

## 4. Sources of Developing Asia's economic growth: insights from the standard growth accounting approach

### 4.1 INTRODUCTION

The previous three chapters depict the catching-up performance of Developing Asia and its rise in the global landscape during the past two decades. This chapter examines the sources of economic growth in the individual economies of the region to identify the key drivers of their economic performance. The chapter then analyses the growth gap between Developing Asia and the rest of the world to understand the sources of the region's high economic performance in comparison to the non-Asian developing economies and the economies of developed countries.

The chapter uses the neo-classical growth accounting framework to decompose the aggregate growth of an individual economy into the contribution of various inputs and the total factor productivity (TFP). This growth accounting methodology was pioneered by Solow (1957) and considerably developed by Jorgenson and associates (Jorgenson and Griliches, 1967; Christensen and Jorgenson, 1969, 1970; Christensen et al., 1975; Diewert, 1976; and Jorgenson et al., 1987).<sup>1</sup> The growth accounting framework has been widely accepted as the most accurate way of measuring the contribution of different economic inputs and is therefore the gold standard for the analysis of productivity and sources of growth.

Using the accounting framework for growth in the information age, this chapter decomposes the aggregate gross domestic product (GDP) growth at the economy level into the contribution of three main sources: capital input, labor input, and total factor productivity (TFP). The capital input consists of the information and communication technology (ICT) capital<sup>2</sup>

and non-ICT capital, which includes all of the other types of capital. The contribution of ICT capital captures the impact of the ICT revolution across sectors in the economy. Labor input includes hours worked and labor quality. Hours worked reflects the mobilization of labor through increased labor force participation and longer hours worked per average worker. Labor quality captures the contribution of human capital accumulation, which is proxied by education and experience. TFP growth is considered the contribution of technical progress, efficiency improvement, and other unobservable factors. Comprehensive presentations of the decomposition framework for growth in the information age, in which the split between ICT and non-ICT capital is emphasized, were published by Jorgenson et al. (2005) and Barro and Lee (2010).

Average labor productivity (ALP) of an economy is calculated by dividing its GDP by the total hours worked. ALP is an important indicator of economic performance. Jones (1997) noted that labor productivity is a more reliable measure than per capita income for capturing the wealth level of a nation. Fogel (2011) asserted that 'much of the success of developing countries was due to changes in labor productivity.' The growth accounting framework allows one to decompose ALP growth into the contribution of capital deepening, labor quality, and TFP growth. Capital deepening is a measure of the capital quantity per average worker, which is a major driver of ALP growth in most countries, as will be shown in this chapter.

The decomposition of GDP and ALP growth described in this chapter is based on the growth accounting framework presented by Jorgenson et al. (2003, 2005), which is elaborated in Appendix 4.1. In this exercise, GDP growth is decomposed into the contributions of capital input, which consists of ICT and non-ICT capital, labor input, which includes hours worked and labor quality, and TFP growth. At the same time, ALP growth is decomposed into the contribution of capital deepening, labor quality, and TFP growth.

The decomposition exercise uses the dataset used by Jorgenson and Vu (2011), which is constructed based on the Conference Board's Total Economy Dataset (TED) and the World Bank's World Development Indicators database. The Jorgenson and Vu dataset covers 119 economies that are divided into the seven groups introduced in Chapter 2. Detail of this dataset is provided in Appendix 4.2. Recall that these seven groups are Developing Asia, G7, Non-G7, Latin America, Eastern Europe and former Soviet Union (or Eastern Europe), Sub-Saharan Africa, and Northern Africa and Middle East. The growth decomposition exercise was conducted for the 1990–2010 period, which in turn was divided into two sub-periods: 1990–2000 and 2000–2010.

<sup>1</sup> See OECD (2001) and Caselli (2008) for a comprehensive review.

<sup>2</sup> ICT capital is associated with investment in computer hardware, computer software, and telecommunication equipment.

As in the other chapters of this book, to facilitate comparative analyses, the empirical results obtained for the group composed of 16 Developing Asia economies are arranged into four subgroups. They are: China-India, which includes two giant economies (China and India); Tigers-4, which includes four Asian Tiger economies (Hong Kong, Singapore, South Korea, and Taiwan); ASEAN-6, which includes six ASEAN economies (Cambodia, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam); and SAC-4, which includes four South Asian economies (Bangladesh, Nepal, Pakistan, and Sri Lanka).

The remainder of the chapter proceeds as follows. Section 4.2 examines the sources of GDP growth of the 16 Developing Asia economies at the individual economy level and depicts their performance in a regional picture. Section 4.3 analyses the sources of ALP growth of the 16 Developing Asia economies, and Section 4.4 examines the role of ALP in the driving of GDP growth in these economies. Section 4.5 analyses the factors responsible for the leading economic performance of Developing Asia relative to the group of developed nations and the group of other developing economies. Section 4.6 examines the sources of GDP and ALP growth in a global picture to assess whether the insights gained from the study of Developing Asia can be generalized worldwide. Section 4.7 summarizes the main findings of the chapter.

## 4.2 SOURCES OF GDP GROWTH IN DEVELOPING ASIA

### 4.2.1 Empirical Results

The empirical results for the sources of GDP growth for the 16 Developing Asia economies are reported in Table 4.1. Panel A of the table is for the period of 1990–2010, whereas panels B and C are for the two sub-periods 1990–2000 and 2000–2010, respectively.

#### China-India

China attained an outstanding GDP growth rate of 9 per cent during the period of 1990–2010, of which 5.8 percentage points were due to capital input, 0.5 percentage points were due to labor input, and 2.7 percentage points were due to TFP. Thus, China's GDP growth was largely driven by capital accumulation, which accounted for 64.2 per cent of its growth; TFP growth was also an important source of growth with a share of approximately 30 per cent. In contrast, the labor input accounted for a small share of 6.1 per cent of China's GDP growth, which implies that

Table 4.1 Sources of GDP growth: 1990–2010, 1990–2000, and 2000–2010

(A) Period 1990–2010																
Economy	GDP Growth (%)	Contribution to Growth (% ppa)							GDP Growth	Share in Growth (%)						
		Capital Input			Labor Input			TFP		Capital Input			Labor Input			TFP
		All	ICT	Non-ICT	All	Quality	Hours			All	ICT	Non-ICT	All	Quality	Hours	
<i>China-India</i>																
China	9.0	5.8	1.0	4.8	0.5	0.2	0.4	2.7	100.0	64.2	11.0	53.2	6.1	1.7	4.4	29.7
India	6.4	3.4	0.5	2.9	1.2	0.2	1.0	1.9	100.0	52.7	8.1	44.5	18.3	2.4	15.9	29.0
<i>Tigers-4</i>																
Hong Kong	3.9	1.5	0.3	1.2	1.1	0.1	1.0	1.3	100.0	39.4	7.9	31.5	27.6	3.3	24.4	32.9
Singapore	6.5	3.8	0.8	3.0	2.2	0.5	1.7	0.5	100.0	58.7	12.1	46.6	33.7	8.0	25.7	7.7
South Korea	5.2	1.6	0.5	1.1	1.0	0.7	0.3	2.6	100.0	31.0	9.5	21.5	19.8	13.7	6.1	49.2
Taiwan	4.9	2.0	0.5	1.5	0.8	0.3	0.5	2.1	100.0	40.2	10.0	30.1	16.9	6.0	10.9	42.9
<i>ASEAN-6</i>																
Cambodia	7.4	4.9	0.4	4.6	1.8	0.1	1.7	0.6	100.0	66.9	4.8	62.2	24.4	1.3	23.1	8.6
Indonesia	4.6	3.2	0.4	2.8	1.1	0.2	0.9	0.4	100.0	69.3	8.8	60.5	22.9	3.6	19.3	7.8
Malaysia	5.7	2.9	0.6	2.3	1.5	0.2	1.3	1.3	100.0	51.1	11.1	40.0	26.4	4.0	22.4	22.4
Philippines	3.8	1.7	0.3	1.3	1.4	0.2	1.2	0.6	100.0	44.6	8.7	35.9	38.5	6.3	32.2	16.8
Thailand	4.3	2.7	0.3	2.4	0.9	0.3	0.6	0.7	100.0	62.1	6.6	55.5	21.3	7.4	13.9	16.6
Vietnam	7.2	4.5	0.7	3.8	1.4	0.1	1.3	1.3	100.0	62.5	9.2	53.3	19.2	1.3	17.9	18.3
<i>SAC-4</i>																
Bangladesh	5.2	3.7	0.2	3.6	1.1	0.1	1.0	0.3	100.0	72.5	3.6	68.9	21.6	1.4	20.2	5.9
Nepal	4.3	2.4	0.3	2.1	1.6	0.1	1.5	0.3	100.0	55.5	6.1	49.4	36.4	2.1	34.3	8.1
Pakistan	4.5	2.6	0.5	2.1	1.5	0.1	1.4	0.4	100.0	57.9	10.3	47.6	32.4	1.2	31.2	9.7
Sri Lanka	5.1	1.8	0.4	1.4	1.0	0.1	0.9	2.3	100.0	35.6	7.7	27.9	19.9	2.2	17.7	44.5

Table 4.1 (continued)

(B) Period 1990–2000

Economy	GDP Growth (%)	Contribution to Growth (% ppa)							GDP Growth	Share in Growth (%)						
		Capital Input			Labor Input			TFP		Capital Input			Labor Input			TFP
		All	ICT	Non- ICT	All	Quality	Hours			All	ICT	Non- ICT	All	Quality	Hours	
<i>China-India</i>																
China	7.1	5.2	0.8	4.4	0.7	0.2	0.5	1.2	100.0	73.6	11.5	62.1	9.8	2.2	7.6	16.6
India	5.4	2.8	0.3	2.6	1.1	0.2	0.9	1.5	100.0	52.4	5.0	47.4	19.8	3.0	16.8	27.8
<i>Tigers-4</i>																
Hong Kong	3.9	2.1	0.4	1.7	1.5	0.1	1.4	0.3	100.0	54.4	9.6	44.8	38.5	2.2	36.4	7.0
Singapore	7.3	5.0	0.8	4.2	2.2	0.6	1.6	0.1	100.0	68.2	10.8	57.4	30.1	8.6	21.5	1.7
South Korea	6.3	1.8	0.6	1.2	1.6	0.9	0.7	2.9	100.0	28.6	9.7	19.0	25.3	13.6	11.6	46.1
Taiwan	6.0	2.7	0.6	2.1	1.0	0.3	0.7	2.3	100.0	45.3	10.7	34.6	16.3	4.7	11.6	38.4
<i>ASEAN-6</i>																
Cambodia	7.0	4.0	0.4	3.6	2.0	0.1	1.9	1.0	100.0	57.1	5.8	51.3	28.3	0.9	27.5	14.6
Indonesia	4.1	3.5	0.2	3.3	1.0	0.2	0.8	-0.4	100.0	85.2	5.1	80.1	24.5	4.0	20.5	-9.7
Malaysia	6.9	4.0	0.7	3.4	1.9	0.3	1.6	0.9	100.0	58.8	9.6	49.3	28.0	4.2	23.8	13.1
Philippines	2.9	1.7	0.2	1.5	1.2	0.2	1.1	-0.1	100.0	60.6	6.5	54.1	42.4	5.3	37.1	-3.0
Thailand	4.4	3.8	0.2	3.6	0.4	0.2	0.2	0.1	100.0	87.0	4.4	82.7	9.9	4.9	5.0	3.0
Vietnam	7.3	3.5	0.4	3.2	1.3	0.1	1.2	2.5	100.0	48.4	5.1	43.3	17.9	1.0	16.8	33.7
<i>SAC-4</i>																
Bangladesh	4.7	3.7	0.2	3.5	0.7	0.1	0.7	0.3	100.0	78.3	3.3	75.0	15.9	1.7	14.3	5.8
Nepal	4.9	2.7	0.3	2.4	1.5	0.1	1.5	0.6	100.0	55.9	6.1	49.8	31.7	1.2	30.5	12.3
Pakistan	4.3	2.5	0.4	2.1	0.9	-0.1	1.0	0.9	100.0	57.1	8.2	48.8	21.5	-1.3	22.8	21.5
Sri Lanka	5.1	1.5	0.3	1.2	1.2	0.1	1.1	2.5	100.0	28.5	5.0	23.4	23.5	1.7	21.8	48.0

(C) Period 2000–2010

Economy	GDP Growth (%)	Contribution to Growth (% ppa)							GDP Growth	Share in Growth (%)						
		Capital Input			Labor Input			TFP		Capital Input			Labor Input			TFP
		All	ICT	Non- ICT	All	Quality	Hours			All	ICT	Non- ICT	All	Quality	Hours	
<i>China-India</i>																
China	10.9	6.3	1.2	5.1	0.4	0.1	0.3	4.2	100.0	58.0	10.7	47.3	3.7	1.3	2.3	38.3
India	7.4	3.9	0.8	3.2	1.3	0.1	1.1	2.2	100.0	52.9	10.5	42.4	17.2	2.0	15.2	30.0
<i>Tigers-4</i>																
Hong Kong	4.0	1.0	0.2	0.7	0.7	0.2	0.5	2.3	100.0	24.8	6.3	18.5	17.0	4.4	12.6	58.2
Singapore	5.8	2.7	0.8	1.9	2.2	0.4	1.8	0.9	100.0	46.5	13.6	32.9	38.3	7.3	31.0	15.2
South Korea	4.1	1.4	0.4	1.0	0.5	0.6	-0.1	2.2	100.0	34.7	9.3	25.4	11.3	13.8	-2.4	54.0
Taiwan	3.8	1.2	0.3	0.9	0.7	0.3	0.4	1.9	100.0	32.0	9.0	23.0	17.8	8.1	9.7	50.2
<i>ASEAN-6</i>																
Cambodia	7.7	5.8	0.3	5.5	1.6	0.1	1.5	0.2	100.0	75.9	3.8	72.1	20.9	1.7	19.2	3.2
Indonesia	5.1	2.9	0.6	2.3	1.1	0.2	0.9	1.1	100.0	56.4	11.9	44.5	21.6	3.3	18.3	22.0
Malaysia	4.5	1.8	0.6	1.2	1.1	0.2	0.9	1.7	100.0	39.4	13.4	26.0	24.0	3.7	20.3	36.6
Philippines	4.7	1.6	0.5	1.2	1.7	0.3	1.4	1.3	100.0	34.8	10.1	24.8	36.2	6.9	29.2	29.0
Thailand	4.2	1.5	0.4	1.2	1.4	0.4	1.0	1.3	100.0	36.5	8.9	27.6	32.9	9.9	23.0	30.6
Vietnam	7.0	5.4	0.9	4.5	1.4	0.1	1.3	0.2	100.0	77.1	13.4	63.7	20.5	1.6	19.0	2.3
<i>SAC-4</i>																
Bangladesh	5.6	3.8	0.2	3.6	1.5	0.1	1.4	0.3	100.0	67.8	4.0	63.8	26.3	1.2	25.1	5.9
Nepal	3.8	2.1	0.2	1.9	1.6	0.1	1.5	0.1	100.0	55.0	6.0	48.9	42.4	3.2	39.3	2.6
Pakistan	4.7	2.7	0.6	2.2	2.0	0.2	1.8	-0.1	100.0	58.7	12.3	46.4	42.4	3.5	38.9	-1.1
Sri Lanka	5.1	2.2	0.5	1.6	0.8	0.1	0.7	2.1	100.0	42.9	10.4	32.5	16.2	2.6	13.5	41.0

Source: Author's calculations.

employment played a minor role in the country's GDP growth during 1990–2010 (Table 4.1, Panel A).

India was also a leading performer in terms of GDP growth over the period of 1990–2010. Its GDP growth of 6.4 per cent during this period was the result of 3.4 percentage points from capital input (accounting for a share of 52.7 per cent), 1.2 percentage points from labor input (18.3 per cent), and 1.9 percentage points from TFP (29.0 per cent; Table 4.1, Panel A).

The sources of GDP growth of China and India exhibited rather similar structures, which demonstrate that the robust growth of these two countries was largely driven by capital accumulation and TFP growth. These two sources together accounted for a lion's share of the two countries' growth over 1990–2010: 93.9 per cent for China and 81.7 per cent for India<sup>3</sup> (Table 4.1, Panel A).

It should be noted, however, that India was well below China in both the contributions of capital input (by 2.4 percentage points) and TFP growth (by 0.8 percentage points). In addition, China also outperformed India in the contribution of ICT capital. In fact, the contribution of ICT capital to China's growth during the period of 1990–2010 was 1 percentage point, which was well above the 0.5 percentage points observed for India (Table 4.1, Panel A).

GDP growth notably accelerated for both China and India from the first sub-period, 1990–2000, to the second sub-period, 2000–2010. In general, the patterns of the source of growth in the two sub-periods were consistent with the results observed for the entire period of 1990–2010. Furthermore, the acceleration of the two countries' growth was also driven by their two major growth engines: capital accumulation and TFP growth. China's GDP growth rate increased from 7.1 per cent in 1990–2000 to 10.9 per cent in 2000–2010; the contribution of capital increased from 5.2 to 6.3 percentage points, and the contribution of TFP growth increased from 1.2 to 4.2 percentage points over the two sub-periods. Similarly, India's GDP growth rate accelerated by 2 percentage points from 5.4 per cent in 1990–2000 to 7.4 per cent in 2000–2010; the contribution of capital increased from 2.8 to 3.9 percentage points, and the contribution of TFP growth improved from 1.5 to 2.2 percentage points over the two sub-periods (Table 4.1, Panels B and C). Thus, for both China and India, the growth acceleration between the two sub-periods was driven not only by the increased contribution of capital input but also by the larger contribution of TFP. This finding demonstrates that,

for both countries, the growth of capital accumulation was mainly driven by the economy's strengthened absorptive capability and efficiency improvements.

The decrease in the contribution of hours worked to China's GDP growth from a rather low level of 0.5 percentage points in 1990–2000 to a very low level of 0.25 percentage points in 2000–2010 (Table 4.1, Panels B and C) suggests that the country was facing increasing constraints in its labor supply. Thus, China may face significant wage increases, which would place pressure on labor-intensive industries to move up the value chain or reallocate to other countries. It should be noted that the contribution of hours worked to India's GDP growth increased between the two sub-periods from 0.9 percentage points in 1990–2000 to 1.1 percentage points in 2000–2010. This result demonstrates that the mobilization of labor input is still an important way through which India can promote economic growth.

#### Tigers-4

Among the four Asian Tiger economies, Singapore was the leading performer in GDP growth during the period of 1990–2010 with a rate of 6.5 per cent, whereas Hong Kong's growth was lowest at 3.9 per cent. Both South Korea and Taiwan's growth rates were approximately 5 per cent. The strong GDP growth rate of Singapore was largely driven by capital and labor inputs with contributions of 3.8 and 2.2 percentage points, respectively. In contrast, the contribution to Hong Kong's GDP growth in this period was only 1.5 percentage points from capital input and 1.1 percentage points from labor input (Table 4.1, Panel A).

The largest sources of GDP growth in South Korea and Taiwan, during the period of 1990–2010, were TFP growth and capital accumulation. The contribution to growth from TFP was 2.6 percentage points (accounting for a share of 49.2 per cent) for South Korea and 2.1 percentage points (42.9 per cent) for Taiwan; the contribution from capital accumulation was 1.6 percentage points (31 per cent) for South Korea and 2.0 percentage points (40.2 per cent) for Taiwan (Table 4.1, Panel A).

There were some salient differences in the sources of GDP growth during the period of 1990–2010 between the four Asian Tiger economies. First, although the hours worked was an important source for both Singapore and Hong Kong's growth, this factor played a minor role in driving the growth of South Korea and Taiwan. The share of hours worked in GDP growth during 1990–2010 was 25.7 per cent for Singapore, 24.4 per cent for Hong Kong, 10.9 per cent for Taiwan, and 6.1 per cent for South Korea. Second, ICT played a more important role in Singapore compared with the other Tigers-4 economies. The share of the contribution of ICT

<sup>3</sup> Srinivasan (2011) provided insights that explain why India's reforms since 1990 still had limited effects on employment.

capital to GDP growth during 1990–2010 was 12.1 per cent for Singapore, 10 per cent for Taiwan, 9.5 per cent for South Korea, and 7.9 per cent for Taiwan. Third, improvements in the labor quality were more important in South Korea and Singapore compared with Taiwan and Hong Kong. The share of the contribution of the labor quality to GDP growth during 1990–2010 was 13.7 per cent for South Korea and 8 per cent for Singapore, while it was only 6 per cent for Taiwan and 3.3 per cent for Hong Kong (Table 4.1, Panel A).

As shown in Panels B and C of Table 4.1, there were some notable changes in the growth patterns of the Tigers-4 economies over the two sub-periods. With the exception of Hong Kong, the Tigers-4 economies experienced a notable slowdown in GDP growth over the two sub-periods: from 7.3 per cent in 1990–2000 to 5.8 per cent in 2000–2010 for Singapore, from 6.3 to 4.1 per cent for South Korea, and from 6.0 to 3.8 per cent for Taiwan. In contrast, Hong Kong sustained its GDP growth at a rate of approximately 3.9–4.0 per cent over the two sub-periods.

A common feature observed for all Asian Tiger economies was the notable reduction in the contribution of capital input to the growth over the two sub-periods, which declined from 2.1 percentage points in 1990–2000 to 1 percentage point in 2000–2010 for Hong Kong, from 5.0 to 2.7 percentage points for Singapore, from 1.8 to 1.4 percentage points for South Korea, and from 2.7 to 1.2 percentage points for Taiwan. In contrast, TFP growth significantly increased in Hong Kong (from 0.3 percentage points in 1990–2000 to 2.3 percentage points in 2000–2010) and Singapore (from 0.1 to 0.9 percentage points). TFP growth remained robust at approximately 2 percentage points or higher for South Korea and Taiwan in both sub-periods.

#### ASEAN-6

Cambodia and Vietnam outperformed the other ASEAN economies in GDP growth over 1990–2010 with growth rates of 7.4 per cent and 7.2 per cent, respectively. During the same period, this growth rate was lowest for the Philippines at 3.8 per cent, whereas it was 4.3 per cent for Thailand, 4.6 per cent for Indonesia, and 5.7 per cent for Malaysia. Capital input was the leading driver of GDP growth during the period of 1990–2010 for all of the economies in this group. The share of capital input in GDP growth was highest for Indonesia (69.3 per cent), followed by Cambodia (66.9 per cent), Vietnam (62.5 per cent), Thailand (62.1 per cent), Malaysia (51.1 per cent), and the Philippines (44.6 per cent) (Table 4.1, Panel A).

Based on their shares in GDP growth during 1990–2010, the contribution of labor input was larger than that of TFP for all of the ASEAN-6

economies: was 24.4 versus 8.6 per cent for Cambodia, 22.9 versus 7.8 per cent for Indonesia, 26.4 versus 22.4 per cent for Malaysia, 38.5 versus 16.8 per cent for the Philippines, 21.3 versus 16.6 per cent for Thailand, and 19.2 versus 18.3 per cent for Vietnam. In particular, the hours worked accounted for a significant share in the growth of the Philippines (32.2 per cent), Cambodia (23.1 per cent), and Malaysia (22.4 per cent; Table 4.1, Panel A).

The dynamic changes in the sources of GDP growth of the ASEAN-6 economies from the first sub-period, 1990–2000, to the second sub-period, 2000–2010, show some striking features. First, Vietnam and Cambodia, which recorded strong GDP growth exceeding 7 per cent in both sub-periods, experienced a sharp drop in TFP growth: from 1 percentage point in 1990–2000 to 0.2 percentage points in 2000–2010 for Cambodia and from 2.5 to 0.2 percentage points for Vietnam. In contrast, the remaining four ASEAN-6 economies exhibited a solid improvement in their TFP growth over the two sub-periods: from –0.4 to 1.1 percentage points for Indonesia, from 0.9 to 1.7 percentage points for Malaysia, from –0.1 to 1.3 percentage points for the Philippines and from 0.1 to 1.3 percentage points for Thailand. Second, the contribution of capital accumulation increased sharply over the two sub-periods for Cambodia (from 57.1 to 75.9 per cent) and Vietnam (from 48.4 to 77.1 per cent). It was notably reduced for Indonesia (from 85.2 to 56.4 per cent), Malaysia (from 58.8 to 39.4 per cent), the Philippines (from 60.6 to 34.8 per cent), and Thailand (from 87 to 36.5 per cent) (Table 4.1, Panels B and C). These findings suggest that the economies that suffered most from the Asian financial crisis of 1997–1998 exhibited a robust improvement in their growth efficiency in the second sub-period of 2000–2010.<sup>4</sup>

#### SAC-4

The growth rates during the period of 1990–2010 exhibited by the SAC-4 economies were rather strong and similar: the rate was highest for Bangladesh (5.2 per cent), followed by Sri Lanka (5.1 per cent), Pakistan (4.5 per cent), and Nepal (4.3 per cent). With the exception of Sri Lanka,

<sup>4</sup> The improvements in growth efficiency of these economies after the crisis were likely associated with investors' more cautious approach in making capital investment. The fixed investment as a share of GDP declined notably in the 2000s compared to that in the 1990s. In fact, this average rate fell from 35.5 per cent in 1990–2000 to 22.3 per cent in 2000–2010 for Malaysia, from 34.2 to 25.5 per cent for Thailand, from 22.5 to 20.2 per cent for the Philippines, and from 25.8 to 24.5 per cent for Indonesia. In addition, decisive regulatory and structural reforms have also played an important role in enhancing the efficiency of these economies. Haraguchi (2009) illustrated these effects through the case of the Thai Automotive Industry.

capital accumulation was the major source of growth of the economies in this group, with a contribution of 72.5 per cent for Bangladesh, 57.9 per cent for Pakistan, and 55.5 per cent for Nepal. In these three countries, the labor hours worked was the second most important source of growth, whereas these countries' TFP growth only played a minor role with a share of less than 10 per cent. Sri Lanka's growth pattern was rather distinct from the other SAC-4 economies: its growth over 1990–2010 was driven more by TFP than by capital accumulation. TFP accounted for 44.5 per cent of Sri Lanka's GDP growth during this period, whereas the contribution of capital input was 35.6 per cent (Table 4.1, Panel A).

Regarding the growth dynamics over the two sub-periods, GDP growth accelerated from 4.7 per cent in 1990–2000 to 5.6 per cent in 2000–2010 for Bangladesh and from 4.3 to 4.7 per cent for Pakistan, whereas the growth remained unchanged at 5.1 per cent for Sri Lanka. Nepal was the only economy in this group that experienced a decline in GDP growth: from 4.9 per cent in the first sub-period to 3.8 per cent in the second. With the exception of Sri Lanka, capital accumulation played the leading role in GDP growth of the SAC-4 economies, with a contribution share that exceeded 50 per cent during both sub-periods. At the same time, capital accumulation also became notably more important for Sri Lanka: the share of capital input in the growth increased from 28.5 per cent in 1990–2000 to 42.9 per cent in 2000–2010. In contrast, the contribution of its TFP growth remained robust with a share that exceeded 40 per cent in both sub-periods. Note that TFP growth deteriorated over the two sub-periods for the two weaker performers, Nepal and Pakistan: the contribution of TFP growth decreased from 0.6 percentage points in 1990–2000 to 0.1 percentage points in 2000–2010 for Nepal and from 0.9 to –0.1 percentage points for Pakistan (Table 4.1, Panels B and C).

#### 4.2.2 Sources of GDP Growth in Developing Asia: A Regional Picture

This subsection provides a regional picture of the relationship between each of the sources of GDP growth and GDP growth during the period of 1990–2010 for the 16 Developing Asia economies. Figures 4.1, 4.2, and 4.3 depict the correlations between the sources of GDP growth and GDP growth in the 16 Developing Asia economies. Figures 4.1A, 4.1B, and 4.1C represent the total capital input, non-ICT capital, and ICT capital, respectively, whereas Figures 4.2A, 4.2B, 4.2C indicate the total labor input, hours worked, and labor quality, respectively, and Figure 4.3 analyses TFP growth. In the chart for a given source of growth, the x-axis shows the contribution of the source of growth of interest, whereas the y-axis indicates GDP growth.

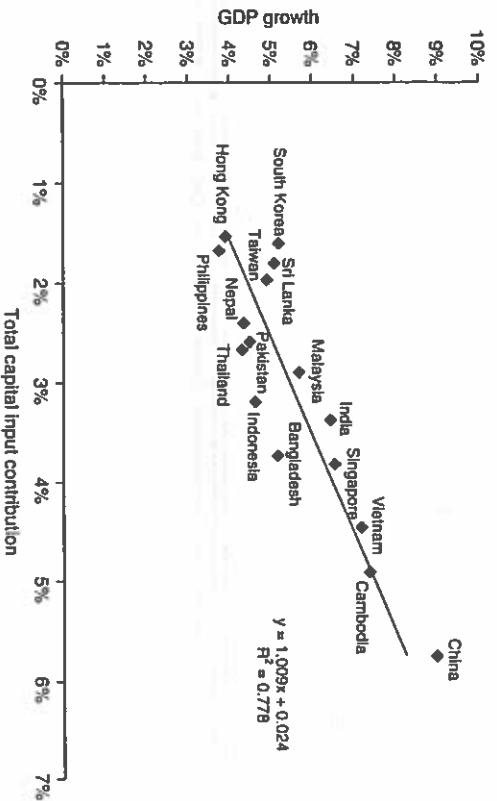
The fitted line of the sample depicts the relationship between the source of growth and GDP growth within this group. The  $R^2$  value, which ranges from 0 to 1, indicates the robustness of this relationship: a higher  $R^2$  value indicates a stronger relationship. An upward fitted line implies a positive relationship between the growth source of interest and GDP growth, i.e., an economy with a larger contribution from the growth source of interest tends to achieve faster GDP growth. A strong positive relationship between a given source of growth and GDP growth can be established through the following two ways. First, the contribution of the source of growth is a significant part of GDP growth. For example, because capital input is a major source of GDP growth, its positive relationship with GDP growth is expected. Second, the source of growth has a positive causal effect on other sources of growth. For example, investment in ICT capital is believed to produce a positive effect on labor quality growth by fostering learning and on TFP growth by stimulating innovation and improving efficiency. As a result, ICT capital is expected to exhibit a positive relationship with GDP growth.

##### Capital input

Figure 4.1A shows a strong positive relationship between the contribution of the total capital input and GDP growth in the Developing Asia group. China, Cambodia, and Vietnam were the economies with highest GDP growth during 1990–2010, and these were the economies with largest capital input contribution to GDP growth. In contrast, Hong Kong, South Korea, and the Philippines exhibited the lowest GDP growth, and the low capital input contribution was a key factor underlying their low performance. However, it is worth noting that South Korea's GDP growth in 1990–2010, which was higher than 5 per cent, was less dependent on capital accumulation, whereas its total capital input contributed less than 2 percentage points.

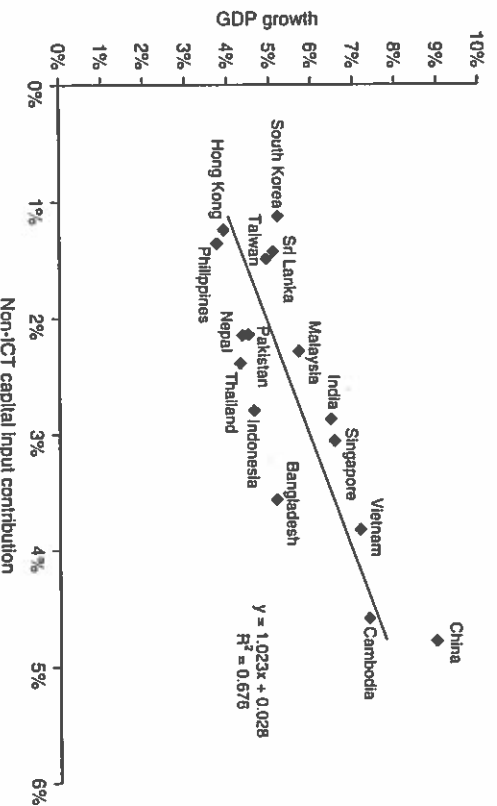
For a more in-depth examination of the correlation between the contribution of capital input to GDP growth and GDP growth in Developing Asia, Figures 4.1B and 4.1C depict this analysis for non-ICT capital and ICT capital, respectively. The correlation between the contribution of non-ICT capital and GDP growth, as shown in Figure 4.1B, exhibits patterns that were similar to those found in the correlation between the contribution of total capital input and GDP growth: this correlation is positive and strong. China, Cambodia, and Vietnam were the three economies with the largest non-ICT capital contribution, whereas Hong Kong, South Korea, and the Philippines exhibited the lowest non-ICT capital contribution.

The correlation between the ICT capital input and GDP growth, however, shows a somewhat different pattern (Figure 4.1C). Whereas the



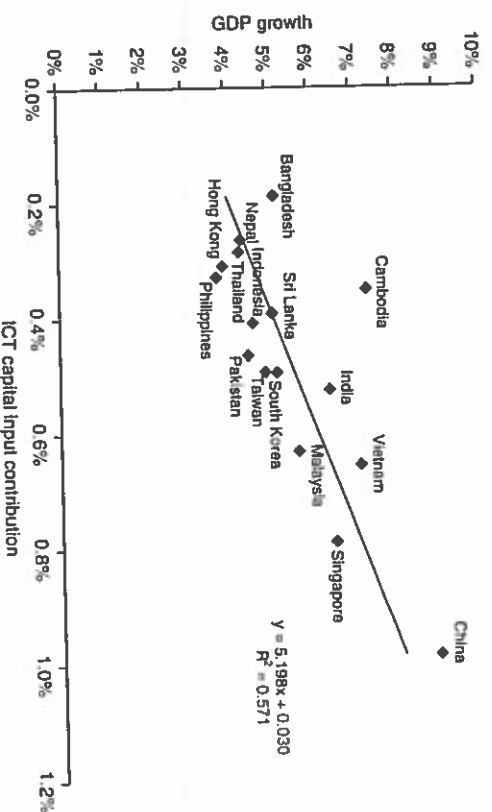
Source: Author's calculations.

Figure 4.1A Correlation between total capital input and GDP growth in Developing Asia, 1990–2010



Source: Author's calculations.

Figure 4.1B Correlation between non-ICT capital and GDP growth in Developing Asia, 1990–2010



Source: Author's calculations.

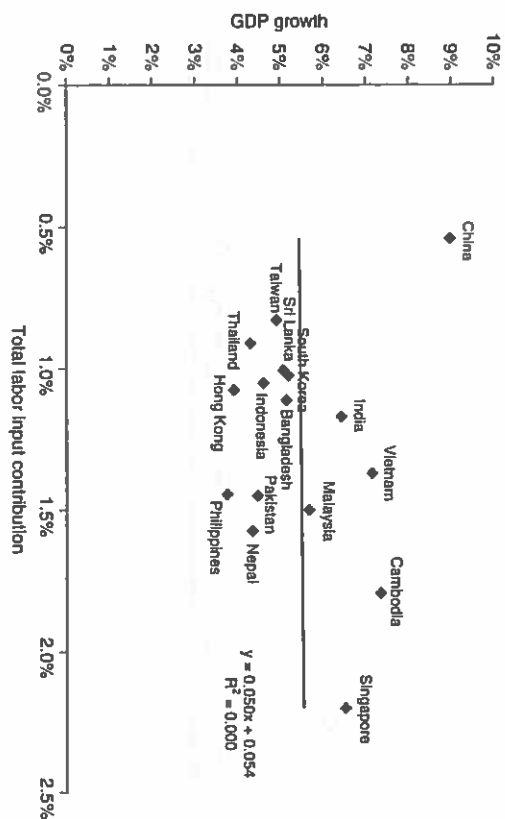
Figure 4.1C Correlation between ICT capital and GDP growth in Developing Asia, 1990–2010

two variables still show a strong positive relationship, the distribution of the economies on the graph is notably changed. The economies with largest ICT capital contribution were China, Singapore, and Vietnam, whereas Cambodia has a rather low ICT capital contribution. Moreover, Bangladesh, Nepal, and Thailand also had low ICT capital contributions, whereas South Korea was among the economies with higher ICT capital contribution.

### Labor input

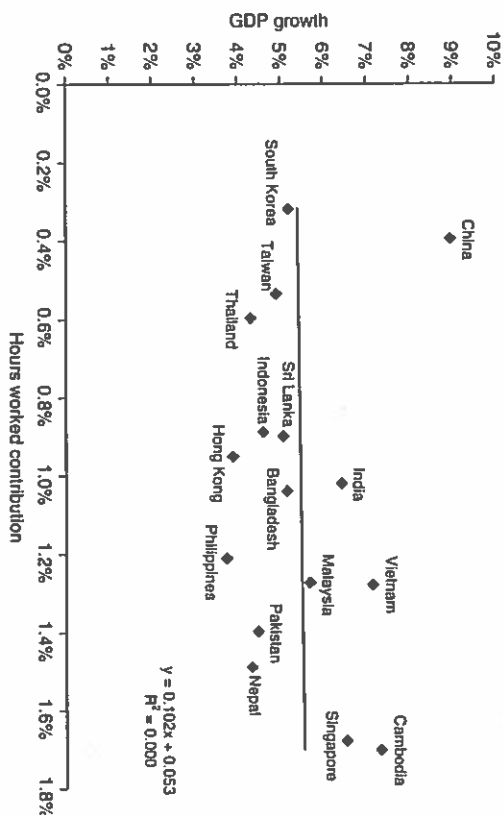
There was no significant correlation between the contribution of total labor input and GDP growth: the fitted line is horizontal, and its  $R^2$  is approximately equal to zero (Figure 4.2A). Similar patterns were obtained for the number of hours worked (Figure 4.2B) and the labor quality (Figure 4.2C). These findings indicate that, within the Developing Asia group, the labor inputs are not a good predictor of GDP growth. For example, as shown in Figure 4.2A, both high-growing economies (such as Singapore and Cambodia) and low-growing economies (such as Nepal and the Philippines) can have a strong contribution of the total labor input. At the same time, a low contribution of the total labor input was observed for China, which is the economy with strongest





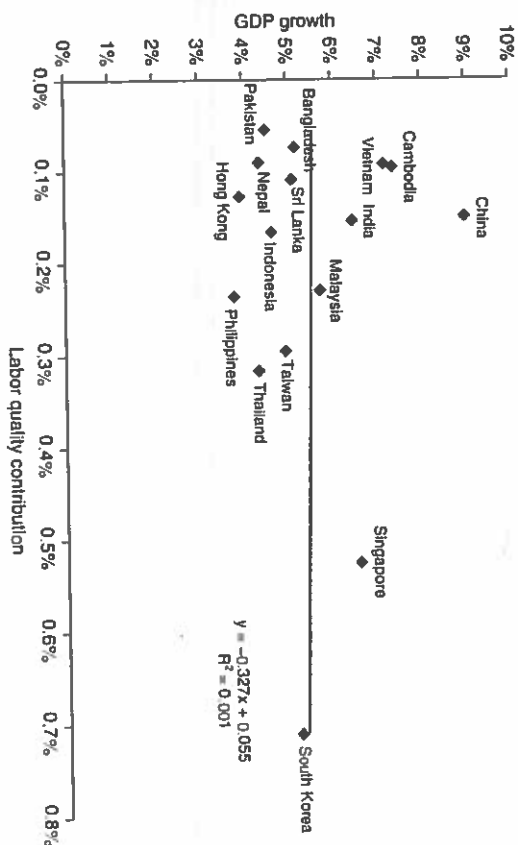
Source: Author's calculations.

Figure 4.2A Correlation between total labor input and GDP growth in Developing Asia, 1990-2010



Source: Author's calculations.

Figure 4.2B Correlation between hours worked and GDP growth in Developing Asia, 1990-2010



Source: Author's calculations.

Figure 4.2C Correlation between labor quality and GDP growth in Developing Asia, 1990-2010

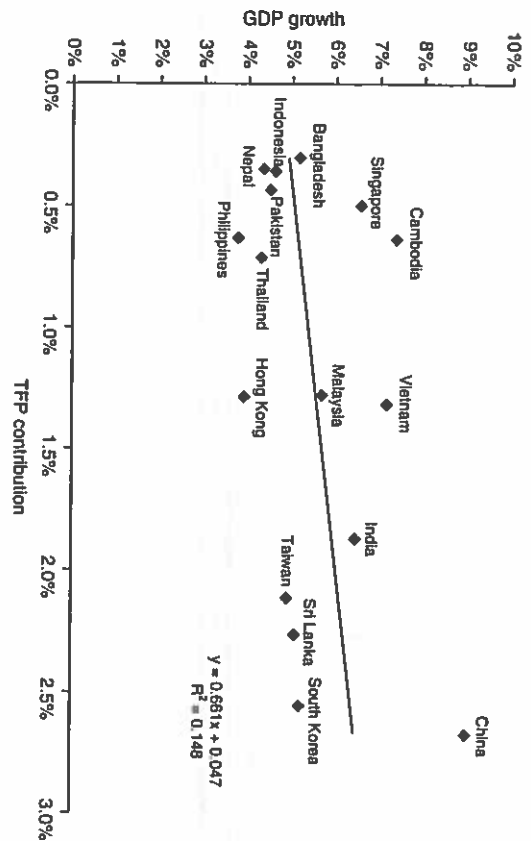
growth, and for the economies with weaker growth, such as Taiwan and Thailand.

#### TFP growth

Figure 4.3 shows a significant positive correlation between TFP growth and GDP growth in the Developing Asia group. However, this relationship ( $R^2 = 0.148$ ) is weaker compared with that between the capital input and GDP growth ( $R^2 = 0.778$  for total capital input,  $R^2 = 0.676$  for non-ICT capital, and  $R^2 = 0.571$  for ICT capital, as shown in Figure 4.1). The economies with largest contribution of TFP included China, South Korea, Sri Lanka, and Taiwan, whereas the economies with smallest contribution of TFP included Bangladesh, Nepal, and Indonesia.

This finding suggests that, for most Developing Asia economies, the capital input was the main driver of GDP growth and that the second highest driver of GDP growth is TFP growth. In addition, the labor input was an important source of growth, but its role was less important compared with the capital input and TFP.





Source: Author's calculations.

Figure 4.3 Correlation between TFP and GDP growth in Developing Asia, 1990–2010

## 4.3 SOURCES OF ALP GROWTH IN DEVELOPING ASIA

### 4.3.1 Empirical Results

The empirical results of the sources of ALP growth for the 16 Developing Asia economies, which are based on the decomposition framework (A4.1.3) presented in Appendix 4.1, are reported in Table 4.2. Panel A of the table reflects the period 1990–2010, whereas panels B and C reflect the sub-periods 1990–2000 and 2000–2010, respectively.

#### China–India

Both China and India recorded strong ALP growth over the period 1990–2010, although China outperformed India by a margin of 3.7 percentage points (8.1 versus 4.4 per cent). For both countries, capital deepening was the leading source of ALP growth, and this source accounted for 65.4 per cent and 53.9 per cent of ALP growth exhibited by China and India, respectively. The contribution of TFP to the two economies' ALP growth over 1990–2010 was also sizable: 32.8 per cent for China and 42.6 per cent

Table 4.2 Sources of ALP growth: 1990–2010, 1990–2000, and 2000–2010

(A) Period 1990–2010												
Economy	ALP Growth (%)	Contribution to Growth (% ppa)					ALP Growth	Share in Growth (%)				
		Capital Deepening			Labor Quality	TFP		Capital Deepening			Labor Quality	TFP
		All	ICT	Non-ICT				All	ICT	Non-ICT		
<i>China–India</i>												
China	8.1	5.3	1.0	4.4	0.2	2.7	100.0	65.4	11.8	53.6	1.8	32.8
India	4.4	2.4	0.5	1.9	0.2	1.9	100.0	53.9	10.9	43.0	3.5	42.6
<i>Tigers-4</i>												
Hong Kong	2.5	1.1	0.3	0.9	0.1	1.3	100.0	44.4	10.7	33.7	5.0	50.5
Singapore	3.2	2.2	0.6	1.6	0.5	0.5	100.0	67.8	18.9	48.9	16.5	15.7
South Korea	4.8	1.5	0.5	1.1	0.7	2.6	100.0	32.1	10.1	22.0	14.8	53.1
Taiwan	4.2	1.7	0.4	1.3	0.3	2.1	100.0	42.0	10.8	31.3	7.1	50.8
<i>ASEAN-6</i>												
Cambodia	4.0	3.2	0.3	2.9	0.1	0.6	100.0	81.5	7.0	74.5	2.4	16.1
Indonesia	2.8	2.3	0.4	1.9	0.2	0.4	100.0	81.4	12.7	68.7	5.9	12.7
Malaysia	3.1	1.6	0.3	1.3	0.2	1.3	100.0	52.0	11.1	40.9	7.3	40.7
Philippines	1.3	0.5	0.3	0.2	0.2	0.6	100.0	34.9	19.1	15.7	17.7	47.4
Thailand	3.1	2.1	0.2	1.8	0.3	0.7	100.0	66.8	7.8	59.0	10.2	23.0
Vietnam	4.6	3.2	0.6	2.6	0.1	1.3	100.0	69.4	12.9	56.5	2.0	28.5
<i>SAC-4</i>												
Bangladesh	3.1	2.7	0.1	2.6	0.1	0.3	100.0	87.8	4.5	83.2	2.4	9.8
Nepal	1.4	0.9	0.2	0.7	0.1	0.3	100.0	67.6	15.0	52.6	6.6	25.8
Pakistan	1.7	1.2	0.4	0.8	0.1	0.4	100.0	71.0	21.9	49.1	3.2	25.8
Sri Lanka	3.3	0.9	0.3	0.6	0.1	2.3	100.0	27.7	10.6	17.2	3.3	68.9

Table 4.2 (continued)

(B) Period 1990–2000

Economy	ALP Growth (%)	Contribution to Growth (% ppa)					ALP Growth	Share in Growth (%)				
		Capital Deepening			Labor Quality	TFP		Capital Deepening			Labor Quality	TFP
		All	ICT	Non-ICT				All	ICT	Non-ICT		
<i>China-India</i>												
China	6.0	4.6	0.8	3.9	0.2	1.2	100.0	77.7	13.1	64.6	2.6	19.8
India	3.6	1.9	0.2	1.7	0.2	1.5	100.0	53.6	6.9	46.7	4.5	41.9
<i>Tigers-4</i>												
Hong Kong	1.9	1.5	0.3	1.2	0.1	0.3	100.0	80.8	16.8	64.0	4.5	14.7
Singapore	4.2	3.4	0.6	2.8	0.6	0.1	100.0	82.0	15.2	66.8	15.1	2.9
South Korea	5.4	1.6	0.6	1.0	0.9	2.9	100.0	30.2	10.8	19.3	15.9	53.9
Taiwan	5.0	2.4	0.6	1.9	0.3	2.3	100.0	48.3	11.3	37.0	5.6	46.0
<i>ASEAN-6</i>												
Cambodia	3.2	2.1	0.3	1.7	0.1	1.0	100.0	65.7	10.7	54.9	1.9	32.5
Indonesia	2.4	2.7	0.2	2.5	0.2	-0.4	100.0	109.6	7.2	102.4	6.8	-16.4
Malaysia	3.6	2.4	0.2	2.2	0.3	0.9	100.0	66.8	6.4	60.4	8.1	25.1
Philippines	0.7	0.7	0.1	0.5	0.2	-0.1	100.0	90.9	17.7	73.3	20.6	-11.6
Thailand	3.9	3.6	0.2	3.4	0.2	0.1	100.0	91.2	4.4	86.8	5.5	3.4
Vietnam	4.8	2.3	0.3	2.0	0.1	2.5	100.0	47.6	7.1	40.6	1.6	50.8
<i>SAC-4</i>												
Bangladesh	3.4	3.0	0.1	2.9	0.1	0.3	100.0	89.5	3.5	86.1	2.3	8.1
Nepal	1.9	1.2	0.2	1.0	0.1	0.6	100.0	65.2	12.6	52.6	3.2	31.6
Pakistan	2.3	1.5	0.3	1.2	-0.1	0.9	100.0	63.0	12.9	50.1	-2.4	39.4
Sri Lanka	2.9	0.3	0.2	0.1	0.1	2.5	100.0	11.8	7.3	4.5	3.0	85.2

(C) Period 2000–2010

Economy	ALP Growth (%)	Contribution to Growth (% ppa)					ALP Growth	Share in Growth (%)				
		Capital Deepening			Labor Quality	TFP		Capital Deepening			Labor Quality	TFP
		All	ICT	Non-ICT				All	ICT	Non-ICT		
<i>China-India</i>												
China	10.3	6.0	1.1	4.9	0.1	4.2	100.0	58.2	11.0	47.2	1.4	40.4
India	5.2	2.8	0.7	2.1	0.1	2.2	100.0	54.2	13.7	40.4	2.8	43.0
<i>Tigers-4</i>												
Hong Kong	3.2	0.8	0.2	0.5	0.2	2.3	100.0	23.6	7.2	16.4	5.3	71.0
Singapore	2.2	0.9	0.6	0.3	0.4	0.9	100.0	40.9	25.9	14.9	19.2	39.9
South Korea	4.2	1.5	0.4	1.1	0.6	2.2	100.0	34.6	9.2	25.4	13.3	52.1
Taiwan	3.3	1.1	0.3	0.7	0.3	1.9	100.0	32.3	9.9	22.4	9.4	58.3
<i>ASEAN-6</i>												
Cambodia	4.7	4.4	0.2	4.2	0.1	0.2	100.0	92.0	4.6	87.5	2.8	5.1
Indonesia	3.2	1.9	0.5	1.4	0.2	1.1	100.0	60.1	16.9	43.2	5.2	34.8
Malaysia	2.7	0.9	0.5	0.4	0.2	1.7	100.0	32.2	17.4	14.8	6.3	61.6
Philippines	1.9	0.3	0.4	-0.1	0.3	1.3	100.0	13.5	19.7	-6.2	16.6	69.9
Thailand	2.3	0.6	0.3	0.3	0.4	1.3	100.0	24.9	13.7	11.3	18.4	56.7
Vietnam	4.4	4.1	0.8	3.2	0.1	0.2	100.0	93.7	19.3	74.3	2.6	3.8
<i>SAC-4</i>												
Bangladesh	2.8	2.4	0.2	2.2	0.1	0.3	100.0	85.6	5.7	79.9	2.5	11.9
Nepal	0.8	0.6	0.2	0.4	0.1	0.1	100.0	73.2	20.6	52.6	14.7	12.1
Pakistan	1.0	0.9	0.4	0.5	0.2	-0.1	100.0	89.1	42.3	46.8	15.9	-5.0
Sri Lanka	3.7	1.5	0.5	1.0	0.1	2.1	100.0	40.2	13.1	27.1	3.6	56.2

Source: Author's calculations.

for India (Table 4.2, Panel A). The contribution of labor quality to ALP growth was low at 1.8 per cent for China and 3.5 per cent for India.

Both China and India experienced a notable acceleration in their ALP growth between the two sub-periods: from 6.0 per cent in 1990–2000 to 10.3 per cent in 2000–2010 for China and from 3.6 to 5.2 per cent for India. Furthermore, for both countries, capital deepening and TFP growth played significant roles in driving their ALP acceleration. The contribution of capital deepening increased from 4.6 percentage points in 1990–2000 to 6.0 percentage points in 2000–2010 for China, and from 1.9 to 2.8 percentage points for India. The contribution of TFP growth increased from 1.2 to 4.2 percentage points for China and 1.5 to 2.2 percentage points for India (Table 4.2, Panels B and C).

Note that the contribution of the ICT capital deepening to ALP growth was significant and exhibited a rising trend for both China and India. However, the magnitude of this contribution was notably larger for China than for India: 1 percentage point for China compared to 0.5 percentage points for India during the period of 1990–2010. In addition, this pattern was consistent over the two sub-periods.

#### **Tigers-4**

The Tigers-4 economies showed strong ALP growth during the period of 1990–2010, with South Korea as the leader with an ALP growth of 4.8 per cent, followed by Taiwan (4.2 per cent), Singapore (3.2 per cent), and Hong Kong (2.5 per cent). For all Tigers-4 economies, capital deepening accounted for a sizable share in ALP growth during 1990–2010: 67.8 per cent for Singapore, 44.4 per cent for Hong Kong, 42 per cent for Taiwan, and 32.1 per cent for South Korea. However, with the exception of Singapore, capital deepening was less important than TFP in driving ALP growth of the Tigers-4 economies during this period. In fact, the contribution of TFP to ALP growth during 1990–2010 was 53.1 per cent for South Korea, 50.8 per cent for Taiwan, and 50.5 per cent for Hong Kong (Table 4.2, Panel A).

As shown in Panels B and C of Table 4.2, the dynamic change between the two sub-periods, 1990–2000 and 2000–2010, demonstrated several salient features. First, with the exception of Hong Kong, all of the Tigers-4 economies experienced a notable slowdown in ALP growth over the two sub-periods: from 4.2 per cent in 1990–2000 to 2.2 per cent in 2000–2010 for Singapore, from 5.4 to 4.2 per cent for South Korea, and from 5.0 to 3.3 per cent for Taiwan. In contrast, Hong Kong's ALP increased from 1.9 per cent in the first sub-period to 3.2 per cent in the second. Second, the contribution of capital deepening decreased substantially for all Tigers-4 economies over the two sub-periods: from 1.5 to 0.8 percentage points for

Hong Kong, from 3.4 to 0.9 percentage points for Singapore, from 1.6 to 1.5 percentage points for South Korea, and from 2.4 to 1.1 percentage points for Taiwan. Third, the contribution share of TFP in ALP growth substantially increased over the two sub-periods for Hong Kong (from 14.7 per cent in 1990–2000 to 71 per cent in 2000–2010) and Singapore (from 2.9 to 39.9 per cent) and remained large (approximately 50 per cent) for South Korea and Taiwan during both sub-periods. These findings imply that, since the Asian financial crisis of 1997–1998, the Tigers-4 economies have experienced significant economic transformations, which have shifted the focus from the promoting of growth via capital accumulation to technological progress and efficiency improvements.

#### **ASEAN-6**

ALP growth over the period of 1990–2010 was highest for Vietnam (4.6 per cent) and lowest for the Philippines (1.3 per cent), whereas this growth was 4 per cent for Cambodia, 2.8 per cent for Indonesia, and 3.1 per cent for both Malaysia and Thailand. With the exception of the Philippines, capital deepening was the major driver of ALP growth in this period with a contribution share of 81.5 per cent for Cambodia, 81.4 per cent for Indonesia, 52 per cent for Malaysia, 66.8 per cent for Thailand, and 69.4 per cent for Vietnam. In contrast, TFP growth played a more varied role in driving ALP growth during this period. The share of TFP in ALP growth during 1990–2010 was lowest for Indonesia (12.7 per cent) and Cambodia (16.1 per cent), largest for the Philippines (47.4 per cent) and Malaysia (40.7 per cent), while it was 23 per cent for Thailand and 28.5 per cent for Vietnam (Table 4.2, Panel A).

As shown in Panels B and C of Table 4.2, the dynamic changes in the sources of ALP growth of the ASEAN-6 economies between the two sub-periods show several striking features. On the one hand, the two leading performers in terms of ALP growth (Vietnam and Cambodia) sustained strong ALP growth in both sub-periods: 3.2 per cent in 1990–2000 and 4.7 per cent in 2000–2010 for Cambodia and 4.8 per cent and 4.4 per cent for Vietnam. However, the changes in the composition of these countries' sources of ALP growth showed a significant deterioration of their growth efficiency. The contribution share of capital deepening increased from 65.7 per cent in 1990–2000 to 92 per cent 2000–2010 for Cambodia and from 47.6 to 93.7 per cent for Vietnam, while the contribution share of TFP decreased from 32.5 per cent to 5.1 per cent for Cambodia and from 50.8 to 3.8 per cent for Vietnam. On the other hand, capital deepening became much less important in ALP growth of the remaining four ASEAN-6 economies, whereas the role of TFP in driving their ALP growth was substantially enhanced. The contribution share of capital deepening in

ALP growth decreased from 109.6 per cent in 1990–2000 to 60.1 per cent in 2000–2010 for Indonesia, from 66.8 to 32.2 per cent for Malaysia, from 90.9 to 13.5 per cent for the Philippines, and from 91.2 to 24.9 per cent for Thailand, whereas the contribution share of TFP increased from –16.4 per cent to 34.8 per cent for Indonesia, from 25.1 to 61.6 per cent for Malaysia, from –11.6 to 69.9 per cent for the Philippines, and from 3.4 to 56.7 per cent for Thailand. These findings suggest that the economies that were most affected by the Asian financial crisis that erupted in 1997–1998 have since undergone significant transformations that have boosted the efficiency of their growth.

#### SAC-4

Among the economies of this group, ALP growth over the period of 1990–2010 was highest for Sri Lanka at 3.3 per cent, followed by 3.1 per cent for Bangladesh, 1.7 per cent for Pakistan, and 1.4 per cent for Nepal. With the exception of Sri Lanka, ALP growth of the SAC-4 economies during this period was largely driven by capital deepening, which contributed a share of 87.8 per cent for Sri Lanka, 67.6 per cent for Nepal, and 71 per cent for Pakistan. At the same time, the contribution share of TFP was minor: 9.8 per cent for Bangladesh and 25.8 per cent for both Nepal and Pakistan. In contrast, capital deepening accounted for only 27.7 per cent of Sri Lanka's ALP growth during this period, whereas TFP claimed a dominant share of approximately 70 per cent (Table 4.2, Panel A).

Sri Lanka and the other three SAC-4 economies exhibited different dynamic changes between the two sub-periods of 1990–2000 and 2000–2010. Sri Lanka's ALP growth increased from 2.9 per cent in 1990–2000 to 3.7 per cent in 2000–2010; however, it decreased from 3.4 to 2.8 per cent for Bangladesh, from 1.9 to 0.8 per cent for Nepal, and from 2.3 to 1 per cent for Pakistan. Capital deepening was the main driver of the contrast in these dynamics: the contribution of capital deepening increased from 0.3 to 1.5 percentage points for Sri Lanka and decreased from 3.0 to 2.4 percentage points for Bangladesh, from 1.2 to 0.6 percentage points for Nepal, and from 1.5 to 0.9 percentage points for Pakistan. In contrast, Sri Lanka sustained a robust TFP growth that exceeded 2 percentage points in both sub-periods, whereas TFP growth was meager in both sub-periods for Bangladesh and decreased for Nepal and Pakistan from the first to the second sub-period (Table 4.2, Panels B and C).

#### 4.3.2 Sources of ALP Growth in Developing Asia: A Regional Picture

This subsection analyses the sources of ALP growth of the economies of Developing Asia during 1990–2010 as part of a regional picture. The find-

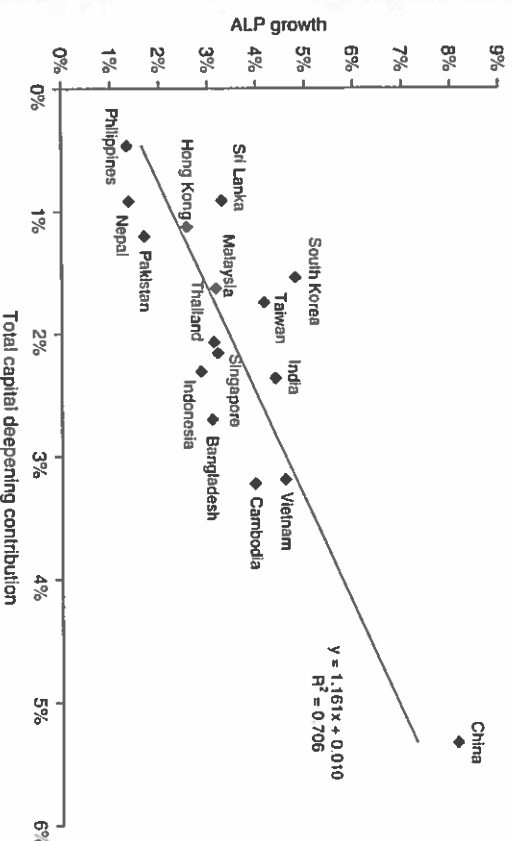
ings are consistent with those found from the comparative examination of the sources of GDP growth presented in subsection 4.2.2.

#### Capital deepening

Figure 4.4A shows a strong positive correlation between the contribution of the total capital deepening and ALP growth ( $R^2 = 0.706$ ). China, Cambodia, and Vietnam exhibited the highest contribution of total capital deepening, whereas the Philippines, Nepal, and Sri Lanka had lower contribution of total capital deepening. A similar pattern was observed for the relationship between the contribution of non-ICT capital deepening and ALP growth (Figure 4.4B). The contribution of ICT capital deepening and ALP growth also had a strong positive correlation ( $R^2 = 0.674$ ), but the distribution of the economies was somewhat changed (Figure 4.4C). China, Singapore, and Vietnam exhibited the highest contributions of ICT capital deepening, whereas Cambodia exhibited a modest contribution, and Bangladesh, Nepal, and Thailand exhibited the lowest contributions.

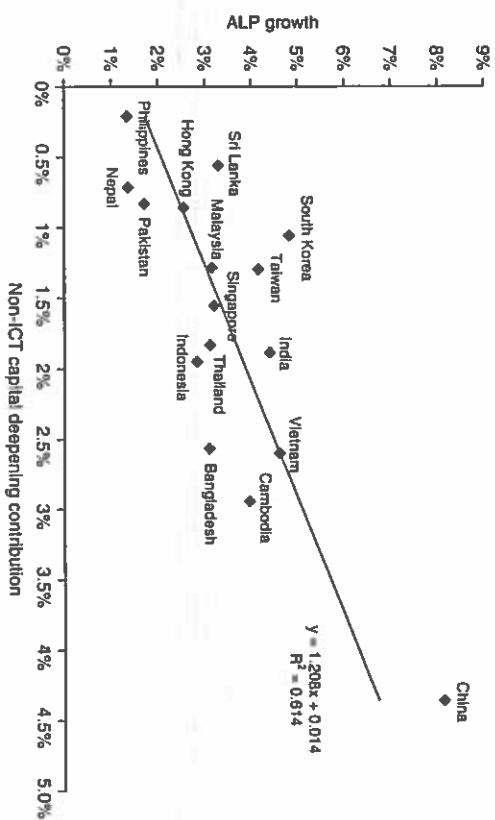
#### Labor quality

As shown in Figure 4.5, the correlation between the contribution of labor quality and ALP growth was positive but not strong ( $R^2 = 0.027$ ). South



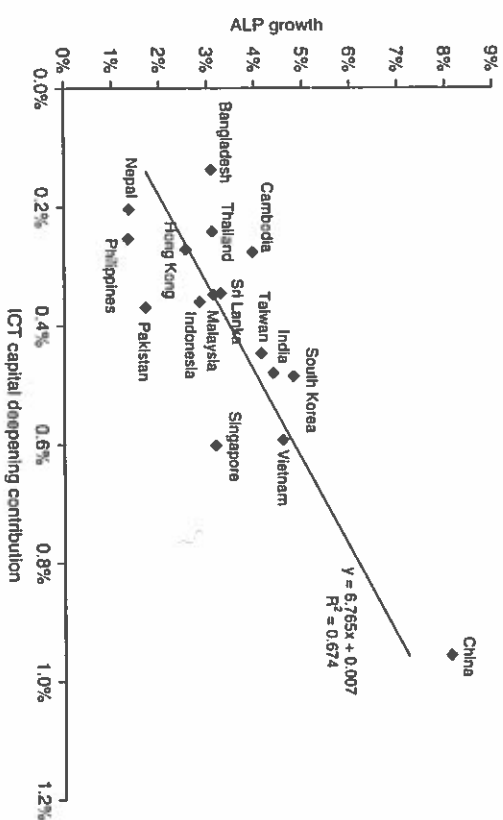
Source: Author's calculations.

Figure 4.4A Correlation between total capital deepening and ALP growth in Developing Asia, 1990–2010



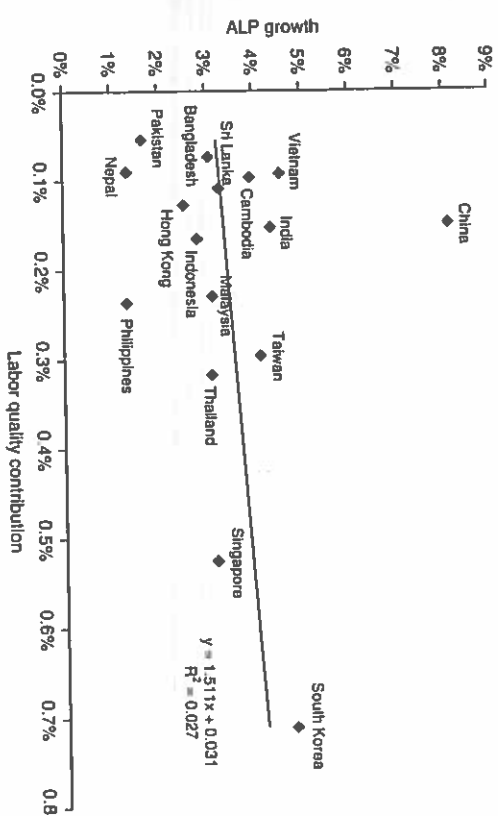
Source: Author's calculations.

Figure 4.4B Correlation between non-ICT capital deepening and ALP growth in Developing Asia, 1990-2010



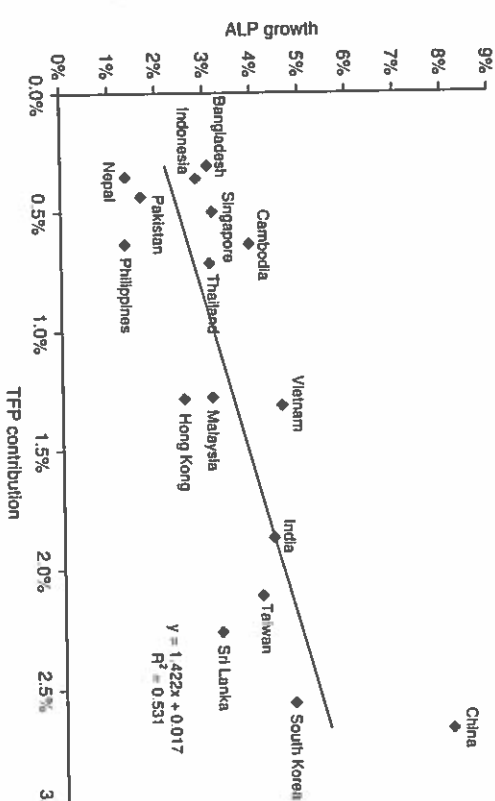
Source: Author's calculations.

Figure 4.4C Correlation between ICT capital deepening and ALP growth in Developing Asia, 1990-2010



Source: Author's calculations.

Figure 4.5 Correlation between labor quality and ALP growth in Developing Asia, 1990-2010



Source: Author's calculations.

Figure 4.6 Correlation between TFP and ALP growth in Developing Asia, 1990-2010

Korea, Singapore, and Thailand were the leading performers on the contribution of labor quality, whereas Pakistan and Bangladesh were the economies with the lowest values of this measure.

#### TFP growth

As shown in Figure 4.6, TFP growth and ALP growth had a strong positive correlation ( $R^2 = 0.531$ ). China, South Korea, and Sri Lanka were the economies that exhibited the highest TFP growth, whereas Bangladesh, Nepal, and Indonesia exhibited the lowest values of this measure.

### 4.4 ALP AS A DRIVER OF GDP GROWTH IN DEVELOPING ASIA

To examine the role of ALP in driving GDP growth, one can decompose GDP growth into the contributions of two sources: ALP growth and employment expansion. The framework for this decomposition is presented in Appendix 4.3. This section investigates the role of ALP in driving GDP growth for the 16 Developing Asia economies over the period of 1990–2010. The results from this exercise are reported in Table 4.3.

#### 4.4.1 The Contribution of ALP and Employment to GDP Growth

##### China-India

ALP was the major driver of GDP growth for both China and India. Its contribution share in GDP growth over the period of 1990–2010 was 90.7 per cent for China and 68.3 per cent for India. Moreover, the role of ALP in driving GDP growth was enhanced from the first to the second sub-period for both countries: the share of ALP in GDP growth increased from 84.3 per cent in 1990–2000 to 94.9 per cent in 2000–2010 for China and from 66.4 to 69.6 per cent for India. Note that more than 30 per cent of India's GDP growth was due to employment expansion, whereas this share was less than 10 per cent for China (Table 4.3).

##### Tigers-4

With the exception of Singapore, ALP was the major driver of GDP growth for the Tigers-4 economies, especially South Korea and Taiwan. The contribution share of ALP in GDP growth over the period 1990–2010 was 92.6 per cent for South Korea, 84.4 per cent for Taiwan, 65.2 per cent for Hong Kong, and 48.7 per cent for Singapore. In addition, the role of ALP in driving GDP growth was strengthened from the first to the second sub-period for South Korea, Taiwan, and Hong Kong. In fact, the share

Table 4.3 Contributions of ALP and employment to GDP growth, 1990–2010

Economy	1990–2010			1990–2000			2000–2010		
	GDP Growth (%)	Contribution to GDP Growth (%)		GDP Growth (%)	Contribution to GDP Growth (%)		GDP Growth (%)	Contribution to GDP Growth (%)	
		ALP	Employment		ALP	Employment		ALP	Employment
<i>China-India</i>									
China	9.0	90.7	9.3	7.1	84.3	15.7	10.9	94.9	5.1
India	6.4	68.3	31.7	5.4	66.4	33.6	7.4	69.6	30.4
<i>Tigers-4</i>									
Hong Kong	3.9	65.2	34.8	3.9	48.0	52.0	4.0	81.9	18.1
Singapore	6.5	48.7	51.3	7.3	57.1	42.9	5.8	38.1	61.9
South Korea	5.2	92.6	7.4	6.3	85.6	14.4	4.1	103.6	−3.6
Taiwan	4.9	84.4	15.6	6.0	83.4	16.6	3.8	86.2	13.8
<i>ASEAN-6</i>									
Cambodia	7.4	53.7	46.3	7.0	45.1	54.9	7.7	61.6	38.4
Indonesia	4.6	61.5	38.5	4.1	59.1	40.9	5.1	63.4	36.6
Malaysia	5.7	55.2	44.8	6.9	52.4	47.6	4.5	59.4	40.6
Philippines	3.8	35.5	64.5	2.9	25.8	74.2	4.7	41.5	58.5
Thailand	4.3	72.2	27.8	4.4	90.0	10.0	4.2	53.9	46.1
Vietnam	7.2	64.2	35.8	7.3	66.3	33.7	7.0	62.1	37.9
<i>SAC-4</i>									
Bangladesh	5.2	59.7	40.3	4.7	71.5	28.5	5.6	49.9	50.1
Nepal	4.3	31.3	68.7	4.9	39.0	61.0	3.8	21.4	78.6
Pakistan	4.5	37.7	62.3	4.3	54.5	45.5	4.7	22.2	77.8
Sri Lanka	5.1	64.6	35.4	5.1	56.3	43.7	5.1	72.9	27.1

of ALP in GDP growth increased from 85.6 per cent in 1990–2000 to 103.6 per cent in 2000–2010 for South Korea, from 83.4 to 86.2 per cent for Taiwan, and from 48 to 81.9 per cent for Hong Kong. In contrast, although Singapore was the leading economy in the Tigers-4 group in terms of GDP growth, its growth was more driven by employment expansion, especially in the second sub-period of 2000–2010. The share of ALP in Singapore's GDP growth decreased from 57.1 per cent in 1990–2000 to 38.1 per cent in 2000–2010 (Table 4.3). These findings suggest that Singapore's GDP growth may slow down significantly in the next decade if its inflows of foreign workers are reduced.

#### ASEAN-6

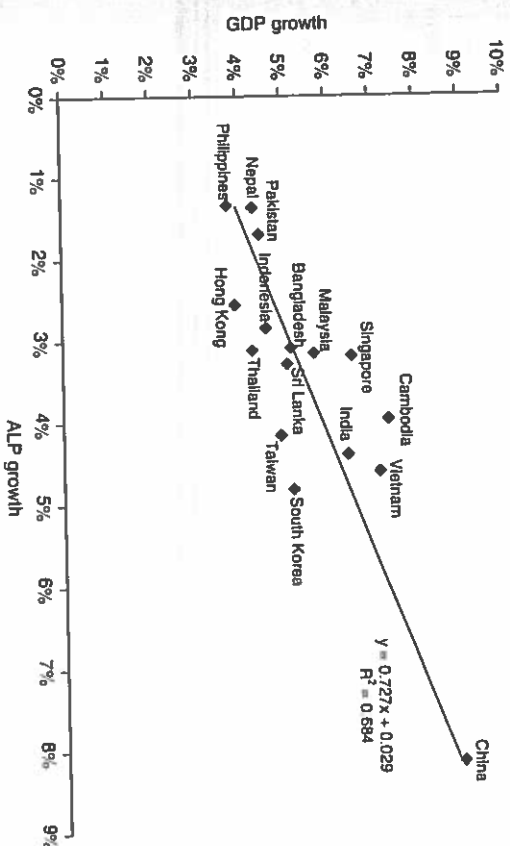
With the exception of the Philippines, ALP was also the major driver of GDP growth during 1990–2010 for the ASEAN-6 economies. The share of ALP in GDP growth during this period was 53.7 per cent for Cambodia, 61.5 per cent for Indonesia, 55.2 per cent for Malaysia, 72.2 per cent for Thailand, 64.2 per cent for Vietnam, and 35.5 per cent for the Philippines.

Furthermore, for most of the ASEAN-6 economies, the share of ALP in GDP growth increased over the two sub-periods: from 45.1 per cent in 1990–2000 to 61.6 per cent in 2000–2010 for Cambodia, from 59.1 to 63.4 per cent for Indonesia, from 52.4 to 59.4 per cent for Malaysia, and from 25.8 to 41.5 per cent for the Philippines. However, the share of ALP in GDP growth decreased from 90 per cent to 53.9 per cent for Thailand and from 66.3 to 62.1 per cent for Vietnam (Table 4.3).

#### SAC-4

Among the economies in this group, Sri Lanka and Bangladesh were the leading performers in terms of GDP growth. Moreover, ALP was the main driver of their growth. In contrast, GDP growth experienced by Pakistan and Nepal was lower and more dependent on employment expansion. The share of ALP in GDP growth during the period of 1990–2010 was 64.6 per cent for Sri Lanka, 59.7 per cent for Bangladesh, 31.3 per cent for Nepal, and 37.7 per cent for Pakistan (Table 4.3).

With the exception of Sri Lanka, the role of ALP in driving growth in the SAC-4 economies tended to weaken from the first to the second sub-period. The share of ALP in GDP growth decreased from 71.5 to 49.9 per cent for Bangladesh, from 39 to 21.4 per cent for Nepal, and from 54.5 to 22.2 per cent for Pakistan. In contrast, Sri Lanka was the only economy in this group that exhibited an increase in the share of ALP in GDP growth (from 56.3 to 72.9 per cent).



Source: Author's calculations.

Figure 4.7 Correlation between ALP and GDP growth in Developing Asia, 1990–2010

#### 4.4.2 ALP as a Driver of GDP Growth in Developing Asia: A Regional Picture

As shown in Figure 4.7, ALP growth and GDP growth exhibited a strong positive correlation ( $R^2 = 0.684$ ). China, South Korea, and Vietnam were the leading performers in terms of the contribution of ALP to GDP growth, whereas the Philippines, Nepal, and Pakistan exhibited the lowest contribution of ALP to GDP growth.

#### 4.5 THE DRIVING FORCES BEHIND DEVELOPING ASIA'S LEADING ECONOMIC PERFORMANCE

This section examines the drivers of the lead in economic performance that Developing Asia commanded over other parts of the world during the period of 1990–2010. Thus, this section examines the composition of the gap in economic performance between Developing Asia and two other groups: non-Asian developing economies and developed economies.

Confined to the sample of 119 economies introduced in Chapter 2, the group of non-Asian developing economies, which are referred to as



the Rest of the World (ROW), consists of 79 developing economies, of which 20 are from Latin America, 21 are from Eastern Europe, 27 are from Sub-Saharan Africa, and 11 are from North Africa and Middle East. The group of developed economies, which is referred to as Developed Economies, includes 24 developed economies, of which seven are from G7 and 17 are from Non-G7.<sup>5</sup>

The analysis in this section uses the unweighted means of economic growth rates and their sources for the economies in a given group to capture the characteristics of a typical economy of the group. It is worth noting that there are both high performers (such as China and India) and laggards (such as Nepal, Pakistan, and the Philippines) in the Developing Asia group. The same is true for the Rest of World (ROW) and the Developed Economies groups. The results of the analysis, however, are robust to sample outliers.<sup>6</sup>

#### 4.5.1 The Sources of Developing Asia's Lead in GDP Growth

This subsection analyses the sources responsible for the lead in GDP growth exhibited by Developing Asia compared with the two comparison groups (the Industrialized Economies and the ROW, which includes all of the developing economies that do not belong to Developing Asia). This analysis used unweighted means by group as reported in Table 4.4 to capture the growth pattern of each group's typical economy.<sup>7</sup>

GDP growth gap between Developing Asia and Industrialized Economies was large at 3.2 percentage points. This GDP growth lead exhibited by Developing Asia was the result of all sources of GDP growth, but capital input was the major contributor to this gap with a share of 54 per cent (Table 4.4). It is important to note, however, that the contribution of capital input to the gap was totally driven by non-ICT capital, whereas the ICT capital had a negative share in this gap. The labor input accounted for 16.1 per cent of the gap, of which 18.7 per cent was due to the hours worked, whereas the labor quality had a negative

<sup>5</sup> Details on the sample of 119 economies and its seven groups are presented in Section 2.1 of Chapter 2.

<sup>6</sup> The analysis yields similar results if the outliers (upper 10 per cent and lower 10 per cent based on GDP or ALP growth) are removed from each of the groups. This finding indicates that the potential distorting effect of the sample outliers is not a cause of concern.

<sup>7</sup> Note that simple means instead of weighted means are used for this analysis because the use of the latter can cause a bias toward large economies. For example, the weighted means for Developing Asia represent the growth pattern of China more than the group's average economy. Appendix 4.4 provides results based on weighted means. Although these results show more vivid evidence on the importance of capital formation in Developing Asia's growth, they are heavily influenced by the growth pattern of China.

Table 4.4 Sources of Developing Asia's lead in GDP growth, 1990–2010

			Sources of GDP Growth, 1990–2010 (% points per annum)			The Gap between Developing Asia and	
			Developing Asia	Industrialized Economies	Rest of World (ROW)	Industrialized Economies	Rest of World (ROW)
			(1)	(2)	(3)	(4) = (1)–(2) Structure	(5) = (1)–(3) Structure
GDP Growth			5.5	2.3	3.2	3.2 100	2.3 100
Capital Input	All		3.0	1.3	1.6	1.7 54.0	1.4 61.7
	ICT		0.5	0.5	0.3	–0.02 –0.8	0.1 6.0
	Non-ICT		2.6	0.8	1.3	1.8 54.7	1.3 55.7
Labor Input	All		1.3	0.7	1.0	0.5 16.1	0.2 10.7
	Quality		0.2	0.3	0.1	–0.1 –2.5	0.1 3.3
	Hours		1.0	0.4	0.9	0.6 18.7	0.2 7.3
TFP			1.2	0.2	0.6	1.0 29.9	0.6 27.6

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

share of -2.5 per cent. TFP was a strong driver of the growth gap with a share of approximately 30 per cent. This analysis suggests that the non-ICT capital, TFP, and hours worked, in this order, were important sources of the lead in GDP growth exhibited by Developing Asia over the Industrialized Economies. However, Developing Asia exhibited a lower contribution of ICT capital and labor quality to the growth compared with the Industrialized Economies.

As shown in Table 4.4, Developing Asia outperformed the ROW on GDP growth during 1990-2010 by a gap of 2.3 percentage points, and all of the sources of GDP growth contributed to this gap. However, capital input was the main determinant of the gap with a contribution of 61.7 per cent, of which 55.7 per cent was due to non-ICT capital and 6 per cent was due to ICT capital. In contrast, labor input accounted for approximately 10 per cent of GDP growth gap, of which 7 per cent was due to hours worked and 3 per cent was due to the labor quality, whereas the share contributed by TFP was 27.6 per cent. The comparison of GDP growth between Developing Asia and the ROW indicates that capital accumulation, especially in non-ICT capital, was the major driver of GDP growth gap that Developing Asia commanded over other developing economies. TFP was the second most important source of this lead, whereas labor input, including hours worked and labor quality, had a positive but quite modest contribution share.

#### 4.5.2 The Sources of Developing Asia's Lead in ALP Growth

Table 4.5 elaborates the gaps in ALP growth between Developing Asia and the two comparison groups: Industrialized Economies and the ROW. Similar to Table 4.4, the rate of ALP growth for a group and its components were measured as group means.

Developing Asia commanded an ALP growth gap of 1.9 percentage points over Industrialized Economies. Capital deepening and TFP growth contributed almost equally to this gap: capital deepening accounted for 53.5 per cent of the gap, and the share of TFP was 50.9 per cent. The contribution of capital deepening to the gap was completely driven by non-ICT capital, whereas the contribution of ICT capital deepening was negative (-3.5 per cent). Furthermore, the labor quality had a negative contribution to this gap with a share of -4.3 per cent. This finding suggests that non-ICT capital accumulation was the major driver, and TFP was an important source of Developing Asia's catching-up with the developed nations on labor productivity. Developing Asia, however, can accelerate its catching-up speed by fostering investment in ICT capital and boosting improvements in labor quality.

Table 4.5 Sources of Developing Asia's lead in ALP growth, 1990-2010

			Sources of ALP Growth, 1990-2010 (% points per annum)			The Gap between Developing Asia and	
			Developing Asia	Industrialized Economies	Rest of World (ROW)	Industrialized Economies	Rest of World (ROW)
			(1)	(2)	(3)	(4) = (1)-(2) Structure	(5) = (1)-(3) Structure
ALP Growth			3.5	1.6	1.4	1.9 100	2.0 100
Capital Deepening	All		2.1	1.0	0.7	1.0 53.5	1.3 65.5
	ICT		0.4	0.5	0.3	-0.1 -3.5	0.1 5.8
	Non-ICT		1.7	0.6	0.4	1.1 57.0	1.2 59.7
Labor Quality			0.2	0.3	0.1	-0.1 -4.3	0.1 3.7
TFP			1.2	0.2	0.6	1.0 50.9	0.6 30.8

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

Table 4.5 shows that Developing Asia outperformed the ROW on ALP growth during 1990–2010 by a gap of 2 percentage points, and all of the sources of ALP growth contributed positively to this gap. Among these sources, capital deepening was the largest driver of the gap with a share of nearly 66 per cent, of which almost 60 per cent was due to non-ICT capital deepening and 6 per cent was due to ICT capital deepening. This finding indicates that capital deepening, especially non-ICT capital, was the major driver of the lead in ALP growth of Developing Asia over the ROW. TFP, which was responsible for 30.8 per cent of the gap, was the second most important source of Developing Asia's ALP growth. The labor quality, however, accounted for less than 5 per cent of the gap.

#### 4.5.3 ALP as a Driver of Developing Asia's Lead in GDP Growth

As presented in Section 4.4, GDP growth can be split into the contributions of ALP growth and employment (hours worked) expansion. GDP growth gaps between Developing Asia and the two compared groups, therefore, can be decomposed into the contributions of ALP and employment, as shown in Table 4.6.

ALP was also the leading driver of GDP growth gap of 3.2 percentage points between Developing Asia and the Industrialized Economies with a share of nearly 60 per cent of the gap. Employment claimed the remaining share of approximately 40 per cent. This finding indicates that both the pace of catching-up represented by ALP growth and the employment expansion were important sources of Developing Asia's GDP growth lead over the Industrialized Economies.

GDP growth gap of 2.3 percentage points between Developing Asia and the ROW was largely determined by ALP, which contributed nearly 90 per cent. ALP growth was the overriding driver of the difference in GDP growth between Developing Asia and other developing economies.

#### 4.6 SOURCES OF ECONOMIC GROWTH, 1990–2010: A GLOBAL PICTURE

The findings from the previous sections, particularly the major role of capital accumulation and TFP in the economic growth of Developing Asia, can be generalized to the world and other groups of economies. Similar to the analysis presented in Section 4.5, this section analyses the unweighted means of economic growth rates and their sources for each of the groups of interest. The section uses the sample of 119 economies to represent the world. The sample is divided into two groups: Industrialized Economies

Table 4.6 ALP as a driver of Developing Asia's lead in GDP growth, 1990–2010

	Sources of GDP Growth, 1990–2010 (% points per annum)			The Gap between Developing Asia and			
	Developing Asia	Industrialized Economies	Rest of World (ROW)	Industrialized Economies		Rest of World (ROW)	
	(1)	(2)	(3)	(4) = (1)–(2)	Structure	(5) = (1)–(3)	Structure
GDP Growth	5.5	2.3	3.2	3.2	100	2.3	100
ALP Growth	3.5	1.6	1.4	1.9	58.8	2.0	89.6
Employment Growth	2.0	0.7	1.8	1.3	41.2	0.2	10.4

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

and Developing Economies. The Industrialized Economies consists of 24 economies representing developed economies, and the group of Developing Economies, which represent the developing economies, consists of two developing groups: Developing Asia (16 economies) and the remaining 79 developing economies, which are referred to as the Rest of World (ROW) in this chapter. Similar to the approach employed in Section 4.5, the results of the analysis in this section are robust to sample outliers.<sup>8</sup>

### Sources of GDP growth

The sources and structure of the unweighted average GDP growth during 1990–2010 obtained for the world and the sub-samples are reported in Table 4.7. The worldwide GDP growth rate was 3.3 per cent, higher at 3.6 per cent for the Developing Economies, and lower at 2.3 per cent for the Industrialized Economies. At the same time, Developing Asia far outperformed the ROW on GDP growth (5.5 versus 3.2 per cent). The following features stand out from the inspection of the structure of GDP growth of the world and its sub-samples:

- The main driver of GDP growth was capital formation. The share of capital input in GDP growth was 52.5 per cent for the world (represented by 119 economies) and exceeded 50 per cent for all of its sub-samples. The major role of capital accumulation in the growth is consistent with the analysis performed by Lin (2009), who found that development is a transition toward more capital-intensive forms of growth.
- It is interesting to note that the share of capital input in GDP growth was larger for Industrialized Economies (56.9 per cent) compared with the developing groups: 51.8 per cent for the Developing Economies, 55.2 per cent for Developing Asia, and 50.6 per cent for the ROW. A large part of the contribution of capital input to the growth of Industrialized Economies was due to ICT capital input, which accounted for 21.8 per cent of the group's growth, whereas the corresponding share was only 11.6 per cent for the world, 10 per cent for the Developing Economies, 8.6 per cent for Developing Asia, and 10.5 per cent for the ROW.
- The share of non-ICT capital input in growth was 40.9 per cent for the world and substantial for all of the sub-samples.

<sup>8</sup> The analysis yields similar results if the outliers (upper 10 per cent and lower 10 per cent based on GDP or ALP growth) are removed from each of the groups. This finding indicates that the potential distorting effects of outliers should not be a cause of concern.

Table 4.7 Sources of GDP growth, 1990–2010: a global picture

	World Economies	Developing Economies			Rest of World (ROW)
		Industrialized Economies	All Developing Asia		
Sources of Growth (% points per annum)					
GDP Growth	3.3	2.3	3.6	5.5	3.2
Capital Input	All	1.7	1.3	1.9	3.0
	ICT	0.4	0.5	0.4	0.5
	Non-ICT	1.4	0.8	1.5	2.6
Labor Input	All	1.0	0.7	1.1	1.3
	Quality	0.2	0.3	0.2	0.2
	Hours	0.8	0.4	0.9	1.0
TFP	0.6	0.2	0.7	1.2	0.6
Structure (GDP Growth = 100)					
Capital Input	All	52.5	56.9	51.8	55.2
	ICT	11.6	21.8	10.0	8.6
	Non-ICT	40.9	35.1	41.8	46.6
Labor Input	All	29.7	32.4	29.3	22.9
	Quality	5.4	13.0	4.2	3.9
	Hours	24.3	19.4	25.1	19.0
TFP	17.8	10.7	18.9	21.9	17.9

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

This share was largest for Developing Asia (46.6 per cent), followed by the ROW (40.1 per cent), while it was lowest for the Industrialized Economies (35.1 per cent).

- The ratio between the contributions of non-ICT to ICT capital toward GDP growth was approximately 4:1 for Developing Economies and approximately 3:2 for Industrialized Economies.
- The second most important contribution to GDP growth is labor input. The share of the total labor input in growth was 29.7 per cent for the world, 32.4 per cent for Industrialized Economies, 29.3 per cent for Developing Economies, 22.9 per cent for Developing Asia, and 31.5 per cent for the ROW.

- It is interesting to note that the share of labor input was larger for Industrialized Economies compared with those obtained for the world and the other analysed groups. This is because the labor quality had a notably larger share in the growth for Industrialized Economies (13 per cent) compared to the world (5.4 per cent) and other groups: Developing Economies (4.2 per cent), Developing Asia (3.9 per cent), and the ROW (4.3 per cent). The small contribution of labor quality to growth, which is proxied by education, implies an important policy issue. Education alone may not have a solid effect on growth if the business environment and economic conditions are not favorable to capital accumulation that requires high-skilled labor. This observation is consistent with the findings from various studies, which have shown that education alone does not exhibit a robust significant effect on growth.

- In contrast, the share of hours worked on GDP growth was 24.3 per cent for the world. This share was largest for the ROW (27.2 per cent) and lowest for Developing Asia (19 per cent) and was as low as 19.4 per cent for Industrialized Economies.

• TFP is the third most important contribution to GDP growth. The share of TFP in GDP growth was 17.8 per cent for the world. This share was higher for the developing groups: 18.9 per cent for Developing Economies, 21.9 per cent for Developing Asia, and 17.9 per cent for the ROW. In contrast, it was lower at 10.7 per cent for the Industrialized Economies. Three conclusions can be drawn from this observation. First, the large share of TFP in economic growth of the developing groups suggests, to some extent, the advantage of 'backwardness': a country distant to the technological frontier can boost its productivity growth by importing ideas and innovation from more advanced countries. Second, the share of TFP in growth is larger for Developing Asia than for the ROW because the former was more effective in technology imitation and knowledge diffusion, as presented in Chapter 3. Third, the contributions of the labor quality and the ICT input capture a significant part of the residual in GDP growth decomposition, which is defined as TFP growth. Therefore, the large contributions of the labor quality and the ICT input toward GDP growth of the Industrialized Economies group reduce the residual, which implies a smaller TFP growth.

It is important to emphasize that, although TFP played an important role, 80–90 per cent of the world's GDP growth was driven by capital

accumulation and labor input. This finding implies the crucial role of the policies that foster capital investment and job creation in the promotion of economic growth. These findings suggest that the creation of an enabling environment that encourages robust capital investment and vibrant job creation plays a crucial role in the promotion and sustenance of high economic performance in a country.

#### Sources of ALP growth

The sources and structure of the unweighted average ALP growth during 1990–2010 for the world and its sub-samples are reported in Table 4.8. ALP growth rate was 1.7 per cent for the world; in contrast, it was higher at 1.8 per cent for Developing Economies and lower at 1.6 per cent for Industrialized Economies. Developing Asia, on average, far outperformed the ROW on ALP growth (3.5 versus 1.4 per cent). With regard to the structure of ALP growth of the world and its sub-samples, the following findings are salient.

Table 4.8 Sources of ALP growth, 1990–2010: a global picture

	World	Industrialized Economies	Developing Economies	Rest of World
			All	Developing Asia (ROW)
<i>Sources of Growth (% points per annum)</i>				
ALP Growth	1.7	1.6	1.8	3.5
Capital	1.0	1.0	0.9	2.1
Deepening	0.3	0.5	0.3	0.4
Non-ICT	0.6	0.6	0.6	1.7
Labor Quality	0.2	0.3	0.2	0.2
TFP	0.6	0.2	0.7	1.2
<i>Structure (ALP Growth = 100)</i>				
Capital	55.5	65.9	53.2	59.2
Deepening	19.2	29.3	16.9	11.5
Non-ICT	36.3	36.6	36.2	47.7
Labor Quality	10.4	18.7	8.5	6.2
TFP	34.1	15.4	38.3	34.7
				40.1

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

- The main driver of ALP growth was capital deepening. The share of capital deepening in ALP growth was 55.5 per cent for the world and exceeded 50 per cent for all of its sub-samples. Among the sub-samples, this share was largest for Industrialized Economies (65.9 per cent), moderate for Developing Asia (59.2 per cent), and smallest for the ROW (50.2 per cent).
- The structure of capital deepening differed notably between the sub-samples:
  - The share of ICT capital deepening in ALP growth was 29.3 per cent for Industrialized Economies compared with 16.9 per cent for Developing Economies. This finding indicates that developed countries were more heavily reliant on ICT capital deepening than developing economies in boosting ALP growth.
  - The share of non-ICT capital deepening in ALP growth was 47.7 per cent for Developing Asia, and this share was far larger than the shares of 30.6 per cent for the ROW and 36.6 per cent for Industrialized Economies. This finding suggests that Developing Asia relied more heavily on non-ICT capital deepening than other groups in fostering its ALP growth.
- The second most important contribution to ALP growth is TFP growth. The share of TFP in ALP growth was 34.1 per cent for the world. This share was lower for Industrialized Economies (15.4 per cent) and higher for the developing groups: 38.3 per cent for Developing Economies, 34.7 per cent for Developing Asia, and 40.1 per cent for the ROW.
- The share of labor quality in ALP growth was 10.4 per cent for the world. This share was much larger for the developed group (18.7 per cent) and lower for the developing group (8.5 per cent). This result suggests that the developing countries can increase their ALP growth by making more efforts toward the improvement of their labor quality.

#### ALP as a driver of GDP growth

Details on the breakdown of GDP growth during 1990–2010, that is, the contribution of ALP and employment, for the world and its sub-samples are reported in Table 4.9. The following features stand out:

- On average, ALP growth was the major driver of GDP growth for the world, and this pattern was much more pronounced for Industrialized Economies and Developing Asia. The share of ALP in GDP growth was 52.2 per cent for the world, 69.6 per cent for Industrialized Economies, and 63.3 per cent for Developing Asia.

Table 4.9 ALP as a driver of GDP growth, 1990–2010: a global picture

	World	Industrialized Economies	Developing Economies		
			All	Developing Asia	Rest of World (ROW)
GDP Growth	3.3	2.3	3.6	5.5	3.2
ALP Growth	1.7	1.6	1.8	3.5	1.4
Employment Growth	1.6	0.7	1.8	2.0	1.8
<i>Structure (GDP Growth=100)</i>					
ALP Growth	52.2	69.6	49.4	63.3	44.6
Employment Growth	47.8	30.4	50.6	36.7	55.4

Note: The measures for a given group are its unweighted means.

Source: Author's calculations.

- For the ROW, however, ALP was less important than the hours worked in the driving of GDP growth. The share of ALP in GDP growth of this group was only 44.6 per cent, whereas the share of employment was 55.4 per cent.

## 4.7 SUMMARY OF KEY RESULTS

This chapter examines the sources of GDP growth and ALP growth experienced by the 16 Developing Asia economies to gain insights from regional and global comparisons. The findings of the chapter can be divided into three groups. One group of findings includes the sources responsible for the growth of GDP and ALP of the individual economies compared with their peers and to the overall pattern of the group. The second set of findings is the drivers of the lead in economic performance experienced by Developing Asia over the rest of the world. The third group of findings consists of the global pattern of the sources of economic growth.

### 4.7.1 Sources of Economic Growth of Individual Economies

Capital accumulation was the largest source of GDP growth over the period of 1990–2010 for most of the 16 Developing Asia economies. ICT capital was a significant source of GDP and ALP growth for all of the 16 Developing Asia economies. Its contribution to GDP growth during 1990–2010 was notably larger for China, Singapore, Vietnam, Malaysia,

India, South Korea, Taiwan, and Pakistan compared with the remaining economies of the group. In addition, the contribution to growth was larger in the second sub-period, 2000–2010, in comparison to the first sub-period, 1990–2000. This observation for Developing Asia supports the conclusion of Kretschmer (2012) based on his survey of a large number of studies that the effect of investment in ICT on growth is not only significant and positive, but also increasing over time.

The share of TFP in GDP growth was notably enhanced from the first sub-period, 1990–2000, to the second sub-period, 2000–2010, for most of the 16 Developing Asia economies. This trend was most pronounced for the economies that suffered the most from the 1997–1998 Asian financial crises, which includes all four Asian Tiger economies and four of the ASEAN-6 countries: Indonesia, Malaysia, the Philippines, and Thailand. This finding suggests that the crisis stimulated some significant structural transformations in these economies that boosted their growth efficiency. In contrast, the share of TFP in GDP growth decreased sharply over the two sub-periods to alarmingly low levels (below 10 per cent) for several economies: Cambodia, Vietnam, Nepal, and Pakistan.

ALP was the main driver of GDP growth over the period of 1990–2010 for the Developing Asia economies, with the exception of Singapore (for which ALP accounted for 48.7 per cent of GDP growth), Pakistan (37.7 per cent), the Philippines (35.5 per cent), and Nepal (31.3 per cent). This low contribution of ALP to GDP growth was most evident for Nepal and Pakistan in the second sub-period, 2000–2010, during which approximately 80 per cent of GDP growth was due to employment expansion.

#### 4.7.2 Sources of Developing Asia's Lead in Economic Performance

Developing Asia outperformed the Industrialized Economies by a gap of 3.2 percentage points and the Rest of World (ROW) by a gap of 2.3 percentage points on GDP growth during the period of 1990–2010. Capital accumulation, especially non-ICT capital, was the main driver of the lead exhibited by Developing Asia and accounted for more than 50 per cent of the gap. TFP growth was also an important source of Developing Asia's superior GDP growth and accounted for nearly 30 per cent of the gap that Developing Asia commanded over the other groups.

With regard to ALP growth during 1990–2010, Developing Asia commanded a lead of 1.9 percentage points over the Industrialized Economies and 2.0 percentage points over the ROW. The principal driver of Developing Asia's lead was non-ICT capital deepening. Its share in ALP growth gap was approximately 60 per cent. TFP was the second most important source of Developing Asia's lead in ALP growth. In

particular, the share of TFP in ALP growth gap between Developing Asia and Industrialized Economies was 50.9 per cent, which indicates that TFP growth played a very important role in the catch-up exhibited by Developing Asia toward the developed nations. Developing Asia, however, exhibited lower contributions of ICT capital deepening and labor quality toward ALP growth compared with the developed countries. ALP growth was the major driver of the outperformance in GDP growth during 1990–2010 exhibited by Developing Asia over the other two groups. In fact, ALP accounted for approximately 90 per cent of GDP growth gap between Developing Asia and the ROW, whereas the corresponding share in the gap between Developing Asia and Industrialized Economies was approximately 60 per cent.

#### 4.7.3 Global Patterns of the Sources of Economic Growth

The examination of the global patterns of the sources of economic growth revealed results that were similar to those found for Developing Asia. Capital accumulation played a crucial role in driving economic growth. The share of capital input in GDP growth exceeded 50 per cent for the world and its sub-samples. The share of ICT capital input in GDP growth, however, was far larger for developed countries than for developing ones. TFP was an important source of GDP growth with share close to 20 per cent for the world and the developing groups.

Similar results were found for the sources of ALP growth. Capital deepening was the major source of ALP growth with shares that exceeded 50 per cent for the world and its sub-samples. TFP growth was the second most important source of ALP growth with shares that exceeded one third for the world and its developing groups.

ALP and employment contributed rather equally to GDP growth in the world sample: the share in GDP growth was approximately 52 per cent for ALP and 48 per cent for hours worked. The role of ALP in GDP growth, however, was far more important for Industrialized Economies and Developing Asia. The share of ALP in GDP growth was approximately 70 per cent for Industrialized Economies and 63 per cent for Developing Asia.



## APPENDIX 4.1: THE ACCOUNTING FRAMEWORKS FOR DECOMPOSING THE SOURCES OF ECONOMIC GROWTH

Jorgenson et al. (2003) provided a framework for decomposing economic growth into the contribution of capital and labor inputs and total factor productivity (TFP) growth. In the general production function below, output ( $Y$ ) is produced by an input bundle  $X$  of capital services and labor services. Capital services can be decomposed into ICT capital ( $K_{ICT}$ ) and non-ICT capital ( $K_{NICT}$ ). Labor services is the product of hours worked ( $H$ ) and labor quality ( $L_q$ ). Input ( $X$ ) is augmented by Hicks-neutral total factor productivity ( $A$ ).

$$Y = A \cdot X(K_{ICT}, K_{NICT}, H, L_q) \quad (A4.1.1)$$

Under the assumption of perfect competitive factor markets where the marginal product of each input equals its price and constant returns to scale, Equation (A4.1.1) can be transformed into the following growth accounting framework:

$$\begin{aligned} \Delta \ln Y = \bar{v}_K \Delta \ln K + \bar{v}_L \Delta \ln L + \Delta \ln A = \bar{v}_{K_{ICT}} \Delta \ln K_{ICT} + \bar{v}_{K_{NICT}} \Delta \ln K_{NICT} + \bar{v}_L \Delta \ln H + \bar{v}_L \Delta \ln L_q + \Delta \ln A \end{aligned} \quad (A4.1.2)$$

where  $\bar{v}$  denotes the two-period average shares of total factor income, and  $\Delta \ln$  in front of a variable denotes its real growth rate over the period of interest. The assumption of constant returns to scale of the aggregate input function implies that  $\bar{v}_K + \bar{v}_L = 1$  ( $\bar{v}_K = \bar{v}_{K_{ICT}} + \bar{v}_{K_{NICT}}$ ).

Equation (A4.1.2) means that GDP growth can be decomposed into three main sources:

- Contribution of capital inputs, which consists of the contributions of ICT and non-ICT capital:  $\bar{v}_K \Delta \ln K = \bar{v}_{K_{ICT}} \Delta \ln K_{ICT} + \bar{v}_{K_{NICT}} \Delta \ln K_{NICT}$ ,
- Contribution of labor input, which comprises the contributions of hours worked and labor quality:  $\bar{v}_L \Delta \ln L = \bar{v}_L \Delta \ln H + \bar{v}_L \Delta \ln L_q$ , and
- Contribution of TFP growth:  $\Delta \ln A$

The framework (A4.1.2) can be rearranged to decompose the growth of the average labor productivity ( $\Delta \ln P$ ),  $y = Y/H$ , as follows:

$$\Delta \ln y = \Delta \ln Y - \Delta \ln H$$

$$\Delta \ln y = \bar{v}_{K_{ICT}} \Delta \ln k_{ICT} + \bar{v}_{K_{NICT}} \Delta \ln k_{NICT} + \bar{v}_L \Delta \ln l_q + \Delta \ln A \quad (A4.1.3)$$

where  $k_{ICT} = K_{ICT}/H$  and  $k_{NICT} = K_{NICT}/H$  are referred to as ICT capital deepening and non-ICT capital deepening, respectively. Equation (A4.1.3) indicates that ALP growth comes from three sources:

- Contribution of capital deepening, which consists of the contributions of ICT capital deepening and non-ICT capital deepening:  $\bar{v}_K \Delta \ln k = \bar{v}_{K_{ICT}} \Delta \ln k_{ICT} + \bar{v}_{K_{NICT}} \Delta \ln k_{NICT}$
- Contribution of labor quality:  $\bar{v}_L \Delta \ln l_q$ , and
- TFP growth:  $\Delta \ln A$ .

## APPENDIX 4.2: DATASET FOR THE GROWTH DECOMPOSITION EXERCISE

The dataset used for the growth decomposition exercise is from Jorgenson and Vu (2011), which is constructed based on the two datasets: the Conference Board's Total Economy Database (TED)<sup>9</sup> and the World Bank's World Development Indicators (WDI) database.<sup>10</sup> The TED dataset is used because it provides complete data needed for the growth decomposition exercise for a large sample of economies for the period 1990–2010, to which all the large economies belong. The WDI dataset is used as a supplementary source of data for the economies for which the TED data are missing. Among the 16 Developing Asia economies, the complete TED data for the period 1990–2010 is not available for four economies: Cambodia, Nepal, Singapore, and Vietnam.

The methods for estimating capital stocks, capital services, and labor services are elaborated in the Methodological Notes of the Conference Board's TED dataset, which is available on its website. The sections below provide a brief description of these estimation methods.

### 1. Estimating Capital Stocks and Capital Services

#### Capital stocks

The quantity of capital stock for asset type  $i$  is determined using the 'perpetual inventory method' as follows:

$$S_{i,T} = S_{i,T-1}(1 - \delta_i) + I_{i,T} = \sum_{t=0}^T (1 - \delta_i)^{T-t} I_{i,t} \quad (A4.2.1)$$

<sup>9</sup> The TED is available on the Conference Board's website at URL: <http://www.conference-board.org/data/economydatabase/>.

<sup>10</sup> The WDI database is available on the World Bank's website at URL: <http://data.worldbank.org/data-catalog/world-development-indicators>.

where  $S_{i,T}$  is the capital stock in year  $T$  for asset type  $i$  which is one of the six asset types listed below,  $\delta_i$  is its constant rate of geometric depreciation, and  $I_{i,T-1}$  is the constant price investment flow in year  $T-1$ .

The six asset types belong to two capital categories: ICT and non-ICT. The ICT capital category consists of Computer hardware ( $\delta_i=30$  per cent), Telecom Equipment ( $\delta_i=12$  per cent), and Computer software ( $\delta_i=46$  per cent), while the non-ICT capital category include Construction ( $\delta_i=3$  per cent), Transportation equipment ( $\delta_i=20$  per cent), and Machinery ( $\delta_i=13$  per cent).

### Capital services

The procedure used to estimate the capital services rendered by a given type of capital asset was presented by Jorgenson et al. (2005). The procedure requires the estimation of the quantity of capital services, the rental price of those capital services, the contribution of the capital asset to income, and the ex-post nominal rate of return.

The quantity of capital services rendered by capital asset type  $i$  in year  $T$  is defined as the average capital stock between years  $T$  and  $T-1$ :

$$K_{i,T} = \frac{(S_{i,T} + S_{i,T-1})}{2} \quad (\text{A4.2.2})$$

The rental price  $c_{i,T}$  of capital services from capital asset type  $i$  in period  $T$  is obtained using the assumption that the typical investor in period  $T-1$  who invests in this capital asset at price  $p_{i,T-1}$  will obtain a return rate that will justify the nominal rate of return  $r_T$  observed for the economy and the market price of the remaining value of the asset in year  $T$ . Under the market equilibrium condition, this assumption implies that

$$p_{i,T-1}(1+r_T) = c_{i,T} + (1-\delta_i)p_{i,T} \quad (\text{A4.2.3})$$

Equation (A4.2.3) suggests the formula for computing the rental price  $c_{i,T}$

$$c_{i,T} = r_T p_{i,T-1} + \delta_i p_{i,T} - \pi_{i,T} p_{i,T-1} \quad (\text{A4.2.4})$$

where  $\pi_{i,T} = (p_{i,T} - p_{i,T-1})/p_{i,T-1}$  is the asset's price change over the period. The contribution to income  $V_{i,T}$  of capital services rendered by capital good  $i$  in year  $T$  is computed as

$$V_{i,T} = \frac{K_{i,T}}{Y_T} c_{i,T} \quad (\text{A4.2.5})$$

where  $Y_T$  is the GDP in current prices in year  $T$

The nominal rate of return  $r_T$  is determined as follows. The contribution to income of aggregate capital input is the sum of the contributions of all capital asset types as follows:

$$V_K = \sum_i V_{i,T} \quad (\text{A4.2.6})$$

Combining Equations (A4.2.4), (A4.2.5), and (A4.2.6) yields

$$V_K = \sum_i \frac{K_{i,T}}{Y_T} (r_T p_{i,T-1} + \delta_i p_{i,T} - \pi_{i,T} p_{i,T-1}) \quad (\text{A4.2.7})$$

Therefore, the nominal rate of return  $r_T$  (based on the ex-post approach), can be estimated using Equation (A4.2.7) as follows:

$$r_T = \frac{\left\{ V_K Y_T + \sum_i K_{i,T} \pi_{i,T} p_{i,T-1} - \sum_i K_{i,T} \delta_i p_{i,T} \right\}}{\sum_i K_{i,T} p_{i,T-1}} \quad (\text{A4.2.8})$$

The income share of capital input  $v_K$  is assumed one-third if it cannot be estimated from the country's national account. In this case, the income share of labor input is two-thirds.

## 2. Estimating Labor Services

### Labor quantity

It is ideal to use total hours worked as the measure of labor quantity. However, data on total hours worked is available only for 51 economies from the TED dataset. For the remaining countries, labor quantity is captured by the number of full-time equivalent workers, which can be converted into total hours worked under the assumption that a full-time equivalent works on average 2,000 hours per year.

### Labor quality

For the countries for which data on labor quality is not provided by the TED dataset, the labor quality index  $L_Q$  is constructed, following the approach employed by Barro and Lee (2010):<sup>11</sup>

$$L_Q = e^{\theta^*} \quad (\text{A4.2.9})$$

<sup>11</sup> This formula for estimating human capital is used by Barro and Lee (2010).

where  $s$  is the mean of years of schooling for adults aged 25 years and older;<sup>12</sup> the return rate to schooling  $\theta$  is assumed to be at a conservative rate of 3 per cent.<sup>13</sup>

#### APPENDIX 4.3: THE SHARES OF ALP AND EMPLOYMENT IN GDP GROWTH

GDP generated by a given economy, denoted by  $Y$  can be expressed as:

$$Y = (Y/L) \cdot L = y \cdot L \quad (\text{A4.3.1})$$

where  $L$  is the economy's quantity of labor input, which can be measured as number of full-time equivalent workers or total hours worked;  $y = Y/L$  is its average labor productivity (ALP).

Equation (A4.3.1) suggests that GDP growth can be split into two components—ALP growth and employment growth:

$$\Delta \ln Y = \Delta \ln y + \Delta \ln L \quad (\text{A4.3.2})$$

where  $\Delta \ln$  in front of a variable denotes its growth over the period of interest. Equation (A4.3.2) allows one to estimate the share of ALP in GDP growth as  $(\Delta \ln y / \Delta \ln Y) \cdot 100\%$  and the share of employment as  $(\Delta \ln L / \Delta \ln Y) \cdot 100\%$ .

#### APPENDIX 4.4: SOURCES OF DEVELOPING ASIA'S LEAD IN GDP GROWTH (WEIGHTED MEANS), 1990–2010

Table A4.1 provides the sources of growth for groups, using weighted means instead of simple means as used in Table 4.4 presented in the chapter. GDP measured in purchasing power parity is used to compute the weight of a country in a given group.

<sup>12</sup> The data is available on the United Nation Development Program (UNDP)'s Human Development Report website, <http://hdr.undp.org>, accessed March 10, 2013.

<sup>13</sup> Psacharopoulos and Patrinos (2004), surveying the studies on returns to schooling for 98 countries, showed that the raw rate of returns to schooling varied largely, which ranged from 1.5 per cent (for Estonia) to 16.5 per cent (for Brazil).

Table A4.1 Sources of Developing Asia's lead in GDP growth (weighted means), 1990–2010

Sources of GDP Growth, 1990–2010 (% points per annum)				The Gap between Developing Asia and			
				Industrialized Economies		Rest of World (ROW)	
			Developing Asia	Industrialized Economies	Structure	Rest of World (ROW)	Structure
			(1)	(2)	(3)	(4) = (1)–(2)	(5) = (1)–(3)
GDP Growth			6.8	2.0	2.5	4.8	100
Capital Input	All		3.9	1.1	1.2	2.8	58.0
	ICT		0.7	0.5	0.3	0.2	3.5
	Non-ICT		3.2	0.6	0.8	2.6	54.5
Labor Input	All		0.9	0.5	0.7	0.4	8.9
	Quality		0.2	0.3	0.2	–0.1	–1.3
	Hours		0.7	0.2	0.5	0.5	10.2
TFP Growth			1.9	0.4	0.6	1.6	33.0

Notes: The measures for a given group are its weighted means.

Source: Author's calculations.