth in the primary sector, combined with an acceleration for services beginning in the mid 1990s. By 2004, Indian labor productivity in industry and services had risen somewhat to four and five times that for primary activities, respectively. Due to the rapid and sustained labor productivity in industry, the productivity differences are even larger for China. In 2004 the levels of value added per worker were seven times (secondary) and five times (tertiary) that for the primary sector. [12]

How much of the aggregate economic growth in each country can be attributed to sectoral gains in output per worker? A simple measure of the contribution from each sector is

[11] The results are quite similar if market exchange rates are used instead.

[12] A recent study notes that "for the world as a whole, labor productivity in nonagricultural sectors is about three times higher than in agriculture." IMF (2006, p. 11). Thus, the sectoral productivity gaps that have emerged in India and especially China appear quite large.

simply the sector's growth rate (from table 2) weighted by the sector's share in value added at the outset of each sub-period (from table 3). The difference between total growth and the sum of the sectoral contributions provides a (residual) measure of the effects due to resource reallocation. Table 4 shows the resulting decompositions by period, for each country as well as the cross-country differences in each component. During the first sub-period, 1978-93, Indian growth can be attributed in roughly four equal proportions to gains in each of the three sectors and gains from resource reallocation. In the more recent period the main difference has been a tripling of the contribution from services, and a doubling of the contribution from resource reallocations. As expected given the previous discussion, the Chinese performance is dominated by the industrial sector, which accounts for more than a third of aggregate growth during the first period, and more than half during the second. However, the magnitude of the reallocation is larger than that for India in the first period and of equal size in the second. With a higher rate of overall growth, the reallocation effect falls from roughly one-fourth of the total before 1993 to just fifteen percent more recently.[13]

The table also highlights a striking shift in the sources of the difference in economic growth between the two countries. During both 1978-93 and 1993-2004, China's average annual growth in output per worker exceeded that for India by nearly four percent. While strong Chinese industrial sector performance is the most important factor in the earlier period, relatively strong growth in China's primary and tertiary sectors and a larger reallocation effect all contributed to the overall growth differential. In contrast, after 1993, all of the difference between China and India's labor productivity growth rates can be explained by the much larger

[13] The magnitude of these reallocation effects is comparable to those found by Bloom and others (2006) for an earlier sample period, and by IMF (2006).

contribution from China's industrial sector. India's services sector now shows a slightly higher contribution to total growth and the reallocation effects are of equal magnitude.

Future Prospects

Even if we use PPP exchange rates, China and India are still very poor countries relative to the United States. At 15 and 8 percent of the U.S. level of GNI per capita, catch-up will continue to be a major source of growth. China is faced with a slowing of the increase in the population of labor force age, but it should be able to sustain its economic growth in future years by continuing to shift workers out of agriculture to higher productivity jobs in industry and services. India is faced with an even more favorable demographic situation of continued growth in its labor force and an even larger share of its workforce still in agriculture.

However, China has made much greater progress in raising the educational skills of younger workers. According to the OECD (2005), illiteracy has essentially been eliminated among new entrants to the workforce. Enrollment rates are rising rapidly at every educational level, and 98 percent of primary school enrollees reach the 5^{th} grade compared to 60 percent for India. Despite an external reputation for having a large pool of highly educated persons, India faces serious deficiencies in the education of the bulk of its youth population.

With respect to capital accumulation, China is actually faced with an excess that threatens to disrupt growth through over-investment in some sectors. In addition to a national saving rate above 40 percent, the country is the recipient of private capital inflows equal to ten percent of the GDP. A continued rate of growth near 10 percent annually seems easily warranted from the supply side of the economy. India faces a more constrained situation. While the private saving rate has increased substantially over the past decade, much of this is drained off into the

financing of a large public sector deficit. Similarly, private capital inflows have increased; but as a share of GDP, the flow is about half that of China. Current rates of capital accumulation are consistent with a GDP growth rate near 7 percent, but higher rates would require reductions in the public sector deficit or increased capital inflows from abroad.[14]

Overall, we conclude that the supply-side prospects for continued rapid growth in China and India are very good. Future problems of sustaining growth are more likely to occur in other areas, such as inefficiencies in the financial sector for China, and the lack of an adequate infrastructure in India.

Both countries will also need the stimulus of access to global markets to deepen and sustain their growth. In this respect, China has had extraordinary achievements in raising the ratio of total trade to GDP to 65 percent in 2004 compared to 14 percent in 1978. India was at the same 14 percent of GDP in 1978 and for many years lagged far behind. Recently, however, India's trade has also expanded rapidly and reached 42 percent of GDP in 2004. In the first part of this decade, China's trade has expanded at a 24 percent annual rate, but India has also had extremely rapid growth, 17 percent per year (table 5). However, the composition of the trade has been much different. Just as with the sector composition of GDP, China's exports are concentrated in goods exports whereas India's trade has a much larger services component. The extent of China's lead in goods trade is also evident in table 6, which shows the commodity composition of exports. China's trade has grown 7-fold since 1993 compared with 3 ½ for India, and the volume of India's merchandise exports is similar to that of China a decade earlier.

[14] The differences in the structure of the public sector finances between China and India are not as great as they may appear. India borrows funds directly to finance its expenditures. China does not report a similar public sector deficit, but only because it covers the losses of state enterprises with loans that are unlikely to be repaid. At some future date, the Chinese government will need to assume the debt directly.

Finally, the two countries differ substantially in terms of another measure of integration with the global economy--foreign direct investment inflows. In recent years, the inflows into China have exceeded $50 billion per year, and a few years ago they represented over 4 percent of GDP. The inflows into India have been about $5 billion and less than one percent of GDP. FDI can be important in promoting access to global markets, and accumulation of technology and management skills, all of which have been significant in China's growth.

Conclusions

Our constructed growth accounts for China and India provide empirical documentation for much of the prior discussion of their growth performance. In international comparisons, China's achievements have truly been extraordinary, but India has also grown at a rate that matches the other industrializing economies of East Asia. Key differences between the two economies also stand out, with China's concentration of growth in industry while India's growth has been strongest in various service-producing industries; but China's growth is remarkably broad across agriculture, industry and services. Overall, the growth of services in China actually exceeds that of India. Thus, juxtaposing the experiences of China and India offers a valuable perspective on each country's individual performance.

Our work also extend the growth accounting literature for these economies in a number of ways. First, it incorporates all of the recent data revisions, some of which are quite large. Second, the analysis disaggregates by major economic sector. This provides new estimates of the contributions to overall labor productivity growth from growth within sectors versus from the gains due to reallocation of labor and capital among sectors. In China, we document the strong contribution to growth that is provided by both increases in capital per worker and TFP.

Surprisingly, we find no support for some of the recent arguments that China is experiencing a significant deceleration of growth in TFP due to wasteful and excessive expansions of capital investment. The comparison of China and India highlights the weak performance of India's manufacturing sector as much as the strong growth of services.

Looking forward, supply-side factors suggest that both economies should be able to sustain their growth. They have plentiful supplies of underutilized labor, though India faces greater challenges of raising educational attainment. Both have high rates of private saving, although again China stands out. India currently devotes much of its saving to finance the large fiscal deficit.

The growth prospects for both depend upon continued integration with global economy, including trade in goods and services, and investment flows. India in particular will need to broaden its trade beyond the current emphasis on services. Only an expansion of goods production and trade can provide employment opportunities for the current pool of underemployed and undereducated workers. China has done well in the international dimension and now needs to focus on development of domestic markets and a more balanced trade position.

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Table 1. Sources of Growth: China, India, and East Asia 1978-2004

Annual percentage rate of change

Period		Output	Employment	Output per Worker	Contribution of: Physical Capital	Land	Education	Factor Productivity
Total Economy								
1978-04	China	9.3	2.0	7.3	3.2	0.0	0.2	3.8
	India	5.4	2.0	3.3	1.3	0.0	0.4	1.6
1978-93	China	8.9	2.5	6.4	2.5	-0.1	0.2	3.6
	India	4.5	2.1	2.4	1.0	-0.1	0.3	1.1
1993-04	China	9.7	1.2	8.5	4.2	0.0	0.2	4.0
	India	6.5	1.9	4.6	1.8	0.0	0.4	2.3
East Asia Excluding China								
1960-80		7.0	3.0	4.0	2.2		0.5	1.2
1980-03		6.1	2.4	3.7	2.2		0.5	0.9
1980-93		7.3	2.7	4.6	2.6		0.6	1.4
1993-03		4.5	2.0	2.5	1.8		0.5	0.3

Source: Authors' estimates as described in text; Bosworth and Collins (2003). The employment series is a census comparable concept for both China and India.

Table 2. Sources of Growth by Major Sector, 1978-2004

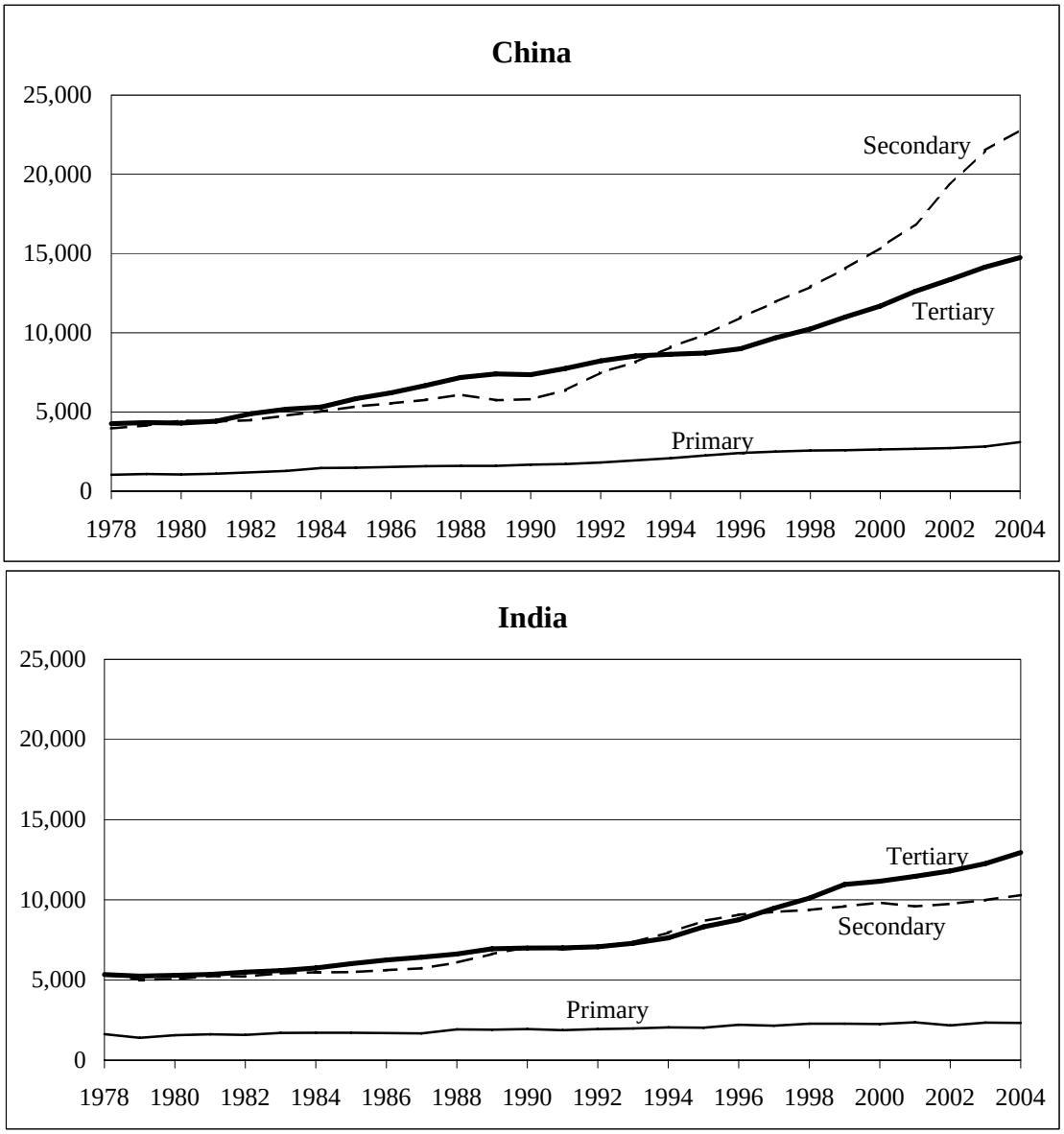
Annual percentage rate of change

Period		Output	Employment	Output per Worker	Contribution of: Physical Capital	Land	Education	Factor Productivity
Agriculture								
1978-04	China	4.6	0.3	4.3	2.3	0.0	0.2	1.8
	India	2.5	1.1	1.4	0.4	-0.1	0.3	0.8
1978-93	China	5.2	0.9	4.3	2.5	-0.2	0.2	1.8
	India	2.7	1.4	1.3	0.2	-0.1	0.2	1.0
1993-04	China	3.7	-0.6	4.3	2.1	0.2	0.1	1.8
	India	2.2	0.7	1.5	0.7	-0.1	0.3	0.5
Industry								
1978-04	China	10.0	3.1	7.0	2.2		0.2	4.4
	India	5.9	3.4	2.5	1.5		0.3	0.6
1978-93	China	9.3	4.4	4.9	1.5		0.2	3.1
	India	5.4	3.3	2.1	1.4		0.4	0.3
1993-04	China	11.0	1.2	9.8	3.2		0.2	6.2
	India	6.7	3.6	3.1	1.7		0.3	1.1
Services								
1978-04	China	10.7	5.8	4.9	2.7		0.2	1.9
	India	7.2	3.8	3.5	0.6		0.4	2.4
1978-93	China	11.3	6.5	4.7	1.8		0.2	2.7
	India	5.9	3.8	2.1	0.3		0.4	1.4
1993-04	China	9.8	4.7	5.1	3.9		0.2	0.9
	India	9.1	3.7	5.4	1.1		0.4	3.9

Source: Authors' estimates as described in text. For China, the output data are the official series of the the national accounts for agriculture and services, and the series for industry is based on the alternative price deflator discussed in the text.

Figure 1. Output per Worker by Sector, China and India, 1978-2004

International dollars of 2004



Source: China Data Center and CSY; India National Accounts; India NSSO.

Table 3. Value-Added and Employment by Industry as Share of Total

Percent

		Primary	Secondary	Tertiary	Total
			Value added		
1978	China	28	48	24	100
	India	44	24	32	100
1993	China	17	51	33	100
	India	33	28	39	100
2004	China	9	58	33	100
	India	22	28	50	100
			Employment		
1978	China	71	17	12	100
	India	71	13	16	100
1993	China	56	22	21	100
	India	64	15	21	100
2004	China	47	23	31	100
	India	57	18	25	100

Source: China Data Center and CSY; India National Accounts; India NSSO.

Table 4. Sectoral Growth in Ouput per Worker, 1978-2004

Percentage Contribution to Growth

		Total	Primary	Secondary	Tertiary	Reallocation
1978-93	China	6.4	1.2	2.4	1.1	1.7
	India	2.4	0.6	0.5	0.7	0.6
	Difference	4.0	0.6	1.9	0.5	1.0
1993-04	China	8.5	0.7	5.0	1.7	1.2
	India	4.6	0.5	0.9	2.1	1.2
	Difference	3.9	0.2	4.1	-0.4	0.0

Source: authors calculations as explained in text.

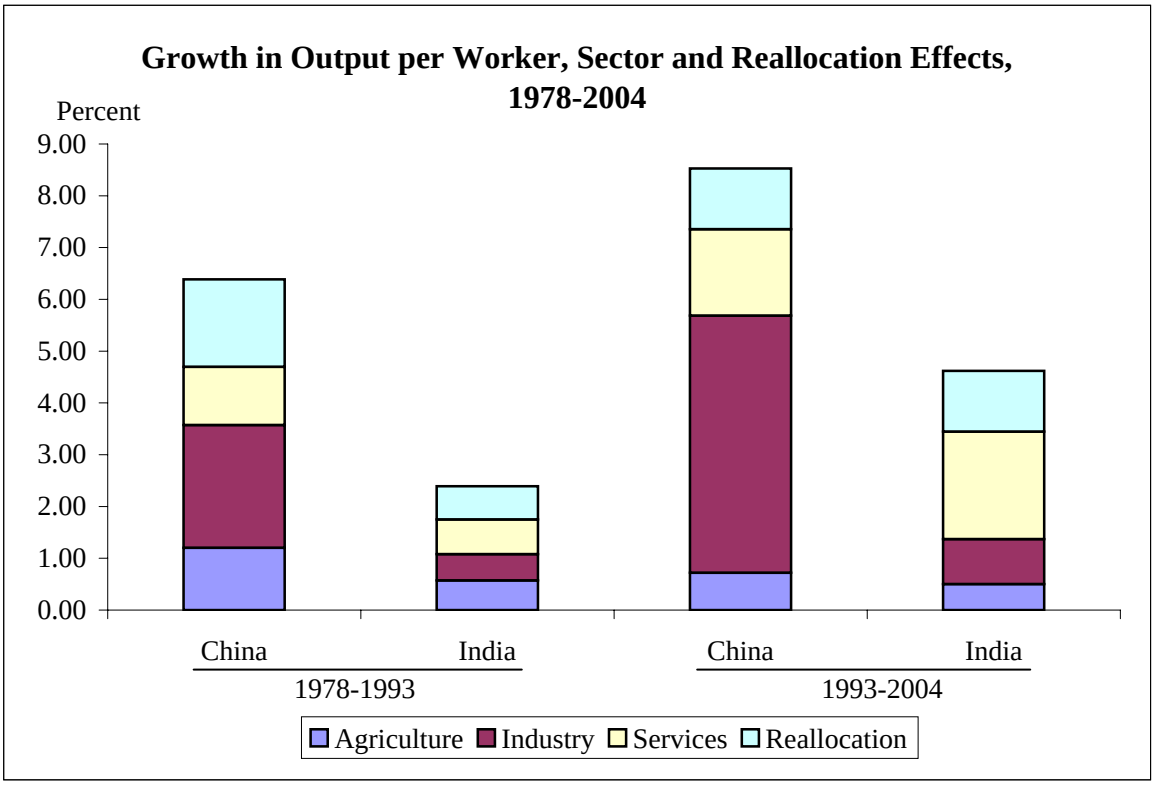


Table 5. Annual Growth in Exports, China and India, 1995-2004
Percent

	1995-04	1995-00	2000-04
China			
Total Exports	18.1	13.7	23.8
Goods	18.6	14.2	24.2
Services	14.0	9.7	19.7
India			
Total Exports	12.6	9.5	16.6
Goods	10.1	6.7	14.5
Services	20.6	19.8	21.6

Memo: Share of Goods in Total Exports			
	1995	2000	2004
China	87.0	89.1	90.5
India	82.2	72.2	67.1

Source. World Bank. 2006. **World Development Indicators**.

Table 6. Exports by Commodity Type, China and India, 1993-2004

USD Millions

	China		India	
Commodity	1993	2004	1993	2004
Food and live animals	8,381	18,844	3,384	6,843
Beverages and obacco	901	1,214	159	303
Crude materials, inedible, except fuels	3,041	5,753	1,299	5,514
Mineral fuels, lubricants and related materials	4,112	14,497	496	6,895
Animal and vegetable oils, fats and waxes	205	148	101	349
Chemicals and related products	4,590	25,995	1,539	9,106
Manufactured goods, classified chiefly by material	16,803	101,713	9,096	28,924
Machinery and transport equipment	15,222	268,218	1,513	7,763
Office machines and computers	1,647	87,101	116	388
Telecommunications and sound-recording equipment	4,522	68,497	48	236
Electrical machinery, apparatus and appliances	4,437	61,137	228	1,546
Miscellaneous manufactured articles	38,093	155,813	4,287	13,285
Clothing, footwear and travel goods	25,308	82,908	3,456	7,752
Other	395	1,131	363	864

Source: United Nations, Comtrade