2 Economic Growth in South Asia

A Growth Accounting Perspective

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Introduction

South Asian economies have achieved impressive rates of economic growth since the 1980s. Output for India, Pakistan, Bangladesh, and Sri Lanka (SA4) has grown more rapidly since 1980 than for any other region except East Asia. However, unlike East Asia, these countries have not been characterised by particularly high rates of investment. Indeed, as a share of output, investment has averaged just one-half to two-thirds of the levels typical in East Asia during its sustained periods of high growth. This fact – which some see as a puzzle, could be taken to imply that capital accumulation has been a relatively unimportant factor in the region's growth experience. If capital accumulation mattered little in the past, perhaps it need not be a central focus for South Asia to sustain, and increase, its rates of growth in the future.

The main objective here is to take issue with that perspective.[1] It is argued instead that capital accumulation is indeed important for growth and that this is evident in South Asia's experience. Furthermore, countries in South Asia will need to increase their rates of investment so as to accumulate (both physical and human) capital more rapidly if they are to achieve the desired rise in growth rates going forward. It is also important to emphasise that capital accumulation is certainly not all that matters. Strong, sustained growth also requires countries to increase the efficiency with which they use domestic factors to produce goods and services, which economists label total factor productivity (TFP). The two should both be seen as central to the growth process, and indeed many policies undertaken to foster one will also tend to promote the other.

Thus, the perspective that capital accumulation matters goes hand-in-hand with the extensive and convincing new findings linking positive growth experience with strong domestic institutions (such as those protecting property rights). Growth accounting provides a useful framework for exploring the roles of capital accumulation and TFP, and is the basis for the empirical analysis presented. The approach, including its strengths and limitations, is discussed as under. Some of the implications will be discussed from work to date from ongoing research on economic growth in South Asia and elsewhere.

Growth in South Asia: An Overview

Table 2.1 highlights some key features of South Asia's growth. As shown, during the period 1980–2000, two of the economies (India and Bangladesh) increased their gross domestic product (GDP) growth rates by roughly 2 percentage points per annum relative to the rates they had sustained in the two decades prior to 1980. Sri Lanka's growth increased only marginally, but from the initially strong rate of 4.5 per cent per year. While average output growth declined after 1980 in Pakistan, it remained about 5 per cent per year. Growth rates of these magnitudes are impressive achievements that have helped these countries to reduce poverty rates and raise living standards. Indeed, South Asia grew more rapidly than any other region except East Asia.

However, as also shown in Table 2.1, these growth achievements do not seem closely related to what has happened to underlying inputs. In particular, investment as

Table 2.1: South Asia: Selected Indicators

Region/Period			*Annual Rates of Change*		
	GNI/Capita (PPP)[a] ($)	*Population (Millions)[a]*	*GDP*	*Labour Force*	*Investment Share (Per Cent)*
India					
1960–80			3.5	2.1	21.9
1980–2003	2,880	1,064	5.7	2.0	21.3
Bangladesh					
1960–80			2.4	2.2	22.7
1980–2003	1,870	138	4.4	2.3	18.2
Pakistan					
1960–80			5.9	2.7	22.1
1980–2003	2,040	148	4.9	2.7	19.5
Sri Lanka					
1960–80			4.5	2.2	23.2
1980–2003	3,740	19	4.4	2.0	22.6

Source: World Bank 2005.

Notes: [a]These data are for 2003. PPP, purchasing power parity.

a share of GDP did not rise after 1980 in the countries where growth surged. Instead, it declined slightly in India and more sharply in Bangladesh. Moreover, in none of the four countries has investment rates approached the 30–40 per cent range typical for East Asian economies during their rapid growth periods. The table also shows that, while the labour force continued to grow rapidly in all four countries, this growth did not accelerate in either India or Bangladesh.

Thus, the figures in Table 2.1 raise questions related to South Asia's growth experience. In particular, should they be taken to imply that capital accumulation played little role in explaining strong growth in the region? And what are the implications for the importance of investment, if South Asia is to sustain, and hopefully increase, its output growth over the next decade? While the investment rate relates to the role of physical capital, it is also of interest to explore the role of increases in human capital, which is done briefly as under.

Output Growth versus Living Standards

Most of this examines the growth in South Asia's GDP. The growth accounting methodology focuses attention on the proximate role of underlying factor inputs: physical capital, labour augmented for changes in labour quality using educational attainments, and the residual role of increases in the efficiency with which those factors are used. Thus, much of the analysis emphasises growth in GDP scaled by labour inputs (GDP/LF), an indicator of productivity.

However, it is important to keep in mind that a primary objective is to raise living standards for residents in each of these countries. GDP does not measure how much of the income earned from production actually goes to locals. Given the wide disparities in age distribution and labour force participation across countries, labour force is not an accurate indicator of population. Gross national income per resident (GNI/capita) is a much better indicator of living standards than GDP/LF.

There is a close linkage between the two indicators. As shown in Equation 2.1, each country's per capita income can be decomposed into productivity, the portion of domestic income that accrues to residents and the labour force as a share of the total population. Data permitting, this last term can be further decomposed into a demographic effect – the population share of labour force age, and the labour force participation rate (LFPR). The split between labour force participation and a demographic effect is not presented because the results for some countries are quite sensitive to the selected start and end dates, raising questions about data reliability. However, the demographic effect does appear to have been positive in all four countries as dependency rates have declined.[2]

$$(GDP/LF) \times (GNI/GDP) \times (LF/Pop) = GNI/Pop \qquad (2.1)$$

where

GDP/LF = production per member of the labour force
GNI/GDP = the proportion of income from production that accrues to residents
LF/Pop = the proportion of the population that is economically active
GNI/Pop = national income per capita

Table 2.2 reports this decomposition for each country. In addition to measures for 1980 and 2003, it also shows the percentage change over the period. The top panel shows that for India, productivity and living standards both more than doubled, increasing by roughly the same percentage. Nearly all income accrued to residents in 2003, as in 1980. Similarly, there was little change in the labour force as a share of the total population. In contrast, living standards have grown more slowly than productivity in Pakistan, reflecting a shift from net inflow to a net outflow of factor payments.[3] However, in Bangladesh and Sri Lanka, growth in per capita incomes have significantly

Table 2.2: Components of Gross National Income per Capita

Region/Period	*GDP/Labour Force Participant (2000 International US$)*	*GNI/GDP*	*Labour Force/ Population*	*GNI/Capita (2000 International US$)*
India				
1980	2,705	1.00	0.44	1,185
2003	6,144	0.99	0.44	2,721
Per cent change	*127.2*	*–0.7*	*2.0*	*129.5*
Pakistan				
1980	2,916	1.08	0.37	1,148
2003	5,277	0.97	0.38	1,927
Per cent change	*81.0*	*–9.9*	*2.3*	*67.8*
Bangladesh				
1980	2,257	0.97	0.49	1,074
2003	3,259	1.06	0.51	1,767
Per cent change	*44.4*	*8.5*	*5.2*	*64.5*
Sri Lanka				
1980	4,550	0.99	0.38	1,704
2003	7,791	0.99	0.46	3,533
Per cent change	*71.2*	*–0.4*	*21.0*	*107.4*
South Korea				
1980	11,180	0.98	0.41	4,482
2003	32,594	1.00	0.52	17,004
Per cent change	*191.5*	*1.9*	*27.8*	*279.4*
Thailand				
1980	4,705	0.99	0.53	2,463
2003	12,041	0.98	0.60	7,038
Per cent change	*155.9*	*–1.1*	*12.7*	*185.7*

Sources: *World Development Indicators* and author's calculations.

exceeded growth in productivity. For Bangladesh and especially Sri Lanka, this reflects a rise in the share of the population that is economically active. Bangladesh has also experienced a net inflow of factor payments.

Table 2.2 also highlights that a relatively small share of the people in these four South Asian countries are economically active. As discussed under, this is attributable in part to the relatively low labour force participation for women in India, Sri Lanka, and especially Pakistan. Increases in the percentages of labour force-aged women who become economically active, combined with continued declines in dependency rates, are important channels for raising the growth of income per capita above the growth rate of productivity.

Growth Accounts

Growth accounting is a useful framework for organising data. It provides a means for decomposing increases in output per worker into the contributions from accumulation of physical and human capital (per worker) and a residual measure of the change in total factor productivity.[4] In recent work with Barry Bosworth, we have constructed growth accounts for 84 industrial and developing economies over the period 1960–2003. This sample of countries, which encompasses 95 per cent of world GDP and 85 per cent of world population, gives a useful means for comparing growth experiences across countries, regions and other time periods. Methodology and data sources are explained in the Appendix 2.1.

Growth accounting is simple and internally consistent, and has been used in a wide variety of contexts. For example, growth accounts (often based on industry-level decompositions) are central to the ongoing debate over recent productivity growth in the United States and Europe, and the role of computers and other information technology goods. Given their extensive usage within industrial countries, it is somewhat surprising that some in the development literature view them with skepticism. Bosworth and Collins (2003) argue that this partially reflects issues of measurement and interpretation, and that when appropriately implemented and interpreted, they provide extremely informative benchmarks for studying growth experiences.

It is also important to keep in mind their limitations. These are noted briefly here and discussed further in Bosworth and Collins (2003). First, growth accounting shows only the *proximate* sources of growth and is not intended to determine the *underlying causes* of growth. Consider a country with rapid increases in both accumulation of capital per worker and factor productivity. The decomposition provides no information about whether the productivity growth caused the capital accumulation (for example, by increasing the expected returns to investment) or whether the capital accumulation made additional innovations possible, or some combination.

Second, growth accounts measure total factor productivity (TFP) as a residual. In addition to changes in economic efficiency, this residual will reflect a range of other determinants of growth, not accounted for by the measured increases in factor inputs. Changes in TFP should not be taken as a proxy for technological innovation.[5]

Third, some express concern that the decomposition is sensitive to measurement of inputs and outputs, and to the underlying assumptions about the production process. Thus, we pay considerable attention to measurement issues in constructing the dataset.

Fourth, growth accounts are an appropriate tool for examining growth experiences over longer run periods of a decade or more. The supply side approach is not designed to capture cyclical relationships between variables or effects of short-term shocks such as droughts. By construction, cyclical movements in output simply will be reflected in the residual measure of TFP.

Table 2.3 reports the resulting growth decompositions for each of the SA4 by decade and for the entire period. Figure 2.1 provides graphical representations of the decomposition, with the contributions from physical and human capital combined

Table 2.3: Sources of Growth, South Asia, 1960–2003

Region/Period			*Contribution of*		
	Output	*Output per Worker*	*Physical Capital*	*Education*	*Factor Productivity*
India					
1960–70	3.74	1.81	1.34	0.17	0.74
1970–80	3.08	0.70	0.73	0.33	–0.21
1980–90	5.50	3.48	1.06	0.36	2.05
1990–2003	5.82	3.99	1.48	0.46	1.95
1960–2003	4.62	2.59	1.17	0.34	1.19
Bangladesh					
1960–70	3.99	2.09	0.10	0.13	1.85
1970–80	0.81	–1.61	–0.73	0.30	–1.18
1980–90	3.72	1.07	0.84	0.18	0.05
1990–2003	4.84	2.67	1.61	0.34	0.70
1960–2003	3.43	1.15	0.53	0.24	0.37
Pakistan					
1960–70	7.22	4.67	3.75	0.35	0.54
1970–80	4.68	1.59	0.68	0.23	0.68
1980–90	6.28	3.55	0.98	0.92	1.61
1990–2003	3.82	1.08	0.46	–0.08	0.69
1960–2003	5.37	2.60	1.39	0.33	0.87
Sri Lanka					
1960–70	4.57	2.16	0.08	0.33	1.73
1970–80	4.40	2.25	1.55	0.39	0.29
1980–90	4.19	2.11	2.05	0.22	-0.16
1990–2003	4.64	2.53	1.10	0.34	1.07
1960–2003	4.46	2.28	1.19	0.32	0.75

Source: Authors' calculations as explained in text.

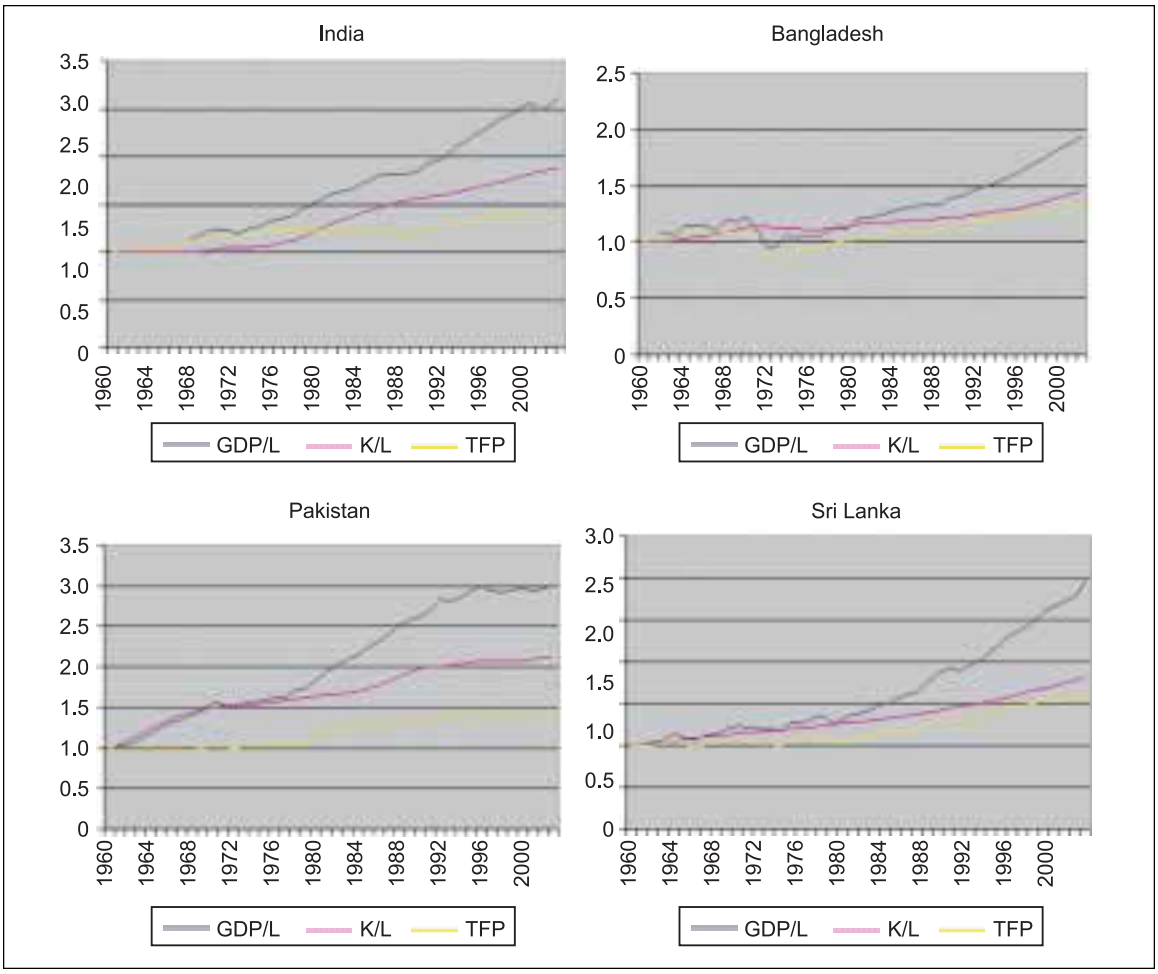

Figure 2.1: Output per Worker and its Components: South Asia, 1960–2003

for ease of presentation. Regional averages are shown in Table 2.4 for comparison purposes. China is reported separately from the rest of East Asia owing to concerns about data reliability. (Heston, 2001.) The discussion below refers to these tables and figures in highlighting the main findings.

It is also interesting to note that strong growth associated with rapid increases in TFP was a standard pattern observed during the 1960s (not shown separately). During this decade, efficiency increases were associated with roughly 60 per cent of the rise in output per worker among industrial economies, still recovering from the World War II, as well as in Latin America and the Middle East.

Consider first the regional comparisons. At 3.3 per cent per annum since 1980, growth in output per worker in South Asia has clearly been well above the world

Table 2.4: Sources of Growth by Region

Region/Period			Contribution of		
	Output	Output per Worker	Physical Capital	Education	Factor Productivity
South Asia (4)					
1960–80	3.61	1.41	0.85	0.32	0.24
1980–2003	5.52	3.35	1.17	–0.36	1.76
1960–2003	4.63	2.44	1.02	0.35	1.05
World (84)					
1960–80	4.48	2.77	1.19	0.39	1.17
1980–2003	3.25	1.82	0.85	0.29	0.68
1960–2003	3.82	2.26	1.00	0.33	0.91
Industrial countries (22)					
1960–80	4.25	2.95	1.19	0.42	1.32
1980–2003	2.59	1.62	0.75	0.22	0.63
1960–2003	3.36	2.23	0.95	0.31	0.95
China (1)					
1960–80	4.04	1.83	0.80	0.38	0.64
1980–2003	9.48	7.77	2.78	0.35	4.49
1960–2003	6.91	4.97	1.86	0.36	2.68
East Asia less China (7)					
1960–80	7.02	3.98	2.23	0.53	1.18
1980–2003	6.08	3.67	2.22	0.53	0.88
1960–2003	6.52	3.81	2.23	0.53	1.02
Latin America (23)					
1960–80	5.74	2.75	1.04	0.32	1.37
1980–2003	1.96	–0.58	0.10	0.41	–1.08
1960–2003	3.70	0.95	0.54	0.36	0.05
Africa (19)					
1960–80	4.40	1.94	1.01	0.12	0.80
1980–2003	2.16	–0.55	–0.08	0.41	–0.88
1960–2003	3.20	0.60	0.43	0.28	–0.11
Middle East (9)					
1960–80	5.43	3.20	1.81	0.38	0.99
1980–2003	3.81	0.82	0.35	0.52	–0.05
1960–2003	4.56	1.92	1.02	0.45	0.43

Source: Authors' calculations as explained in text.

average, rivaling East Asia's experience (3.9 per cent). Furthermore, since 1980 increases in TFP contributed fully twice as much to growth in SA4 as in East Asia, while increases in capital per worker contributed just half as much. At the same time, the overall contribution to growth from capital deepening in SA4 was not low by world standards, but exceeded that for all other regions except East Asia.

However, a more careful look at the results to distinguish across countries and decades suggests a much more nuanced view of the contribution of TFP to growth in South Asia (Table 2.3). First, the regional average (GDP weighted) is, of course, dominated by India's experience. Only two of the other three (Bangladesh and

Pakistan) exhibited strong TFP growth since 1980, and both well below that for India.

Second, in all three of these economies, TFP surged during the 1980s after two decades of little growth. For India and Bangladesh, this surge partially reflected a recovery from the poor performance during the 1970s. Especially for India and Pakistan, TFP growth then slowed substantially during 1990–2003.

Third, the most recent period is certainly not one in which physical capital accumulation was relatively unimportant for growth. For Bangladesh, Pakistan, and Sri Lanka, its contribution accounts for 43 per cent of total growth in output per worker, a share identical to the overall global average. For India this share is lower, but not substantially, at 39 per cent.

Investment Rates versus Capital Accumulation

The growth accounting methodology highlights the fact that the change in a country's capital stock is the appropriate way to measure the contribution of capital accumulation to growth – not the country's investment rate. This is particularly relevant here, because the average ratios of investment to GDP understate capital's contribution for all of the SA4 (Equation 2.2).

The change in the capital stock is given by

$$\Delta K = I - dK \tag{2.2}$$

where d represents depreciation. Dividing through by K and assuming a steady-state constant value (γ) for the inverse of the capital-output ratio allows the rate of change of the capital stock (k) to be measured by the investment rate ($i = I/Y$) (Equation 2.3).

$$k = i\gamma - d \tag{2.3}$$

However, if the capital output ratio is not constant, I can be a very poor proxy for k. The assumption of a constant capital output ratio and steady-state seems particularly unreasonable for developing countries struggling to catch up. Indeed capital-output ratios not only differ across countries, but also evolve over time for many of the developing countries in our sample.[6]

In fact, the correlation between the two measures is surprisingly low, as illustrated in Figure 2.2. Each point represents the average investment rate and the average change in physical capital stock for one of the countries in the sample. The SA4 (as well as Korea and Thailand) are each denoted with the first letter of their country name. Countries that devote modest shares of their output to investment can exhibit

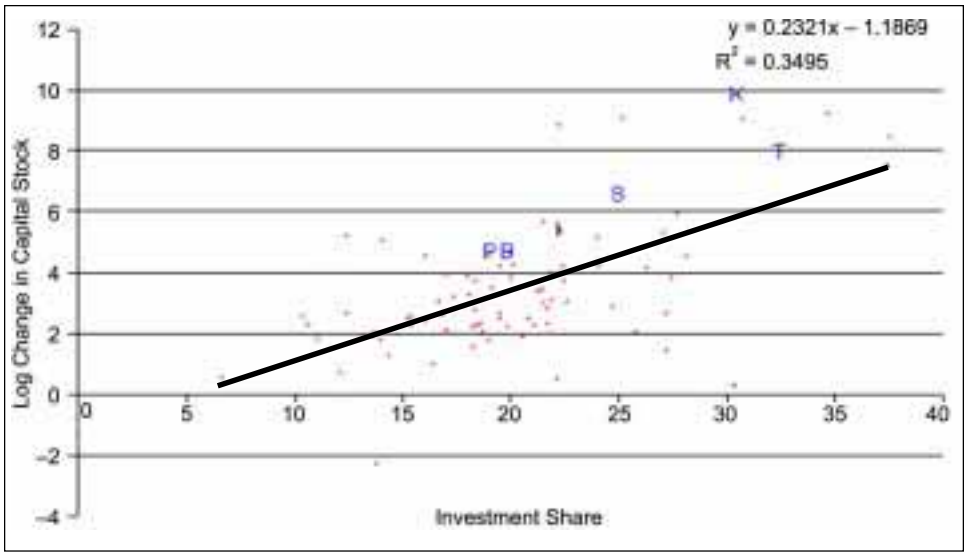

Figure 2.2: Comparison of Investment Share and Change in the Capital Stock, 1980–2003
(all countries except IND, LKA, PAK, BGD through 2000)

relatively large increases in their capital stocks if their output is growing rapidly. In contrast, countries with very slow output growth will tend to have small changes in their capital stocks despite high investment shares.

Educational Attainment: A Labour Quality Index

The growth accounts also highlight increases in labour quality, which we measure using average years of schooling and an assumed rate of return to each additional year of schooling.[7] Overall, for our sample, increases in education contribute 0.3 percentage points per annum to growth. During much of its rapid growth period, East Asia stands out for very rapid rise in years of schooling, contributing roughly 0.6 per cent to annual growth, or twice the global average.

Table 2.5: Average Years of Schooling (Population Aged 15+)

	Average Years of School		
	1960	*1980*	*2000*
India	1.7	3.3	5.1
Bangladesh	0.6	1.9	2.6
Pakistan	0.7	2.1	3.9
Sri Lanka	3.9	5.6	6.9

Source: Provided by Jong-Wha Lee (Barro and Lee 2000 dataset).

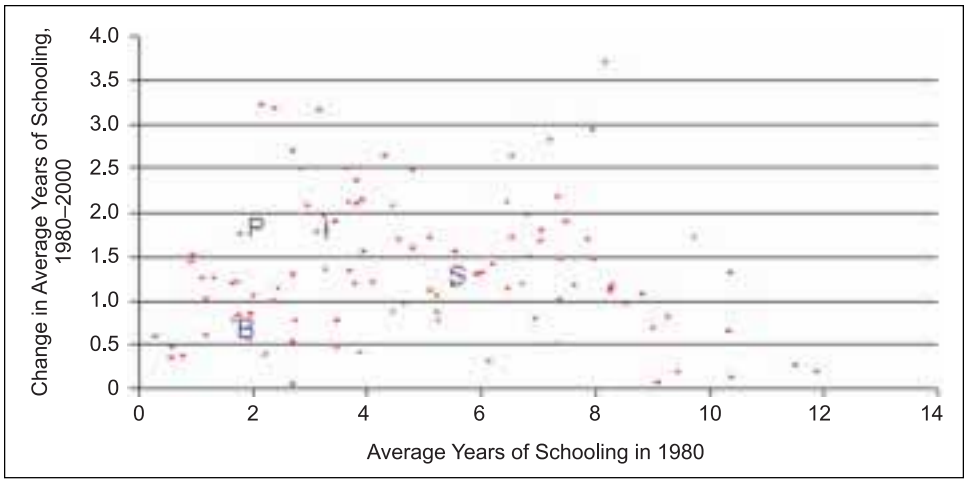

Figure 2.3: Average Schooling in 107 Countries

Increases in education among the South Asian economies have not been as impressive (Figure 2.3) and the average level of schooling remains quite low (Table 2.5). Data constructed by Robert Barro and Jong-Wha Lee for 2000 show that the percentages of the population over age 15 who had completed at least the first level of schooling (six years) were just 17 per cent in Bangladesh, 28 per cent in India and Pakistan,[8] and 52 per cent in Sri Lanka. However, in India the population share with post-secondary school education has risen relatively rapidly. Our growth accounts show the contribution from increased schooling ranging from under 0.3 to just over 0.4 per cent.

Some Implications Looking Forward

In sum, growth accounts show that both capital accumulation and increased efficiency of factor usage have been important for South Asia's growth. Modest investment rates to the contrary, capital accumulation has not played an unusually small role. At the same time, there is considerable room for increasing investments in both physical and human capital. This final section provides a much more speculative discussion, looking to the future. What are the prospects for achieving double digit growth, and what would it require?

Could South Asia achieve this goal through concentrating on approaches intended to accelerate TFP growth? There are at least two reasons one might reach this conclusion. First, it has become popular in the literature on economic growth to emphasise the role of TFP. Thus, researchers now frequently model capital accumulation as endogenous, such that increases in TFP automatically induce the investment required to maintain the capital-output ratio (Easterly and Levine, 2001 and Klenow and Rodriguez-Clare, 1997). However, there is little evidence for this in our data. Capital

accumulation and TFP growth exhibit surprisingly little correlation, consistent with the view that investment decisions are influenced by a great many factors (such as availability of finance and tax consideration) in addition to changes in TFP. It is also worth noting in this context that initial conditions and available policy indicators explain investment and capital accumulation at least as well as they explain changes in TFP (for example, see Bosworth and Collins, 2003). There are no magic policy bullets for generating TFP growth. Since both capital and TFP matter, a prudent policy stance should seek to foster both.

Second, India has achieved strong TFP growth with modest investment. Over this period, it has also achieved very impressive growth in its information technology (IT) sector, which the Ministry of Finance forecasts will account for fully 25 per cent of value added by 2020, up from roughly 7 per cent today. However, in a recent paper, Srinivasan (2006) identifies a variety of potential constraints to the sectors' growth. The domestic ones include shortages of appropriately skilled labour, poor infrastructure, and difficult labour and bankruptcy laws. External ones include concerns about increased protectionism if the US fears about offshoring intensify.

Perhaps more importantly, one can agree that there are strong prospects for continued growth of India's IT sector without concluding that IT is a likely engine of more rapid growth that could be sustained with modest investment. As discussed earlier, our data show somewhat more impressive Indian TFP during the 1980s than in the past decade. Furthermore, the IT sector is concentrated in a few urban areas. As in the other South Asian economies, a substantial share of India's labour force is relatively low skilled, living in rural areas, and involved with agricultural activities. Though difficult to estimate, underemployment is extremely high. Substantial increases in living standards will necessitate reallocating much of this labour to activities in the industrial or service sector, where their productivity will be significantly higher. And for them to be productive in these activities will require investments in their human capital, as well as increases in infrastructure and other types of physical capital.

However, one should not be surprised if this reallocation generates relatively little TFP increase in the sectors to which these workers move. For example, there is considerable scope for expanding production of manufactured goods, using technology that is standard in the global marketplace. Assuming the required capital is purchased at world prices, and the goods are sold in world markets, this is unlikely to generate increases in TFP in the manufacturing sector. However, to the extent that labour pulled out of agriculture was at least partially redundant, one would expect to observe measured productivity in agriculture increase. Much of the aggregate productivity gains would be associated with the reallocation of labour from agriculture where productivity is relatively low, to the rest of the economy, where it is considerably higher.

To study the implications of this reallocation for aggregate growth requires consistent data series so as to disaggregate the growth accounts by sector. We hope to extend our growth accounts to the broad categories of agriculture, industry, and services for at least some of the South Asian countries. However, this type of analysis has been done recently for Thailand, and the results for the period 1977–96, during which agriculture's share of employment fell from roughly 65 to 45 per cent, are quite interesting. In particular, Bosworth (2005) finds that fully two-thirds of the rise in Thailand's TFP during this period can be attributed to reallocation of labour (1.1 percentage points out of a total TFP contribution to growth of 1.6 per cent per annum).

Finally, it is interesting to construct some benchmark scenarios that project the implications for required investment of achieving alternative rates of growth over the coming decade. While based on relatively simple assumptions, and focusing on the results for India, the results are provocative. We begin by assuming that India maintains balanced growth, with investment sufficient for capital to grow at the rate of output. Sustainable output growth would be given by the growth of the labour force (adjusted for labour quality), and the rate of TFP increase, scaled by labour's share of income. Consider growth in the number of workers ranging from 2 to 2.8 per cent per year. Asian Development Bank (ADB) (2005) projects India's labour force will grow at 1.8 per cent through 2015. These figures are augmented to reflect prospects for increased labour force participation of women, and reduced underemployment. Next suppose the feasible range for India to increase average years of schooling is from one to one and a half years over the next decade. (Note that the changes in Figure 2.3 reflect a twenty year period.) The implied increases in labour quality would add an additional 0.7–1.2 per cent per year to effective labour force growth. Suppose that India can achieve TFP growth of at least 1.5 per cent per year, but perhaps as much as 3 per cent per year. Finally, assume labour share equal to 65 per cent, as for the growth accounts. The result is GDP growth ranging from 4.9 to 8.7 per cent per annum. Using the capital output ratio for India from our data, and assuming a 5 per cent rate of capital depreciation, the required investment ranges from 22 to 30 per cent of GDP. And with the other variables all at the top of their ranges, India could achieve output growth of 10 per cent per annum with an investment share of 38 per cent of GDP.

These scenarios suggest that output growth rates of about 5 per cent per annum in South Asia are quite consistent with maintaining investment rates of 22 per cent of GDP, the average since 1980. However, these scenarios support the view that sustained increases in the region's growth will require significant increases in the investment rate, as well as efforts to increase labour force participation and increase worker skills through schooling.

Appendix 2.1. Growth Accounts

Earlier, growth accounting is used to examine South Asia's growth experience over the period 1960–2003. As discussed in Bosworth and Collins (2003), we have used this methodology to construct consistent accounts for an additional 80 countries during 1960–2000.[9] Readers can refer to Bosworth and Collins (2003) for additional details about the data and methodology and for further discussion of its strengths and shortcomings.

A country's output in any given year depends on its factor inputs – labour and (human and physical) capital, as well as on the efficiency with which factors are used in production. Thus, the key pieces to the procedure are a growth accounting equation for constructing the decomposition, parametre assumptions, and data on output and factor inputs.

Define Y as GDP, K as the physical capital stock, and A as the level of technology. L is labour inputs (measured as 'bodies of economically active persons') which we assume is 'augmented' by H, an index of the average 'level of labour quality', which we measure by average years of schooling. We also assume that a country's output can be expressed as a function of these inputs, using the specific functional form shown in (A.1).[10]

$$Y = A\,K^{\alpha}\,(HL)^{(1-\alpha)} \tag{A.1}$$

We report our results in a form that decomposes growth in output per worker into the contributions from the growth of physical capita per worker, the growth of education per worker, and the growth in total factor productivity, as shown in (A.2). (Lower case letters denote a variable's average annual growth rate.)

$$y/\mathrm{l} = \alpha\,(k/\mathrm{l}) + (1-\alpha)\,h + a \tag{A.2}$$

Given an estimate for α and measures of Y, L, K, and H, it is straightforward to solve for A (or a) and construct the decomposition. As for our 84-country study, this decomposition assumes α capital share: $\alpha = 0.35$. An analysis that used the actual income shares in each period would allow for the consideration of a much wider range of underlying production functions. However, few countries are able to allocate the incomes of the self-employed between capital and labour.[11]

As noted earlier, Y is real GDP. L is employment for industrial countries and labour force for all non-industrial countries. The capital stock measure is constructed from investment data using the perpetual inventory method, with a depreciation rate of 0.05 per cent. Finally, to construct H, we assume that human capital is directly related to average years of schooling (S) , and that there is a 7 per cent return to each additional year of schooling (A.3).

$$H = (1.07)^{S} \quad \text{(A.3)}$$

Information about data sources for the 1960–2000 sample is provided in Bosworth and Collins (2003). Data from *World Development Indicators* (2005) were used to update GDP, *L,* and *K* to 2003 for India, Bangladesh, Pakistan, and Sri Lanka. Average years of schooling was interpolated to 2003 for these countries, based on trends during 1990–2000.

Notes

Key arguments are drawn from work with Barry Bosworth, who I thank without implicating. I would also like to thank Gabriel Chodorow-Reich for expert research assistance.

1. See Bosworth and Collins (2003).
2. With employment data, productivity can be measured as GDP per employed worker, and the last term can be split between the demographic effect, the LFPR, and the employment rate.
3. However, net factor payment to Pakistan have been quite variable, in part due to remittances, and do not exhibit a clear trend.
4. As discussed above, 'worker' refers to a member of the labour force except for the industrial countries.
5. See Hulten (2001) for a detailed discussion of growth accounting and the TFP residual.
6. Note that with investment equal to 20 per cent of GDP and a 5 per cent depreciation rate, the growth in the capital stock would equal 5 per cent with a capital-output ratio equal to 2, but just 2 per cent with a capital-output ratio just under 3.
7. Our work to date assumes a constant rate of return to each additional year of schooling. The results reported here use 7 per cent, which is in the lower range of estimates from microeconomic studies. We have also considered higher rates of return, and explored approaches to controlling for the quality as well as number of years, of schooling. However, some estimates suggest that the returns to education may not be constant and it would be useful to explore this further.
8. The educational data reported for Pakistan appears particularly noisy and may be unreliable.
9. Country coverage was determined by data availability. The main exclusions are the transition economies and countries with population less than one million.
10. Equation (A.1) assumes constant returns to scale.
11. See Bosworth and Collins (2003) for further discussion and references in the cross-country context.

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