

# PART I. LOOKING AT THE HORIZON: POTENTIAL GAINS

## Chapter 2

### Has South Asia Benefitted from Growth in India?

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#### 2.1 Introduction

India has experienced accelerated growth rates since the 1990s and has become one of the fastest growing emerging economies of the world. With the rise of the South, especially the BRICS countries, many have argued that South–South integration can sustain the growth of the South in the future. In this context, this chapter examines whether India, given its geographical location, can be the driver of growth for South Asia and become its growth pole.

The theory of growth poles leading to regional development dates back to the 1950s, when Perroux (1950, 1970, 1988) put forward his theory of active units, which assumed that under certain conditions actors have the capacity to change their environment. Perroux argued that the poles of development, which are the centres of most intense activity, could produce polarisation in leading sectors determined by their proximity in economic space, resulting in growth in the corresponding close sectors. Friedman (1966, 1972) applied these ideas to physical space as opposed to economic space to arrive at the much discussed ‘core-periphery model’. Since then there has been much interest generated in the regional growth models, which have been based on the fundamental condition of geographical proximity.

This chapter examines the extent to which growth in India is linked with the growth of its surrounding region. It estimates both long-term and short-term relationships between the growth of India and the growth of the rest of South Asia as a region and with the growth of individual countries in the region. To explain the existing/non-existing growth linkages, an in-depth analysis of the composition of trade between the countries is also undertaken.

To investigate the linkages in these growth rates, the standard procedures of multivariate time series analysis are followed. Growth series of India, the rest of South Asia, Bangladesh, Bhutan, Pakistan, Nepal and Sri Lanka for the period 1970–2009 are examined for the existence of unit roots. This is followed by co-integration of growth rates analysis and tests of causality of relationship. For each group, the Johansen maximum likelihood test for co-integration is conducted for testing long-term relationships in growth rates, followed by estimation by vector error correction model (VECM) and Granger causality test (Wald test).

The data on GDP (at constant US\$) is collected from the World Development Indicators (2010). To take into account the structural breaks that may have occurred in the growth series of the economies, the co-integration analysis is undertaken using Zivot and Andrews (1992) tests for one structural break and Clemente et al. (1998) tests for more than one structural breaks. Growth linkages in the post-structural breaks have also been examined.

The rest of the chapter is structured as follows: Section 2.2 presents a brief review of literature with respect to growth linkages; Section 2.3 examines the trends in growth rates and trade in the region; Section 2.4 discusses the methodology adopted for estimating growth linkages; Section 2.5 presents the results; and Section 2.6 concludes and provides policy directions.

## 2.2 Brief review of existing literature

The theory of growth poles has been extensively used to explain North–South trade. Findlay (1980) concluded that trade acts as an engine of growth for the South but the pace of this engine is set by the growth in the North. Taylor (1983) came to the same conclusion through a structuralist model which allowed for capital flows to the South. Studies estimating econometric models, such as those carried out by Beenstock (1988) and Samiei (1988), have also supported that there is a stronger influence of the growth in the North on that of the South than the other way around.

However, the rise in growth of some developing countries, irrespective of the slowing down in the North, especially since the 1990s, has led to the ‘decoupling’ argument. Hoffmaister et al. (1998) used time series analysis to show that growth in the North is also affected by growth in the South. They concluded that the improved resilience of the South not only allowed growth to continue at high levels during 1991–93 despite the downturn in the North, but also helped to limit the severity of that downturn. However, they argue that the increased resilience of the South and the boost to the North stem mainly from the improved performance of some of the emerging economies in Asia.

Examining the growth linkages between the North and the emerging South, Akin and Kose (2008) concluded that the impact of the North on the growth dynamics of the emerging South declined in the period 1986–2005, relative to earlier periods, but both the North and emerging South economies exhibited more intensive intra-group growth spillovers. Further, they found that, in contrast to the emerging South, other developing countries continued to be significantly affected by growth in the North. On similar lines, Kose et al. (2008) found convergence of business cycles within the OECD countries and within the emerging economies (including non-Asian countries) but found that there was a decoupling of business cycles between the two groups. In other words, the business cycles of developed countries and emerging economies remained largely independent of each other. Fidrmuc and Korhonen (2009), using dynamic correlation analysis, concluded that most of the developed countries showed low or even negative dynamic correlation with China and India for the traditional business cycles (cycles with periods of between 1.5 and 8 years); however, the co-movement of these business cycles increased after the global financial crisis of 2007. Therefore, they concluded that there may be, in the future, increased interdependencies between developed countries and these two key emerging economies.

The economic crisis of 2007, which led to a slowdown in the growth of the North, has shifted the focus of debate from whether the North is the growth pole for the South to whether the emerging economies can be the drivers of growth for the South. In his Nobel lecture, Arthur Lewis (1979) argued that if growth in the North slowed down sharply then South–South trade could be an important instrument to sustain the growth of the South. The growing markets in some of the countries of the South could generate demand for the South and fill the gap left by the contracting markets of the North.

Many studies have argued that India could play the role of growth pole for other developing countries of Asia (Kaplinsky and Messner 2008; Jenkins et al. 2008). However, very little empirical evidence exists of the linkages in the growth rates of these emerging economies with the growth rates of other developing countries. For instance, with regards to China, Reisen (2010) found that a slowdown of one percentage point in China's growth would reduce low-income countries' growth rate by 0.56 percentage points and middle-income countries' growth rate by 0.36 percentage points for the period 1990–2009.

In this context, this chapter estimates the extent of linkages in the growth rates of India with South Asia as a region as well as individual countries in South Asia. It estimates both long-term and short-term relationships between the growth rates and undertakes tests to identify the direction of the causality in the growth linkages.

## 2.3 Trends in growth rates in India and the rest of South Asia

### 2.3.1 Trends in growth

South Asia as a region has witnessed a steady growth since the 1970s, with rising average annual growth rates from 2.5 per cent in the 1970s to 5.3 per cent in the 1980s and further still to 6.7 per cent in the 2000s. However, India accounts for the major portion of this growth. Average annual growth rates decelerated in the rest of South Asia – excluding India – from 5 per cent in the 1980s to 4.3 per cent in the 1990s and improved slightly to 4.9 per cent in the 2000s (Table 2.1). India, on the other hand, had an increased average annual growth rate from 5.4 per cent in the 1990s to 6.9 per cent per annum in 2000–09. Within the individual countries of South Asia, it can be seen that growth has been very uneven. While Bangladesh has experienced a rising average annual growth rate since the 1970s, average annual growth rates declined in Bhutan and Pakistan in the 1990s compared with the 1980s; and average annual growth rates declined in Sri Lanka and Nepal in the 2000s compared with the 1990s.

A close look reveals that the difference in the trend growth rates of India and China has declined steadily since 2000, while that of India and rest of South has grown steadily since the 1990s (Figure 2.1).

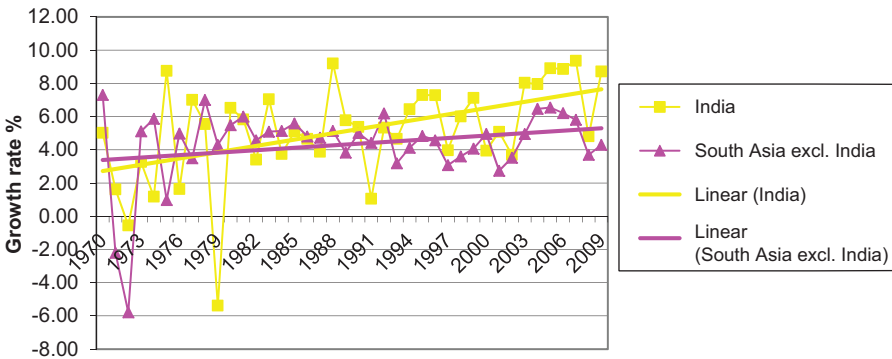
All South Asian countries, apart from India, experienced less than one percentage point increase in their average annual growth rates in the 2000s compared with the 1990s. In fact average annual growth rates declined in Nepal and Sri Lanka in the

**Table 2.1 Average annual growth rates: South Asia**

	South Asia	South Asia excluding India	India	Bangladesh	Bhutan	Nepal	Pakistan	Sri Lanka
1970–79	2.58	3.10	2.81	1.27		2.54	4.68	4.12
1980–89	5.30	5.03	5.52	3.16	9.08	3.94	6.63	4.05
1990–99	5.16	4.30	5.46	4.69	5.13	4.72	3.88	5.12
2000–09	6.76	4.91	6.94	5.65	8.13	3.91	4.52	4.85

**Source:** Author’s estimations based on World Development Indicators

**Figure 2.1 Growth rates of South Asia (excluding India) and India, 1970–2009**



**Source:** Author’s estimations based on World Development Indicators

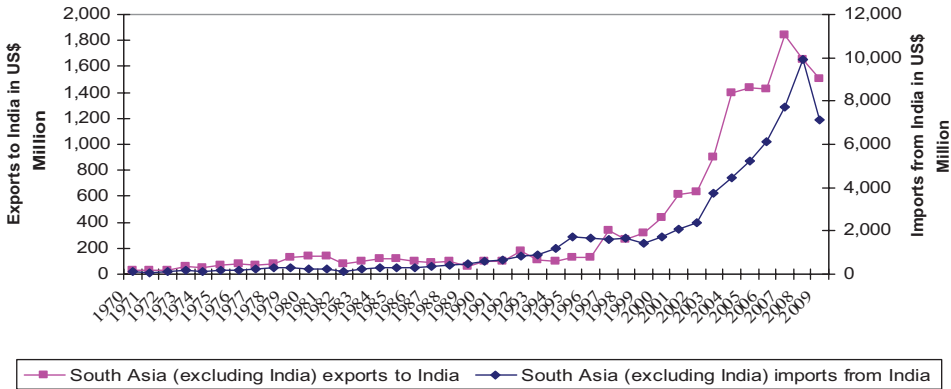
2000s. However, all countries in South Asia experienced a rise in their average annual growth rates in the 1980s compared with the 1970s, the decade in which India started growing (Table 2.1).

**2.3.2 Trends in trade**

South Asia’s trade with India has experienced a rising trend since the 1990s (Figure 2.2). Trade with India picked up in the 2000s. The average exports to India of the countries of South Asia increased from US\$62 million in the 1970s to US\$1.1 billion in 2000–09 (Table 2.2).

India’s exports to the rest of South Asia grew by 15.8 per cent and imports by 12.4 per cent. In absolute terms the region’s exports to India are much lower than their imports from India (Figure 2.2).

The trend in trade between countries in South Asia reveals the growing engagement of India with the rest of the region. However, compared with India’s global trade, its trade with South Asia seems to be very low. Less than 5 per cent of India’s global exports in 2000–09 were to countries in South Asia.

**Figure 2.2 India's trade with the rest of South Asia, 1970–2009**

Source: UN Comtrade database

**Table 2.2 Average annual exports and imports of the rest of South Asia and India (million US\$)**

	Imports from India	Exports to India
1970–79	179	62
1980–89	304	104
1990–99	1,225	175
2000–09	5,043	1,183

Source: UN Comtrade database

## 2.4 Are the growth rates linked?

The trends reveal that the region of South Asia (excluding India) experienced less than 5 per cent average annual growth rates since the 1990s, while India experienced around 6 per cent average annual growth rates in the same period. The region has also experienced growing trade with India, especially since the start of the twenty-first century, though the region's share in global trade of these countries is very small. One of the important factors linking growth of different countries is trade. However, a higher volume of trade does not necessarily percolate into growth. Apart from the extent of trade, what may matter is also the composition of trade.

To estimate the extent to which growth in India is linked to growth in South Asia as a region and individual countries, the following linkages are tested:

- I. the growth rate of India with the growth rate of the rest of South Asia;
- II. the growth rate of India with the growth rates of Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka.

Further, the composition of trade between these groups is examined to show a plausible explanation for growth linkages.

### 2.4.1 Has India acted as a growth pole for South Asia?

India is an important trade partner for countries in South Asia. The Granger causality test is used to test the lead–lag relationship between two variables. Granger causality determines whether one series is useful in forecasting the other series; it does not imply ‘causality’ in the sense generally used, but indicates which series predicts the other and, therefore, indicates the direction of the causal relationship.

The relationship between growth rates in India and the rest of South Asia were tested. No evidence was found of any relationship between them, whether short term or long term. The results of the tests are reported in Table 2.3, the details of which are reported in Appendix Tables A2.2 and A8.8. To find a plausible explanation for this result, the top five product categories of India’s exports and imports with the region in the last ten years are examined. This provides insights into the composition of trade of these countries.

Examining India’s top five exports to the region in the period 1999–2009, it is found that India exported chemical, rubber and plastic products, petroleum and coal products, textiles, machinery and equipment, and ferrous metals to the region (Table 2.4). However, the value of this trade amounted to US\$29.5 billion, while the value of India’s imports amounted to US\$3.5 billion. The top product of India’s trade with the region is chemical, rubber and plastic products, which may not necessarily allow the region to benefit from comparative advantage.

This provides for an interesting case study as India, being a part of the region, has not been able to provide benefit to the region in terms of growth spillovers and has also not been able to benefit from the growth of the region. India’s exports to the region in the period 1999–2009 were 5 per cent of its global exports. India’s imports to the region in the same period were 0.7 per cent. Further, the percentage of Indian exports of the total global exports of the region in the period 1999–2009 was 4.2 per cent, while the percentage of India’s imports of the region’s global imports was 10 per cent.

What matters is ‘what you trade’ (or the composition of trade) and not just ‘how much you trade’. India’s exports are concentrated on chemical, rubber and plastic products and petroleum and coal products, while imports include chemical, rubber and plastic

**Table 2.3 The results of tests of relationships between growth in India and individual countries in South Asia**

Variable name: Growth rates	Long-term relationship	Short-term relationship	Granger causality
<b>Bhutan (1980–2009)</b>	Yes	Yes	– One-way: growth in India Granger-causes growth in Bhutan
<b>Bangladesh</b>	Yes	Yes	One-way: growth in China Granger-causes growth in Bangladesh
<b>Nepal</b>	No	No	Two-way
<b>Pakistan</b>	No	No	No evidence
<b>Sri Lanka</b>	No	No	

**Table 2.4 India's top five exports and imports from rest of South Asia: 1999–2009**

India's top five exports to the rest of South Asia (US\$ million)		The rest of South Asia's top five exports to India (US\$ million)		India's exports as percentage of total exports from rest of South Asia
Chemical, rubber, plastic products	8,771	Chemical, rubber, plastic products	1,268	<b>11.8%</b>
Petroleum, coal products	7,541	Metals n.e.c.	996	<b>65.5%</b>
Textiles	7,057	Electricity	940	<b>99.9%</b>
Machinery and equipment n.e.c.	3,310	Textiles	899	<b>1.15%</b>
Ferrous metals	2,991	Crops n.e.c.	723	<b>8.8%</b>

**Note:** n.e.c. – not elsewhere classified

**Source:** UN Comtrade database, GTAP product classification

products, indicating product differentiation. However, the above analysis of growth linkages at the regional level may hide some important growth linkages at the country level. Further, the composition of trade with the region may not reveal whether trade is with only one country or many and, therefore, it may not provide the relevant insights. Country-level analysis of growth linkages is undertaken in the next section.

## 2.5 India's growth linkages with countries in South Asia

At the country level, the tests for co-integration of growth linkages are undertaken using the same methodology. The long-term relationship between the growth rates has been tested using Johansen tests for co-integration and VECM while the short-term relationship and its direction is tested by estimating the impact of lagged growth rates and conducting Granger causality tests. The analysis is undertaken for the period 1970–2009 and also for the post-structural break period, which differs for each country. Clemente et al. (1998) tests have been applied to identify two structural breaks for each country.

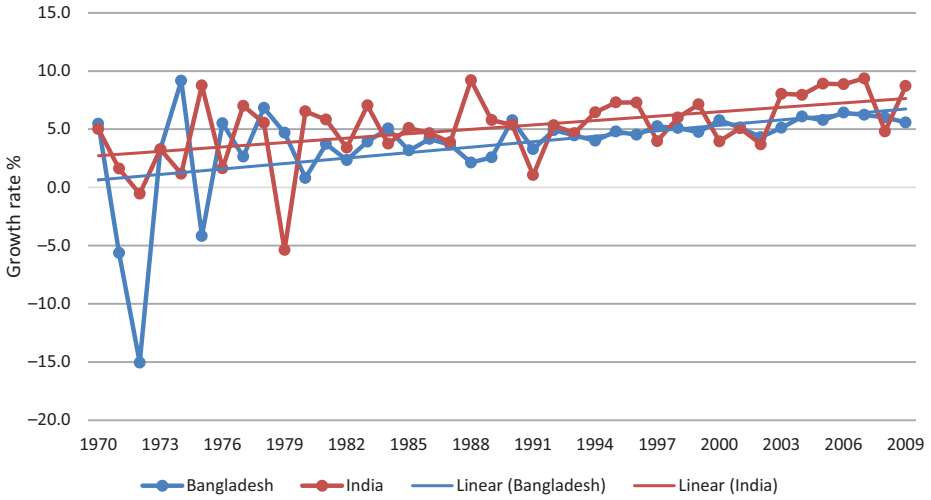
The results of the tests are reported in Appendix Tables A2.2 to A2.8. The broad conclusions from the tests are reported in Table 2.3. The results provide insights into the relationship of growth rates. Empirical results show long-term relationships between growth in India and growth in Bangladesh and Bhutan.

### 2.5.1 The relationship between growth in Bangladesh and India

Bangladesh's growth is found to have a long-term relationship with the growth of India. The short-term relationship between growth in India and Bangladesh is found to go both ways. One of the probable reasons for this could be that Bangladesh has provided an expanding market for India's exports, as they multiplied by a factor of 3.5 from 1990 to 2010, (i.e. from US\$644 million to US\$2.4 billion), while India's imports from Bangladesh were less than \$500,000 in 2009 (Reserve Bank of India 2010).

Examining the growth rates, we find that the difference in the linear trends in growth of Bangladesh and India has steadily narrowed since the 1990s (Figure 2.3).

**Figure 2.3 Growth rates of India and Bangladesh, 1970–2009**



**Source:** World Development Indicators

Rising trade between the two countries over the years could probably be a reason for the growth linkages.

The growth of Bangladesh is found to have both a long-term and short-term relationship with the growth of India and the causality is found to be in both directions for the period 1970–2009. One of the probable reasons for this is the growing market which Bangladesh is providing to India. Among the developing countries, India has become one of the principal sources of Bangladesh’s imports since the 1990s. India alone supplied 30.5 per cent of Bangladesh’s total imports from developing countries in 1998, though the figure was only 10.5 per cent in 1978 (Rahman 2007).

The composition of trade between the two shows that India exported US\$3 billion of cotton to Bangladesh in the period 1999–2009. This is an important input for the textiles industry of Bangladesh, but much lower than China’s US\$11.4 billion of textiles in the same period. India also exported more final products to Bangladesh such as cereals, agricultural products and vehicles, and imported more input products such as textile fibres, inorganic chemicals and fertilisers (Table 2.5).

The results, therefore, show that growth in India has fuelled growth in Bangladesh, and Bangladesh’s growth has further contributed to growth in India.

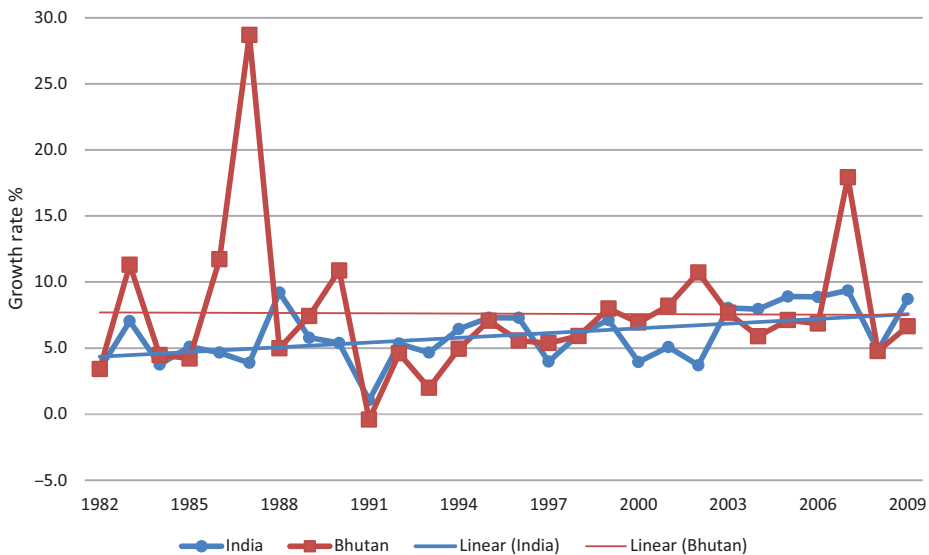
### 2.5.2 The relationship between growth in Bhutan and India

The empirical results indicate long-term and short-term relationships between growth in India and Bhutan. Figure 2.4 explicitly shows the convergence of the trend growth lines of India and Bhutan. India has a rising trade with Bhutan, especially after it set up the second hydroelectric project in Bhutan in 2002; thereafter 90 per cent of Bhutan’s exports went to India. India’s exports to Bhutan consist of electrical machinery, iron and steel, mineral fuels, machinery and appliances, and vehicles. India has been a key driver of growth for Bhutan.

**Table 2.5 India's top five imports and exports to Bangladesh: 1999–2009**

India's exports to Bangladesh (US\$ million)		India's imports from Bangladesh (US\$ million)	
Cotton	3,013	Other vegetable textile fibres; paper yarn and woven fabrics	337
Cereals	2,832	Inorganic chemicals; compounds of precious metal radioactive elements, etc.	279
Mineral fuels, oils and product of their distillation, etc.	1,062	Other made up textile articles; sets; worn clothing, etc.	200
Edible vegetables and certain roots and tubers	1,057	Fertilisers	148
Vehicles o/t railw/tramw roll-stock, pts and accessories	1,029	Fish and crustacean, mollusc and other aquatic invertebrate	137

**Source:** UN Comtrade database, GTAP product classification

**Figure 2.4 Growth rates of India and Bhutan, 1982–2009**

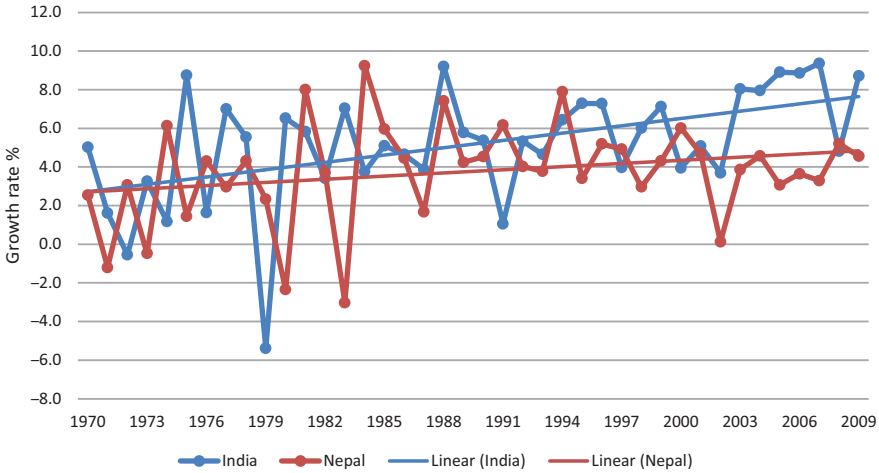
**Source:** World Development Indicators

### 2.5.3 The relationship between growth in Nepal and India

Nepal shares borders with both China and India. India is the most important trading partner for Nepal given the geography of the region. The average value of India's exports to Nepal in the period 1999–2009 was around US\$700 million, while the average value of Nepal's imports to India was US\$355 million. However, the empirical results show that there is little long-term connection between growth rates in Nepal and India. In fact, Figure 2.5 shows a divergence in the trend growth rates of India and Nepal.

Imports to India from Nepal comprise mainly vegetable fats and oils, wood and articles of wood, essential oils, raw hides and plastic articles. Concentration of trade

**Figure 2.5 Growth rates of India and Nepal, 1970–2009**



**Source:** World Development Indicators

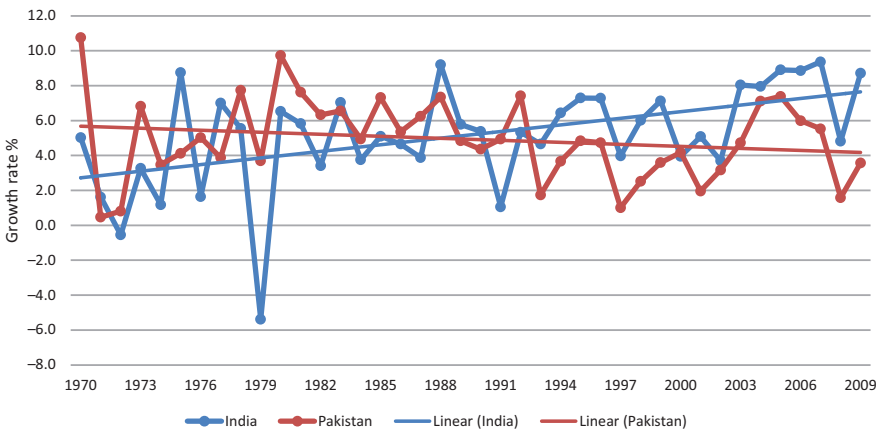
in final products with Nepal may also be one of the reasons for the lack of short-term growth linkages between Nepal and India. Further, one of the main sources of export earnings for Nepal is tourism (Table 2.6).

### 2.5.4 The relationship between growth in Pakistan and India

Empirical results suggest no growth linkages between Pakistan and India. According to the empirical results there is no evidence of causality. The causality of growth linkages is found only in the post-1984 period, which is identified as a period of structural break for Pakistan.

Figure 2.6 depicts the growth rates of India and Pakistan. Clearly, no relationship can be seen in their growth, where the growth rate of India was lower than that of Pakistan in the pre-1988 period.

**Figure 2.6 Growth rates of India and Pakistan, 1970–2009**



**Source:** World Development Indicators

**Table 2.6 India's top five imports and exports to Nepal: 1999–2009**

India's exports to Nepal (US\$ million)		India's imports from Nepal (US\$ million)	
Mineral fuels, oils and product of their distillation, etc.	2,599	Animal/vegetable fats and oils and their cleavage products, etc.	438
Vehicles o/t railw/tramw roll-stock, pts and accessories	682	Iron and steel	392
Iron and steel	574	Plastics and articles thereof	331
Pharmaceutical products	481	Essential oils and resinoids; perfume, cosmetic/toilet prep	289
Synthetic staple fibres	250	Salt; sulphur; earth and stone; plastering materials; lime and cement	359

**Source:** UN Comtrade database, GTAP product classification

**Table 2.7 India's top five imports and exports to Pakistan: 1999–2009**

India's imports from Pakistan (US\$ million)		India's exports to Pakistan (US\$ million)	
Vegetables, fruit, nuts	480	Chemical, rubber, plastic products	3,158
Petroleum, coal products	354	Plant-based fibres	915
Textiles	253	Textiles	668
Chemical, rubber, plastic products	181	Sugar	578
Mineral products not elsewhere classified	122	Vegetable oils and fats	512

**Note:** n.e.c. – not elsewhere classified

**Source:** UN Comtrade database, GTAP product classification

**Table 2.8 India's top five imports and exports to Sri Lanka: 1999–2009**

India's exports to Sri Lanka (US\$ million)		India's imports from Sri Lanka (US\$ million)	
Petroleum, coal products	4,139	Metals n.e.c.	584
Textiles	1,883	Vegetable oils and fats	436
Chemical, rubber, plastic products	1,866	Machinery and equipment n.e.c.	323
Motor vehicles and parts	1,217	Crops n.e.c.	318
Transport equipment n.e.c.	974	Chemical, rubber, plastic products	314

**Note:** n.e.c. – not elsewhere classified

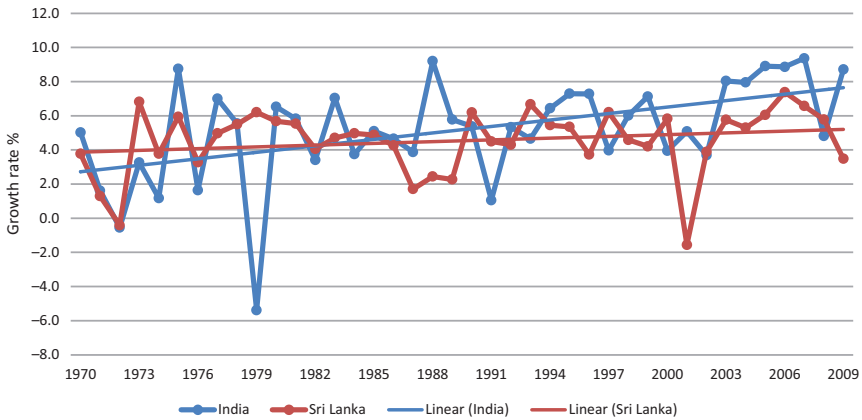
**Source:** UN Comtrade database, GTAP product classification

India's trade with Pakistan has been low, amounting to a value of US\$7.9 billion of exports and US\$1.7 billion of imports. India's top five exports to Pakistan consist mainly of finished products such as chemicals, rubber and plastic products, sugar and vegetable oils, while its highest imports are also characteristically similar, being vegetables, fruits and nuts (Table 2.7). Even though India's trade with Pakistan is much higher than its trade with Bhutan, the growth linkages are missing, probably because of the composition of trade.

### 2.5.5 The relationship between growth in Sri Lanka and India

Empirical results show that growth in Sri Lanka is not co-integrated with growth in India. No long-term or short-term relationship is found between these

**Figure 2.7 Growth rates of India and Sri Lanka, 1970–2009**



**Source:** World Development Indicators

countries. Figure 2.7 also reflects the divergence of growth rates between Sri Lanka and India.

The value of India’s exports to Sri Lanka in the period 1999–2009 was US\$16.1 billion while its imports were around US\$3 billion. Though India’s trade has been higher with Sri Lanka than with Bhutan, the growth rates are found to be co-integrated in the case of India and Bhutan but not in the case of India and Sri Lanka. The probable reasons for this are the size of the country, its stage of development and the composition of trade.

The most important export item of India to Sri Lanka in the period 1999–2009 was petroleum and coal products, followed by textiles, chemical rubber and plastic products, motor vehicles and parts, and other transport equipment. The top five imports included mainly metals, vegetable oils and fats, machinery and equipment crops and chemical, rubber and plastic products.

## 2.6 Conclusions and policy implications

Economic theories on regional growth argue that growth spillovers may occur from growth poles in the region. Given the high levels of poverty in the region, where 40 per cent of the population live below the poverty line, South Asia is a region which is in need of a growth propeller. India has the potential to become the growth pole of the region. This chapter empirically examined the extent to which the South Asian region has benefitted from the growth of India.

Both long-term and short-term relationships between the growth of the region and growth in India were tested using co-integration analysis, VECM and causality tests. The analysis was undertaken at the regional level as well as at the country level. Structural breaks were identified and co-integration between growth rates was estimated in the post-structural break period as well.

Empirical evidence suggests that India’s growth has limited linkages with growth in the region, in spite of its being a part of the region. Its growth is not found to be co-integrated with the growth of the region. The only relationship found between India’s growth and that of other countries in the region is with Bangladesh and Bhutan.

The analysis provides some vital leads in understanding the complex issue of growth spillovers in the region. The existence of fast-growing economies within a region may not necessarily lead to regional growth. It is not the 'extent of trade' with faster-growing economies which matters, but what is being traded. The composition of trade determines the extent of growth linkages that may emerge in the short term as well as in the long term. The more integrated the economies are in each other's supply chains by exporting inputs to each other, the stronger will be the growth linkages.

It is unlikely for trade to automatically transform into being input-oriented. Conscious policies regarding the composition of trade need to be adopted which encourage trading of inputs within the region. India's top items of export and import with the region have been chemical, rubber and plastic products. India's weighted average of tariffs for many inputs originating in the region is still compared with China, for instance. The weighted average of tariffs for textiles vis-à-vis the region is around 6 per cent in China and around 10 per cent in India; for minerals it is around 1 per cent in China and around 5 per cent in India.

The South Asian Free Trade Area (SAFTA) provides a real opportunity to leverage the building of strong growth linkages. However, SAFTA has a long sensitive list, wherein tariffs cannot be brought down to zero. India is now making an effort to reduce its sensitive list under SAFTA. The new list considerably reduces the number of items for LDCs in the region. LDCs in the region have a lower number of products on the sensitive list than India's sensitive list in its duty-free, quota-free (DFQF) scheme vis-à-vis other LDCs of the world. But there still exists a quota for Bangladesh's exports in garments. Given the fact that India is exporting textiles to Bangladesh, higher exports of clothing from Bangladesh increase the demand for its imports of textiles. Therefore, there exists a potential for increasing integration which can be realised by conscious policies. Further, the new list does not offer any removal of tariff lines for Pakistan and Sri Lanka. Removal of all inputs from the SAFTA sensitive list of India can help India to integrate into the region with mutual benefits.

South-South trade can act as an important vehicle for growth of the South, as it can provide vital growth linkages, especially within the region. However, higher trade with faster-growing economies may not necessarily lead to higher growth spillovers. It is important to consciously promote input-based composition of trade which helps integrate the economies into each other's global supply chains. The faster-growing economies in the region can not only provide larger markets for finished products of other developing countries in the region, but also boost their growth by providing the necessary inputs and machinery and equipment. It is also important to note that the causality of growth linkages may run two ways and the growth poles of the region can also benefit by integrating into the regional and global supply chains.

## Appendices

### Appendix 1 Methodology used

To estimate the extent to which growth of a country is linked to growth of another country, co-integration analysis and causality tests are undertaken for the period 1970–2009. The data on real GDP constant US\$2000 are collected from the World Development Indicators (2009).

Unit root tests are conducted to verify the stationarity properties (absence of trend and long-run mean reversion) of the time series data to avoid spurious regressions. A series is said to be integrated of order  $d$ , denoted by  $I(d)$ , if it has to be differenced  $d$  times before it becomes stationary. If a series, by itself, is stationary in levels without having to be first differenced, then it is said to be  $I(0)$ . We use standard Augmented Dickey-Fuller (ADF) (Dickey and Fuller 1981), and MacKinnon (1991) critical values for that purpose. Second, for appropriate lag lengths, we use the VAR process in conjunction with the Akaike Information Criterion (AIC). Third, the co-integration tests are applied to detect the presence of any long-term and short-term relationship between the variables.

For two series to be co-integrated, both need to be integrated of the same order 1 or above. Lack of co-integration implies no long-run equilibrium among the variables such that they can wander from each other randomly. Their relationship is thus spurious. We use the maximum likelihood method developed by Johansen and Juselius (1990). Finally, the causality among the variables is studied by applying the statistical concept of Granger causality, which does not imply any cause-and-effect relationship in a philosophical sense. It refers strictly to the concept of predictability (Granger 1969, 1980, 1981), meaning that a variable  $X$  is said to Granger-cause a variable  $Y$ , if taking into account past values of  $X$  enables better predictions to be made for  $Y$ , *ceteris paribus*. VECM were estimated to infer the number of lag terms required (with the help of AIC) to obtain the best-fitting model and appropriate lag lengths were then used in causality tests yielding the F-statistics and respective  $p$ -values.

The time series properties of all the series were examined. The results of the unit root test are presented in Table A2.1. To verify the hypothesis that the time series follow a unit root process three different tests are used. To begin with, time series are tested for stationarity by using the ADF test. Since the lag length affects the power properties of the ADF test, we establish the correct number of the lags that should be included in our model using both the AIC and Schwarz's Bayesian Information Criterion (BIC). We fail to reject the null hypothesis of unit root for all series.

In order to test the unit root hypothesis, taking into account the possibility of structural breaks in the data, we perform the Zivot and Andrews (1992) test and the tests proposed by Clemente et al. (1998). All results are reported in Tables A.2 and A.3. When taking into account the existence of different kinds of structural breaks, we fail to reject the null hypothesis of unit root for all time series, except for Pakistan, with a break in the intercept. Two alternative events within the time series are captured: the 'additive outlier' (CLEMAO2) model that captures a sudden change in the series and the 'innovation outlier' (CLEMIO2) model that allows a gradual shift in the mean of the series. According to both the test results, we fail to reject the null hypothesis of unit root in all cases. We can conclude that unit roots are present even when instantaneous structural breaks and more gradual shifts are accounted for.

Johansen's tests for co-integration are conducted to determine whether co-integrating vectors exist between the country in question and India, which would imply non-spurious long-run relationships among the growth series. Johansen tests can determine the number of co-integrating equations. The dynamic relationship between the two growth series can be summarised by a VECM that combines the long-run co-movements

of output growth with the short-run cyclical movements (see Engle and Granger 1987). The error correction term indicates the presence of a long-term relationship, while the coefficients of lagged error correction term indicate a short-term relationship. To further test the causality of the relationships, Granger causality tests are undertaken, which test for the direction of the short-term relationship between the growth series.

## Appendix 2 Econometric findings

**Table A2.1 ADF unit root tests**

Variable name: Growth rates	ADF	Test statistic
India	Trend (2)	-3.169**
	Difference	-5-589
South Asia excluding India	Trend (1)	-3.311*
	Difference	-5.013
Bangladesh	Trend (3)	-0.603**
	Difference	-4.792
Bhutan	Trend (1)	-1.988*
	Difference	-3.912
Pakistan	Trend (2)	-1.095*
	Difference	-2.719
Nepal	Trend (2)	-2.798**
	Difference	-3.722
Sri Lanka	Trend (1)	-3.359*
	Difference	-2.524**
	2nd Difference	-8.912

**Note:** \* denotes the value is significant at 5 per cent. Figures in brackets are the optimum lag lengths determined by AIC and BIC for ADF and Ng-Perron modified AIC (MAIC) for Dickey-Fuller generalised least squares (DF-GLS). \*\* denotes the value is significant at 1%. (For ADF it denotes the test statistic being greater than the critical value at 1%).

**Table A2.2 Zivot and Andrews unit root test with one unknown structural break**

Variable name: Growth rates	Zivot and Andrews (break in intercept)	Year of break	Zivot and Andrews (break in trend)	Year of break	Zivot and Andrews (break in both intercept and trend)	Year of break
India	-2.430	1979	-2.465	2001	-2.469	2003
South Asia excluding India	-3.495	1997	-3.488	1991	-3.470	1997
Bangladesh	-2.216	1987	-2.379	1995	-2.203	1995
Bhutan	-2.741	1994	-2.421	1988	-2.558	1992
Pakistan	-3.641	1980	-4.663*	1989	-4.097	1993
Nepal	-3.831	1990	-2.940	2002	-2.883	2003
Sri Lanka	-4.309	1987	-3.606	2003	-4.495	1987

**Note:** \* denotes critical values for break in trend: 1%:-4.93 5%:-4.42.

**Table A2.3 Unit root test with two structural breaks**

Real GDP	Additive outliers	Breaks		Innovative outliers	Breaks	
	CLEMAO2	Year of break 1	Year of break 2	CLEMIO2	Year of break 1	Year of break 2
India	-2.680	1985	2000	-1.879	1979	2002
South Asia excluding India	-2.467	1984	1997	-4.993	1976	2002
Bangladesh	-2.427	1987	1999	-3.710	1974	1994
Bhutan	-2.637	1989	2001	-2.682	1985	2000
Pakistan	-2.653	1984	1997	-5.292	1976	2002
Nepal	-2.875	1985	1997	-2.571	1972	1982
Sri Lanka	-2.402	1982	1996	-1.696	1971	2002

**Note:** Critical value for two breaks is -5.49

**Source:** Clemente et al. (1998)

**Table A2.4 Johansen tests for co-integration of growth rates from 1980 to 2009**

Variable name: Growth rates	Test statistics	H0: No co-integrating relation	H0: At most one co-integrating relation	H0: No co-integrating relation	H0: At most one co-integrating relation
		1970–2009		Post-structural break	
India/South Asia excluding India	Trace statistics	13.06 <sup>a</sup>	0.026	12.00 <sup>a</sup>	1.53
	Max Eigen statistics	13.04	0.026	10.47	1.53
<b>India/Bangladesh</b>	Trace statistics	<b>44.39</b>	<b>8.71</b>	<b>27.71</b>	<b>10.13</b>
	Max Eigen statistics	<b>36.68</b>	<b>8.71</b>	<b>17.58</b>	<b>10.13</b>
<b>India/Bhutan (1982–2009)</b>	Trace statistics	<b>15.77</b>	<b>5.37</b>		
	Max Eigen statistics	<b>10.40</b>	5.37		
India/Pakistan	Trace statistics	15.51 <sup>a</sup>	0.77	19.62	1.17
	Max Eigen statistics	14.74	0.77	18.45	1.17

(continued)

**Table A2.4 Johansen tests for co-integration of growth rates from 1980–2009 (continued)**

Variable name: Growth rates	Test statistics	H0: No co-integrating relation	H0: At most one co-integrating relation	H0: No co-integrating relation	H0: At most one co-integrating relation
		1970–2009		Post-structural break	
India/Nepal	Trace statistics	19.11 <sup>a</sup>	1.59	11.30 <sup>a</sup>	4.50
	Max Eigen statistics	17.52	1.59	6.80	4.50
India/Sri Lanka	Trace statistics	15.05 <sup>a</sup>	0.60	14.35 <sup>a</sup>	4.44
	Max Eigen statistics	14.45	0.60	9.91	4.44

**Note:** <sup>a</sup>denotes that the null hypothesis is accepted as trace statistic is lower than the critical value.

**Table A2.5 Vector error correction model: India and Bangladesh**

	Growth rate of India (1)	Growth rate of Bangladesh (2)
Error correction term	0.09 (1.04)	<b>-0.53***</b> <b>(-7.39)</b>
$\Delta$ GR Bangladesh <sub>t-1</sub>	<b>0.22**</b> <b>(1.82)</b>	<b>0.20**</b> <b>(2.08)</b>
$\Delta$ GR India <sub>t-1</sub>	-0.09 (-0.04)	-0.01 (-0.07)
Adj R-squared	0.77	0.82
N	39	39

**Note:** \*\*\* denotes significant at 1%; \*\* denotes significant at 5%.

**Table A2.6 Vector error correction model: India and Bhutan**

	Growth rate of India (1)	Growth rate of Bhutan (2)
Error correction term	-0.11 (-0.73)	<b>0.74***</b> <b>(2.84)</b>
$\Delta$ GR Bhutan <sub>t-1</sub>	-0.09 (-0.72)	<b>0.20**</b> <b>(2.08)</b>
$\Delta$ GR India <sub>t-1</sub>	<b>-0.47**</b> <b>(-2.46)</b>	<b>-0.41**</b> <b>(-2.23)</b>
Adj R-squared	0.31	0.35
N	26	26

**Note:** \*\*\* denotes significant at 1%; \*\* denotes significant at 5%.

**Table A2.7 Vector error correction model: India and Sri Lanka**

	Growth rate of India (1)	Growth rate of Sri Lanka (2)
<b>Error Correction Term</b>	-0.06 (-1.06)	-0.007 (-0.59)
$\Delta$ GR India <sub>t-1</sub>	-0.20 (-1.28)	0.02 (0.17)
$\Delta$ GR Sri Lanka <sub>t-1</sub>	-0.01 (-0.06)	0.12 (0.71)
Adj R-squared	0.83	0.85
N	39	39

**Table A2.8 Results of Granger causality**

Dependent variable	Full sample: 1970–2009	
	chi <sup>2</sup>	Reject/Accept
<b>Growth in China does not Granger-cause growth in South Asia excluding India</b>	<b>9.70**(0.008)</b>	<b>Reject</b>
Growth in South Asia excluding India does not Granger-cause growth in India	1.32(0.24)	Accept
Growth in India does not Granger-cause growth in South Asia excluding India	0.03(0.99)	Accept
<b>Growth in Bangladesh does not Granger-cause growth in India</b>	<b>12.04***(0.002)</b>	<b>Reject</b>
<b>Growth in India does not Granger-cause growth in Bangladesh</b>	<b>8.09*(0.01)</b>	<b>Reject</b>
Growth in Bhutan does not Granger-cause growth in India (1982–2009)	0.31(0.85)	Accept
<b>Growth in India does not Granger-cause growth in Bhutan</b>	<b>5.64**(0.05)</b>	<b>Reject</b>
Growth in Sri Lanka does not Granger-cause growth in India	2.50(0.28)	Accept
Growth in India does not Granger-cause growth in Sri Lanka	0.33(0.84)	Accept

**Note:**  $p$ -values are in brackets ; \*\*\* denotes significant at 1%; \*\* denotes significant at 5%.

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