EFFECTS OF INFRASTRUCTURE ON REGIONAL INCOME IN THE ERA OF GLOBALIZATION: NEW EVIDENCE FROM SOUTH ASIA

*Prabir De** and *Buddhadeb Ghosh***

The South Asian Association for Regional Cooperation (SAARC), a combination of seven nations – Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka – in a diverse subcontinent of Asia, is going through the process of structural adjustment programmes. Without proper trading infrastructure, no country or economic bloc can succeed in the new borderless world where, for all practical purposes, regional cooperation has become an instrument for creating a competitive edge over other regional blocs. This paper tries to find out the role played by infrastructure facilities in economic development across South Asian countries over the past quarter century. The findings are statistically very significant to warrant major changes in future regional policies in order to remove rising regional disparities in both infrastructure and income. This also has a strong bearing on the success of poverty removal policies as the poor are regionally concentrated in such a diverse and heterogeneous region of the world, where market imperfections abound and heterogeneities are insurmountable.

At a time when the world is set to become virtually borderless in terms of flows of commodities and factors of production, it apparently may be felt that regional economic cooperation is coming to an end. If reality is any guide, however, the need for economic integration and cooperation leading to a regional economic bloc is much more pressing for the developing nations in a rule-based competitive World Trade Organization environment. Theoretically and practically, justification for stronger economic cooperation among the South Asian countries has become substantial beyond their inherent historical, cultural and socio-economic commonalties, geographical and ecological propinquity in time and space. Indeed,

* Research Associate, Research and Information System for the Non-aligned and Other Developing Countries, India Habitat Centre, India.

** Associate Scientist, Economic Research Unit, Indian Statistical Institute, India.

countries in South Asia were fully under one Government (British) rule just half a century ago. Bangladesh, India and Pakistan were ruled by the same laws, and had a common currency; even Nepal and Sri Lanka permitted the Indian rupee to circulate freely. Countries in the region, divided by a common heritage and bondage, quarrels and conflicts, have now to reorient their internal and external policies for mutual benefit.

Being one of the poorest regions of the world, there is a high degree of simultaneity among all seven members of SAARC insofar as government initiatives in undertaking liberalization policies are concerned (see table 1).[1] Despite the

Table 1. Selected economic and social indicators of South Asian countries in 2002

	Population (million)	*Population growth*[a] (%)	*Population density* (per sq km)	*Poverty headcount*[b] (%)	*GDP per capita*[c] (US$)	*GDP per capita PPP*[c] (US$)	*Trade in goods*[d] (%)	*Gross FDI*[e] (US$ Bln.)	*Gross CAB*[f] (US$ Bln.)	*Gross FCF*[g] (%)
Bangladesh	135.68	1.91	1 042	33.70	396.20	1 501.34	29.45	0.953	0.742	23.09
Bhutan	0.85	3.40	18	..	580.10	..	50.07	0.004	-0.042	47.27
India	1 048.64	1.92	353	28.60	493.27	2 364.61	20.78	22.592	4.656	22.14
Maldives	0.29	2.79	957	..	2 262.50	..	76.97	0.117	-0.044	26.87
Nepal	24.13	2.70	169	..	240.68	1 216.88	35.81	0.058	-0.165[h]	19.21
Pakistan	144.90	2.77	188	32.60	518.41	1 719.25	35.80	6.170	3.871	13.80
Sri Lanka	18.97	1.39	293	..	898.82	3 159.75	65.21	2.061	-0.264	23.65
South Asia	1 373.46	2.01	431	31.63	770.00	1 992.37	44.87	31.956	8.754	25.15

Source: World Bank, *World Development Indicators CD-ROM 2004.*

Notes: [a] Decadal population growth rate for the period 1991-2001.

[b] Taken in percentage of population.

[c] Taken in constant 1995 US$.

[d] As a percentage of GDP.

[e] Gross cumulative foreign direct investment, taken at current US$ billion for the period 1991-2002.

[f] Gross current account balance, taken at current US$ billion.

[g] Gross fixed capital formation, taken in average as a percentage of GDP for the period 2000-2002.

[h] Data are for the year 2001.

.. Data not available.

[1] In essence, all these countries undertook such economic policies specifically from the late 1980s and early 1990s. These essentially involve removal of licensing and monopolistic practices, de-nationalization, permission of foreign equity participation in domestic industries, etc. In this endeavour, Sri Lanka is the only country which was embarked upon the path of economics of reforms as early as 1977 (Kelegama, 1998). A good review for these countries can be found in ESCAP (2002).

recent success in raising the general level of prosperity, as observed in some of the countries in South Asia, many changes are taking place that are reshaping regional integration in South Asia (Dash, 1996; Paranjpe, 2002; Srinivasan, 2002; RIS, 2004). However, the real problem facing most of the South Asian countries is not necessary demographic but economic in nature, i.e. how to ensure good infrastructure for all the countries in the region for mutual benefit (Ghosh and De, 2000b; De and Ghosh, 2003). When South Asian countries agreed to establish the South Asian Free Trade Area (SAFTA) with effect from 1 January 2006, an important objective was improved and integrated transport infrastructure to economically help member countries not only to reduce transaction costs but also to generate higher intraregional trade and promote international market access. Faster progress in infrastructure development will be crucial to sustaining South Asia's competitive advantages. The low quality of infrastructure and high logistics costs for South Asian countries are the result of underdeveloped transport and logistics services and slow and costly bureaucratic procedures dealing with intraregional trade. Opportunities for improvement of infrastructural facilities are immense in this region.

The purpose of this paper is to investigate the role played by infrastructure facilities in determining per capita income across South Asian countries over different timespans during the past quarter century, particularly to understand better the linkages between infrastructure and income across the region. Section I deals with data and methodology. Sections II and III elaborate on regional disparity in per capita income and infrastructure endowment among South Asian countries. Section IV focuses on the nature and strength of the relationship between different categories of infrastructure endowments and economic development. Finally, section V presents the summary, limitations of the study and implications for policy.

I. DATA AND METHODOLOGY

The most serious hurdle has been the lack of a consistent set of data on income, labour, capital and other related variables in South Asian countries over a reasonable period of time. The problem becomes multiplied when one has to work with infrastructure variables' for, in the absence of detailed information on infrastructure investment, one has to opt for infrastructural facilities or services rather than capital expenditures on such areas.

For the present purpose, we use decadal data (and not manual figures) for seven South Asian countries over the period 1971-2001.[2]

Infrastructure facilities can be understood largely as public infrastructural inputs from the supply side. However, depending on the nature of services delivered, infrastructure can be broadly divided into physical, social and financial categories – all economically desirable. The first of these consists of transport (railways, roadways, airways and waterways), electricity, irrigation, telecommunication, water supply and the like. Notwithstanding their very direct impact on production through external economies, they are beneficial for "crowding in" private investment (both domestic and foreign) in the concerned geographical region. In a "cumulative causation" fashion, physical infrastructure contributes to economic growth through lower transaction cost and generates "multipliers" of investment, employment, output, income and ancillary development. Social infrastructure, through the enrichment of human resources in terms of education, health, housing, recreation facilities and the like, improves the quality of life. This is primarily responsible for the higher concentration of better human resources in a region, and helps improve productivity of labour. Finally, financial infrastructure incorporating banking, postal and tax capacity of the concerned population represents the financial performance of the state. These three taken together represent the relative income-generating capability of a state within a country or a country within a region. Hence, even in a federal polity, some amount of competition is inevitable among the constituent regions.

We have taken 11 important infrastructural variables across the seven South Asian countries for four different time points over the period 1971-2002. Unlike most other inputs into the production process, the supply of infrastructural facilities is not continuously derivable, i.e. it increases as fixed inputs almost appear to leap over different time spans. We have tried to consider infrastructure variables from most of the sectors of the economy, from agriculture to transport to banking to communication. These include (a) transport facilities (TF), which are composed of railway route length in kms per thousand sq km of area, and road length in kms per thousand sq km of area, and waterways in kms per thousand sq km of area, (b) proportion of irrigated land area to total crop land area (IL), (c) per capita

[2] The major sources of these data are various issues of (i) *World Development Indicators,* World Bank, (ii) *Economic Survey,* Government of India, (iii) *Statistical Abstract,* Government of India, (iv) *Direction of Trade Statistics Yearbook,* International Monetary Fund, (v) *Asian Development Outlook*, Asian Development Bank, (vi) *Economic Survey,* Government of Pakistan, (vii) *Bangladesh Economic Review,* Government of Bangladesh, and (viii) *Statistical Yearbook,* Government of Sri Lanka. This data set is supplemented by various publications of the Centre for Monitoring Indian Economy (CMIE) and the India Infrastructure Database (Ghosh and De, 2005b).

consumption of electricity (PCE), (d) telephone main line per 1,000 persons (TL), (e) fertilizer consumption per 100 grams per hectare of arable land (FC), (f) tractors per 100 hectares of arable land (AM), (g) literacy rates (LR), (h) infant mortality rates (IMR), (i) domestic credit provided by the banking sector as percentage of GDP (BC), (j) tax collected as percentage of GDP (TC) and (k) port capacity utilization (PC).[3]

II. MEASURES OF INFRASTRUCTURE DEVELOPMENT

An attempt is made here to estimate some composite index of infrastructure development, namely the infrastructure development index (IDI), having derived the weights for 11 representative indicators of infrastructure, namely TF, IL, PCE, TL, FC, AM, LR, IMR, BC, TC and PC on the basis of principal component analysis (PCA). The basic limitation of the conventional method of construction of IDI is that, while combining the infrastructure indicators, they either give subjective ad hoc weights to different indicators or leave them unweighted. Since there is every possibility for the indicators to vary over time and space, assignment of equal ad hoc weights could lead to unwarranted results. To overcome these limitations, we have employed the well-known multivariate technique of "factor analysis" from which follows the required weights (Fruchter, 1967).

In the PCA approach, the first principal component is that linear combination of the weighted variables which explains the maximum of variance. Hence, here the sole objective is to explain the variance across the countries for each of the variables. Thus the numerical bias of this method does not give much value to economic judgement.

We have at our disposal values of 11 infrastructure variables for four different years, 1971-1972, 1981-1982, 1991-1992 and 2001-2002, across seven South Asian countries, namely, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The last two breaks help us evaluate the impact of differential infrastructure endowments on the performance of the countries in the post-liberalization period.

[3] Supply of infrastructure is a sort of static stock available over different discrete time points that make it difficult for continuous treatment in a framework of typical neo-classical growth regression. On the other hand, an individual infrastructure facility on overhead basis is certainly more important than the mere amount of capital investment on the facility. The point is not that investment is unimportant. Over and above, due to the non-availability of a consistent and reliable set of data on various infrastructure facilities across South Asian countries over a reasonably long period of time, we have proxied some infrastructure variables by close substitutes cases such as education and health care services, where we have considered literacy and infant mortality rates as indicators to represent the state of education and health care in the region.

Table 2. Weights of infrastructure variables: PCA

Variables	1971-1972		1981-1982		1991-1992		2001-2002	
	Weights	Rank	Weights	Rank	Weights	Rank	Weights	Rank
IL	0.475	11	0.393	10	0.380	10	0.421	10
PCE	0.740	9	0.777	8	0.814	5	0.888	4
PC	0.836	7	0.794	7	0.884	3	0.851	5
TL	0.601	10	0.104	11	-0.305	11	-0.058	11
TF	0.934	2	0.908	5	0.928	1	0.905	1
FC	0.888	4	0.943	2	0.895	2	0.894	2
LR	0.910	3	0.926	4	0.833	4	0.894	3
IMR	0.868	5	0.886	6	0.802	6	0.670	7
BC	0.788	8	0.438	9	0.755	8	0.638	8
AM	0.843	6	0.943	1	0.797	7	0.800	6
TC	0.967	1	0.935	3	0.633	9	0.482	9
Eigen value	7.341		6.709		6.288		5.839	
Total variance (%)	67.00		61.00		57.00		53.00	

Note: Weights count only first principal factor (unroated factor loadings).

The weights and corresponding ranks of 11 infrastructural variables are presented in table 2. A few observations are as follows.

First, TF as desired has become the most influential infrastructure variable for most of the years. Thus, transport facilities such as road, rail and waterways have been emerging as important factors in determining economic life across the South Asian countries.

Second, next to TF, FC and LR have appeared as the other two important factors. IMR has been unequivocally left as the least influential factor.

Third, in contrast to popular belief, TL and IL have emerged as factors of low importance in determining IDI.

It may be demanding to touch upon the intercountry variations of the raw infrastructure variables over time.[4] Interestingly, the coefficients of variation (CV) for all the facilities have been either falling or have remained almost constant over time, which, in another way, indicates a tendency towards equalization of infrastructure facilities across the countries in South Asia. That is, the relative difference of these facilities among these countries has been narrowing down over

[4] The values of the mean, standard deviation (SD) and CV of the raw infrastructure variables over time, are given in appendix 1.

time. First, we have not found any single facility whose supplies across the countries have become equitable over time. Second, while the coefficient of variations for TL has been rising continuously from 0.639 in 1971-1972 to 0.820 in 2001-2002 (incidentally, this is the highest value of disparity among all), that of PC (port facility) has marginally increased from 0.878 in 1971-1972 to 0.883 in 2001-2002. Thus, on the whole, the supply of infrastructure facilities as appeared from the CV of raw data bears some symptoms of long-run convergence in this region in a neo-classical sense. Or, in other words, overall infrastructure facilities in the region have been increasing in the recent period.

Spatial variation of IDI over time

An attempt is made here to investigate the spatial variation of infrastructure stock across the South Asian countries over time. The weights derived from PCA are used as the multiplying factor with the unit free values of the 11 infrastructure variables. However, after multiplying the unit free values with the weight of each of the 11 factors we have obtained the individual index. Then adding all 11 indices for a particular country in a particular year we have derived the IDI for that country. The process is repeated for all seven countries in South Asia for four years. The final values of IDI with corresponding ranks across the countries over time are given in table 3a.

Table 3a. Infrastructure Development Index (IDI): PCA

	1971-1972		*1981-1982*		*1991-1992*		*2001-2002*	
	IDI	*Rank*	*IDI*	*Rank*	*IDI*	*Rank*	*IDI*	*Rank*
Nepal	3.928	5	5.323	5	6.319	5	7.871	5
Bangladesh	7.374	4	8.187	4	9.277	4	10.527	4
Bhutan	2.183	7	2.392	7	2.502	7	3.960	7
Maldives	3.343	6	4.506	6	4.000	6	6.722	6
India	13.007	3	12.995	3	14.897	3	16.045	2
Pakistan	14.094	2	13.737	2	15.672	2	15.738	3
Sri Lanka	24.238	1	23.377	1	20.770	1	21.842	1
Mean	9.738		10.074		10.491		11.815	
SD	7.341		6.709		6.288		5.839	
CV	0.754		0.666		0.599		0.494	

Interestingly, the coefficient of rank correlation of IDI has been very high throughout the years (table 3b). It tells us that the relative positions of the countries in South Asia have remained unaltered in terms of infrastructural endowment over the past three decades. The evolution of these countries has produced some interesting outcomes as revealed from both values and rankings of IDI and values of mean, standard deviation (SD) and CV. That is, although the disparity among the countries in terms of infrastructure endowments is low, there is nothing unusual in the estimated infrastructure development indices across the countries.

Table 3b. Year-wise rank correlation of IDIs

	1971-1972	*1981-1982*	*1991-1992*	*2001-2002*
1971-1972	1.000	1.000	1.000	0.964
1981-1982		1.000	1.000	0.964
1991-1992			1.000	0.964
2001-2002				1.000

Insofar as regional convergence or divergence in income is concerned, the easiest way to verify that hypothesis is to establish the relationship with the help of initial income and long run rate of growth (Barro and Sala-i-Martin, 1995 in general; Ghosh, Marjit and Neogi, 1998 for India). However, since infrastructure by any definition is a flow of services out of a certain amount of capital stock at a point of time which essentially provides the service for income or output generation, the Barro-type testing cannot be done here. Logically, we have opted to show countries in final IDI ranking over time, which is given in table 4.

Table 4. Countries in descending order of IDI

1971-1972	*1981-1982*	*1991-1992*	*2001-2002*
Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka
Pakistan	Pakistan	Pakistan	India
India	India	India	Pakistan
Bangladesh	Bangladesh	Bangladesh	Bangladesh
Nepal	Nepal	Nepal	Nepal
Maldives	Maldives	Maldives	Maldives
Bhutan	Bhutan	Bhutan	Bhutan

Table 4 shows consistency in Sri Lanka's development during the past quarter century. The ranks of the countries were determined in 1971-1972, and the same set of countries in the respective groups has been repeated in 1981-1982, 1991-1992 and 2001-2002. In the post-reform period, there is a noticeable change in this grouping. India is benefiting from the reform started in 1991 and has in fact replaced Pakistan, occupying second place after Sri Lanka in 2001-2002. Caution is needed at this stage. As the values of IDI are derived from a principal component analysis, they represent some composite scores in a comparative perspective, and do not mean an absolute decline. The apparent decline of the value for Sri Lanka and rise for other nations in a waypoint to a long-term tendency towards regional equalization.

Two notable trends have also been confirmed from this analysis. There has been no compositional change among the countries holding the bottom three positions. Bhutan has recorded the lowest infrastructure endowment in all four points. In essence the relative positions of the countries have remained unaltered during the past quarter century.

Individual infrastructure facilities

The revelation so far made on the basis of IDI might suggest that intra-South Asia variations are so diverse that an aggregate concept may not make much sense. The actual picture in terms of each of the 11 infrastructure variables, however, is not so straightforward. As the construction of IDI implies, the losing countries consistently represent lower values for most of the individual infrastructure facilities. Table 5 presents the list in terms of rank of individual infrastructures. South Asia's landlocked countries, namely Nepal and Bhutan, comprise the geographical area that suffers most.

Even those countries that are ranked higher – India (in IL and IMR), Sri Lanka (in IL), Pakistan (in IMR) and Bangladesh (in TC and TL) – have inadequate infrastructure facilities. Interestingly, Maldives has a better penetration of telephone lines (which may be owing to its small size), but is inadequate in other infrastructure endowments. All infrastructure endowments are inadequate in Nepal and Bhutan.

A very common feature for all of these countries is that the spread of infrastructure varies across three broad categories of regions: congested, intermediate and lagging. Congested regions are characterized by a very high concentration of population, industrial and commercial activities and public infrastructure. Lagging regions are characterized by a low standard of living owing to small-scale agriculture or stagnant or declining industries and poor infrastructural facilities. The intermediate region lies in-between. However, the performance in

Table 5. Ranking of countries in individual infrastructure facilities

	IL	*PCE*	*PC*	*TL*	*TF*	*FC*	*LR*	*IMR*	*BC*	*AM*	*TC*
1971-1972											
Nepal	6	5	5	7	5	5	5	5	5	4	4
Bangladesh	5	4	4	6	3	4	3	2	4	5	5
Bhutan	4	6	5	5	6	6	7	6	6	6	7
Maldives	7	6	5	2	7	6	6	6	6	6	6
India	3	1	1	4	2	3	2	3	3	3	3
Pakistan	1	2	3	3	4	2	4	4	1	2	2
Sri Lanka	2	3	2	1	1	1	1	1	2	1	1
1981-1982											
Nepal	3	5	5	5	5	5	5	4	5	4	4
Bangladesh	6	4	3	6	3	3	3	2	6	5	6
Bhutan	4	7	5	7	7	6	7	6	7	6	7
Maldives	7	6	5	1	6	7	6	6	1	6	5
India	5	1	4	4	2	4	2	3	4	3	3
Pakistan	1	2	2	3	4	2	4	5	3	2	2
Sri Lanka	2	3	1	2	1	1	1	1	2	1	1
1991-1992											
Nepal	2	5	5	6	5	5	5	3	5	4	5
Bangladesh	3	4	3	7	4	2	4	2	6	5	6
Bhutan	4	7	5	5	7	6	7	6	7	6	7
Maldives	7	6	5	1	6	7	6	6	4	6	2
India	5	2	2	4	2	4	2	4	1	3	4
Pakistan	1	1	4	3	3	3	3	5	2	1	3
Sri Lanka	6	3	1	2	1	1	1	1	3	2	1
2001-2002											
Nepal	3	5	5	6	5	5	4	4	3	4	5
Bangladesh	2	4	3	7	4	2	5	2	6	5	7
Bhutan	6	7	5	4	7	6	7	6	7	6	6
Maldives	7	6	5	1	6	6	6	3	5	6	2
India	5	1	1	3	2	4	2	5	1	2	4
Pakistan	1	2	4	5	3	3	3	7	4	1	3
Sri Lanka	4	3	2	2	1	1	1	1	2	3	1

individual infrastructure does serve, for all practical purposes, both the policymakers as well as the potential investors who can choose the regions for a higher return on investments. Hence, the scope for improvement in the lagging regions could be utilized through better incentives to private sector investment and is a coordinated regional development policy for South Asia. In this context, it is worth mentioning the work of Basu (2001): "If in an economy some people control all the water, some all the food and some all the energy, even if the total amount of water, food and energy is very large, if this society does not learn how to exchange and trade, it will be a very poor society; indeed so poor that all may die. In a modern nation, it is not enough for there to be a lot of medical knowledge and engineering knowledge and knowledge of information technology. If the nation does not have the organization to share and exchange this knowledge and to harness it where it is needed, it will be a miserable and poor nation. Since we do not typically think of organizational skill and the ability for coordinated action as a resource or capital, it is easy to overlook their importance."

The critiques of interregional comparisons cannot refute the fact that lower inter-South Asia variations in IDI (and which are not unachievable) could facilitate better utilization of hitherto unutilized resources in the lagging regions. Hence, a major outcome of a spatial approach to economic growth analysis is to call for more coordination between government agencies at all levels and for the integration of all infrastructure decisions in an overall regional development strategy.

Before the wisdom of such a development strategy is assessed, a number of questions must be answered. For example, how do we identify the mechanisms by which infrastructure generates regional growth? What types of infrastructure investments are crucial for promoting regional growth? Does the existing infrastructural stock put South Asia in any steady-state position? These questions are being dealt with in the subsequent sections.

III. COMPARISON OF INCOME OVER TIME

As discussed earlier, it is widely believed that infrastructure is not an end in itself. It is a composite means for generating income. Table 6a presents the rankings of the countries in terms of per capita income (PCI) at constant 1995 United States dollars from 1971-1972 to 2001-2002. Caution must be made here. Although economists' concept of regional imbalance is generally represented by the coefficient of variation over time and across countries, it is highly probable that there may be subregions (e.g. states or provinces) even within a richer country that are deprived, which is true across the board for South Asia. For simplicity of analysis, South Asia mean real PCI is also provided. Some interesting findings follow from this table.

Table 6a. Ranking of countries in terms of PCI

	1971-1972		1981-1982		1991-1992		2001-2002	
	PCI	Rank	PCI	Rank	PCI	Rank	PCI	Rank
Nepal	143.05	7	157.0	7	195.8	7	248.13	7
Bangladesh	228.99	5	242.0	5	282.4	6	386.11	6
Bhutan	229.56	4	250.0	4	389.9	4	553.62	3
Maldives	620.70	1	980.5	1	1 450.3	1	1 937.92	1
India	211.75	6	237.1	6	320.5	5	477.06	5
Pakistan	267.47	3	333.7	3	459.1	3	517.20	4
Sri Lanka	348.58	2	474.6	2	637.1	2	876.37	2
Mean	292.87		382.1		533.6		713.77	
SD	145.57		261.2		396.4		530.43	
CV	0.50		0.68		0.74		0.74	

Note: Per capita income taken at constant price (1995).

First, if we cluster the countries above and below the South Asia average, it is clear that the economic conditions of the countries have remained unaltered on both sides over the past quarter century (see table 6b for rank correlation of countries in PCI). Countries such as Bhutan, Maldives and Sri Lanka, where growth rates also happen to be higher, have maintained their above-average positions throughout the period. India's total income is considerably high in the world but the PCI is miserably low even by South Asian comparison. Second, Nepal is the only country with an income ranking that is consistently the worst in South Asia and also over time. Finally, the performance of Pakistan in 2001-2002 is no better than that of India.

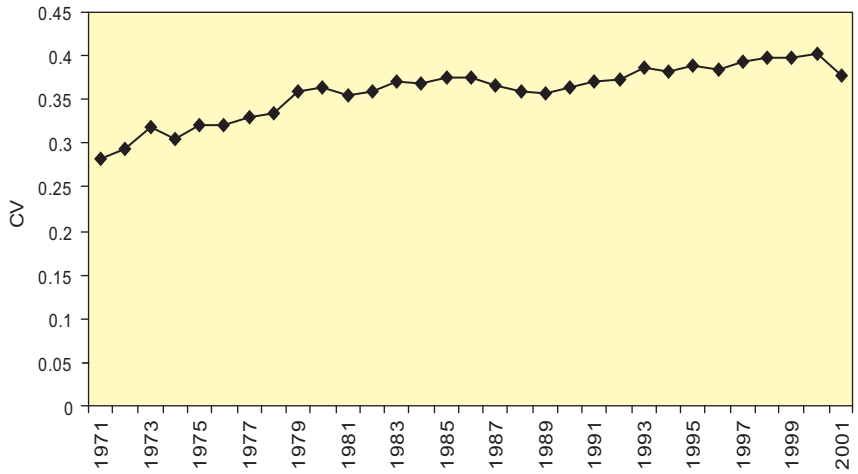
As with IDI, here also the composition of the countries has not significantly changed during the past quarter century. Whereas the average per capita income of South Asia has more than doubled from US$ 293 to US$ 714 over 30 years, the

Table 6b. Year-wise rank correlation of PCI

	1971-1972	1981-1982	1991-1992	2001-2002
1971-1972	1	1.000	0.964	0.929
1981-1982		1	0.964	0.929
1991-1992			1	0.964
2001-2002				1

poorest country (Nepal) has recorded an increase from US$ 143 to US$ 248 and the best performing country (Maldives) from US$ 621 to US$ 1,937. What is more, the combined population of these seven countries was 1.35 billion in 2001, i.e., 22 per cent of world's total population, or roughly about five times the population of the United States of America, or the combined population of Australia, France, Germany, Italy, Russian Federation, Sweden and the United Kingdom of Great Britain and Northern Ireland. On the whole, CV is increasing, and the hypothesis of rising regional disparity has strengthened. It can be seen from figure 1 (representing the time series trend of CV) that there is an exponentially rising tendency of income disparity across the countries.

Figure 1. Trends of CV of PCI (1995 = 100)



Therefore, the evidence supports the fact that the poorer countries in South Asia have remained poor and the more affluent countries have remained so, relatively speaking. Specifically, intra-South Asia disparity in income has been rising steadily, particularly during the post-liberalization period.

IV. RELATIONSHIP BETWEEN INFRASTRUCTURE AND INCOME

Beyond the neo-classical simplification of classifying different factors into only capital and labour, the indispensable role played by social overhead capital, which is used to build up infrastructure, in helping productive activities directly and indirectly was recognized by the pioneers of development economics (Hirschman,

1958 and Myrdal, 1958). An economy's infrastructure network, broadly speaking, is the very socio-economic climate created by the institutions that serve as conduits of commerce. Some of these institutions are public, others private. In either case, their roles can be conversionary, helping to transform resources into outputs, or diversionary, transferring resources to non-producers. Its role is very critical in reducing natural inequality among different regions within a country.

In general, infrastructure is a social concept for some special categories of inputs external to the decision-making units, which contribute to economic development both by increasing productivity and by providing amenities. It requires a long period of time to create these facilities.[5] For example, Hansen (1965), in looking into the role of public investment in economic development, divides public infrastructure into two categories: economic overhead capital (EOC) and social overhead capital (SOC). Mera (1973), examining the economic effects of public infrastructure in Japan, extends Hansen's definition of EOC to include communication systems. The absence of these facilities in a region may result in lower "productive efficiency" of the population (Munnell, 1990). These are the common set of characteristics that make an economic system successful while another a failure, and these characteristics are substantial enough to explain most, if not all, of the differences in prosperity that separate nations today.

The linkage between infrastructure and economic growth is multiple and complex, because not only does it affect production and consumption directly, but it also creates many direct and indirect externalities, and involves large flows of expenditure thereby creating additional employment. Most of the studies on macroeconomic impact were generated in the 1980s as a result of the initial failure to account for the productivity slowdown in the developed nations, particularly the United States (Aschauer, 1989). There are many studies which suggest that infrastructure does contribute towards a hinterland's output, income and employment growth and quality of life (Aschauer, 1990; Munnell, 1990; Gramlich, 1994; and Esfahani and Ramirez, 2003). However, much less focus has been placed on the least developed countries. Generally, unequal distribution of basic infrastructure facilities across different regions within South Asia may be so pervasive as to nullify the operation of the law of diminishing returns in the neo-classical sense (Kaldor, 1972). Ultimately, economies of agglomeration create a "backwash effect"

[5] For example, the construction of a dam or power plant in a disadvantaged region, or an underground railway in a congested city (the underground rail of Delhi), or a new port (the extension of the port of Colombo) needs very long-term perspective planning. Interested readers may consult Gramlich (1994).

against the waning regions. In fact, much before the recent resurgence of the theory of convergence, the pioneering works of Myrdal (1958) and Hirschman (1958) showed why economic activities starting from "historical accident" are concentrated in a particular region. The very recent works of Krugman (1991, 1995) have been largely responsible for the renewed interest in geographical and locational factors as possible determinants of regional inequality in the context of trade.

Although quite a large number of studies have addressed the problem of regional disparity in South Asia during the last few decades, only a few of them have dealt directly with infrastructure and economic development. Barnes and Binswanger (1986), Elhance and Lakshmanan (1988), Binswanger, Khandker and Rosenzweig (1989), Ghosh and De (2000b), Datt and Ravallion (1998), Sahoo and Saxena (1999), Khondker and Chaudhury (2001) and Jayasuria (2001) deal more directly with infrastructure and income. Binswanger and others (1989) show that the major effect of roads in rural India does not work through their impact on private infrastructure but rather through marketing and distribution and also through reduced transportation costs of agricultural goods. Yet electricity and other rural infrastructures have more direct impact on agricultural productivity through private investment in electric pumps (Barnes and Binswanger, 1986). Elhance and Lakshmanan (1988), using both physical and social infrastructures, have shown that reductions in production costs in manufacturing mainly result from infrastructure investment. In a detailed study, Datt and Ravallion (1998) prove that States starting with better infrastructure and human resources, among others, have seen significantly higher long-term rates of poverty reduction. Ghosh and De (2000b), using physical infrastructure facilities across the South Asian countries over the past two decades, have shown that differential endowments in physical infrastructure were responsible for the rising regional disparity in South Asia. Sahoo and Saxena (1999), using the production function approach, have concluded that transport, electricity, gas and water supply, and communication facilities have a significant positive effect on economic growth, and concurrently have found increasing returns to scale.

As is well known, the building up of additional infrastructural facilities in the initial stage may not have an immediate, high or positive impact on income. After the critical minimum level of overhead infrastructure level is crossed, the impact of IDI on PCI exponentially helps to increase income. The economic rationale behind this may be that in the initial stage the building up of an infrastructure facility may act as a downward pressure (or burden) on income thereby implying a sort of sacrifice, and beyond that level various external economies may multiply the contribution of infrastructure to income exponentially. Such a relationship may be captured in the following function:

$$Y = a + bX + cX^2 \quad (1)$$

where Y = PCI, and X = IDI.

The fitted results of the non-linear regression of equation 1 are presented in appendix 2 and the fitted curves with the corresponding scatters are presented in appendix 3. In finding out such a relationship between income and infrastructure, it is quite likely that the said relationship might be influenced by "time". To capture such an explanatory role of time in a recursive pooled regression framework,[6] equation (1) has been estimated as follows:

$$Y = a + bX + cX^2 + eD \quad (2)$$

where Y = PCI, X = IDI, and D = time dummy (= 0 for initial year, and = 1 otherwise). The fitted results of equation 2 are presented in table 7 with the corresponding values of the coefficients and the required statistics for four combinations of

Table 7. Recursive pooled ordinary least squares results

	Independent variables	*Coef-ficients*	*t-stat.*	R^2	*Adj.* R^2	*F-value*	*DW*	*SC*	*N*
1971-1972 and	Intercept	186.659	4.168	0.765	0.677	8.673	1.741	0.044	12
1981-1982	IDI	-2.761	-0.342						
	IDI^2	0.474	1.580						
	Dummy	46.688	1.575						
1971-1972,	Intercept	183.982	2.812	0.609	0.526	7.276	1.089	0.429	18
1981-1982 and	IDI	-5.980	-0.514						
1991-1992	IDI^2	0.692	1.549						
	Dummy	97.613	2.239						
1971-1972,	Intercept	191.446	2.132	0.537	0.467	7.717	0.906	0.564	24
1981-1982,	IDI	-12.532	-0.801						
1991-1992 and	IDI^2	1.061	1.766						
2001-2002	Dummy	157.638	2.611						

[6] In recursive least squares the equation is estimated repeatedly, using ever larger subsets of the sample data. If there are k coefficients to be estimated in the b vector, then the first k observations are used to form the first estimate of b. The next observation is then added to the data set and k+1 observations are used to compute the second estimate of b. This process is repeated until all the T sample points have been used, yielding T-k+1 estimates of the b vector. At each step the last estimate of b can be used to predict the next value of the dependent variable. It may be mentioned here that in all the regression exercises Maldives consistently came out as an outlier judged by the statistics (Cook's distance).

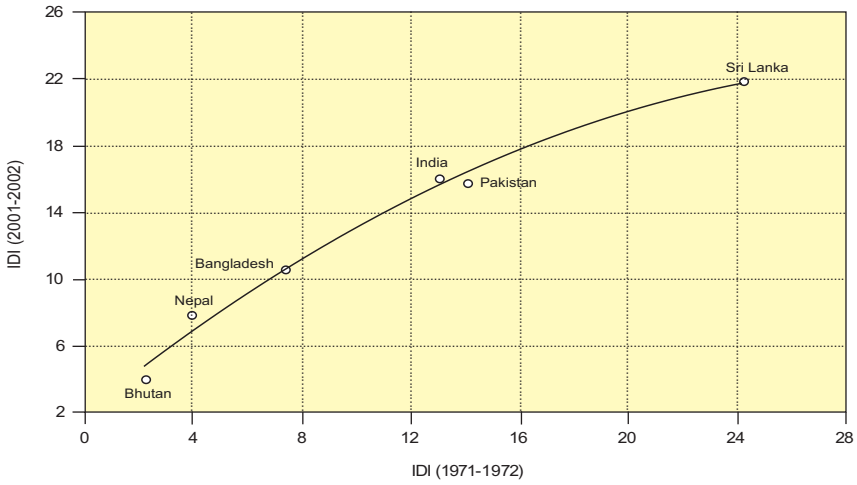
cross-section years. The results are very satisfactory. A brief analysis of the results is as follows.

Given the cross-section nature of the data, the value of adjusted R^2 confirms the fact that the composite index of infrastructure development alone explains a reasonably high proportion of income across the countries. It is interesting to note that in no situation has the coefficient of IDI produced any statistically significant t-value. The coefficient of the square term also does not appear to be very significant. The time dummy, however, has become increasingly significant as we have moved from 1971-1972 to 1981-1982 to 1991-1992 to 2001-2002. The time dummy appears to be highly significant particularly for the last two pairs of years when we consider three and four years of pooled regressions. The role of infrastructure with a high level of significance and expected signs of the coefficients concerned confirms the nature of the relationship between PCI and IDI as discussed above. Therefore, there are reasons to believe that this exercise has recorded a significantly changing scenario in all these countries in the relatively liberalized economic environment. Thus, the Governments of these countries should place emphasis on strengthening the infrastructure sector. One unwarranted implication of this relationship is that if the existing infrastructural differences across these countries persist, the rate of regional divergence is bound to increase in the years to come.

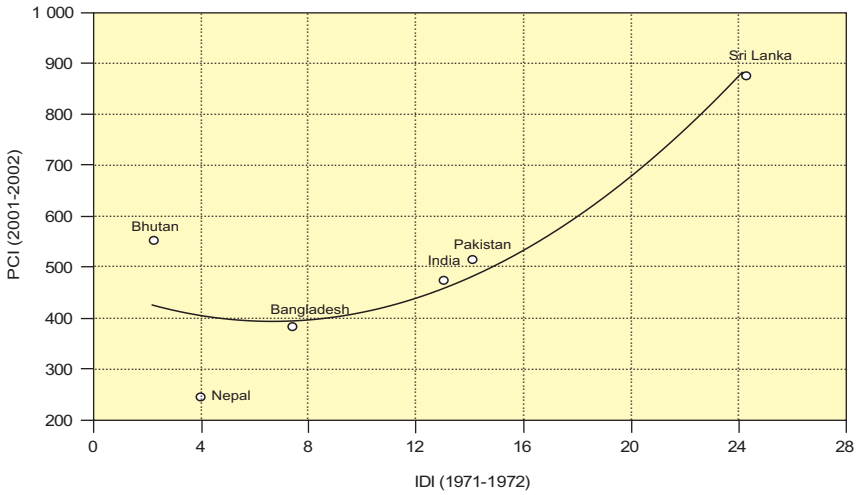
Second, we have seen in earlier sections that best endowed countries in terms of infrastructure in 1971-1972 have more or less remained in the same position relative to their poorer counterparts. As revealed from figure 2a, all the countries lie along the diagonal line where we measure IDI (1971-1972) in the horizontal axis and IDI (2001-2002) in the vertical axis. This general tendency is also largely true in figure 2b except for Bhutan and Nepal, where we measure IDI (1971-1972) and PCI (2001-2002). To be more specific, Nepal's PCI in 2001-2002 has not increased in pari passu with its IDI in 1971-1972, whereas Bhutan's PCI in 2001-2002 has reached a much higher level compared with its performance in infrastructure in 1971-1972. Therefore, a cursory look into figure 2 makes it clear that, perhaps, the infrastructure endowment of the 1970s has sealed the fate of South Asian countries at the beginning of the new century of the new millennium. In other words, unequal opportunities among the countries in terms of the most crucial utility resources on which the locus for further economic development depends have been the order of South Asia's regional development during the past quarter century.

Figure 2. Scatter diagram of IDI and PCI: 1971-1972 and 2001-2002

(a) IDI vs IDI



(b) IDI vs PCI



V. SUMMARY AND IMPLICATIONS

After a long period of state planning and a protected industrial regime since the Second World War, South Asia as a region has failed to foster a balanced regional development. The available evidence shows that inter-South Asia disparity in both basic infrastructure facilities and per capita income has been rising over the years. Rising inequality in major infrastructure facilities across the countries might be responsible for the widening income disparity over time. On the whole, there have been enormous differences in individual performance among the countries in terms of all the basic indicators of development. However, the relative positions of the countries have remained unchanged during the past quarter century in terms of the conventional definition of development.

These findings have very important policy implications. Given that the geopolitical situation has failed to make SAARC an economically prosperous bloc, the question is, given the diverse geopolitical complexities, does SAARC have any role to play in fostering balanced regional development? As we know, the unequal distribution of infrastructure facilities across the countries is largely responsible for differences in the income performance of the countries. To begin, it would be wrong to assume that performance difference is caused by the unequal distribution of public investment alone. There are reasons to believe that the efficiency in the utilization of public investment is not equal in all countries. This difference has serious repercussions on the level and rate of private capital accumulation. Under a liberal economic regime, the free play of market forces may further accentuate the problem of regional imbalance in South Asia. Therefore, a coordinated policy under a liberal economic regime, in sharp contrast to general belief, must play a very critical and decisive role in order to cure regional imbalance in this region.

South Asian countries have different options with respect to infrastructure development. First, they may invest in infrastructure in response to serious bottlenecks taking place owing to an expansion of the private sector. This leads to a passive strategy: transport infrastructure is following private investment. Another option is that Governments use transport infrastructure as an engine for regional development. This implies an active strategy where transport infrastructure is leading and inducing private investment. Although both the approaches have some pros and cons, many countries have used the latter approach to attract private investments vis-à-vis regional development. We have good examples of success stories of the North American Free Trade Agreement (NAFTA), the Southern African Development Community (SADC), the South American Common Market (Mercosur), through which improved transportation and transit facilities have created great value to the regional economies. As many of the regional blocs have been

engaged in formulating a regional infrastructure policy for enhancement of their interregional infrastructure networking, countries in South Asia may also formulate a comprehensive infrastructure policy which will foster trade and transport in the region.

Interestingly, setting in place adequate infrastructure in South Asia is gaining momentum because of (a) the rising stock of intraregional capital, represented by the current account balance (US$ 8.75 billion in 2002) and (b) the growing fixed capital formation (25.25 per cent of GDP in 2002). Nonetheless, most of the countries in South Asia have realized that without having a proper infrastructure in place, foreign direct investment (only US$ 32.96 billion for the period 1991 to 2002) may not flow in large denominations despite the region's labour cost advantage (Kumar, 2002). Focusing on South Asia's infrastructure is also pressing if we look into Eastern South Asia's trade coverage. When Eastern South Asia[7] – either through the Bay of Bengal Initiative for Multi-sectoral Technical and Economic Cooperation (BIMST-EC)[8] or through the South Asian Free Trade Area (SAFTA) or a combination of both – is planning to promote intraregional trade, integration of the whole region is limited by lack of an integrated and improved transport system the lifeblood of the process of globalization in tangible goods. Moreover, given the socio-cultural homogeneity and vast resources of the region, an improved and integrated regional integration process for the whole of South Asia is expected to boost intraregional trade at a time when most of the economies have been growing at a faster rate during the last few years. Even though political conflicts exist among its members, there is growing recognition in South Asia for setting in place regional public goods while leaving aside political disputes. Therefore, the relative paucity of integrated and improved infrastructure networks within South Asia in the past is not difficult to remove, given the outward-looking policies and rising openness. In addition, the liberalization process in South Asia has infused dynamism in the region's economies in several ways. South Asia is becoming more open, outward-oriented and more receptive to foreign investment and trade. At this juncture, working together for the improvement of infrastructural facilities, an essential element to promote intraregional trade, will pave the way for the region's international market access and through this to higher income. Therefore, the aim of cooperation in the infrastructure sector in South Asia should be to utilize the available resources optimally for the maximization of the welfare of the region as whole. Naturally, the rationale for this type of cooperation lies in developing regional

[7] Eastern South Asia in this context includes Bangladesh, Bhutan, India and Nepal.

[8] Prior to 31 July 2004, the official name was the Bangladesh-India-Myanmar-Sri Lanka-Thailand-Bhutan-Nepal Economic Cooperation.

public goods in an integrated manner and exploiting the complementarities for the mutual benefit of all.

The present paper suffers from some limitations. First, our aggregate indexation fails to synchronize between the varying perceptions of what is meant by development by the different communities of varying localities which comprise this diverse set of countries. In general, people who are poor will have very different perceptions of development from those who are affluent. While an aggregate index is useful in evaluating the effectiveness of a particular investment programme in a situation of tremendous resource scarcity and unequal distribution, it may still beg some fundamental groundwork with a smaller geographical area as a unit of analysis for defining a meaningful comprehensive indicator for the extreme diversities manifested in South Asia.

Second, it fails to incorporate institutional factors representing political will, work ethics and social networking by which to judge the quality of life, rule of law, motivation for development and economic reasoning on the part of both Governments and the people.

Third, efforts should also be made for collecting representative environmental factors, which contain information regarding intergenerational equity as well as short-term versus long-term rationality.

Finally, a sophisticated dynamic analysis may be tried for verifying the strong findings of this paper derived from artless statistical techniques.

Appendix 1

Mean, SD and CV of infrastructure variables

Variables	Mean				Standard deviation (SD)			
	1971-1972	*1981-1982*	*1991-1992*	*2001-2002*	*1971-1972*	*1981-1982*	*1991-1992*	*2001-2002*
IL	20.567	27.859	34.422	37.440	20.458	21.258	22.134	23.151
PCE	36.097	59.025	116.891	169.097	37.907	58.251	114.007	145.573
PC	50.971	50.507	52.541	57.453	44.748	43.794	45.635	50.714
TL	2.277	3.547	9.259	35.331	1.455	2.704	10.582	28.987
TF	62.374	93.323	122.092	344.073	73.137	106.339	119.911	405.108
FC	273.211	461.676	745.637	1 011.993	456.291	564.626	660.672	942.172
LR	29.335	35.399	42.650	48.904	22.125	21.738	20.126	19.349
IMR	0.007	0.008	0.014	0.022	0.005	0.007	0.012	0.015
BC	17.641	34.174	32.324	40.178	18.054	20.388	16.579	14.683
AM	0.299	0.338	0.422	0.511	0.619	0.468	0.462	0.558
TC	8.083	9.070	10.519	10.794	4.380	3.997	4.495	2.889

Variables	Coefficient of variation (CV)			
	1971-1972	*1981-1982*	*1991-1992*	*2001-2002*
IL	0.995	0.763	0.643	0.618
PCE	1.050	0.987	0.975	0.861
PC	0.878	0.867	0.869	0.883
TL	0.639	0.762	1.143	0.820
TF	1.173	1.139	0.982	1.177
FC	1.670	1.223	0.886	0.931
LR	0.754	0.614	0.472	0.396
IMR	0.743	0.799	0.877	0.712
BC	1.023	0.597	0.513	0.365
AM	2.070	1.385	1.096	1.091
TC	0.542	0.441	0.427	0.268

Appendix 2

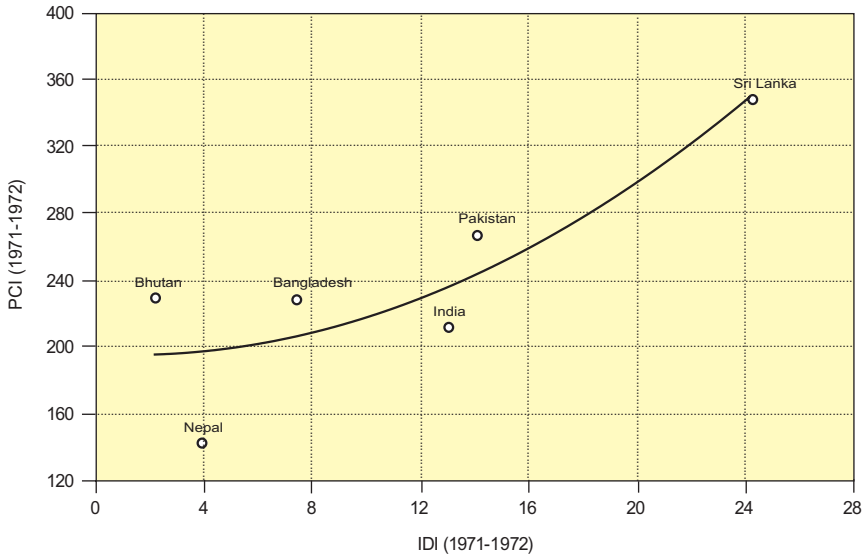
Ordinary least squares regression results

	Independent variables	*Coefficients*	*t-stat.*	R^2	*Adj.* R^2	*F-value*	*DW*
1971-1972	Intercept	195.758	3.952	0.865	0.581	4.462	2.147
	IDI	-0.744	-0.080				
	IDI^2	0.294	0.848				
1981-1982	Intercept	226.029	3.249	0.854	0.757	8.783	2.439
	IDI	-5.659	-0.446				
	IDI^2	0.708	1.494				
1991-1992	Intercept	458.388	4.574	0.882	0.804	11.265	2.536
	IDI	-47.398	-2.358				
	IDI^2	2.740	3.226				
2001-2002	Intercept	772.115	4.881	0.905	0.842	14.296	1.737
	IDI	-83.896	-3.047				
	IDI^2	4.101	3.904				

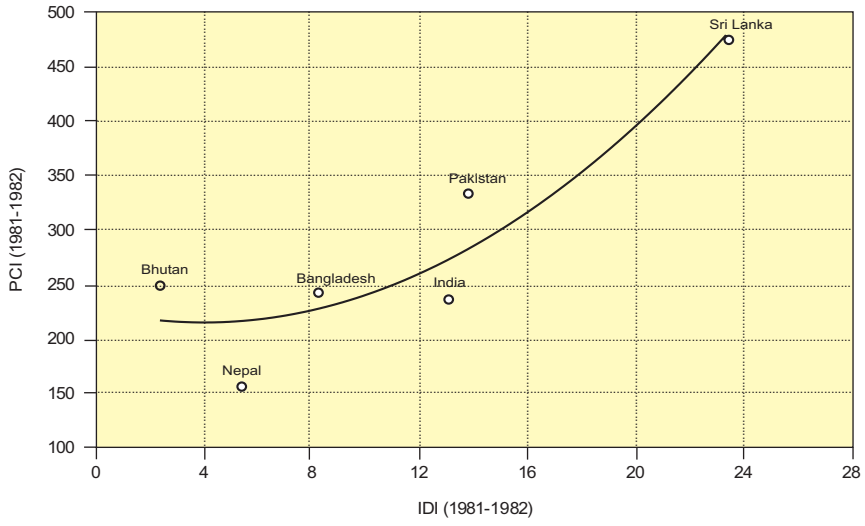
Appendix 3

Scatter diagram of IDI and PCI

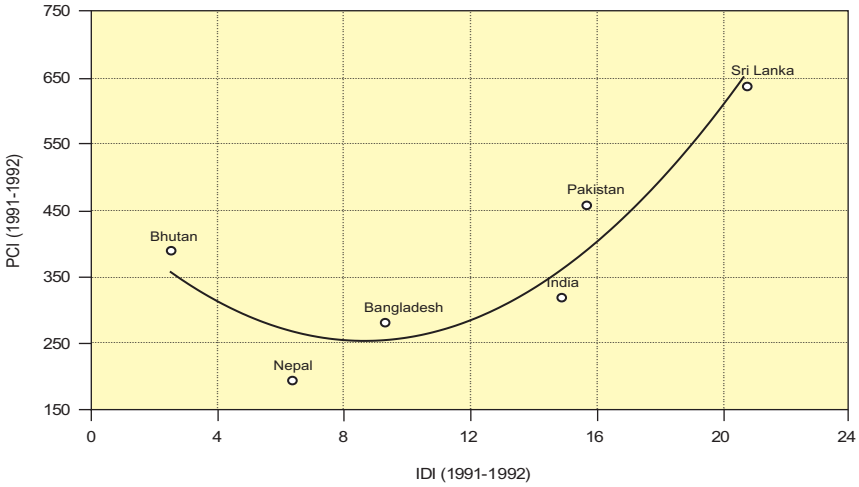
(a) 1971-1972



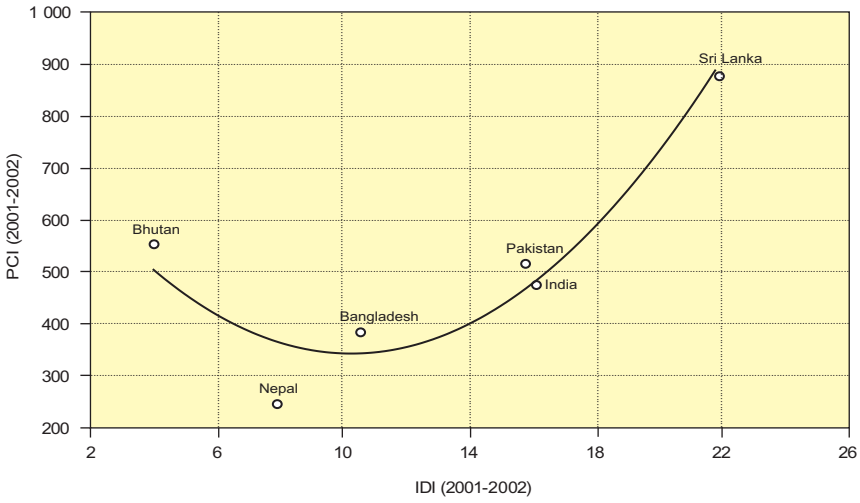
(b) 1981-1982



(c) 1991-1992



(d) 2001-2002



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