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Chief Editor
Asia-Pacific Development Journal
Macroeconomic Policy and Development Division
ESCAP, United Nations Building
Rajadamnern Nok Avenue
Bangkok 10200
Thailand
Fax: 66 2 288-3007 or 66 2 288-1000
E-mail: escap-mpdd@un.org

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ECONOMIC DEVELOPMENT IN SOUTH AND EAST ASIA: EMPIRICAL EXAMINATION OF EAST ASIAN DEVELOPMENT MODEL

*Prakash Kumar Shrestha**

In this paper, a comparison is made of the level of economic development between South Asia and East Asia, and the East Asian Development Model (EADM) is analysed as well as empirically examined. Several development indicators reveal that South Asia in general is far behind East Asian countries where some distinctive features of the development process followed in the past were the developmental role of the state, high investment, emphasis on the manufacturing sector, export-led growth and a focus on infrastructure and human capital. Based on an empirical examination, which supports these facts, policymakers in South Asia should take heed of some of these features despite changing circumstances.

JEL Classification: O11, O53, O57.

Key words: South Asia, East Asia, economic development, East Asian Development Model.

I. INTRODUCTION

Some East Asian countries witnessed a great economic transformation in the second half of the twentieth century characterized by an increase in per capita income (Maddison, 2000). These countries followed Japan, the first non-western economy to reach the status of an industrialized country, with many of them obtaining similar economic success (Stark, 2010; Chang, 2007). Their success has attracted the attention of many policymakers and academicians, resulting in a vast number of scientific publications and formal discussions.

* PhD, Deputy Director, Research Department, Nepal Rastra Bank, Baluwatar, Kathmandu, Nepal (Tel: 977 1 4411638; fax: 977 1 4441048; e-mail: praks_shrestha@yahoo.com/shresthap@nrb.org.np). The views expressed in this paper are of the author's and do not represent those of his affiliated institution. I would like to thank the participants of the New York Conference on Asian Studies for their helpful comments. The conference was organized by the State University of New York, New Paltz in September 2012. I would also grateful to useful comments provided by anonymous referees.

The East Asian Development paradigm, however, has lost its significance after the subregion was severely hit by an economic crisis in 1997. Attention has shifted towards the Anglo-Saxon (Western style) market-based development model. Despite this, Chang (2007), and Boltho and Weber (2009) continued to argue that the East Asian Development Model (EADM) associated with the spectacular economic growth experienced of the economies of, for example, Japan; the Republic of Korea; Singapore; Hong Kong, China; and Taiwan Province of China, could be considered a success. Some other South-East Asian countries, such as Indonesia, Malaysia and Thailand have followed almost a similar path in transforming their economies and thus, within a short period of time, have reached a middle-income status. These countries successfully managed to recover from the crisis of 1997. Hence, there are a number of studies on the East Asian development experience, such as World Bank (1993), Krueger (1995), Rodrik (1995), Collins and Bosworth (1996), Akyuz, Chang and Kozul-Wright (1998), Chang (2007), Boltho and Weber (2009), and Kwon and Kang (2011). However, no comparative studies between East Asia and South Asia on the level of economic development that draws some lessons for South Asia have been done.

In this context, for this paper, the author compares the level of economic development in East Asia and South Asia by tracking each subregion's position on the ladder of development, and also analyses the features of EADM and empirically examines those features. In addition, the situation in South Asia is analysed in order to assess the application of EADM. For this study, the economies of Japan, the Republic of Korea, Singapore, Malaysia, Thailand, Indonesia, the Philippines and China comprise East Asia,[1] and Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka comprise South Asia.[2] Data are taken from the World Bank World Development Indicators and the *Human Development Report* of the United Nations Development Program (UNDP).[3] As indicated earlier, some East Asian countries, such as Japan, the Republic of Korea and Singapore, have joined the group of advanced countries by climbing the ladder of development, while others, such as Indonesia, Malaysia, Thailand, and the Philippines have reached the middle-income level. China has been advancing at a higher rate, and is now the second largest economy in the world. Along with an increase in per capita income and decline in their poverty levels, these countries have also witnessed reductions in infant mortality and improvements in educational achievement and other indicators of human development.[4]

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1 The United Nations classifies these countries as being in East Asia or South-East Asia.

2 These countries are members of South Asian Association of Regional Corporation (SAARC), which was established in 1985. Afghanistan joined SAARC in 2007; hence, it is excluded here.

3 Since the World Bank and UNDP do not publish data for Hong Kong, China and Taiwan Province of China, these economies are not included in the studies, although both have witnessed spectacular economic growth in the last century.

4 Chang (2007, p.1) mentioned that not everything has been rosy in East Asia. Many of the economies have been plagued by political authoritarianism, human right violations, corruption, the repression of labour unions, gender discrimination and the mistreatment of ethnic minorities.

Although some economies in South Asia have advanced marginally, such as Maldives and Sri Lanka, some of the major ones remain far behind the emerging East Asian economies. Most development indicators point out that South Asia is far below East Asia in the ladder of economic development. In addition, an assessment and empirical examination of data show that some distinctive features of EADM could be adopted in South Asia.

The paper is structured as follows. In section II, a comparison of the level of economic development in the two different subregions of Asia is provided. Section III contains outlines of some of the features of EADM, while section IV presents an empirical model. An empirical analysis is carried out in section V and in section VI, the reality and changing scenario in South Asia is discussed before conclusions are drawn out in section VII.

II. COMPARATIVE LEVEL OF ECONOMIC DEVELOPMENT

Economic development has multidimensional aspects. There are several developmental indicators to gauge the level of economic development. For this section, a few important indicators, such as per capita income and the Human Development Index (HDI), have been selected as a basis for comparing the level of economic development between East Asia and South Asia.

Per capita income

To begin with, table 1 presents the GDP per capita at constant 2000 United States dollars (US$) in South Asian and East Asian countries for the selected years spanning between 1960 and 2010, and table 2 shows an average growth in per capita income in different decades. In 1960, GDP per capita in South Asian countries was higher than in some East Asian countries, such as China and Indonesia. However, during the 1960s and 1970s, GDP per capita in South Asian countries remained almost stagnant; it declined in some countries, such as in Bangladesh and Nepal, and increased in increments in India, Pakistan and Sri Lanka. Meanwhile, in the countries of East Asia, during those two decades, GDP per capita increased substantially, except in China. Notably, GDP per capita more than doubled in Malaysia and Thailand, and more than tripled in Japan, the Republic of Korea and Singapore. In Indonesia and the Philippines, GDP per capita income also increased but to a lesser degree than in the other countries in the subregion. In the 1980s the East Asian countries, except for the Philippines, experienced higher per capital GDP growth when compared to South Asian countries.

Due to the adverse impact of the 1997 financial crisis, growth of per capita GDP in several East Asian countries slowed in the 1990s. Since the beginning of the decade, the Japanese economy has been wrestling with a recession, triggered by the bursting of the real estate bubble. On the other hand, the tables turned with regard to China, which became one of the fastest growing economies in the world in the 1990s and 2000s, with an average per capita GDP growth of 9.3 per cent per year. Similarly, by avoiding the contagion effects of the Asian financial crisis, many South Asian countries, particularly small countries, such as Bhutan, Maldives and Sri Lanka, performed relatively well in the 1990s, while other countries in the subregion, such as Bangladesh, India, and Nepal witnessed marginal growth in their per capita GDP during that period.

Table 1. GDP per capita

($ at 2000 prices)

	1960	1970	1980	1990	2000	2010
South Asia						
Bangladesh	255	282	254	280	364	558
Bhutan				465	749	1 324
India	181	216	230	316	450	795
Maldives					2 285	3 864
Nepal	139	145	141	177	225	269
Pakistan	187	291	339	449	512	668
Sri Lanka	274	333	442	577	855	1 309
East Asia						
China	105	127	186	392	949	2 426
Indonesia	201	233	390	592	773	1 145
Japan	7 775	16 651	23 022	34 237	37 292	39 972
Malaysia	813	1 139	1 910	2 592	4 006	5 185
Philippines	692	821	1 098	991	1 048	1 383
Republic of Korea	1 154	1 994	3 358	6 896	11 347	16 219
Singapore	2 251	4 628	9 458	15 788	23 815	32 641
Thailand	321	530	785	1 390	1 943	2 712
United States	13 723	18 229	22 630	28 298	35 082	37 330

Source: World Bank (2012).

Table 2. Growth of per capita GDP

(Percentages)

	1960s	1970s	1980s	1990s	2000s
South Asia					
Bhutan			6.8	4.9	5.9
India	1.8	0.7	3.3	3.6	5.9
Maldives				6.2	5.7
Nepal	0.5	-0.2	2.3	2.5	1.8
Pakistan	4.5	1.6	2.8	1.3	2.7
Sri Lanka	2.2	2.7	2.7	4.0	4.4
East Asia					
China	2.4	4.4	7.8	9.3	9.9
Indonesia	1.6	5.3	4.3	2.9	4.0
Malaysia	3.4	5.3	3.2	4.6	2.7
Philippines	1.7	3.0	-0.9	0.6	2.8
Republic of Korea	5.7	5.4	7.5	5.2	3.7
Singapore	7.6	7.4	5.3	4.3	3.3
Thailand	5.0	4.2	5.9	3.6	3.4
USA	2.9	2.2	2.3	2.2	0.6

Source: World Bank (2012).

In the 2000s, India, the largest South Asian economy, expanded at an almost double-digit rate, nearly on par with the economic growth of China. Hence, per capita GDP increased by 5.9 per cent in India, which was higher than the growth observed in many East Asian economies during that time. Excluding Nepal and Pakistan, which were marred by internal conflicts and political instability, other South Asian countries also performed reasonably well in the 2000s. Growth of per capita GDP in those countries was equal to or greater than that of many East Asian countries during that time. Maintaining this momentum of growth in the coming years remains a challenging task for South Asian economies. Despite better performances in the 2000s, per capita GDP of South Asian countries in 2010 remained stagnant on the lower rungs of the income ladder comparatively (figure 1). Only three countries, namely Bhutan, Maldives and Sri Lanka, recorded a per capita GDP that exceeded US$1,000. Thus, economic policymakers in South Asia should take heed of the results achieved in East Asia to maintain higher growth for a long period of time.

Figure 1. Per capita GDP in 1960 and 2010 ($ at 2000 prices)

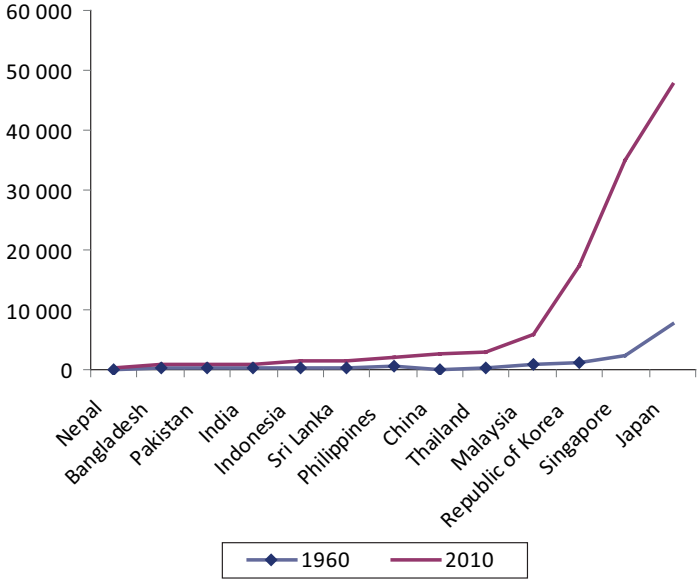

Table 3 presents the per capita GDP relative to the per capita GDP of the United States of America. The table further amplifies the relative sluggishness of economic growth in South Asia. Even in 2010, the relative per capita GDP of many South Asian countries was not much different than what it was in 1960. Only Maldives had a per capita GDP that even approached 10 per cent of the United States per capita GDP in 2010. The relative per capita GDP in Bangladesh and Nepal was lower in 2010 than what was recorded in 1960. On the other hand, as shown in table 3, the GDP per capital relative to that of the United State of America increased substantially in the countries of East Asia, with the exception of the Philippines and Indonesia. The per capita GDP of Japan (in constant dollars) outpaced the per capita GDP of the United States in 1980. The per capita GDP of the Republic of Korea stood at 43.4 per cent relative to that of the United State in 2010, a sharp gain from being just 8.4 per cent in 1960. Similarly, per capita GDP of Singapore, which was 16.4 per cent of that of the United States in 1960, increased to 87.4 per cent in 2010.

Table 3. Per capita GDP as a percentage of that of the United States

	1960	1970	1980	1990	2000	2010
South Asia						
Bangladesh	1.9	1.5	1.1	1.0	1.0	1.5
Bhutan				1.6	2.1	3.5
India	1.3	1.2	1.0	1.1	1.3	2.1
Maldives					6.5	10.3
Nepal	1.0	0.8	0.6	0.6	0.6	0.7
Pakistan	1.4	1.6	1.5	1.6	1.4	1.8
Sri Lanka	2.0	1.9	1.9	2.0	2.4	3.5
East Asia						
China	0.8	0.7	0.8	1.4	2.7	6.5
Indonesia	1.5	1.3	1.7	2.1	2.2	3.1
Japan	56.6	91.3	101.7	120.9	106.3	107.0
Malaysia	5.9	6.2	8.4	9.2	11.4	13.9
Philippines	5.0	4.5	4.8	3.5	2.9	3.7
Republic of Korea	8.4	10.9	14.8	24.4	32.3	43.4
Singapore	16.4	25.4	41.8	55.8	67.9	84.7
Thailand	2.3	2.8	3.5	4.9	5.5	7.3

Source: World Bank (2012).

Human Development Index

Table 4 presents the Human Development Index (HDI) in 2011, computed and published by UNDP as an indicator of development. The Human Development Index of South Asian countries was below 0.6, except for Maldives and Sri Lanka, which in both countries was slightly above 0.6. However, in all of the East Asian countries selected for the study, HDI exceeded 0.6. Notably in Malaysia, it was 0.761 while in the Republic of Korea, it was 0.897. Inequality adjusted human development indices in East Asian countries also have been relatively higher than in the majority of the South Asian countries (table 4). As HDI incorporates literacy and life expectancy in addition to per capita income, the low HDI in major South Asian countries is an indication that the subregion, in general, is still lagging in the important dimensions of human development.

Table 4. HDI in 2011

	HDI ranking	HDI	Inequality-adjusted HDI
South Asia			
Bangladesh	146	0.500	0.360
Bhutan	141	0.522	
India	134	0.547	0.392
Maldives	109	0.661	0.495
Nepal	157	0.458	0.301
Pakistan	145	0.504	0.346
Sri Lanka	97	0.691	0.579
East Asia			
China	101	0.687	0.537
Indonesia	124	0.617	0.504
Malaysia	61	0.761	
Philippines	112	0.644	0.516
Republic of Korea	15	0.897	0.749
Thailand	103	0.682	0.537

Source: United Nations Development Programme, *Human Development Reports*. Available from http://hdr.undp.org/en/statistics.

III. REVISITING EAST ASIAN DEVELOPMENT MODEL

South Asia has remained far behind East Asia in almost all development indicators as explained in the above discussion. The subregion as a whole is home to the largest concentration of poor people globally, suffers from wide gender disparities and rates low in human development indices (Ghani, 2011). Among East Asian countries, economic development has not been evenly distributed, many of the selected countries for the study have achieved notable success, while others, such as Indonesia and the Philippines have been laggards. Even though East Asia and South Asia are in the same region, began the second half of the twentieth century in a similar economic situation and are well connected with each other, why has there been such a wide discrepancy in the economic development between the two subregions. In other words, why did the East Asian economies of Japan, the Republic of Korea, Singapore and Taiwan Province of China,[5] perform well in the first phase of development following the Second World War (from the 1950s to the 1970s) and

[5] Taiwan Province of China is not covered in the study since World Bank does not report the data of Taiwan.

the economies of Indonesia, Malaysia and Thailand take off and become large enough to reach the respective status of high income and middle income countries in the second phase (the 1970s to the 2000s), while the economic performances of the countries in South Asia remained sluggish? This is a challenging question that needs to be analysed. The development performance of many East Asian countries has showed that economic development is possible even without utilizing the colonization process, which helped propel the economic progress of many European countries until the twentieth century (Reinert, 2007). Many European countries colonized different parts of Asia, Africa and Latin America in the past during the time of their economic development. They heavily exploited the natural and human resources available in their colonies. In this context, one can ask whether the East Asian Development Model (EADM) serves as an alternative to the Anglo-Saxon development model.

Boltho and Weber (2009) argued that there is no well-defined EADM. The performance of East Asian countries has differed among one another and there is no unique way for achieving economic progress (Park, 2002). Multiple factors and approaches can be attributed to the economic development. For example, the Republic of Korea industrialized through large business groups or conglomerates, while Taiwan Province of China developed smaller firms (Grabowski, 2000). However, many scholars, such as Comeau (2003), Chang (2007) and Park (2002), attempted to draw some common elements which drove the growth momentum in several East Asian countries.

During the initial stage of economic development, some East Asian economies, such as Japan, the Republic of Korea, Singapore and Taiwan Province of China had a number of common policy approaches, including, among them, protection of domestic firms from foreign competition through import substitution, the provision of direct and indirect subsidies and the use of preferential foreign exchange facilities and undervalued exchange rates, as well as large-scale fixed investment supported by ample domestic savings (Boltho and Weber, 2009; Comeau, 2003; Chang, 2007). Those economies had strict capital control regimes until recently (Chang, 2007). In addition, they pursued active industrial policies (Park, 2002; Chang, 2007). The second-tier of newly industrialized countries (NIC), such as Indonesia, Malaysia and Thailand, also followed similar approaches to propel their economies. An important impetus in kick starting the development process in those countries was the crucial role of the government as a developmental state (Wade, 1990; Dietz, 1992; Suzuki, 2007; Stark, 2010; Park, 2002). Dietz (1992) argued that there was a "nationalist" State with a developmental vision that had the capacity to identify "strategy switching points" once diminishing returns set it. Grabowski (2000) similarly argued that the transformation of the East Asian subregion could not be attributed to the results of free trade and unregulated markets. According to Chang (2007, p. 3), EADM basically includes (a) a pro-investment macroeconomic policy, (b) control on luxury

consumption,[6] (c) strict controls on foreign direct investment, (d) infant industry protection with export promotion, and (e) a productivity-oriented instead of an allocation oriented view of competition.

Political stability and credibility are also important for economic development since unstable politics generates greater uncertainty, which, in turn, makes economic activities subject to constant revisions (Comeau, 2003). The Keynesian notion of "animal spirits" and "investor confidence" can only emerge in stable political environment. During the rapid growth phase, authoritarian or at least semi-authoritarian regimes had ruled these countries (Thompson, 1996, p. 637). Governments in the East Asian countries have, in fact, remained strong enough to exercise widespread control and to even take potentially unpopular decisions if they were considered to promote economic development (Stark, 2010, p. 203). The governments of those countries have been effective due to strong bureaucracies, which are organized under a strict meritocracy and have attracted highly capable graduates from top universities by offering competitive pay (Akyuz, Chang and Kozul-Wright, 1998, p. 28). Many South Asian countries, on the other hand, have been constantly marred by political instability and internal conflict, resulting in a weak government and bureaucracy.

Regarding the success of East Asian countries, instead of giving credit to the role of the government, some studies have pointed to human capital and egalitarian income distribution (Boltho and Weber, 2009) and competent bureaucracy, homogenous population and conservative macroeconomic policies (World Bank, 1993). Furthermore, Stark (2010, p. 197) even opined that cultural rules that shaped the decisions of public officials should also be taken into account.

Despite the different views, there are some common features. Under the guiding role of the State, East Asian countries encouraged high investment, export-led growth and a focus on the manufacturing sector to absorb excess labour from rural and traditional sectors as a way to boost labour productivity (Ghani, 2011). EADM is in fact a state-guided development model which does not let the market identify the areas of comparative advantage. Instead, government plays an active role through industrial policy, development planning, technology transfer and selective incentives (Chang, 2007; Stark, 2010). Rodrik (1995) argued that state coordination led to an investment boom — utilizing credit policies, subsidies and tax policies. Both the Republic of Korean and Taiwan Province of China provided these incentives for selective increases in investment spending.

[6] Japan and the Republic of Korea have recorded the two lowest numbers of passenger cars per capita among advanced and developing countries with comparable level of development (Chang, 2007, p. 25). The Republic of Korea had a restriction on foreign tourism until early the 1980s. Foreign tourism was heavily controlled until 1988 when the government liberalized it (Chang, 2007, p.9).

Although many salient features of the East Asian development experience are difficult to quantify, such as the development role of the government and industrial policies, the following sections present some empirical facts which show some distinctive features of East Asian countries as compared to South Asian countries.

Higher savings and investment

Annex I presents average savings and investment scenarios in South and East Asian countries starting from the 1960s. Savings and investments remained impressive in East Asia. During the high growth phase (1970-2000), the saving and investment in East Asian countries exceeded 20 per cent of GDP — in some economies it had even exceeded 30 per cent. During the 1970s, the gross investment ratio of Singapore and Japan was higher than 30 per cent. Similarly, in the 1980s, the investment spending in China and in the Republic of Korea was greater than 30 per cent of GDP, and in Singapore, it was above 40 per cent of GDP. Although investment in Japan decelerated after 1990, due to the maturation of the economy and the start of a protracted period of economic stagnation after the outburst of the real estate bubble, in other major East Asian economies the investment-GDP ratio continued to rise. For example, it increased from 27.8 per cent on average in the 1980s to 36.3 per cent in the 1990s in Malaysia, and from 29.4 per cent to 36.3 per cent in Thailand. In China, Singapore, and the Republic of Korea, the ratio stayed above 30 per cent in the 1990s. In the aftermath of the Asian financial crisis, investment in East Asian countries decelerated, except in China in which investment was 41.3 per cent of GDP in the 2000s on average. In the Republic of Korea, investment was close to 30 per cent of GDP in the 2000s, recovering quickly from the crisis. In parallel to investment, these countries were able to accumulate ample domestic savings to finance such a higher level of investment (annex I).

On the other hand, the investment-GDP ratio remained at around 10 per cent in the 1960s and below 20 per cent in the 1970s in South Asian countries. In Bhutan and Sri Lanka, investment spending rose in the 1980s to some extent. However, in many other South Asian countries, investment was below 20 per cent of GDP during the 1980s. Recently in the 2000s, in India, the investment to GDP ratio increased to 30 per cent and in Bhutan to 49 per cent. In the other countries in South Asia, investment was well below 30 per cent of GDP (annex I). Savings have also remained very low in South Asian countries, resulting in a higher saving-investment gap.

Focus on manufacturing and exports

Another important feature of the East Asian development experience was the focus on manufacturing and exports. The countries in this subregion, in fact, adopted the process of development that European countries and the United States had followed in

the past, with manufacturing serving as an important sector to spur economic growth and employment in the economy (see Reinert, 2007, for details). The manufacturing sector exhibits increasing returns to scale, while the agriculture sector is normally subjected to diminishing returns to scale. The development of the manufacturing sector can create synergies in the economy, which can induce development in the agricultural sector as well. Annex II presents the value added from the manufacturing sector in the national GDP. The contribution of the manufacturing sector remained almost stagnant and stable, and below 20 per cent in the 2000s in South Asian countries. Only Bhutan increased the contribution of the manufacturing in GDP during the 2000s. In contrast, by 1990, in all of the selected East Asian countries, the contribution of the manufacturing sector to GDP was above 20 per cent. This contribution further increased in those countries in the 2000s, except in Japan. Hence, more than a quarter, even about one-third of GDP in the cases of Thailand and China, came from the manufacturing sector (see annex II). Paradoxically, with globalization and liberalization, many South Asian countries adopted structural adjustment programmes and were forced to open up their economies, which have had a detrimental effect on local industries.

In addition, annex II shows the exports of goods and services as a percentage of GDP. In the 2000s, exports of goods and services as a percentage of GDP remained relatively low, below 20 per cent, in South Asian countries, except for in Bhutan, Maldives and Sri Lanka. In contrast, exports of goods and services in emerging East Asian countries remained quite high, for example, the ratio stood at 110 per cent in Malaysia and 214.3 per cent in Singapore in the 2000s. In other East Asian countries, the ratio also increased. For example, in Thailand, the export of goods and services rose to 70 per cent of GDP in the 2000s from 19 per cent in the 1970s, in the Philippines from 21.5 per cent to 44.5 per cent, in Indonesia from 22.4 per cent to 32.4 per cent, in China from 11.8 per cent to 31.1 per cent and in the Republic of Korea from 24.6 per cent to 40.7 per cent. Exports seemed to have played a vital role for expanding effective demand for these economies.

More importantly, the manufacturing sector has been the dominant share in merchandise exports throughout East Asia. Almost all of the selected East Asian countries have increased the share of manufacturing sector in merchandise exports. For example, in Indonesia, Malaysia, the Philippines and Thailand, the shares of manufacturing exports increased from being negligible (less than 10 per cent) in the 1960s to 48.5 per cent, 73.6 per cent, 88.5 per cent, and 75.5 per cent, respectively, in the 2000s (annex III). The ratio exceeded 90 per cent in China, Japan and the Republic of Korea in the 2000s. Only in Indonesia was the share of manufacturing exports in the merchandise exports less than 50 per cent. In some South Asian countries, such as Bangladesh, India, Pakistan and Sri Lanka, a significant proportion of merchandise exports have been from the manufacturing sector. However, most of the manufacturing exports in South Asia consist of low-end technology (annex III). In manufacturing exports, the share of high-technology exports was

very nominal — the highest ratio was just 6.6 per cent in the 2000s in India. In contrast, this ratio was markedly higher among the East Asian countries (annex III).

Importance of human capital

Developing human capital also has been a higher priority among East Asian countries. However, many South Asian countries are still struggling to increase their literacy rate. In some of those countries about 40 to 45 per cent of people aged 15 and above are illiterate. In contrast, Sri Lanka and Maldives in South Asia achieved a literacy rate of 91 per cent in 2008. As for the East Asian countries selected for the study achieved a literacy rate that exceeds 90 per cent (World Bank, 2012). The literacy level has paved the way for developing skilled manpower necessary for industrial development. In fact, the literacy rates of the East Asian countries were higher in 1980 than the rates achieved recently among South Asian countries. The higher literacy rate has helped diffuse new technology. In addition, other educational indicators of South Asia countries, such as gross education enrolment rates, average years of schooling, indicators of trainability of workers are considerably lower than those in the East Asian countries (Sri Lanka being an exception) (Nabi, 2010).

Physical infrastructure

Regarding infrastructure comparisons, another driver of international competitiveness, annex IV presents some indicators of infrastructure in East Asian and South Asian countries, namely road density, percentage of paved roads, telephone line per 100 people, mobile phone per 100 people and access to electricity. The South Asian countries were well behind the East Asian countries in those areas as well. Bhutan, Maldives and Nepal had very low road density. Moreover, access to telephone and mobile phones was low in South Asia, except in Maldives and Sri Lanka, compared to the selected East Asian countries. More importantly, access to electricity in South Asia was far behind compared to East Asia. Except in Indonesia, more that 90 per cent of the population in East Asian countries have access to electricity. On the other hand, a large chunk of the population in South Asia are still living without electricity.

IV. THE MODEL

Following Radelet, Sachs and Lee (1997), the following basic growth equation is taken as

$$\frac{1}{T}\left[\log\left(Q_T/Q_0\right)\right]_{it} = \alpha_0 + \beta Za_{it} + \delta \log Q_0^{\,i} + \varepsilon_{it} \qquad (1)$$

Dependent variable is the average growth in income per capita (pgdpg) over the period "T". Za is an average value of Z during the period of observation and Z is a vector of explanatory variables. $LogQ_0$ is *initial per capita income* at time 0. As per the neoclassical growth model, there should be a negative relationship between initial income and subsequent growth, which implies that a country with a lower initial per capita GDP tends to grow at a higher rate because of the higher marginal productivity of capital (Radelet, Sachs and Lee, 1997).

The annual data was constructed into five-year average intervals, namely T= 5, as 1966-1970, 1971-1975, 1976-1980, 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2005, 2006-2010. An unbalanced panel was used because of the unavailability of data for Bangladesh before 1976. Some past data are not available for which some extrapolation was done based on the latest three-year average growth. For the model, data on five countries from South Asia, Bangladesh, India, Nepal, Pakistan and Sri Lanka, and seven countries from East Asia, namely China, Indonesia, Malaysia, the Philippines, the Republic of Korea, Singapore and Thailand, are used based on availability. Those countries had a similar level of development status in the beginning of the 1960s. A complete data set for Bhutan and Maldives are not available, hence those countries have been excluded.

There could be several variables affecting the growth of per capita income (Barro, 2003; Radelet, Sachs and Lee, 1997). However, as per the East Asian Development Model discussed above, in this paper, Z mainly includes investment – GDP ratio *(invgdp*), manufacturing – GDP ratio *(macgdp)*, exports — GDP ratio *(expgdp)*, life expectancy *(lifexp)*, average schooling at the beginning of the period *(avsch)*, telephone lines per 100 population *(tel100)*, and energy use (kg of oil equivalent per capita), namely *(enruse)*. The variables *avsch* and *lifexp* represent human capital and *tel100* and *enruse* represent the situation of physical infrastructure.[7] Following Barro (2003), the average years of secondary schooling for the working-age population at the start of the period of observation is applied as the primary measure of the initial skill level of the population.[8] This is available only at a five-year interval beginning from 1950. Other data are obtained from World Bank's World Development Indicator.

Figure 2 presents the graphical bi-variate relationship between dependent variable (growth rate of per capita GDP) and explanatory variables. The growth rate of per capita GDP has a positive correlation with all selected explanatory variables as expected.

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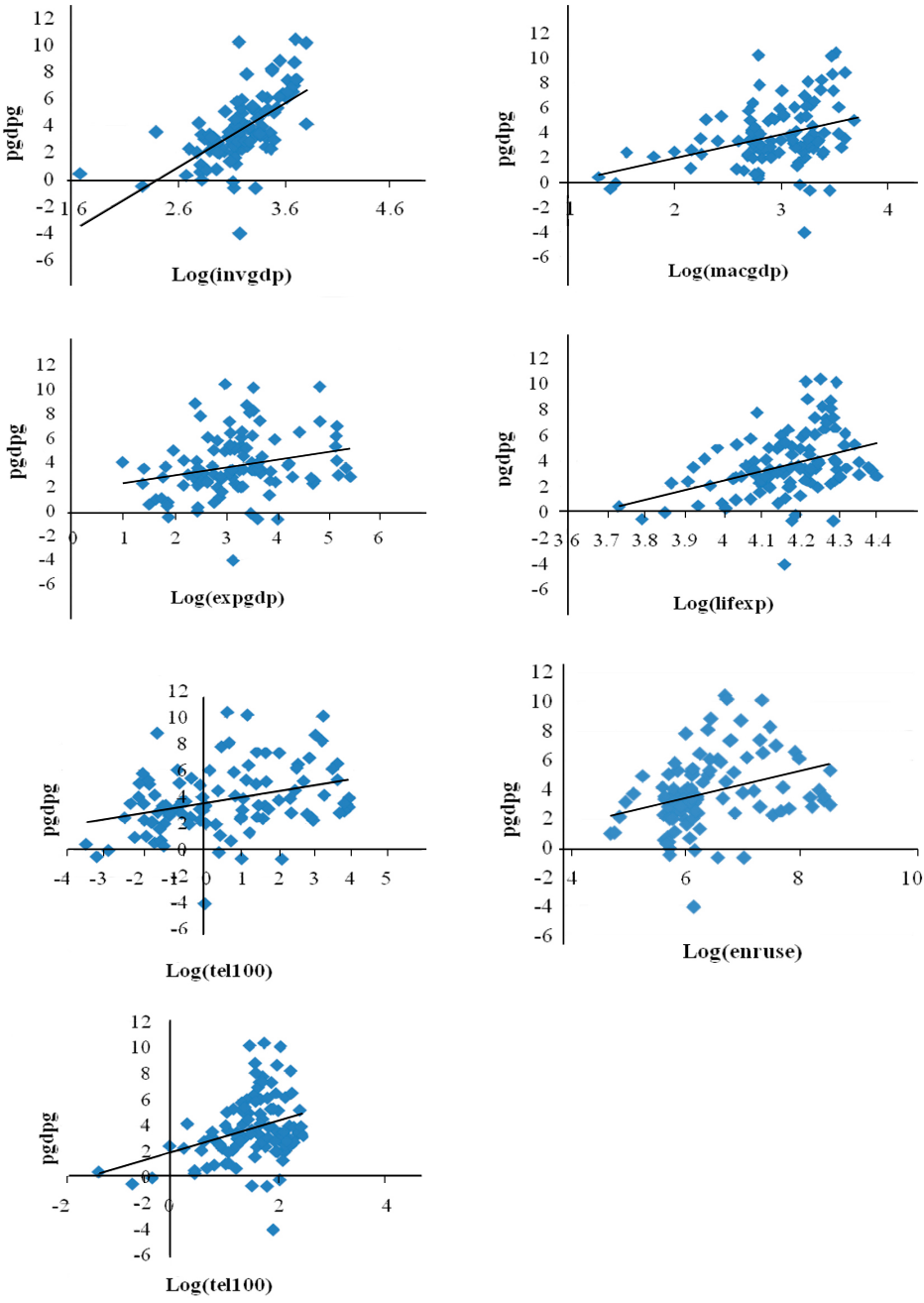
[7] There should be an index of physical infrastructure to represent the actual situation of infrastructure development. However, there are no such data available and constructing such an index is beyond the scope of this paper.

[8] For details, please refer to www.barrolee.com.

Figure 2. Growth rate of per capita GDP and various explanatory variables



V. EMPIRICAL EXAMINATION

Unit root tests

Before estimating the model, it is necessary to examine the time series properties of the data. Table 5 presents a summary of unit root tests of the variables under consideration. As per the Levin, Lin and Chu test, all variables except *tel100* and *eneuse* are stationary; these two variables are stationary in the first difference. Im, Peasaran and Shin (IPS) W-Stat does not reject the null of unit root test for some variables, such as *pdgpg* and log*(expgdp)*. Since the variables are a five-year average and there are just nine time periods, IPS test may not be robust. Moreover, five-year average data or data at five-year intervals, such as *avsch*, are used so that unit root may not be a serious issue.

Table 5. Unit root tests

Variables	Levin, Lin and Chu test	ADF-Fisher Chi-square	PP-Fisher Chi-square	IM, Pesaran and Shin W-Stat
pgdpg	-3.75(0.00)	36.92(0.04)	49.93(0.001)	-0.96(0.17)
Log(invgdp)	-6.69(0.00)	43.96(0.01)	67.99(0.001)	-2.08(0.02)
Log(macgdp)	-6.66(0.00)	55.91(0.00)	66.26(0.00)	-3.03(0.00)
Log(expgdp)	-5.84(0.00)	44.04(0.01)	56.22(0.00)	-1.28(10.07)
Log(lifexp)	-17.66(0.00)	53.68(0.00)	134.73(0.00)	-5.82(0.00)
Log(avsch)	-9.39(0.00)	59.70(0.00)	118.82(0.00)	-2.82(0.00)
Log(tel100)	0.26(0.60)	19.67(0.72)	26.18(0.34)	2.54(0.99)
dlog(tel100)	-4.14(0.00)	26.20(0.34)	16.30(0.88)	-0.29(0.39)
Log(enruse)	5.65(1.00)	14.17(0.94)	19.90(0.70)	5.07(1.00)
dlog(enruse)	-4.30(0.00)	32.02(0.13)	21.70(0.60)	-0.82(0.21)

Note: Exogenous variables: individual effects; automatic selection of maximum lags based on Akaike information criterion; Newey-West automatic bandwidth selection and Bartlett kernel. P-value in parenthesis.

Correlation

Table 6 presents the cross-correlation of explanatory variables. Some explanatory variables are highly correlated, such as log*(invgdp)*, which is found to be highly correlated with log*(lifexp)*, log*(macgdp)*, dlog*(enruse)* and log*(avsch)*. Similarly log*(macgdp)* is highly correlated with log*(lifexp)*, log*(avsch)*, and log*(expgdp)* is highly correlated with log*(lifexp)* and log*(avsch)*. This situation can create the problem of multi-collinearity.

Table 6. Cross-correlation of explanatory variables

	L(invgdp)	L(macgdp)	L(expgdp)	L(lifexp)	L(avsch)	DL(tel100)	DL(enruse)
L(invgdp)	1	0.59	0.46	0.64	0.55	0.33	0.56
L(macgdp)	0.59	1	0.42	0.75	0.73	0.03	0.34
L(expgdp)	0.46	0.42	1	0.72	0.64	-0.03	0.27
L(lifexp)	0.64	0.75	0.72	1	0.89	0.02	0.28
L(avsch)	0.55	0.73	0.64	0.89	1	0.03	0.25
DL(tel100)	0.33	0.03	-0.03	0.02	0.03	1	0.23
DL(enruse)	0.56	0.34	0.27	0.28	0.25	0.23	1

Empirical results

To consider the cross correlation of explanatory variables, explanatory variables are applied one by one to avoid the multicollinearity with a log of the initial per capita income and dummy for the East Asian financial crisis from columns 1 to 7 as shown in table 7. In addition, to avoid the possibility of endogeneity between the dependent variable and explanatory variables, one period lag of explanatory variables is used. All of the selected explanatory variables have a positive impact on growth of per capita GDP as expected. Except log*(macgdp(-1))*, log*(lifexp(-1))*, and dlog*(enruse(-1))*, the country fixed effect and period fixed effect are found in other explanatory variables.

Initial per capita GDP has negative signs as expected in development literature but the coefficients are not statistically significant in most cases except when there is log*(expgdp(-1))* as an explanatory variable. Hence, initial per capita GDP is not an important matter. The South Asian countries have not been performing well in terms of increasing per capita GDP despite having a low initial per capita GDP in contrast to the prediction of neoclassical growth theory. The coefficients of the dummy for the East Asian crisis are statistically significant in all cases reflecting the serious impact of the crisis in East Asia. Except for China, all of the selected East Asian countries in the sample suffered from the crisis, which occurred in 1997, starting in Thailand. Among the selected explanatory variables, adjusted R-square is found high when log*(expgdp)* is applied as the main independent variable, followed by dlog*(tel100)* and log*(invgdp)* and log*(avsch)*. This represents relative importance of exports, infrastructure, investment and education in the economy to increase per capita GDP.

Table 7. Panel growth regression (Unbalanced panel)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
c	0.15(0.04)	0.04(0.02)	0.25(0.00)	-0.27(0.00)	0.08(0.31)	0.18(0.07)	0.02(0.03)
Log(Y_0)	-0.01(0.27)	-0.00(0.98)	-0.03(0.00)	-0.003(0.14)	-0.01(0.35)	-0.02(0.13)	0.00(0.46)
Log(invgdp(-1))	0.02(0.10)						
Log(macgdp(-1))		0.01(0.02)					
Log(expgdp(-1))			0.03(0.00)				
Log(lifexp(-1))				0.07(0.01)			
Log(avsch)					0.02(0.04)		
dlog(tel100(-1))						0.015(0.03)	
dlog(enruse(-1))							0.07(0.00)
Dum_cri	-0.03(0.01)	-0.04(0.00)	-0.02(0.06)	-0.04(0.00)	-0.03(0.00)	-0.02(0.06)	-0.04(0.01)
pgdpg(-1)		0.51(0.00)		0.50(0.00)			
AdjR2	0.51	0.43	0.60	0.45	0.51	0.54	0.18
DW Stat	1.77	2.44	2.02	2.47	1.56	2.31	1.30
Obs	94	94	94	94	94	82	82
Country-fixed effect	Yes	No	Yes	No	Yes	Yes	No
Period effect	Yes	No	Yes	No	Yes	Yes	No

Notes: P-value in parenthesis.
Dependent variable: growth rate of per capita GDP (pgdpg).
White diagonal standard errors and covariance (d.f. corrected).

VI. REALITY AND CHANGING SCENARIO IN SOUTH ASIA

Although East Asian countries did not follow a unique approach to transform their economies, there were some distinctive characteristics associated with their development process as explained above. As such, the question is whether that model can be replicated in South Asia to achieve economic development. The World Bank (1993) argued that the East Asian development experience cannot be replicated in other countries because of changed circumstances, such as globalization, financialization, World Trade Organization (WTO) agreements and the lack of effective domestic institutions, namely an efficient bureaucracy. Hence, following the prescriptions of the International Monetary Fund (IMF) and the World Bank, and against the backdrop of weak performance of the governments, South Asian countries, starting in the mid-1980s, adopted policies of economic liberalization through structural adjustment programmes. These efforts were accelerated after 1990, with the change in political regimes in Bangladesh, Nepal and Pakistan, and the balance of payments crisis in India. Based on the view that economic liberalization is the key to success, South Asian countries adopted neoliberal policies (Grabowski, 2000). With the exception of India in recent years, the performance of many South Asian countries has, however, remained sluggish despite the liberalization of their economies. It shows that openness is a necessary but not a sufficient condition for successful economic development; a country at a take-off stage can only benefit from openness (Reinert, 2007).

The development experiences of East Asia show that the governments played a constructive role as a developmental state. In South Asian countries, until recently, governments had been involved significantly in economic affairs. Before the adoption of economic liberalization in the 1980s and in the beginning of 1990s, South Asian countries had pursued economic policies similar to the ones applied in East Asia. These included promoting import substitution, setting up a licensing system, regulating the financial system, disbursing concessional loans to domestic industries, maintaining favourable exchange rates to promote exports, developing state-owned enterprises and setting a high tariff wall to discourage imports. Despite this, the South Asian economies failed to grow at the same level as those experienced by East Asian countries. Grabowski (2000) argued that the failure in South Asia was due to the absence of rapid growth in agriculture, an equitable income distribution and substantial accumulation of human capital. More importantly, East Asian governments did pursue an active industrial policy to develop the manufacturing sector and technology transfer with human capital development. In contrast, South Asian governments were weaker than those in East Asia and the development process was fragile in the subregion due the weak interlinkage in the economy (Grabowski, 2000). It appeared that the governments of countries in South Asia failed to identify “strategy switch points” to lead to greater growth as pointed out by Dietz (1992). Instead, they mainly relied on the exports of simple and labour-intensive manufactured commodities. During the controlled

regime, rent-seeking activities directed at unproductive sectors were rampant in South Asia and thus the countries did not succeed in expanding exports after applying import substitution programmes.

Against the background of the weak development performances of the South Asian economies, neoliberal policies were adopted by many South Asian countries after the mid-1980s. The International Monetary Fund and the World Bank pushed South Asian countries to liberalize their economies. However, drawing on the lessons learned from liberalization, the full swing towards this approach halted after the financial crisis in East Asia in 1997. The South Asian economies remained insulated from that crisis as they maintained closed capital accounts. Many South Asian countries have yet to liberalize there capital account, even though their current accounts are open and their tariff rates are low. Despite the steps taken to liberalize trade, the opening up the current accounts and lowering of tariffs in a line with the WTO agreement, the performance of the external sector in South Asian countries has remained weak (annex II). In addition to external sector weakness, the performance of manufacturing sector has also been very dismal. In many South Asian countries, it seems that both government-led initiatives and changes in the market have failed to advance economic development. The liberalization process has further weakened the capacity of the Governments of South Asian countries, without improving market efficiency and lowering corruption and the rent-seeking behaviour of the public sector. Meanwhile, a recent World Bank study (Ghani, 2011) presented some optimistic scenarios as well as possible challenges for economic development in South Asia. In the report, it was highlighted that a young population, a new wave of globalization in services, labour mobility and the rise of middle class could engender growth in that subregion. At the same time, on the downside, factors that could derail the growth process, such as failure of the government, weak physical infrastructure, low human capital and entrepreneurship, and high levels of conflicts and violence were identified.

In recent years, one important scenario has emerged in South Asia in line with liberalization and globalization, a sharp increase in the inflow of remittances, which has become a far more important source of external financing in South Asia than in East Asia, where external financing has been primarily in the form of foreign direct investment (Devarajan and Nabi, 2006). For examples, in 2010, remittances comprised 21.6 per cent of GDP in Nepal, 10.8 per cent in Bangladesh, 8.4 per cent in Sri Lanka, 5.5 per cent in Pakistan and 3.2 per cent in India (World Bank, 2012). Except for in the Philippines, remittance inflows have made up less than 1 per cent of GDP in the East Asian countries selected for the study. On the other hand, in all of the South Asian economies, the volume of remittance inflow has been considerably larger than the inflow of foreign investment and official development assistance combined (Nabi, 2010). Given the changes in demographics among advanced countries as well as among the countries of South Asia, out migration is likely to increase further. Hence, it is expected that remittance inflows will increase further. Now the problem is

how to channel the remittances towards economic development. Can inflows of remittances spur higher economic growth? Answers to these questions are neither straightforward nor immediate.

Moreover, in East Asia, manufacturing and export-led growth resulted in a large number of people working in the agriculture sector, which has low productivity and low wages, to take manufacturing jobs, which are higher paid and the productivity is greater (Nabi, 2010). The share of agriculture in total output of the economy has declined in these countries. In South Asia, agricultural output as a percentage of the total economic output has been trending lower, but the manufacturing sector has remained sluggish (annex II). Meanwhile, an increase in the share of service in GDP has been observed. Nabi (2010) argued that an increasing share of services were accounted for by modern sectors, such as financial intermediation, communications and transport, and that the rise of services made possible by information technology had created employment opportunities that are more productive and command higher wages than employment in agriculture. But again an important question remains as to whether this service-led expansion can result in long-term sustained high growth with enough employment opportunities to absorb most of the working poor in South Asia over the coming years. It will be possible if the service sectors can exhibit an increasing return to scale with a higher demand for modern services by households receiving remittances. However, Nabi (2010) argued that that derived demand for services was subject to considerable uncertainty. Although the recent success of India in developing its information technology sector can be taken as an example, none of the other South Asian economies had achieved such success in the export of information technology services (Nabi, 2010).

Against these changing circumstances, South Asian countries may not be able to follow EADM completely. But, South Asian countries can and should emulate many strategies and policies to accelerate and enhance economic growth for a considerable period. An active state policy with a focus on infrastructure development, manufacturing and the service sector in conjunction with an export-led policy cannot be ignored. Economic growth and economic development is not possible without high investment in infrastructure, health and education, as reflected in the empirical results of this study. Inflows of remittance should be utilized to develop infrastructure and human capital by improving the quality of education and health.

VII. CONCLUSION

In this paper, a comparison is made between the level of economic development in South Asia and East Asia. In the first phase of the post-Second World War period, the East Asian economies of Japan, the Republic of Korea, Singapore and Taiwan Province of China became developed while in the second phase, the economies of Indonesia, Malaysia, the

Philippines and Thailand moved up the development ladder. In contrast, the economies of South Asia have remained underdeveloped relative to most of the economies of East Asia, as shown by various developmental indicators. Notably, this has occurred despite the fact that all of these countries were in a similar situation and enacted similar policies at the end of the Second World War. The Governments in East Asia have played an effective role in the development of their economies while those in South Asia were not in a position to do so. The high-growth of East Asian economies can be attributed to a range of government strategies, such as heavy investment, industrial development, export-led growth, human capital development and macroeconomic stability. Finally, of note, these East Asian countries have achieved international competitiveness in the high-tech manufacturing sectors. In South Asian countries, both the government and the market have failed so far to propel economic development. In recent years, the neoliberal "Washington Consensus" policies further weakened the capability of the Government to steer the development process in many South Asian countries and failed to improve market efficiency. At the same time, many South Asian countries have been suffering from internal conflicts and political instability, which have been further adversely affecting the development activities.

Based on the experience of East Asian countries, economic development requires high investment, the construction of infrastructure, the expansion of health facilities and quality education, adoption of technology and innovative practices, and job creation inside the economy. The government should play an active role in promoting those areas although in many instances, it may not be in a position to do so. For the private sector to thrive, a congenial environment for economic activities with adequate physical infrastructure must be in place. Even by adopting a changing scenario, the countries of South Asia, taking into account the experiences of the countries in East Asia, should increase investment in their economies, follow an export-led policy, and develop human capital and physical infrastructure. In addition, the countries in South Asia need to think about the productive use of remittances. Moreover, managing conflict is also a key public policy issue to ensure the future stability and growth in South Asia.

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ANNEX I

Savings and Investments in South and East Asia

(Percentage of GDP)[a]

Regions/ countries	1960s		1970s		1980s		1990s		2000s	
	s	i	s	i	s	i	s	i	s	i
South Asia										
Bangladesh	8.1	10.6	1.9	9.4	7.7	16.5	13.3	19.1	17.6	23.9
Bhutan					3.3	39.7	27.7	41.7	34.1	49.0
India	13.7	14.6	17.5	17.2	20.2	20.4	22.9	24.3	28.5	31.3
Maldives							46.6	31.7	23.7	25.8
Nepal	2.7	5.4	8.1	11.2	11.0	19.9	12.0	22.7	10.6	23.0
Pakistan	9.9	17.5	8.2	15.9	8.3	18.7	15.1	18.7	15.0	18.8
Sri Lanka	12.4	15.4	13.7	17.6	12.9	26.2	16.0	24.9	16.4	25.3
East Asia										
China		20.9	30.4	29.6	35.4	36.0	41.2	39.1	45.9	41.3
Indonesia	8.0	9.7	25.0	20.9	31.6	28.6	30.2	27.6	30.5	25.0
Japan			35.1	34.3	31.4	29.5	30.3	28.8	23.9	22.7
Malaysia	21.7	17.3	27.1	22.3	30.2	27.8	40.7	36.3	42.2	21.8
Philippines	21.3	21.8	24.7	26.4	20.6	22.2	15.9	22.7	16.0	20.2
Republic of Korea	8.6	18.9	22.1	28.5	30.9	30.4	36.3	35.4	31.6	29.5
Singapore	-3.6	19.7	29.1	38.6	42.4	40.9	48.7	33.8	47.7	23.7
Thailand	18.7	20.5	22.3	25.8	26.5	29.4	35.3	36.3	31.6	25.9

Source: World Bank (2012).

Note: [a] Savings (S) comprise gross domestic savings, and investments (I) comprise gross capital formation.

ANNEX II

Manufacturing, value added and exports of goods and services

(Percentage of GDP)

Regions/ countries	Manufacturing, value added					Exports of goods and services				
	1960s	1970s	1980s	1990s	2000s	1960s	1970s	1980s	1990s	2000s
South Asia										
Bangladesh			13.8	14.9	16.6	9.7	5.7	5.2	9.9	16.8
Bhutan			5.7	9.3	19.6			19.7	34.3	40.6
India	13.8	15.2	16.0	15.8	15.3	3.9	5.1	5.8	9.7	17.6
Maldives				7.7	7.9			106.3	84.4	60.0
Nepal	3.6	4.1	5.2	8.8	8.3	6.8	8.2	11.4	19.5	16.2
Pakistan	14.3	15.9	16.0	16.4	17.2	9.0	10.5	12.1	16.4	14.7
Sri Lanka	15.6	19.0	15.4	15.7	18.2	24.3	28.2	27.3	33.7	31.9
East Asia										
China	29.0	37.2	36.0	32.9	32.4		4.7	11.8	19.6	31.1
Indonesia	9.0	10.4	15.3	23.7	27.8	10.4	22.4	25.4	30.1	32.4
Japan			26.6	23.2	19.9	9.9	11.7	12.6	9.8	13.6
Malaysia	9.5	16.8	20.4	27.0	28.8	42.6	44.1	57.2	91.2	110.4
Philippines	24.2	25.7	25.0	23.6	23.7	17.0	21.5	24.7	36.8	44.5
Republic of Korea	15.6	21.6	27.5	27.1	27.2	7.8	24.6	33.9	30.8	40.7
Singapore		23.7	24.4	24.5	24.8	123.8	142.1	174.4	172.1	214.3
Thailand	14.2	19.0	23.3	29.5	34.4	16.3	19.0	25.9	43.0	69.9
United States		23.9	19.9	17.2	14.1	5.2	7.5	8.5	10.5	10.8

Source: World Bank (2012).

ANNEX III

Manufacturing exports and high-technology exports

(Percentage of merchandise and manufactured exports respectively)

Regions/countries	Manufacturing, value added					High-technology exports		
	1960s	1970s	1980s	1990s	2000s	1980s	1990s	2000s
South Asia								
Bangladesh		61.1	67.1	84.4	91.0	0.4	0.1	0.3
Bhutan				41.7	35.4			2.1
India	47.5	53.6	60.1	74.2	71.0	4.1	5.2	6.6
Maldives				25.3	20.7			
Nepal		31.7	48.6	81.1	69.1		1.0	0.2
Pakistan	39.1	56.5	62.3	82.4	81.7		0.1	1.1
Sri Lanka	1.0	5.5	34.4	67.5	71.4		1.3	1.5
East Asia								
China			49.0	81.8	91.3		11.3	26.2
Indonesia	1.3	1.6	14.5	47.3	48.5	1.5	6.6	14.3
Japan	91.0	94.1	96.0	52.2	91.6	24.2	25.5	22.8
Malaysia	5.2	13.2	30.8	70.8	73.6	39.5	45.4	53.8
Philippines	6.0	13.1	27.1	62.9	88.5		47.6	70.4
Republic of Korea	55.8	84.1	91.4	92.5	90.4	16.9	23.6	31.3
Singapore	26.9	40.4	56.1	80.5	80.5	38.2	53.3	54.3
Thailand	2.6	14.4	36.8	70.3	75.5	19.0	25.9	28.4
United States	64.0	66.2	68.4	78.4	78.4	32.2	32.0	29.4

Source: World Bank (2012).

ANNEX IV

Overview of infrastructure (2010, unless indicated otherwise)

Regions/countries	Road density (km of road per 100 sq. km)	Roads, paved (percentage of total roads)	Telephone lines (per 100 people)	Mobiles (per 100 people)	Access to electricity (percentage of the population)
South Asia					
Bangladesh	166 (2003)	9.5 (2003)	0.6	46.0	41 (2009)
Bhutan	20 (2003)	62.0 (2003)	3.6	54.3	
India	125 (2008)	49.5 (2008)	2.8	61.4	66.3 (2009)
Maldives	29 (2005)	100 (2005)	15.2	156.5	-
Nepal	14 (2008)	53.9 (2008)	2.8	30.7	43.6 (2009)
Pakistan	32 (2009)	65.4	2.0	57.1	62.4 (2009)
Sri Lanka	148 (2003)	81.0 (2003)	17.1	83.2	76.6 (2009)
East Asia					
China	40 (2009)	53.5 (2008)	21.9	64.0	99.4 (2009)
Indonesia	25 (2009)	56.9 (2009)	15.8	91.7	64.5 (2009)
Japan	320 (2009)	80.1	31.9	95.4	-
Malaysia	30 (2004)	81.4 (2004)	16.1	119.2	99.4 (2009)
Philippines	67 (2003)	9.9 (2003)	7.3	85.7	89.7 (2009)
Republic of Korea	105 (2009)	79.2 (2009)	59.2	105.2	-
Singapore	473 (2009)	100 (2009)	39.2	145.2	100.0
Thailand	35 (2006)	98.5 (2000)	10.0	103.6	99.3 (2009)
United States	67 (2009)	67.4 (2008)	48.7	89.8	-

Source: World Bank (2012).

EMPIRICAL EXAMINATION OF DEBT AND GROWTH NEXUS IN SOUTH ASIAN COUNTRIES

*Naeem Akram**

Over the years, South Asian countries have been facing the problem of a twin deficit and the need to rely on public external and domestic debt to finance their developmental activities. The positive impact of public debt relates to the fact that in resource-starved economies debt financing, if done properly, leads to higher growth and adds to the borrower's capacity to service and repay external and internal debt. The negative effect works through two main channels, namely "debt overhang" and "crowding out". In the present study, the consequences of public debt for economic growth and investment are examined for the four countries in South Asia, namely Bangladesh, India, Pakistan and Sri Lanka, for the period 1975-2011. To conduct the study, a hybrid model that explicitly incorporates the role of public debt in growth equations was developed. The standard panel data estimation techniques have been used. The results show that both public external debt and debt servicing negatively affect economic growth and investment, which points to the existence of the "debt overhang effect" and the "crowding out effect". Similarly, domestic debt also exhibits a negative and significant relationship with economic growth and investment. The results suggest that reliance on debt for development purposes is not a safe option and countries need to extend the efforts to increase the revenue to finance the development expenditure.

JEL Classification: H63, O43, E22.

Key words: Public debt, economic growth, investment, panel data.

* Assistant Chief, Ministry of Economic Affairs, Islamabad, Pakistan (Tel: +92-51-5124074, e-mail: naeem378@yahoo.com). Author's note: the viewpoints expressed in the present study are those of the author and do not reflect the viewpoints of his affiliated institution. The author is also thankful to Dr. Syed Nawab Haider Naqvi for his valuable suggestions and encouragement in conducting the present research.

I. INTRODUCTION

> What makes some countries rich and others poor? Economists have asked this question since the days of Adam Smith. Yet after more than two hundred years, the mystery of economic growth has not been solved.
>
> (Elhanan Helpman, 2004)

Since the beginning of the twenty-first century, heavy indebtedness of the developing countries has been one of the major development policy issues. Public debt is classified as sum of external debt and domestic debt. Indeed, much of the extraordinary growth in the developing countries since the 1950's can be described as debt-related. According to traditional neoclassical models, at initial stages of economic development, developing countries have limited capital stocks and investment opportunities; therefore, capital mobility increases the economic growth (Chowdhury, 2001). As long as these borrowed resources are used for productive investment, countries do not face macroeconomic instability and economic growth increases (Burnside and Dollar, 2000). Similarly, domestic savings and investment are also positively affected by external debt, leading towards positive impacts on economic growth (Eaton, 1993).

However, a high level of accumulated debt has adverse implications for investment and economic growth. A broad rationalization of these effects is referred as the "debt overhang" theory. The theory asserts that if there is a probability that country's future debt will be more than its repayment ability, then the anticipated cost of debt-servicing can depress the investment (Krugman, 1988). However, the extent to which investment is discouraged by debt overhang depends on how government generates resources to finance debt service obligations (Karagol, 2002). Similarly, if a greater share of foreign capital is used to service the external debt, very little would remain available to finance investment and growth; this channel is known as the "crowding out" effect (Diaz-Alejandro, 1981). It is noteworthy that various authors (Pattillo, Poirson and Ricci, 2002; 2004) are unable to find out the empirical significance of the crowding out effect. However Chowdhury (2004), Clements, Bhattacharya and Nguyen (2003) and Elbadawi, Ndulu and Ndungu (1997) have found that both debt service obligations and debt burden have negative implications on economic growth and investment and according to Cohen (1993) and Hansen (2002), investment and growth are negatively affected by only debt servicing.

In developing countries, domestic debt has received far less attention as compared to external debt. Yet, in many countries, domestic financing is becoming increasingly vital because foreign donor's willingness to lend has reduced over time. In developing countries,

justification behind the creation of domestic debt is that it defends them from adverse external shocks and foreign exchange risks and kindles the development of internal financial markets. Barajas and Salazar (1999), Barajas, Steiner and Salazar (2000) and Kumhof and Tanner (2005) are of the view that the government securities in developing countries are an attempt by banks to guard against high private sector credit risk. Hence, banks are more willing to lend to the private sector and in a way that domestic debt helps in increasing the private investment (Aizenmann, Pinto and Radziwill, 2004).

Internal financing, nevertheless, entails problems of its own. For instance, financing done through the central bank by printing more money is inflationary in nature and would likely promote financial repression. Using the commercial banks to finance the domestic deficit tends to create other distortions in economy. According to Beugrand, Loko and Mlachila (2002), domestic debt is more expensive in comparison with external debt. Moreover, due to high yields on public domestic debt, banks become self-satisfied about costs and consequently, decrease efforts to mobilize deposits and finance private sector projects. Similarly, from a risk-weighted point of view, government borrowing is more attractive to the banks and domestic debt can crowd out private investment (Hauner, 2006).

The organization of the paper is as follows. After a brief introduction, in section II a review of the literature is presented. Section III contains a discussion on the model specification by giving some theoretical background. Empirical methodology applied in the paper along with data sources and main variables are discussed in detail in section IV. Section V is devoted to the discussion of results, while in the last section, the conclusions and policy implications emerging from the present study are presented.

II. LITERATURE REVIEW

Over the last three decades, numerous studies have been conducted on the relationship between debt and economic growth. An overview of the available literature is summarized below.

Neoclassical models have concluded that taxes needed to finance the interest payments of the external debt directly curtail the disposable income and savings of the individual taxpayers. These taxes have led to the reduction in capital stock and economic growth (Diamond, 1965). Sachs (1990) has showed that if higher taxes cover the debt servicing then these taxes by creating distortions in the economy are likely to reduce economic growth. The distortion in the economy caused by taxes includes, among other things, tax evasion, reduction in work effort, capital flight and barriers to trade (taxes on trade). Levy and Chowdhury (1993) also find that due to an expected rise in future taxes,

an increase in public external debt discourages capital formation while encourages capital flight, which causes a reduction in economic growth.

Patillo, Poirson and Ricci (2004) and Fosu (1996; 1999) have estimated that countries having high levels of debt face approximately a 1 per cent reduction in GDP growth rate. They have also concluded that negative impacts of external debt on growth are transmitted through total factor productivity (TFP) and investment (physical capital accumulation). Cunningham (1993), Iqbal and Zahid (1998) and Chowdhury (2001) also have come to similar findings that debt is harmful for economic growth of a country. However, Lin and Sosin (2001) have found that for African countries, debt has a negative and significant relationship with economic growth while for Latin America, it is insignificant. For Asian and other developing countries, the relationship is positive but insignificant. This suggests that efficient utilization of debt is vital for economic growth.

As mentioned in the introduction, one important aspect of the indebtedness is the problem of debt overhang — according to Bauerfreund (1989) there are two debt overhang concepts. Sachs and Williamson (1986) presented the first concept — when indebted countries pay their debts then real resources are transferred from the private sector to public sector. Feldstein (1986) sets out the second concept — government needs to impose taxes on the private sector to finance the debt obligations, which, in turn, results in a reduction in investment. Sawada (1994) and Sen, Kasibhatla and Stewart (2007) conclude that debt overhang is depressing economic growth. Similarly, Elmeskov and Sutherland (2012) are of the view that public debt overhangs affects growth through the increased cost of capital. However, Afxentiou and Serletis (1996) fail to determine a causal relationship between debt and GDP and conclude that debt overhang is rather exaggerated and that if resources were transferred into inputs then external debt would have a positive effect on economic growth.

As mentioned earlier, the crowding out effect also curtails economic growth. Serieux and Samy (2001), Warner (1992) and Taghavi (2000) find that public debt tends to crowd out investment. According to Deshpande (1990), Mahdavi (2004) and Fosu (2007), expenditure on debt servicing may shift public expenditure away from social sectors, such as health and education. Such a shift severely affects economic growth. However, Cohen (1993) shows that, in highly indebted developing countries, the level of debt is not a factor behind slowing investment.

Another strand of literature estimates the optimal level of debt. Smyth and Hsing (1995) find the optimal level of external debt as 38.4 per cent of GDP for developing countries. Clements, Bhattacharya and Nguyen (2003) find that above the threshold level of 20-25 per cent for external debt's net present value and 50 per cent of GDP for its face value, debt depresses the economic growth. Whereas, Patillo, Poirson and Ricce (2002) finds that up to approximately 160 per cent of the export-to-debt level, external debt is growth enhancing;

thereafter it is growth reducing. Maghyereh, Omet and Kalaji (2002) conclude that the optimal threshold level of external debt is 53 per cent of the GDP in Jordan.

The above-mentioned studies focus only on the role of external debt with regard to economic growth. In this regard, they neglect domestic debt entirely or mention it only in passing. However, Abbas (2005) concludes that the relationship between domestic debt and economic growth is negative. Later on, Abbas (2007) finds that if domestic debt as a percentage of bank deposits exceeds 35 per cent, it undermines economic growth while Blavy (2006) finds that the threshold level for domestic debt is 21 per cent of GDP and that domestic debt above 21 per cent of GDP reduces economic growth.

The issue of public debt in developed countries has received considerable attention from the policymakers in the aftermath of the recent financial crisis. In this regard, Cecchetti, Mohanty and Zampolli (2011) find that once the public debts crosses the threshold level of 85 per cent of GDP, it starts reducing the economic growth in Organization for Economic Cooperation and Development (OECD) member countries. Kumar and Woo (2010) also find that an increase of 10 percentage points in the debt/GDP ratio results in a reduction in economic growth of about 0.2 percentage points. However, Panizza and Prebistero (2012) conclude that in advanced economies public debt depresses future growth to a limited extent and in the case of developing countries the debt overhang argument has more power as a significant fraction of debt is external.

Reinhart and Rogoff (2010) find that a debt to GDP ratio of 90 per cent and above is associated with lower economic growth in advanced and emerging market economies. However, lower levels of external debt/GDP ratio of about 60 per cent are associated with adverse outcomes for economic growth of only emerging market economies. These findings have been criticized by Herndon, Ash and Pollin (2013), who have found certain coding errors, as well as a selective exclusion of available data in Rogoff (2010). Consequently, they noted that if these issues are corrected, GDP growth at public debt/GDP ratios of more than 60 per cent is not dramatically different than lower debt/GDP ratios.

The review of literature suggests that divergent opinions exist on every aspect of the relationship of debt with economic growth. Over the years, South Asian countries have been facing a financial crunch. Inadequate resource mobilization and rising expenditures have made the situation with respect to persistent fiscal deficit critical.[1] Similarly, the balance of payments has remained far from satisfactory and most of the countries are facing a current account deficit. The persistence of twin deficit has resulted in the creation of large domestic and external public debt that has prevented these countries from earmarking

[1] For details see Akram (2012).

enough resources for development and social spending. The need to service the debt obligations has undermined efforts pertaining to long-term economic planning. Therefore, it is very important that impacts of public debt on economic growth are analysed. Similarly, most of the studies are focused entirely on external debt (limited studies are focused on domestic debt), leaving out a very important part of total indebtedness — that is impacts of both external and domestic debt. The present study analyses the combined effects of domestic and external debt on economic growth and investment for the countries of South Asia.

III. MODEL SPECIFICATION

According to classical economists, government has a very limited role. The "Ricardian Equivalence Theorem" suggests that taxes and debt are similar and they do not affect the real variables differentially. Hence, in the classical growth model, public debt has no role in determining economic growth. On the contrary, Keynesian and neo-Keynesian models of growth (the Keynesians more than the neo-Keynesians) put greater emphasis on the role of government in economic growth process. They suggest that if there is a gap between saving and investment then this deficit can be filled by public debt. After World War II, the "Marshal Plan" strategy of enhancing economic growth in the war devastated Europe by foreign aid, paid off rich dividends. Due to this success, in almost all the growth models that gained popularity after the Second World War, public debt has been given significant importance.

The present study has attempted to adopt a hybrid model of Cunningham (1993), Romer (1994) and Yakita (2008). The complete derivation of the model is presented in appendix I. The growth equation for the panel data in reduced vector form can be written as under:

$$y_{it} = \alpha + \sum_{j=1}^{k} \delta x_{itj} + \sum_{m=1}^{p} \pi\, Debt_{itm} + \varepsilon_{it} \quad (1)$$

where y_{it} is real GDP growth of i_{th}country at t time and x_{itj} is a vector of control variables, $Debt_{itm}$ is the vector of various public debt indicators, and ε_{it} is the classical error term. Keeping in view the importance of investment, many authors, including, among them, Presbitero (2005), have suggested that it is better that the relationship between public debt and investment also be analysed. To do so, the following reduced form equation of investment also is estimated.

$$Inv_{it} = \alpha + \sum_{j=1}^{k} \delta x_{itj} + \sum_{m=1}^{p} \pi\, Debt_{itm} + \varepsilon_{it} \quad (2)$$

where Inv_{it} is investment of i^{th}country at t time and x_{itj} is a vector of control variables, $Debt_{itm}$ is the vector of various public debt indicators, and ε_{it} is the classical error term.

IV. DATA AND EMPIRICAL METHODOLOGY

To empirically test the relationship between public debt and economic growth, panel data of the four South Asian countries for the period 1975-2011 have been used. The selection countries due to their experience of facing a crisis on balance of payments along with low revenues and savings, which forced them to rely on borrowed resources for economic development. A brief description of the variables used in the present study is summarized in table 1 below.

In order to tackle endogenity along with various other panel data estimation problems[2] and to obtain robust results, five different estimation methodologies are being applied, the Fixed Effect Model (FEM), the Random Effect Model (REM), Pooled OLS, the Dynamic Panel Data Model/Dynamic GMM (DGMM) and the System GMM (SGMM).

Various biases exist. This can result in making the coefficient estimates inconsistent in the panel data analysis in different techniques. In this regard, first is the omitted-variables bias, which is also known as heterogeneity. The omitted-variables bias results due to the correlation between the regressors and country-specific fixed effects. The second one is the endogeneity problem, which occurs due to the correlation between error term and regressors. The third important issue is the measurement errors in the independent variables.

The pooled OLS experiences both measurement errors and omitted-variables bias. However, it reduces the heterogeneity bias because the measurement errors have a propensity to lessen the correlation between country-fixed effects and the regressors. On the other hand, FEM addresses the problem of omitted-variables bias through controlling for fixed-effects, however, in comparison to pooled OLS, it is likely to worsen the measurement error problem (Hauk and Wacziarg, 2009).

Theoretically, the dynamic panel GMM estimator addresses the omitted-variables bias, endogeneity and measurement errors, but it exhibits a weak instruments problem (Roodman, 2009; Bazzi and Clemens, 2009). SGMM is generally more robust to weak instruments than Dynamic GMM, but it can still suffer from weak instruments biases. However, according to Hauk and Wacziarg (2009) and Kumar and Woo (2010), SGMM is the preferred estimation technique.

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2 For details of the panel data estimation see Baltagi (2005).

The selection of valid instruments is the most difficult and tricky issue in all the GMM methodologies. Following the methodologies proposed by Murray (2006), and availability of data, lagged values of the independent variables have been used as instruments. It is worth noting here that in the Dynamic GMM model, an additional instrument of dynamic real GDP growth rate also has been used.

Table 1. Description of the variables

Sr. No.	Name of variable	Data source	Definition	Comment
1.	Real GDP growth (Yt)	WDI	Growth rate real GDP	Different measures of economic growth have been used in literature, such as per capita GDP, GDP growth rate, real GDP and real GNP. In the present study real GDP growth has been used as an indicator for growth.
2.	Investment (KT)	WDI	Gross capital formation as percentage of GDP	For investment, variables used in the literature are gross capital or gross fixed capital formation, investment/output ratio and capital stock calculated by using the hedonic valuation and the perpetual inventory methods. Gross capital formation as a percentage of GDP was used.
3.	External debt (ED_Y)	IDS	Public and publicly guaranteed external debt as percentage of GDP	The indicators of public debt are categorised into two groups. Stock variables: the stock variables relate the value of debt burden to different key economic indicators, such as debt/exports ratio, debt/GDP ratio and domestic debt/ GDP ratio. Public debt as a percentage of GDP is the most commonly used stock measure of debt.
4.	Domestic debt (DD_y)	IFS*	Domestic debt as percentage of GDP	Flow variables: flow variables focused on debt service payment and relate debt servicing to GDP. Public debt consists of two parts, namely external debt and domestic debt. External debt servicing as a percentage of export earnings is the most widely used follow variable. In the study, public external debt/GDP, domestic debt/GDP and debt servicing/exports in percentage was used.
5.	Debt servicing (DS_X)	IDS	Debt servicing of public and publicly guaranteed external debt as percentage of exports	

Table 1. ***(continued)***

Sr. No	Name of variable	Data source	Definition	Comment
6.	Openness (OP)	WDI	(Exports + imports)/GDP*100	The measures used to measure openness include tariffs and quotas, real exports, real imports, balance of trade and the ratio of exports and imports as percentage of GDP (used in the present study).
7.	Labour force (POP)	WDI	Population growth rate	In the growth models, labour force is considered as a key ingredient of economic growth. The number of workers/labour force, employment rate, population growth rate and number of hours worked are among the variables that are most widely used. Population growth rate has been used as a proxy for labour force.
8.	Human capital (SC_ED)	WDI+Data maintained by Easterly (2001)	Secondary school enrolment	Due to the non-availability of data, the selection of an indicator for human capital is the most tricky issue. Among the proxies that are extensively used in the literature are average years of schooling, the enrolment rate, life expectancy ratio, infant mortality rate, and literacy rate. As continuous data for most of these variables are difficult to obtain, secondary school enrolment was selected.
9.	Urbanization (UR)	WDI	Percentage of population living in urban areas	The relationship between economic growth and industrialization is ambiguous because urbanization stimulates industrialization, but it may have some negative impacts on the agriculture sector, which is very important in the developing countries for economic growth.
10.	Inflation (INF)	WDI		There are a number of indicators to measure inflation. Consumer price index and GDP deflator are the most widely used indicators for this purpose. In the present study, CPI is used as an indicator of inflation.

Note : *Abbas (2007) has defined domestic debt as "all domestically held claims of central government" on the analogy of the definition of public & publicly guaranteed external debt by Global Development Finance. In this regard, the International Financial Statistics (IFS) database series 22a+42a and 20c+40c serve the purpose. Hence, **Domestic Debt** = Bank's claims on government + Central bank securities = IFS [(22a+42a)+(20c+40c)].

V. ESTIMATION RESULTS

This section contains a report of the results of the model featuring all the control variables. The results of the estimation exercise are presented in table 2.

Table 2. Estimation results (dependent variable: Yt)

Variables	Pooled OLS	FEM	REM	Dynamic GMM	System GMM
Constant	0.386 (0.605)	0.228 (0.591)	0.472 (0.958)	—	0.201 (3.050)
KT	0.001* (2.007)	0.102* (2.900)	0.057* (4.676)	0.038* (2.090)	0.006* (2.458)
SC_ED	0.488* (3.440)	0.533* (6.484)	0.537* (7.388)	0.102* (3.626)	0.029* (3.226)
ED_Y	-0.316* (-2.819)	-0.109* (-2.276)	-0.115* (-3.445)	-0.032** (-1.920)	-0.009* (-2.075)
DS_X	-0.551* (-4.834)	-0.241* (-3.336)	-0.215* (-4.220)	-0.012* (-2.241)	-0.038** (-1.862)
DD_Y	-0.015* (-3.348)	-0.093** (-1.910)	-0.114 (-0.384)	-0.009** (-1.745)	-0.045** (-1.898)
POP	-0.128** (-1.971)	-0.207* (-3.145)	-0.158** (-1.714)	-0.051* (-6.183)	-0.014* (-3.893)
UR	0.158** (1.715)	0.045* (2.086)	0.020** (1.676)	0.011* (3.004)	0.005* (2.356)
OP	0.933* (11.845)	0.705* (9.864)	0.709* (2.502)	0.074* (2.257)	0.036* (6.722)
Yt(-1)	—	—	—	0.851* (11.637)	—
R-squared	0.7500	0.8459	0.8329	—	0.5227
Adjusted R-squared	0.7358	0.7958	0.8240	—	0.4801
F-statistic	17.982	16.8898	94.0786	—	—
Prob(F-statistic)	0.0000	0.0000	0.0000	—	—
Durbin-Watson stat	2.0523	1.9239	1.804	—	2.1822
J statistic	—	—	—	0.1458	0.000
Hausman test Chi-Sq. statistic	—		4.305	—	—
Prob(Chi-Sq. statistic)	—		0.0102	—	—

Note : * and ** denote significance at 5% and 10% levels, respectively.

These results confirm a negative relationship between external debt variables and economic growth. It is shown in table 2 that external debt as a percentage of GDP and debt servicing as a percentage of exports both have a significant and negative relationship with economic growth. This result is robust because it is invariant with different estimation methodologies used in the study. The reason behind this seems to be that, when domestic resources are mobilized to repay and service external debt (if it is too large in relation to the GDP) not much remains available for investment. As a result, the terms of trade of a country is overburdened with large external debt liabilities. Furthermore, as in most of the studies conducted on the subject, it is pointed out that the debt "overhang effect" of external debt tends to reinforce the "crowding out" of the external debt. It may be noted that this result is similar to those obtained by Chowdhury (2004), Clements, Bhattacharya and Nguyen (2003) and Elbadawi, Ndulu and Ndungu (1997).

The effects of domestic debt are also found to be negative and significant on economic growth. The most important concern about domestic debt is its crowding out effect on private investment, which results in a declining private investment demand, and therefore capital accumulation, growth and welfare (Diamond, 1965).[3] Secondly, domestic debt is comparatively more expensive than external debt (Beaugrand, Loko and Mlachila, 2002).

As mentioned earlier, gross fixed capital formation has been used as a proxy for investment. It comes out as having a significant impact on economic growth. The finding is in accordance with theory that investment enhances economic growth and is supported by numerous studies on the subject, such as Pattillo, Poirson and Ricce (2002), Mankiw, Romer and Weil (1992) and Abbas and Christensen (2007).

Consistent with expectations, openness is significant with a positive sign in all the specifications. It supports the findings of Pattillo, Poirson and Ricci (2002), Coe and Helpman (1995) and Lucas (1988). The reason supporting this is that greater openness of an economy to the outside world represents improved competitiveness and productivity of the economy, which, in turn, leads towards a better economic performance.

The results of the present study suggest that population growth is depressing economic growth. This is supported by numerous studies on the subject. The estimation results also show that secondary education (proxy for human capital) has a positive

[3] It is important to point out that in the Keynesian framework the crowding out effect works only under conditions of full employment, which classical economics regards as the norm. So an argument, such as the one made by Diamond (1965), hold because of the author's implicit acceptance of the classical and neoclassical positions.

and significant relationship with economic growth. It supports the conventional wisdom regarding the impact of human capital on economic growth (Naqvi, 2010).

The results also suggest that urbanization is helpful for economic growth. This supports the findings of Harris and Todaro (1970) and Naqvi (2010). As industrialization gets under way, more people migrate to big cities in search of better job opportunities and improved health and education facilities.

The high value of R2 shows that overall goodness of fit of the model is satisfactory considering the number of variables. The F-statistic measuring the joint significance of all the regressors in the model is also statistically significant. Durban-Watson statics in all the models lies between acceptable range ($1.8 \leq DW \leq 2.2$), indicating that no autocorrelation exists. It is worthwhile to mention here that the models are corrected for heteroskedasticity. The J statistic value (Sargan test) for GMM estimation models is less than 1 suggesting that the instruments are well identified. The Hausman test is also applied to choose between a fixed effect model and a random effect model. The significant value of the test indicates that a fixed effect model is more appropriate.

It may also be of interest that the effects of debt indicators on economic growth, and the non-linear relationships are analysed separately. In this regard three different specifications are tested by using the System GMM method. In the first specification only external debt as percentage of GDP is used as a debt indicator. In the second specification, debt servicing as a percentage of exports and in the third specification, domestic debt as percentage of GDP are used as the only debt indicators. These models are also tested by using both linear and non-linear specifications. The results of the estimations are summarized in table 3.

The results suggest that in linear specifications external debt as percentage of GDP and domestic debt as percentage of GDP have negative and significant impacts on economic growth. The impact of debt servicing as a percentage of exports on economic growth is insignificant. It reveals that debt servicing only in the presence of external debt has a negative impact on economic growth.

As far as the non-linear relationships are concerned, the results show that both coefficients of (squared terms as well as non-squared term) for the external debt as a percentage of GDP are statistically significant. It suggests that there is a quadratic relationship between external debt as a percentage of GDP and economic growth. It is worth noting here that the positive sign of debt as a percentage of GDP seems to contradict the main finding of the present study that external debt exhibits a negative impact on economic growth. In fact, effects of debt could be positive at a low level of debt; however, it becomes negative at higher levels as debt overhang is growth retarding.

Pattillo, Poirson and Ricci (2002) have found similar results. They described the reasoning behind it as follows: "We believe the linear estimation would underestimate the impacts by failing to capture the non-linear relation between debt and growth and therefore imposing a flatter slope even when managed to capture a negative coefficient". However, coefficients of the squared terms of debt servicing as percentage of exports and domestic debt as percentage of GDP are statistically insignificant. It reveals the non-existence of any non-linear relationship between domestic debt and economic growth.

Table 3. Estimation results (dependent variable: Yt)

Name of variables	Specification 1		Specification 2		Specification 3	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
Constant	0.188* (3.056)	0.232 (1.155)	0.162* (2.179)	0.416 (1.510)	0.140* (2.090)	0.148* (2.140)
KT	0.012* (2.050)	0.012* (3.040)	0.017 (1.215)	0.002* (2.127)	0.012* (3.686)	0.013* (3.804)
SC_ED	0.030* (3.096)	0.034* (2.933)	0.027* (2.436)	0.018 (1.390)	0.024* (2.490)	0.023 (1.365)
ED_Y	-0.010* (-2.092)	0.038* (2.351)	—	—	—	—
Squared ED_Y	—	-0.004* (-3.257)	—	—	—	—
DS_X	—	—	-0.004 (-0.679)	-0.201 (-1.112)	—	—
Squared DS_X	—	—	—	-0.037 (-1.097)	—	—
DD_Y	—	—	—	—	-0.004** (-1.909)	0.007 (1.469)
Squared DD_Y	—	—	—	—	—	-0.018 (-1.248)
POP	-0.033* (-4.223)	-0.041* (-3.453)	-0.039 (-1.517)	-0.037* (-3.077)	-0.043* (-3.513)	-0.051* (-3.372)
UR	0.019 (2.753)	0.012** (1.811)	0.011* (2.876)	0.009** (1.894)	0.007 (0.483)	0.006 (0.439)
OP	0.005** (1.877)	0.004* (2.797)	0.002* (2.514)	0.003 (0.686)	0.001* (2.366)	0.002** (1.838)
R-Square	0.4241	0.4182	0.3903	0.4682	0.4873	0.4088
Adjusted R-square	0.3926	0.3809	0.3721	0.4286	0.4544	0.3711
Determinant residual covariance	0.0005	0.0002	0.0006	0.0006	0.0006	0.0006
J-statistic	0.0003	0.0012	0.0450	0.0004	0.0001	0.0000

Note : * and ** denote significance at 5% and 10% levels, respectively.

Analysis of impact of public debt on investment

It is very important that, in order to further confirm the debt overhang hypothesis, the relationship between investment and public debt be analysed. The results are summarized in table 4.

Table 4. Estimation results (dependent variable: Yt)

Variables	Pooled OLS	FEM	REM	Dynamic GMM	System GMM
Constant	3.109 (7.165)	1.146 (3.549)	2.065 (9.228)	—	0.678 (2.777)
OP	0.177* (2.255)	0.283* (4.010)	0.081* (3.007)	0.391** (1.902)	0.011* (2.369)
INF	0.002 (0.117)	0.067* (4.593)	0.063* (2.281)	0.006** (2.899)	0.059** (1.870)
ED_Y	-0.225* (-3.390)	-0.042* (-2.285)	-0.030** (-1.765)	-0.046* (-2.378)	-0.046* (-4.063)
DS_X	-0.025* (-2.132)	-0.021** (-1.740)	-0.073** (-1.908)	-0.046** (-1.913)	-0.009* (-2.213)
DD_Y	-0.100** (-1.900)	-0.067** (-1.785)	-0.023 (-1.307)	-0.125** (-1.641)	-0.008* (-2.347)
SC_ED	0.163** (1.812)	0.363* (4.175)	0.337* (10.004)	0.134* (2.189)	0.093* (2.186)
KT(-1)	—	—	—	0.335** (1.824)	—
R-squared	0.7150	0.6996	0.6453	—	0.3960
Adjusted R-squared	0.6982	0.6772	0.6289	—	0.3482
F-statistic	21.9823	31.3271	39.4966	—	—
Prob(F-statistic)	0.0000	0.0000	0.0000	—	—
Durbin-Watson stat	1.7913	1.8425	2.0629	—	1.6449
J statistic	—	—	—	0.7302	0.0000
Hausman test Chi-sq. statistic	—	—	6.8286	—	—
Prob(Chi-sq. statistic)	—	—	0.0080	—	—

Note : * and ** denote significance at 5% and 10% levels, respectively.

These estimation results confirm that external debt as a percentage of GDP and debt servicing as a percentage of exports tends to affect investment negatively and significantly. These results tend to support, among other things, the plausibility that debt overhang tends to reinforce the crowding out hypothesis. They further strengthen the findings of the relationship between external debt and economic growth, as in the present study, the validity of debt overhang effect along with crowding out effect are confirmed. The domestic debt also seems to have a negative and significant relationship with investment. The results also reveal that openness, inflation and secondary education stimulate investment.

The diagnostic test confirms the goodness of fit, joint significance of all the regressors, non-existence of auto correlation and well identified instruments.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

In the present study, the consequences of contracting public debt for economic growth and investment for the selected South Asian countries is examined in principle. Also investigated is the impact of certain other variables on economic growth. Keeping in view the findings of the study, various policy implications have emerged.

The first implication of the study is that heavy reliance on external debt must be discouraged. Public external debt usually results in a deteriorating economic growth process, partly because it also adversely affects investment. The results suggest that public external debt has hampered economic growth through the debt overhang effect and the crowding out effect. Therefore, in order to accelerate economic growth, developing countries must adopt policies that are likely to result in a reduction in the debt burden, and at least to ensure that the rising debt burden does not reach an unsustainable level.

Given the downward rigidity of current expenditure and crucial importance of the development expenditure, the only way would be to mobilize additional resources by generating a higher level of tax and non-tax revenues. Therefore, there is an urgent need to implement tax reforms. To this end, these countries have to bring under-taxed and un-taxed sectors in the tax net. Above all, sincere efforts should be made to curb smuggling, corruption and tax evasion and the increasing size of the shadow economy.

In the present study, domestic debt is found to also have a negative relationship with economic growth, hence the tendency to acquire both external and internal debt to finance deficits without comprehensive analysis needs to be restricted and domestic debt should not be regarded as a risk-free option. Furthermore, privatization proceeds must be utilized to retire public external debt rather than to finance current expenditure.

It also follows from the estimation results that population growth rate is harmful to economic growth. Thus, in order to stimulate growth performance, these countries must adopt effective population control policies. Similarly, as secondary school enrolment, openness, urbanization and investment are growth enhancing, there is a need for encouraging the education, trade, investment and development of cities.

It may be interesting to highlight new areas of research as suggested in the present study. There is consensus that debt servicing results in reducing the development expenditure. To test this argument further, it is suggested that an empirical study be conducted that explores the relationship between 3D's of public expenditure, namely development expenditure, defense expenditure and debt servicing expenditure. In that study by analysing the interlinkages between 3D's, the government preferences for the development expenditure may be further explored.

Investment plays a pivotal role in the decisive impact domestic debt may have on economic growth. Domestic debt behaves differently for private and public investment; it stimulates public investment, but it can reduce the private investment. Obtaining data for public and private investment separately is a difficult task. Nevertheless, in order to determine the separate effects of public and private investment, it is very important that when conducting a study, the impacts of them are analysed separately.

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APPENDIX I

Model specification

Cunningham (1993) has introduced debt burden into the production function. This is because debt burden has important implications for the capital and labour productivity. Economies that carry a significant debt burden have to spend significant portion of their resources to service debt liabilities, which affect decisions pertaining to the employment of labour and capital in the production function. Therefore, a debt-inclusive production function can be written in the following form.

$$Y = A(K, L, Debt) \tag{1}$$

The main shortcoming of the Cunningham (1993) model is the assumption that the production function consists only of physical capital and labour, and does not include human capital. Romer (1994) eliminated this shortcoming by explicitly including human capital in the production function.

$$Y = A(K, L, Debt, H) \tag{2}$$

where *Y, K, L, H, debt* and *A* are the measure of GDP, capital stock, labour force, human capital public debt and other constant factors, respectively. This makes a standard assumption in the equation that input elasticities of output are constant and technical change is neutral. To begin, by the behaviour of a firm in economy as proposed by Yakita (2008) is applied.

Firms

Let assume that there are *i* firms. The production function of the firm can be written in the following form.

$$y_i = A_i G\ k_i^{\alpha} l_i^{1-\alpha} \tag{3}$$

where A_i is the best practice technology, k_i capital stock of the firm, and l_i the labour available to the firm in the preceding period, and *G* stands for the public capital/facilities available to all the firms. If *w* represent wage and *r* interest rate, then the profit maximizing conditions of the firm are as under:

$$\frac{\partial y_i}{\partial k_i} = \alpha\left(\frac{y_i}{k_i}\right) = r \tag{4}$$

$$\frac{\partial y_i}{\partial l_i} = (1-\alpha)\left(\frac{y_i}{l_i}\right) = w \tag{5}$$

Individuals

A representative worker consumes part of his wage and saves the remainder. The lifetime budget constraint of the individual can be written in the following form.

$$\left(1-\tau_{t-1}\right)w = c_{t-1} + \frac{c_t}{1+(1-\tau_t)r_t} \tag{6}$$

Utility function is of the form

$$U = (1-\delta)c_{t-1} + \delta c_t \tag{7}$$

The saving function of the individual is:

$$s = (1-\tau)w - c_t \tag{8}$$

Government

Government finances its budget from two main sources, taxes and public debt.

$$G_t - G_{t-1} = D_t - D_{t-1} + (1-\ell)T \tag{9}$$

where D and T are public debt and taxes, respectively.

It shows that governments finance their budgets partly by issuing public debt/bonds and partly by generating tax revenues. Where ℓ is the portion of tax revenue used for debt servicing as $rD = \ell T$.

$$T = \tau(w + rs_{t-1})N \tag{10}$$

N is the number of individuals, and rs_{t-1} is income generated from interest on savings. Using equation 10 in equation 9, the budget equation becomes:

$$D_t - D_{t-1} + \tau(w + rs_{t-1})N = G_t - G_{t-1} + rD \tag{11}$$

It is assumed that government invests a constant fraction of GDP, ψ, in public capital and finances a portion ω of expenditure by issuing bond.

$$G_t - G_{t-1} = \psi Y \tag{12}$$

$$D_t - D_{t-1} = \omega\left(G_t - G_{t-1}\right) = \omega\psi Y \tag{13}$$

where $Y = \sum_{i=1}^{n} y_i$

From equations 11, 12 and 13,

$$(D_t - D_{t-1}) - (G_t - G_{t-1}) = rD - T < 0 \tag{14}$$

Equation 14 tells that tax revenue must be greater than interest payment of public debt. Inserting equations 12 and 13 into equation 11, the budget constraint becomes

$$\tau Y = \psi(1-w)\mathrm{Y} + (1-\tau)rD \tag{15}$$

When ψ and w are kept constant then governments have to adjust the tax rate τ in order to satisfy the budget constraint.

Derivation of growth equation

Using equation 2 and assuming the linear homogeneity of the production function for each firm, the production function takes the following form:

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{\gamma} D_t^{1-\alpha-\beta-\gamma} \tag{A}$$

Let assume that A and L grow exogenously at rates η and ρ so

$$L_t = L_o e^{\eta t} \tag{16}$$

$$A_t = A_o e^{\rho t} \tag{17}$$

It can be said that the number of effective units of labour $A_t L_t$ will grow at rate $\eta + \rho$.The assumption of the model is that some part of output s will be invested. Defining k as capital stock of per unit of the effective of labour, i.e. $k = \frac{K}{AL}$. Similarly, h is defined as stock of human capital for per unit of the effective of labour, i.e. $h = \frac{\mathrm{H}}{AL}$. d as the stock of public debt per unit of the effective of labour $d = \frac{D}{AL}$, and y as the level of output per unit of the effective of labour, i.e. $y = \frac{Y}{AL}$, the growth of economy is determined by:

$$\dot{k}_t = s_k y_t - (\eta + \rho + \lambda)k_t$$
$$\dot{h}_t = s_h y_t - (\eta + \rho + \lambda)h_t$$
$$\dot{d}_t = s_d y_t - (\eta + \rho + \lambda)d_t$$

The model further assumes that physical and capital, and public debt depreciate at the same rate. It is also assumed that $(\alpha + \beta + \gamma) < 1$. The steady state conditions can be derived as:

$$\dot{k} = \left(\frac{s_k^{1-\beta-\gamma} s_h^{\beta} s_d^{\gamma}}{(\eta + \rho + \lambda)} \right)^{\frac{1}{1-\alpha-\beta-\gamma}}$$

$$\dot{h} = \left(\frac{s_k^{\alpha} s_h^{1-\alpha-\gamma} s_d^{\gamma}}{(\eta + \rho + \lambda)} \right)^{\frac{1}{1-\alpha-\beta-\gamma}}$$

$$\dot{d} = \left(\frac{s_k^{\alpha} s_h^{\beta} s_d^{1-\alpha-\beta}}{(\eta + \rho + \lambda)} \right)^{\frac{1}{1-\alpha-\beta-\gamma}}$$

Substituting the steady state condition in equation A and taking log, it shows the steady state equation of per capita GDP.

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln A_0 + \rho_t + \frac{\alpha + \beta + \gamma}{1 - \alpha - \beta - \gamma} \ln(\eta + \rho + \lambda) + \frac{\alpha}{1 - \alpha - \beta - \gamma} \ln s_k + \frac{\beta}{1 - \alpha - \beta - \gamma} + \ln s_h + \frac{\gamma}{1 - \alpha - \beta - \gamma} s_d \quad \text{(B)}$$

Equation B shows that per capita GDP depends on physical capital, human capital, level of public debt and some other factors. The A term not only reflects technology, but it also includes institutional, climatic and all other variables. *Equation B is the basic empirical specification of the model.*

DYNAMICS OF STRUCTURAL TRANSFORMATION IN SOUTH ASIA

*P.V. Srinivasan**

This paper contains an analysis of the pattern of growth and the structure of employment in various sectors of six South Asian economies (Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka); the trends in the technological capabilities of these countries are also examined, by characterizing the structure of their exports. It shows that although the level of sophistication is lower compared with East Asian economies, the distribution of exports in South Asian countries has shifted towards products that have a higher productivity index and are located "centrally" in product space, enabling production of several nearby goods. In terms of the summary measure of the proximity of the export basket to all currently unexploited products, high-value ones in particular, the potential for future export sophistication is seen to be the highest for India among the South Asian countries and lowest for Bhutan followed by Bangladesh. Going by the East Asian experience, the South Asian governments have an important role to play in transforming their industrial structures.

JEL Classification: F14, O20, O53.

Key words: Structural transformation, export sophistication, product space, productivity, international trade.

I. INTRODUCTION

Historical evidence from developed countries has shown that large increases in growth rates were accompanied by a shift in the structure of production, from primary to

* Evaluation Specialist, Asian Development Bank, 6 ADB Avenue, Mandaluyong City 1550, Metro Manila, Philippines (e-mail: pv.srinivasan@adb.org). The author is grateful to Benno Ferrarini for sharing with him the COMTRADE data used in this study; and Shikha Jha and three anonymous referees for valuable comments. Responsibility for any errors, however, rests solely with him. The views expressed in this paper are those of the author and do not necessarily reflect the views and policies of the Asian Development Bank (ADB) or its Board of Governors or the Governments they represent.

secondary and then to tertiary outputs. Industrial products are income-elastic and demand for these grows faster compared to income-inelastic agricultural products as incomes grow. The changes over time in the composition of output and the contributions of each sector to employment constitute the structural transformation of an economy (Kuznets, 1971). Economies that depend on primary sectors (agriculture) in their initial stages of development shift to a structure where industry and service sectors dominate as their incomes rise.

The growth process is also accompanied by increases in international trade and countries that export high-value goods that are more income-elastic are the ones that are likely to grow faster. Thus, in addition to the changes at the broad sectoral level, recent literature has emphasized the importance of structural transformation at a disaggregated level in terms of technological sophistication of different products produced by countries for their growth.[1] The growth prospects of an economy depend on its current technological capabilities and its ability to switch to production of a technologically advanced range of products. The speed at which countries can transform their productive capacities to produce goods of greater sophistication and higher value depends on "having a path to nearby goods that are increasingly of higher value" (Hausmann and Klinger, 2006).

The objective of this paper is to characterize the structural transformation process in South Asian countries and analyse its role in economic growth and contrast it with selected economies in East and South-East Asia. Structural transformation is first identified by the changing role of agriculture, industry and the service sectors, as contributors to income and employment in the economy over time. Subsequently, the changing structure of exports of each of the South Asian countries is analysed.[2] Structural transformation has implications for the nature and magnitude of growth. If growth is broad based across sectors it can generate adequate employment for the country's labour force. That is, growth can be inclusive if structural transformation of the economy is conducive to productive employment generation, utilizing the unemployed and underemployed labour force engaged in activities of low productivity.

This study covers six South Asian countries: Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. In Section II there is an analysis of the pattern of growth and the structure of employment in various sectors of these economies. In the next section there is an examination of the trends in technological capabilities of these countries. Section IV contains some concluding remarks.

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1 Hausmann, Hwang and Rodrik (2007) show that countries that specialize in goods that rich countries export (namely, to specialize in technologically sophisticated goods) are likely to grow faster than countries producing other goods.

2 The analysis in this paper is along the lines of recent literature based on measures developed to obtain trends in sophistication levels of production structure of different economies (see e.g. Hidalgo (2009), ESCAP (2011), Felipe and others (2012)).

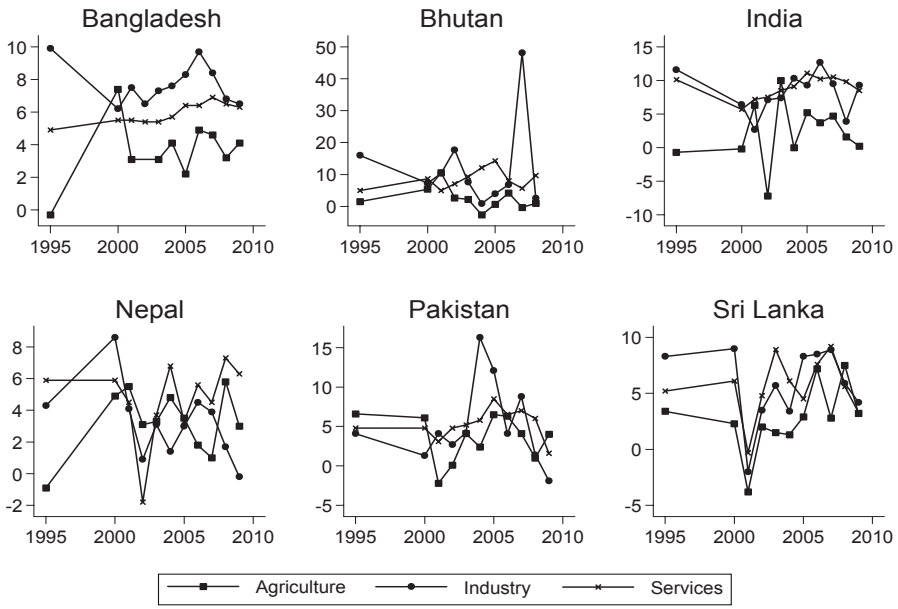
II. STRUCTURAL TRANSFORMATION OF SOUTH ASIAN ECONOMIES

Aggregate and sectoral growth trends

Per capita GDP growth has been remarkable in many of the South Asian economies. The exponential growth rate for the period 1985 to 2009 is as high as 5.4 percent per annum for Bhutan, 4.3 per cent for India and 3.7 per cent for Sri Lanka. Pakistan, Nepal and Bangladesh are slower growing countries with rates of 1.8 percent, 2.0 per cent and 2.9 per cent, respectively.

The high growth rate of per capita GDP in most of these countries is due to the impressive growth in their industry and service sectors (figure 1). It is also the case that service sector growth is more stable as reflected in the small variation for annual percentage growth of value added in services, compared with industry and agriculture, in all the countries. Agricultural growth has been the most unstable in all countries except in the case of Nepal and Pakistan where agriculture and industry are equally unstable.

Figure 1. Annual growth rate (per cent) of value added from different sectors



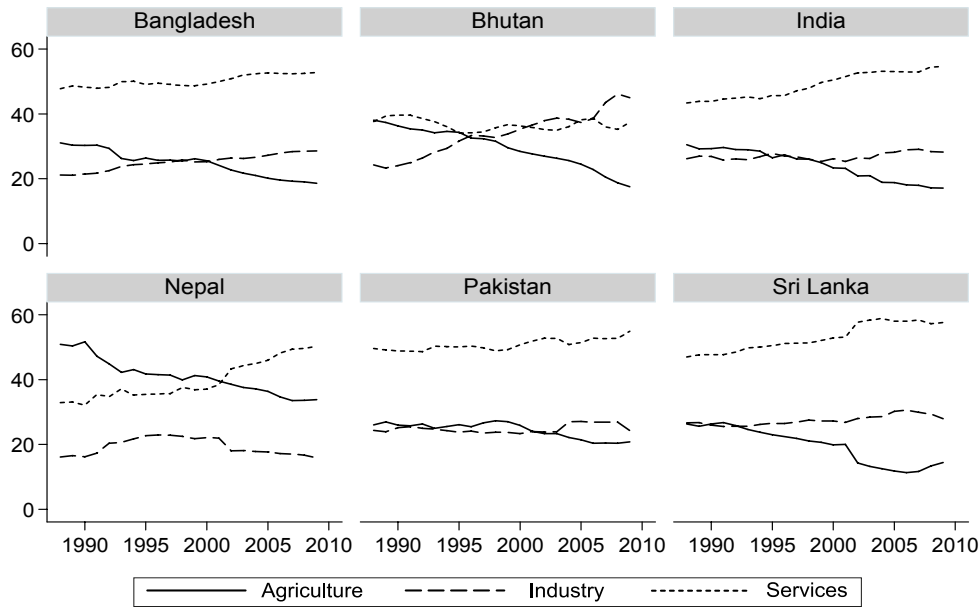
Source: Author's computations based on ADB Key Indicators 2010.

Except in the case of Nepal and Pakistan annual percentage growth in value added in the industry and service sectors is much higher compared with the agriculture sector. In Bangladesh, annual percentage growth rates in industry have been much higher compared with service and agriculture sectors during the years 1985 to 2009. Industrial value added growth varied between 6 and 10 per cent whereas that of services varied between 5 and 7 per cent. Poor agricultural growth in Bhutan is compensated for by high growth in both the industry and service sectors. India registered the highest growth rates for the service sector among all South Asian countries, namely close to or above 9 per cent in most years.

Structure of output

For most South Asian countries the share of services in GDP exceeds the shares of manufacturing and agriculture sectors (figure 2). Agriculture's share in GDP has been declining in all the countries, as is to be expected in the course of a country's development. Industry's share in GDP has been stagnant in all the countries with the exception of Bangladesh and Bhutan. The rising share of services in GDP is remarkable, particularly in Nepal, India and Sri Lanka.

Figure 2. Sector shares in gross domestic product (per cent)



Source: Author's computations based on ADB Key Indicators 2010.

In Bangladesh, the service sector as a percentage of GDP increased from 48 per cent in 1988 to 53 per cent in 2009. At the same time the industry sector increased from 21 to 29 per cent of GDP while the agriculture sector value added declined from 31 to 19 per cent over the same period. Service sector growth in Bangladesh was led by "wholesale and retail trade", and "transport, storage and communications" with strong growth in telecommunications, IT and postal services.

Bhutan is an exception in that its industry sector accounts for the greatest share of GDP; industrial value added increased from 24 per cent of GDP in 1988 to 45 per cent in 2009. The contribution of the service sector to GDP has been stable at around 38 per cent during this period, whereas agricultural value added decreased from 38 to 18 per cent.

In India, the contribution to GDP from industry increased marginally from 26 per cent in 1988 to 28 per cent in 2009. During the same period, the service sector's contribution rose from 43 to 55 per cent and agriculture's share fell from 30 to 17 per cent. Accelerated growth in services was mainly due to increased growth in communications, banking and information technology services in business. Factors such as income growth and the high income elasticity of demand for services and increased growth in foreign demand for service exports, and a decline in relative prices due to productivity gains, have been mainly responsible for this growth (Gordon and Gupta, 2004).

In Nepal, the service sector's contribution to GDP rose from 33 in 1988 to 50 per cent in 2009, while at the same time agriculture's share fell from 51 to 34 per cent. The industry sector's contribution, which peaked in 1996 at 23 per cent, fell to 16 per cent. Nepal derives a substantial share of its GDP from agriculture compared to other South Asian countries.

In Pakistan, the service sector's contribution has been close to 50 per cent since 1988, although it increased to 55 per cent in 2009. During this period, the industry sector's contribution remained stable at 24 per cent while agriculture's share reduced from 26 to 21 per cent.

The service sector in Sri Lanka contributed to 58 per cent of its GDP in 2009, by far the greatest share among all South Asian economies. The share of industry has remained stable at around 27 per cent for the last few years, while agriculture's share decreased from 26 per cent in 1988 to 14 per cent in 2009.

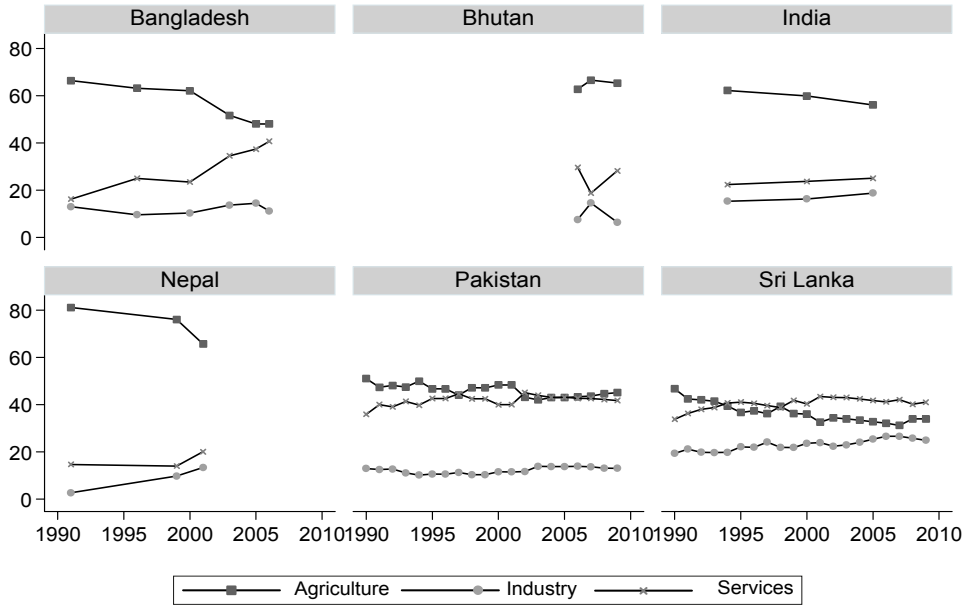
Kuznets (1971) distinguished between two phases of structural transformation. In the first phase, resources are reallocated from agriculture into industry and services and in the second, resources are allocated from both agriculture and industry into services. The share of the manufacturing sector in GDP therefore rises fast in the initial stages of development and that of the service sector increases in subsequent stages as the share of

the agricultural sector in total GDP declines progressively. The trends in figure 2 suggest that the structural shift in South Asian economies, except in the case of Bangladesh and Bhutan, is consistent with the second phase of structural transformation. In all the countries, except Bhutan, the service sector contributes to more than 50 per cent of GDP.

Structure of employment

Although the structural shift in the GDP growth pattern is apparent from the changing contributions to output from different sectors, agriculture constitutes the main source of employment in South Asia, absorbing the highest proportion of the labour force, which varies between 40 and 60 per cent. There has been, however, a significant decline in the share of employment in the agriculture sector in most countries and an increase in employment in the industrial and service sectors (figure 3). In Bhutan, agriculture still provides more than 60 per cent of employment compared to a low 34 per cent in the case of Sri Lanka. Despite the increasing growth in the service sector in India, as of 2005 this sector provides only 25 per cent of total employment compared to around 40 per cent in the case of Sri Lanka, Pakistan and Bangladesh. Inadequate job creation in India's fast-growing service sector could be due to the concentration of growth in subsectors that require more skilled labour. In general, the use of modern technology that is labour saving and capital intensive in the industrial and service sectors is resulting in the slow absorption of labour from the agriculture sector. To some extent the bias against labour-intensive industrial growth is also policy induced (for example, due to restrictive labour laws). Slow growth in jobs in non-agricultural sectors is also due to lack of policies that support development of a competitive private sector. The East Asian experience suggests that South Asian Governments need to undertake industrial policies to restructure their economies, and give importance to the development of education and skills in certain industries, while taking into account the benefits to related industries.

Figure 3. Percentage share of sectors in total employment



Source: Author's computations based on ADB Key Indicators 2010.

III. STRUCTURAL TRANSFORMATION AS REFLECTED IN THE "SOPHISTICATION" OF A COUNTRY'S EXPORTS

In this section, trends in structural transformations are examined using the concepts of "export sophistication" and "connectedness" developed by Hausmann, Hwang and Rodrik (2007) (hereinafter, HHR) and Hausmann and Klinger (2006) (hereinafter, HK). HHR and HK recognize that developed countries not only have greater productivity in terms of output per worker but produce technologically sophisticated products of high value. Structural transformation involves a process in which countries diversify their production structures by developing technological capabilities to produce and export products similar to those of advanced countries. HHR emphasize that a country's trade specialization is not necessarily determined only by its factor endowments and factor intensities of goods as suggested by the Heckscher-Ohlin model and show that a country's exports mix has important implications for its growth. They argue that there is an element of uncertainty in what a country produces because of the uncertainty involved in the successful development of a new product. Once the economy develops a high productivity good, due to knowledge spillovers, emulators are

drawn in to produce this good, setting forth the process of economic growth. The limitation of this framework is that although it characterizes the kind of structural transformation that is associated with economic growth it does not provide concrete guidance regarding how to achieve it.

Export sophistication

HHR develop a measure for a country's level of "export sophistication" (called EXPY) that captures the "productivity" level of a country's exports and can be computed from export statistics.[3] The focus on exports is justified on the grounds that a country is expected to export those goods in which it is most productive. The first step involved in the calculation of EXPY is the construction of an income or "productivity" index (called PRODY) for each commodity based on the income levels of the countries that export the commodity. PRODY can be considered to be a quantitative index that ranks traded goods according to their implied productivity. For each commodity k, $PRODY_k$ is obtained as the weighted average of per capita GDP of countries that export this commodity where the weights are the revealed comparative advantage (RCA) of each country in good k.

$$PRODY_k = \sum_c RCA_k^c \, Y^c \quad (1)$$

Revealed comparative advantage of country c in good k is given by

$$RCA_k^c = (x_k^c/X^c)/(\sum_c (x_k^c/X^c)) \quad (2)$$

where (x_k^c/X^c) is the value share of commodity k in the overall export basket of country c.

Given the productivity index of each of the traded products in the world, the productivity level associated with any particular country's export basket, EXPY is defined as the weighted average of the productivity indices of all the products in that country's export basket, where the weights are the value shares of the products in the country's total exports.

Given the productivity index of each of the traded products in the world, the productivity level associated with any particular country's export basket, EXPY is defined

[3] Hidalgo and Hausmann (2009) use an alternative measure of sophistication to depict the complexity of a productive structure based on the diversity of capabilities present in a country and their interactions. They show that cross-country differences in income can be explained by differences in this measure. The method of reflection used to produce these measures captures the diversity in non-tradable capabilities of countries. Hidalgo (2009) traces the measures of economic complexity for several countries and finds that these measures are correlated with EXPY measures.

as the weighted average of the productivity indices of all the products in that country's export basket, where the weights are the value shares of the products in the country's total exports.

$$EXPY^c = \sum_i (x_i^c/X^c)\ PRODY_i \quad (3)$$

EXPY is also interpreted as the level of sophistication of a country's exports and is positively associated with a country's income level, controlling for other variables. The growth rate of per capita GDP is found to be positively influenced by initial EXPY suggesting that countries that can position themselves higher on the productivity spectrum tend to experience higher growth.[4]

The recent trends in export sophistication (as measured by EXPY) for the South Asian countries are obtained below. The United Nations Commodity Trade Statistics Database (COMTRADE) is used for this purpose, covering 261 products at the 3-digit level for the years 1988-2008 to calculate EXPY.

At the 3-digit level, the productivity levels of products range from roughly $1,000 to $30,000 with a mean value of $16,000 (table 1).

Table 1. Descriptive statistics for the productivity index in South Asia

(US$ at 2000 prices)

Variables	Number of observations	Means	Std. dev.	Min.	Max.
Average PRODY for 1988-1993, PPP adjusted	261	16 059.57	5 173.989	1 359.116	27 418.27

Source: Author's computations based on COMTRADE data.

At the lower end of the productivity range are mainly primary goods such as rice, cotton, tobacco, cocoa, coffee and spices and basic manufactured goods such as leather, vegetable textile fibres, sugar, molasses and clothing (table 2). At the higher end of productivity are mining and advanced manufactured products such as metals, machinery (for printing, textiles, paper, power generation, etc.), medical equipment, steam turbines, engines, taps, cocks and valves (table 3).

[4] See Hausmann, Hwang and Rodrik (2007).

Table 2. Commodities with the lowest productivity values

Product code	Product name	Average PRODY for 1988-1993, PPP adjusted
264	Jute and other textile bast fibres	1 359.12
74	Tea and mate	2 271.17
223	Oilseeds (used for extraction of other fixed vegetable oils)	2 944.41
272	Fertilizers, crude	2 988.59
71	Coffee, coffee substitute	3 017.58
75	Spices	3 290.85
36	Crustaceans, molluscs, etc.	4 096.45
265	Vegetable textile fibres	4 520.00
263	Cotton	4 664.72
72	Cocoa	4 666.78
612	Leather products	5 410.85
42	Rice	5 509.29
37	Fish, etc., prepared, preserved	5 558.37
231	Natural rubber, etc.	5 567.10
61	Sugars, molasses, honey	5 798.19
422	Fixed vegetable fats and oils, other oils	5 844.53
121	Tobacco, unmanufactured	6 330.63
687	Tin	6 505.88
841	Men's and boys' clothing excluding knitwear	7 501.12
843	Men's and boys' clothing, knitted	7 532.51

Source: Author's computations based on COMTRADE data.

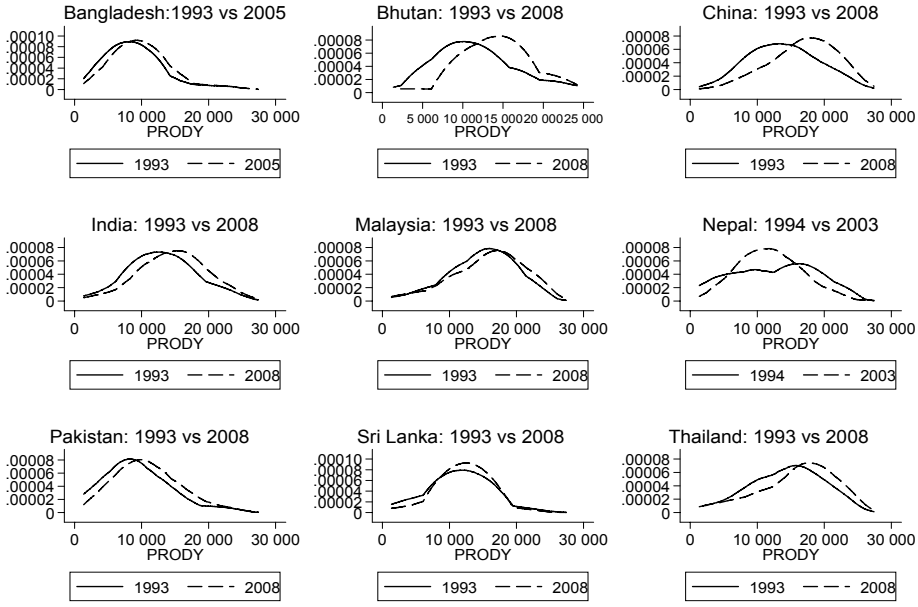
Table 3. Commodities with the highest productivity values

Product code	Product name	Average PRODY for 1988-1993, PPP adjusted
684	Aluminium	27 418.27
726	Printing and bookbinding machinery	24 219.5
731	Metal removal work tools	24 122.45
212	Fur skins, raw	23 983.85
525	Radioactive materials	23 681.36
725	Paper, pulp mill machines	23 604.43
16	Meat and edible meat offal, salted, in brine, dried or smoked	23 595.55
774	Electro-diagnostic medical and x-ray equipment	23 407.47
597	Prepared additives, liquids	23 083.66
724	Textile, leather machines	22 918.98
733	Machine tools, metalworking	22 906.68
735	Parts for machine tools	22 865.57
712	Steam turbines	22 784.4
874	Measuring, controlling instruments	22 631.71
737	Metalworking machinery	22 575.55
714	Engines, motors and non-electric parts	22 512.59
583	Monofilament plastics	22 468.23
718	Other power-generating machinery	22 409.64
541	Medicinal and pharmaceutical products, other than medicaments in group 542	22 396.62
747	Taps, cocks, valves, etc.	22 374.68

Source: Author' s computations based on COMTRADE data.

As mentioned before, the structural transformation of a country is reflected in the changing structure of its exports. We obtain below the frequency distribution of each country's exports (in value terms) with respect to the productivity values of products. Over time, the distribution of exports in most South Asian countries has shifted towards products with a higher productivity index (figure 4).

Figure 4. Distribution of export values across products with different levels of productivity



Source: Author's computations based on COMTRADE data.

The changes in distribution of exports across productivity quintiles for different time points are given in table 4. Export value shares in the top 40 per cent of PRODY values have increased in all the South Asian countries; highest in the case of India. These increases are, however, much smaller compared to the values for East Asian countries (table 5). If only the products that are exported with revealed comparative advantage are considered, very few products fall in the top 40 per cent range of productivity values. The maximum is in the case of India (15 products), which includes products such as organic chemicals, works of art, antiques, man-made fibres, tractors and electric power machinery parts. In the case of Bangladesh, only 4 products are exported with revealed comparative advantage in this range of PRODY values (parts for machine tools, coal gas, plastic waste and printed matter). In the case of Bhutan, it is just one product, which is electric current that constitutes almost 50 per cent of export values. For Sri Lanka, it is two product categories (printed matter and electric power machinery parts) and for Nepal also it is two (works of art and antiques, and Zinc). In the case of Pakistan, it is five products (table 6). As will be seen below, the low share of export values in the high-value products is reflected in a low export sophistication level for the country.

Table 4. Export shares by quintiles of productivity values (South Asian countries)

Bangladesh	**PRODY quintiles**	**1991**	**1995**	**2003**	**2007**
	Bottom 20%	88.49	87.83	91.12	82.55
	Next 20%	9.48	9.03	6.57	12.41
	Middle 20%	0.27	1.01	1.24	2.14
	Next 20%	0.58	1.33	0.84	1.74
	Top 20%	1.17	0.80	0.23	1.17
Bhutan	**PRODY quintiles**	**1993**	**1998**	**2008**	
	Bottom 20%	33.35	15.82	47.81	
	Next 20%	15.88	34.61	3.26	
	Middle 20%	21.36	15.73	0.01	
	Next 20%	29.28	33.53	48.92	
	Top 20%	0.13	0.31	0.01	
India	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	38.13	38.61	25.81	18.54
	Next 20%	40.92	38.11	42.32	46.84
	Middle 20%	8.63	8.85	10.47	13.40
	Next 20%	5.41	6.00	9.55	10.66
	Top 20%	6.92	8.44	11.86	10.55
Nepal	**PRODY quintiles**	**1998**	**2003**		
	Bottom 20%	31.45	45.67		
	Next 20%	63.02	33.65		
	Middle 20%	4.09	16.67		
	Next 20%	0.37	2.80		
	Top 20%	1.07	1.21		
Pakistan	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	61.48	67.59	67.81	65.25
	Next 20%	33.22	27.22	24.58	23.65
	Middle 20%	2.20	2.10	2.27	4.04
	Next 20%	2.53	2.51	3.63	4.11
	Top 20%	0.56	0.58	1.71	2.95
Sri Lanka	**PRODY quintiles**	**1993**	**2003**	**2008**	
	Bottom 20%	71.34	70.36	63.07	
	Next 20%	21.11	17.91	22.36	
	Middle 20%	3.98	5.35	8.42	
	Next 20%	2.60	4.63	4.56	
	Top 20%	0.96	1.75	1.59	

Source: Author's computations based on COMTRADE data.

Table 5. Export shares by quintiles of productivity values (selected East Asian countries)

China	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	38.38	29.82	21.93	15.76
	Next 20%	28.11	24.37	19.15	17.14
	Middle 20%	11.48	14.64	16.80	19.43
	Next 20%	15.76	20.01	24.31	26.04
	Top 20%	6.27	11.17	17.81	21.63
Malaysia	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	19.62	15.00	12.01	14.44
	Next 20%	40.30	34.20	36.51	36.56
	Middle 20%	11.25	10.70	10.07	9.66
	Next 20%	24.85	29.50	28.38	26.23
	Top 20%	3.98	10.59	13.02	13.12
Thailand	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	35.30	28.14	21.45	19.87
	Next 20%	25.57	22.27	23.92	21.25
	Middle 20%	12.85	11.05	13.80	15.98
	Next 20%	19.44	29.72	27.40	22.84
	Top 20%	6.84	8.83	13.44	20.06

Source: Author's computations based on COMTRADE data.

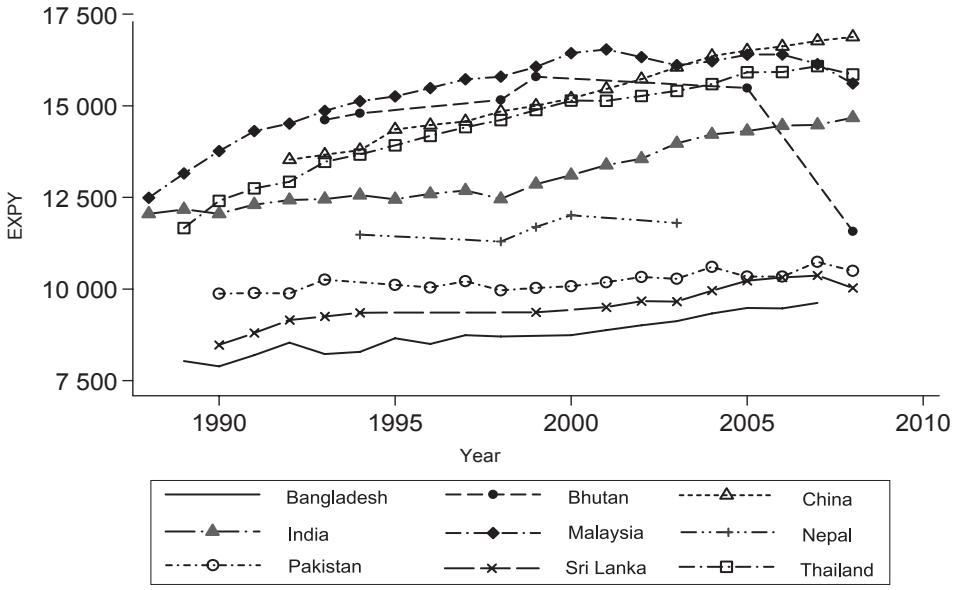
Table 6. Products exported with revealed comparative advantage and in the top 40% productivity index* values

Country	Product name	Average PRODY for 1988-1993, PPP adjusted
Bangladesh	Parts for machine tools	22 865.57
	Coal gas, water gas, etc.	20 880.48
	Plastic waste, scrap, etc.	20 770.13
	Printed matter	18 616.93
Bhutan	Electric current	19 256.51
India	Nitrogen-function compounds	21 482.54
	Other organic chemicals	21 256.6
	Synthetic colours, lakes, etc.	21 164.68
	Coal gas, water gas, etc.	20 880.48
	Works of art, antiques, etc.	20 668.5
	Tractors	20 534.13
	Steam generators, boilers, etc.	20 279.03
	Other man-made fibres	20 145.36
	Carboxylic acids, derivatives	19 933.3
	Rotating electric plant	19 753.56
	Hydrocarbons, derivatives	19 695.58
	Zinc	19 405.74
	Nails, screws, nuts, etc.	19 075.13
	Manufactures of base metals	18 992.23
	Electrical power machinery and parts	18 471.03

Source: Author's computations based on COMTRADE data.
Note: * PRODY.

Figure 5 below shows the differing levels of export sophistication among South Asian economies in comparison to some of the East Asian economies like Malaysia, Thailand and China. Bangladesh has the lowest level of export sophistication followed by Sri Lanka and Pakistan. However, export sophistication has been rising over the years in all the countries and the rise is remarkable particularly in the cases of India and East Asian countries.

Figure 5. Evolution of export sophistication in South Asian countries



Source: Author's computations based on COMTRADE data.

Determinants of export sophistication (EXPY)

As noted in HHR, the measure of export sophistication is strongly correlated with per capita GDP. Based on the time series data for each of the countries it is found that the level of export sophistication in countries is highly correlated with per capita income level (table 7). The observed correlations of EXPY with trade and inflows of FDI are mainly due to the correlations between per capita GDP and these variables.

Transformation to a modern economy is slow in many of the South Asian countries due to low diversification in exports. India, Sri Lanka and Pakistan have substantially diversified exports, but still fall far short of the diversification levels in, for example, China and Thailand (figure 6).

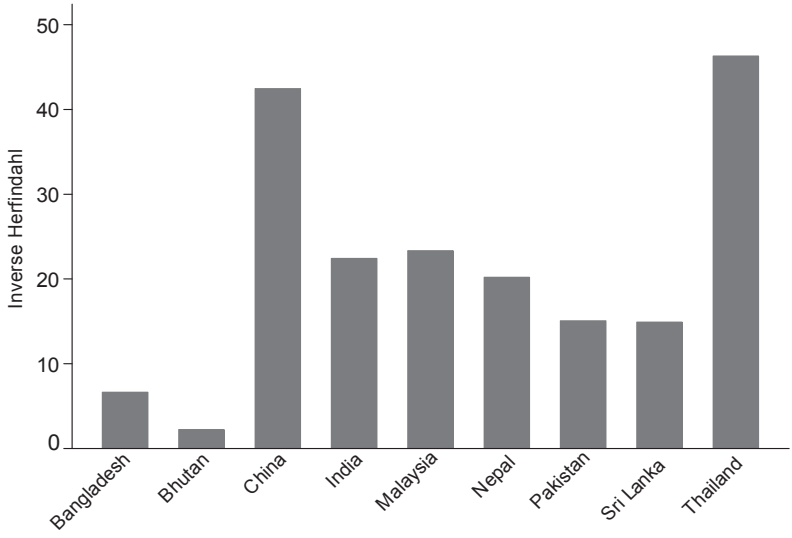
Newly industrialized countries such as the Republic of Korea and China that have been successful in strengthening their export and industrial competitiveness can offer some lessons for export diversification. For countries to move up the value chain from producing raw materials to high-value products it is necessary to boost the skills of their people, apart from providing access to capital through deepening of financial markets.

Table 7. Correlation between export sophistication and trade openness, foreign direct investment and gross domestic product per capita

	EXPY, trade/GDP	EXPY, FDI/GDP	EXPY, GDP per capita	GDP per capita, trade/GDP	GDP per capita, FDI/GDP
Bangladesh (18)	0.9377*	0.7264*	0.9659*	0.9649*	0.8190*
Bhutan (6)	-0.6263	-0.4419	-0.6921	0.9774*	0.0758
China (17)	0.7851*	-0.6248*	0.9613*	0.8351*	-0.5356*
India (21)	0.9672*	0.7735*	0.9674*	0.9868*	0.8621*
Malaysia (21)	0.9518*	-0.2703	0.8555*	0.8644*	-0.3523
Nepal (5)	-0.1984	—	0.7067	-0.2153	—
Pakistan (18)	-0.1602	0.6634*	0.8305*	-0.0639	0.8277*
Sri Lanka (14)	-0.0248	0.4759	0.9219*	-0.2337	0.5006
Thailand (20)	0.9330*	0.6241*	0.9308*	0.8813*	0.4559*

Source: Author's computations based on COMTRADE data.
Note: * indicates significance at 5 per cent level. Numbers in parentheses refer to number of observations.

Figure 6. Export diversification (Inverse Herfindahl index)*



Source: Author's computations based on COMTRADE data.
Note: * Export diversification is obtained as 1/H where H is the Herfindahl index of export shares. $H = \sum_{i=1,N} s_i^2$ where $s_i = x_i/\sum x_i$ is the value share of each product in total exports.

Export sophistication and growth

A cross-section regression using a sample of 165 countries with data between the years 1988 and 2008 reveals the relationship between export sophistication and economic growth. The dependent variable is the annual per capita growth rate of each country obtained from the difference between the initial and final years. The coefficient of initial per capita GDP is negative, indicating growth convergence and the coefficient of initial EXPY is positive and statistically significant indicating the important role of export sophistication for growth (table 8). That is, countries that initially export products with high productivity values tend to grow faster. HHR show that this result is robust and holds good under different model specifications.[5] The estimates in table 8 show that the association between export sophistication and growth is weaker (R^2 = 0.066) than that obtained in the case of HHR (R^2 = 0.35). The estimates here are based on growth rates between the years 1988 and 2008 compared to the years 1992-2003 considered in HHR. Wang, Wei and Wong (2010) show, for example, that the association between initial export sophistication and growth is not stable across different measures of sophistication. These results, however, cannot rule out a relationship between the income levels of countries and their production capabilities in terms of sophistication and complexity. Felipe and others (2012) find, for example, that high-income countries are the major exporters of more complex products and export shares of these products increase with income.

Table 8. Cross-section growth regression

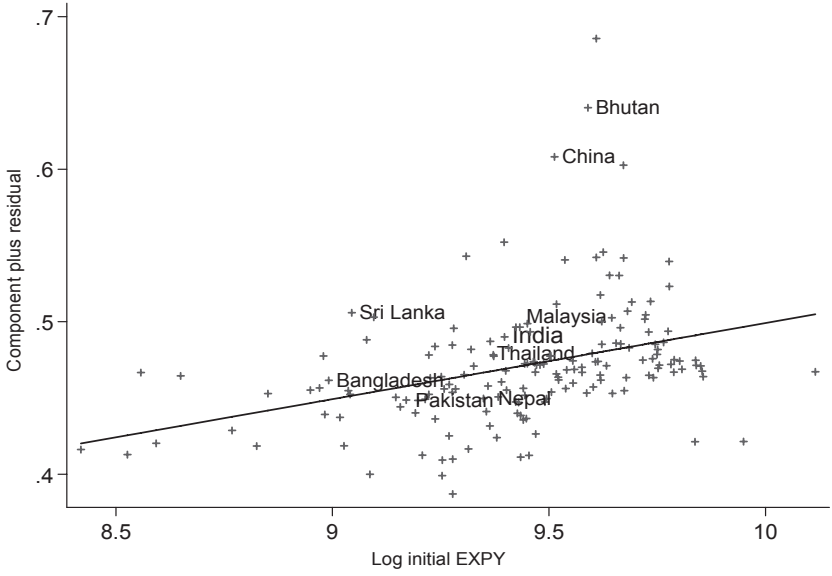
	Dependent variable: Growth rate of GDP per capita between initial and final years
Log(initial GDP per capita)	-0.0096 (-2.97)**
Log(initial EXPY)	0.0499 (3.62)**
Constant	-0.355 (-2.16)**
Number of observations	165
R^2	0.0661

Source: Author's computations based on COMTRADE data.
Note: ** indicates significance at 1% level.

[5] HHR show in fact that this relationship holds strongly in the case of low and lower middle-income countries compared with richer countries.

Figure 7 plots per capita GDP growth against initial EXPY, but after subtracting the effect of the other explanatory variable (initial GDP) on per capita GDP growth. It shows that there is a positive relationship between initial export sophistication and growth after accounting for the effect of the initial level of income on growth. This implies that in addition to policy measures that encourage exports, in general, the Government has a role to play in encouraging entrepreneurs to develop and export high-value products in order to achieve higher economic growth. Since the knowledge externalities created by innovation are not internalized there are likely to be suboptimal levels of this activity (HHR). Even if a country has a comparative advantage to potentially produce high-value products it may end up producing low-value products unless Government plays an active role in fostering innovation. The East Asian growth experience is an example where active public policy played a critical role in catching up, as regards technology, with advanced economies. Apart from providing a stable macroeconomic environment, legal framework and encouraging competitive markets, Governments in countries such as Japan and the Republic of Korea had policies aimed specifically at altering the industrial structure and promoting technological learning.

Figure 7. Partial relationship between initial export sophistication and subsequent growth



Source: Author's computations based on COMTRADE data.

Thus, apart from undertaking steps to improve trade logistics and customs and export procedures to facilitate trade, in general, the Government in collaboration with private entrepreneurs needs to identify the constraints faced in developing high-value products and provide the required support, such as tax incentives and trade protection, without unduly distorting market mechanisms.

Potential for developing export sophistication

Given that the level of export sophistication has an important bearing on economic growth, what are the prospects for a country to develop its export sophistication? HK relate the likelihood that a country develops greater export sophistication in the future to the current positioning of a country's exports in the product space. That is, how closely related are a country's current exports to high productivity products in the sense of mobility or adaptability of factors of production from one product to another? If factors can be adapted easily from the production of one product to another then the products are said to be close to each other. In general, parts of the product space can be dense where goods are distributed close to each other and parts of it can be sparse where goods are situated far from each other. If a product is in the dense part of the product space it is said to be centrally located and if it is in a sparse part it is said to be located peripherally.

HK define a measure of proximity (φ), or closeness of products. Based on the trades taking place between all countries for any year, one can obtain p(i/j), the probability that a country exports good i with revealed comparative advantage given that it exports good j with revealed comparative advantage. The greater this probability is, the greater the proximity between products i and j. Since a distance measure needs to be symmetric, the proximity between i and j is defined as

$$\varphi_{ij} = \text{Min } \{p(i/j), p(j/i)\} \quad (4)$$

Whether a product is central or peripheral is based on a measure of its centrality, which is defined as:

$$\text{Centrality}_{it} = \sum_j \varphi_{ijt} / J \quad (5)$$

where J is the maximum possible number of products.[6]

Based on 3-digit-level export data, the centrality values range between 0.05 and 0.28 with a mean value of 0.19 (table 9). A product's centrality value will be greater if it is close to several other products, or in other words, in a denser part of the product space. Conversely, if a product's centrality value is lower, it is removed from most other products

6 See Hausmann and Klinger (2007).

(or in a sparse part of the product space). It can be noticed that the densest part of the product space tends to be dominated by manufactured products and the sparsest part mostly by unprocessed primary goods (tables 10 and 11).

Table 9. Descriptive statistics for centrality measure for South Asia

Variable	Number of observations	Mean	Std. dev.	Min.	Max.
Centrality (average for 1988-1993)	261	0.19656	0.04487	0.05439	0.27659

Source: Author's computations based on COMTRADE data.

Table 10. Least central (or peripheral) products

Product code	Product name	Centrality (average for 1988-1993)
244	Cork, natural, raw and waste	0.0543903
274	Sulphur and unroasted iron pyrites	0.0643176
231	Natural rubber, etc.	0.0661762
633	Cork manufactures	0.071903
286	Uranium, thorium ores, etc.	0.0739364
284	Nickel ores and concentrates; nickel mattes	0.0792127
272	Fertilizers, crude	0.086642
264	Jute and other textile bast fibres	0.0977179
321	Coal, not agglomerated	0.0982876
881	Photographic apparatus and equipment	0.1087232
763	Sound recorders, phonographs	0.1099827
785	Cycles, motorcycles, etc.	0.1114328
345	Coal gas, water gas, etc.	0.1132215
322	Briquettes, lignite, peat	0.1139405
911	Postal packages not classified according to kind	0.1156764
687	Tin	0.1172754
422	Fixed vegetable fats and oils, other oils	0.1199897
714	Engines, motors and non-electric parts	0.1211135
268	Wool, other animal hair	0.1221932
343	Natural gas	0.1242425

Source: Author's computations based on COMTRADE data.

Table 11. Products that are highly central

Product code	Product name	Centrality (average for 1988-1993)
892	Printed matter	0.2765864
812	Plumbing, sanitary equipment, etc.	0.274293
533	Pigments, paints, etc.	0.2720924
691	Metallic structures	0.2700373
893	Plastic articles	0.2692378
716	Rotating electric plant	0.2676733
621	Rubber materials	0.2648016
692	Containers for storage or transport	0.2634526
895	Office, stationery supplies	0.2606351
581	Plastic tube, pipe, hose	0.2577854
744	Mechanical handling equipment	0.2573103
663	Mineral manufactures	0.2569276
657	Special yarn, textile fabrics	0.256697
513	Carboxylic acids, derivatives	0.2562745
699	Manufactures of base metal	0.2553734
554	Soap, cleaners, polish, etc.	0.2550222
48	Cereal preparations	0.2548453
676	Iron and steel bars, shapes, etc.	0.253457
721	Agricultural machinery (excluding tractors)	0.2532044
642	Paper, paperboard, cut to size or shape	0.2528483

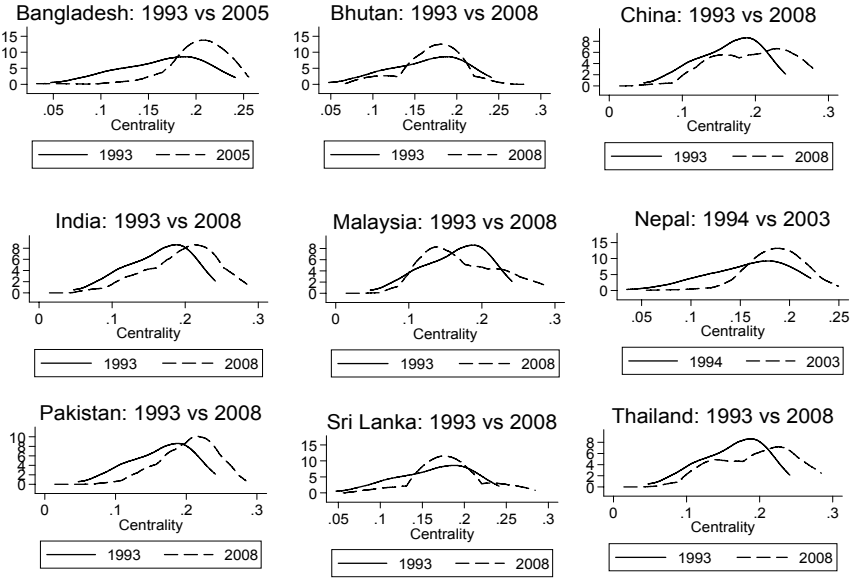
Source: Author's computations based on COMTRADE data.

If a country develops comparative advantage in a product that belongs to the dense part of the product space it leads to spillover benefits, as the capabilities can be transferred to nearby goods. Since these spillovers cannot be internalized in perfectly competitive markets the Government has an important role facilitating innovation, by providing appropriate infrastructure and policy environment. This facilitating role is in direct contrast to the interventionist role adopted by the old structural economics where market failures preventing the development of advanced capital-intensive industries are assumed to be exogenously determined by distorted price signals arising from monopolies or immobility of factors. According to the new structural economics the failure to develop advanced capital intensive industries in developing countries is endogenously determined by their endowments

(Lin, 2010).[7] "The old structural economics advocates development policies that go against an economy's comparative advantage and advise governments in developing countries to develop advanced capital-intensive industries through direct administrative measures and price distortions. By contrast, the new structural economics stresses the central role of the market in resource allocation and advises the state to play a facilitating role to assist firms in the process of industrial upgrading by addressing externality and coordination issues" (Lin, 2010).

Export data can be used to check how each country's export specialization changes over time as measured by the distribution of its exports in the centrality space. In a similar fashion to the distribution of countries' exports across productivity values, structural transformation can be seen in terms of the distribution of a country's export values shifting towards products of higher *centrality* values (figure 8).

Figure 8. Distribution of export values across centrality values



Source: Author's computations based on COMTRADE data.

[7] Lin and Monga (2010) summarize the elements of the new structural economics as: (a) a country's comparative advantage is defined by its evolving potential of its endowment structure; (b) the market provides a reliable mechanism for optimal resource allocation at any given stage of development; and (c) and the state plays a facilitating role in the process of industrial upgrading.

Estimating the potential for exporting high-value products

Based on the proximities between products, one can obtain a measure (called density) to tell how close a country's current export basket is to each of the products it currently does not export with revealed comparative advantage.[8] The density of a country's exports around a product *i* that is not currently exported by the country is given as the sum of proximities from good *i* to all products that are currently exported with comparative advantage, divided by the sum of proximities to all products.

$$\text{Density}_{it}^{c} = \sum k \, \varphi ikt \, x_{kt}^{c} / \sum k \, \varphi_{ikt} \qquad (6)$$

where $x_{kt}^{c} = 1$ if $RCA_{kt}^{c} > 1$, = 0 otherwise.

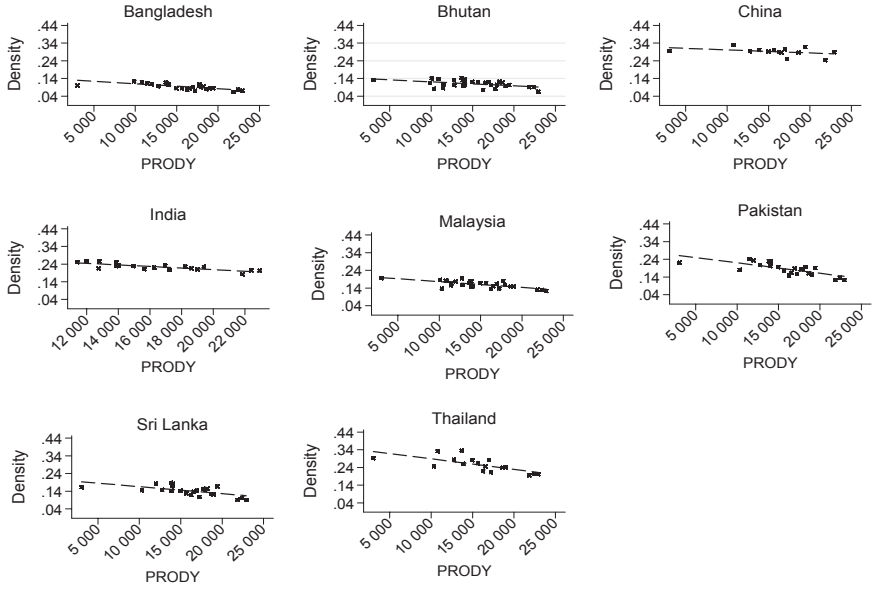
It is easy to check that the density measure lies between 0 and 1. The density measure is a highly significant determinant of structural transformation (that is, the probability of exporting a new good). Firms find it more profitable to move to nearby goods compared to farther ones as the cost of producing a new product rises with distance. Therefore, one can expect rapid structural transformation in countries that have high density around high-productivity (PRODY) goods.

The density measure can be computed for each of the products *i* that a country is currently not exporting (or exporting, but with RCA < 1). It gives an indication of the likelihood of a country developing comparative advantage in good *i* in the future, given its current export comparative advantages. The potential for future structural transformation in a country can be assessed by examining the density of the current export basket around unexploited products with different productivity (PRODY) values.

Figures 9a-9c show that, for all the countries considered, density is lower around unexploited products of high value compared to that around low-value products. This makes it difficult for countries to quickly increase the productivity level of their exports as their current exports are distant from the unexploited high-value products. This situation has not changed over the years for all the countries considered, except in the case of China.

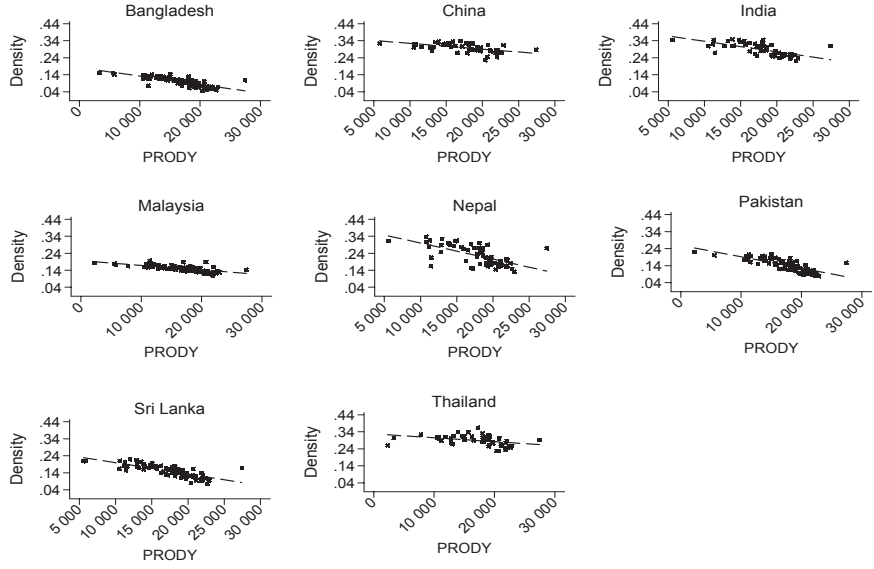
8 Hausmann and Klinger (2007).

Figure 9a. Density of exports around products that are not exported (density vs PRODY : 1993)



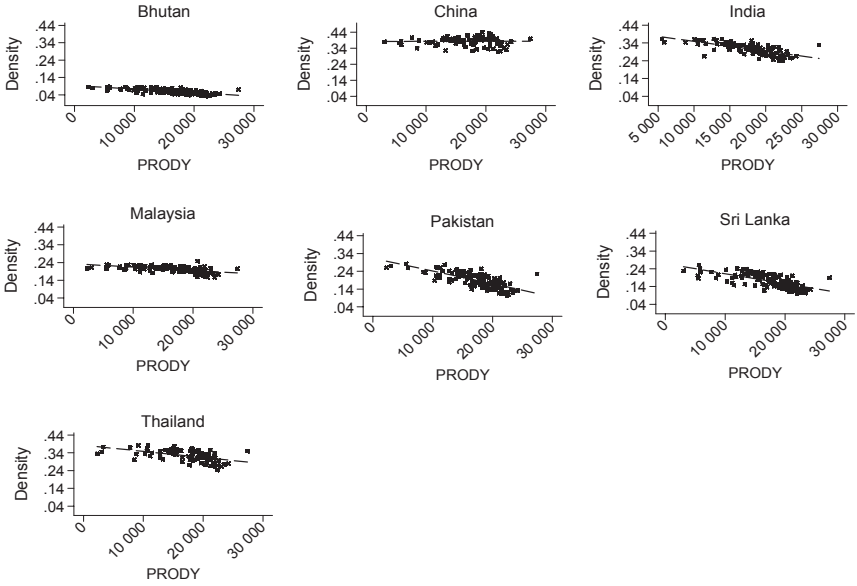
Source: Author's computations based on COMTRADE data.

Figure 9b. Density of exports around products that are not exported (density vs PRODY : 2003)



Source: Author's computations based on COMTRADE data.

Figure 9c. Density of exports around products that are not exported (density vs PRODY : 2008)



Source: Author's computations based on COMTRADE data.

Based on the estimated "densities" around different products, a summary measure called "open forest" can be obtained for each country. This measure denotes a country's productivity potential from exploiting all the products that it is currently not exporting. Hidalgo and others (2007) provide an analogy of a forest for the product space where each tree is considered a product. Each firm operating in a product is like a monkey on a tree. The monkey can easily jump to nearby trees but not to far off ones. Open forest therefore refers to the product space that can potentially be exploited given their current location in the forest (dense areas or sparse ones). They suggest that "lack of connectedness may explain the difficulty faced by countries trying to converge to the income levels of rich countries". If proximities to higher value products are low, structural transformation becomes difficult. "Open forest" is obtained as the weighted sum of PRODYs of products currently not exported, the weights being the density of the country's current export basket around each of these products.

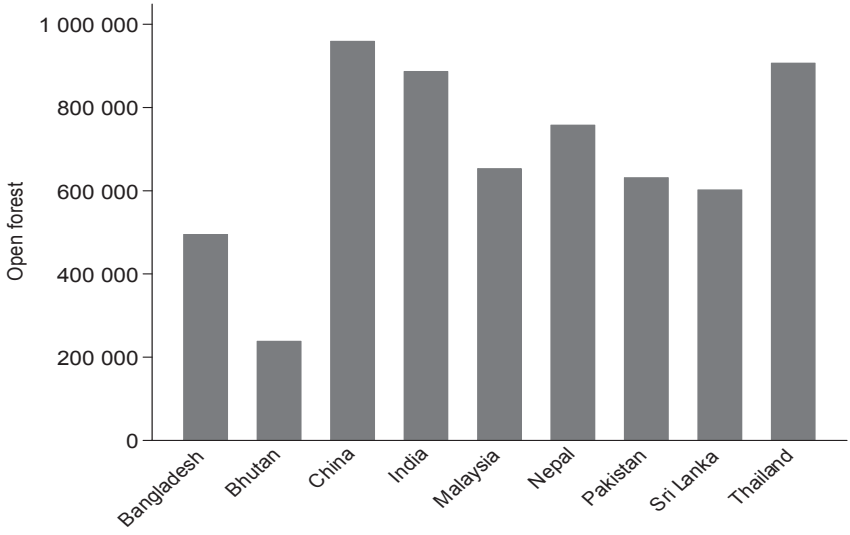
$$\text{Open forest}^c = \sum_i \text{Density}_i^c \, (1 - x_i^c) \, \text{PRODY}_i \qquad (7)$$

where $x_i^c = 1$ if $RCA_i > 1$, $= 0$ otherwise.

HK show that this variable strongly predicts the speed of structural transformation as measured by growth in the level of sophistication of exports. They argue that "the speed at which countries can transform their productive structure and upgrade their exports depends on having a path of nearby goods that are increasingly of higher value".

The open forest measure is obtained for the different countries based on the data available for the latest years (figure 10). Among the South Asian economies, India has the highest potential for structural transformation, close to the values obtained for China and Thailand. Nepal, Sri Lanka and Pakistan have slightly lower potential but comparable to that of Malaysia. Bhutan has the least potential followed by Bangladesh.

Figure 10. Potential for increasing export sophistication



Source: Author's computations based on COMTRADE data.

The factors that can explain the growth in export sophistication over the years are obtained using cross-section regressions. We notice that the initial level of export sophistication has a statistically significant influence on its future growth and is negatively related (table 12). This indicates that there is convergence across countries in terms of export sophistication. Countries with low levels of sophistication tend to advance faster as regards technology, conditional on other factors such as their initial potential given by open forest. To some extent it is also a reflection of the initial level effect on growth. Initial levels of trade openness (trade/GDP) and inflows of FDI (FDI/GDP) do not have any significant impact on the growth in export sophistication. After accounting for the effect of initial EXPY, growth in export sophistication is positively related to initial open forest (potential for export sophistication) (figure 11).

Table 12. Cross-section regression: growth in export sophistication

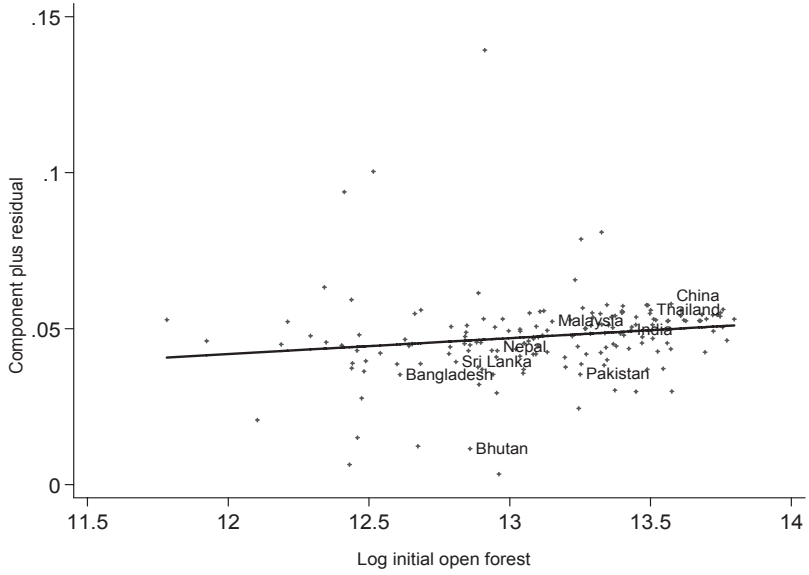
Product code	Dependent variable: growth rate of EXPY between initial and final years		
Log (initial EXPY)	-0.0373 (-7.77)[a]	-0.0367 (-9.27)[a]	-0.0365 (-9.33)[a]
Log (initial trade/GDP)	-0.0014 (-0.47)	—	—
Log (initial FDI/GDP)	0.0003 (0.15)	0.0008 (0.40)	—
Log (initial "open forest")	0.0039 (1.19)	0.0037 (1.61)[b]	0.0036 (1.61)[b]
Constant	0.315 (5.68)[a]	0.303 (5.63)[a]	0.304 (7.65)[a]
Number of observations	114	164	165
R^2 adjusted	0.3408	0.3419	0.3458

Source: Author's computations based on COMTRADE data.

Notes: [a] Indicates significance at 1% level.

[b] Indicates significance at 10% level.

Figure 11. Partial relationship between initial open forest and growth in export sophistication



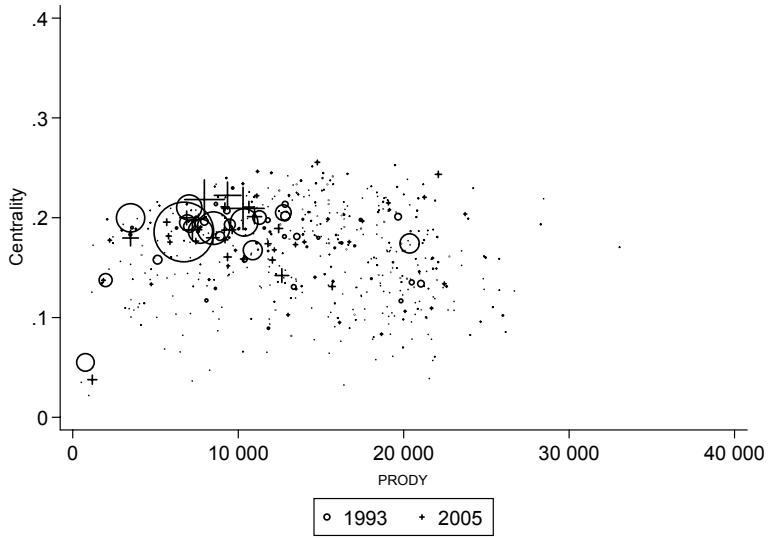
Source: Author's computations based on COMTRADE data.

Note: Open forest is a measure of the productivity potential from exploiting all the currently untraded products based on the density of the current export basket around these products.

Product space: centrality versus productivity index

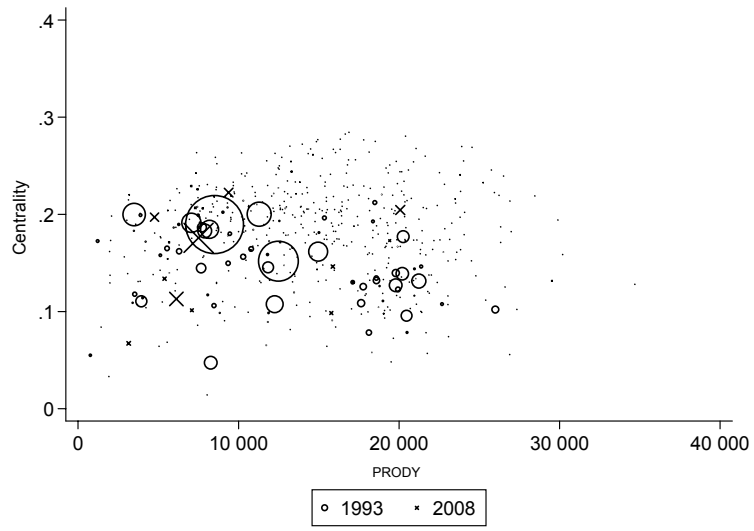
The product space can be characterized by the two measures defined above: (a) the centrality of a product, which indicates the potential for factor substitutability across products; and (b) the income or productivity index of a product (PRODY). One can obtain the distribution of each country's exports across both these characteristics and examine how this distribution changes over time. The pattern of specialization by different countries is revealed by the location of its exports in the product space. Exports of less developed countries are likely to be mostly peripheral (concentrated on products that are less central). They are also more likely to be concentrated in products with low productivity value. Shifts in these distributions can be expected for economies undergoing structural transformation. Figures 12-20 below depict the location of export values in the product space for different countries. In the case of Bangladesh we see that compared to the year 1993, in 2005 most of the export values continue to be low on productivity value but have moved up slightly to denser parts of the product space. In the case of Bhutan, there has been no appreciable change in its position in the product space between the years 1993 and 2008. India's export values, however, moved up on both the centrality and productivity scales between 1993 and 2008. For the East Asian economies, such as China, Malaysia and Thailand, the picture clearly shows that export values have substantially moved up to high-productivity values and also to denser parts of the product space. In the case of Sri Lanka many products in the export basket belong to the denser parts of product space in 2008. But in terms of export values a substantial part of the basket is in the low-productivity region as in 1993. Many more products in Nepal's export basket are centrally located in 2003 compared to 1994. Similarly, in the case of Pakistan quite a few products in 2008 are more centrally located compared to 1993, but a large part of exports in value terms remain in the low-productivity range. These results can also be looked at from the perspective of countries' capabilities, as in Hidalgo and Hausmann (2009). According to them a country's productive structure evolves from two sources: finding new products from combinations of the capabilities they already have, and accumulating new capabilities. Countries that are below the income expected from their capability endowment are yet to develop all of the products that are feasible with their existing capabilities.

Figure 12. Product space (1993 versus 2005): Bangladesh



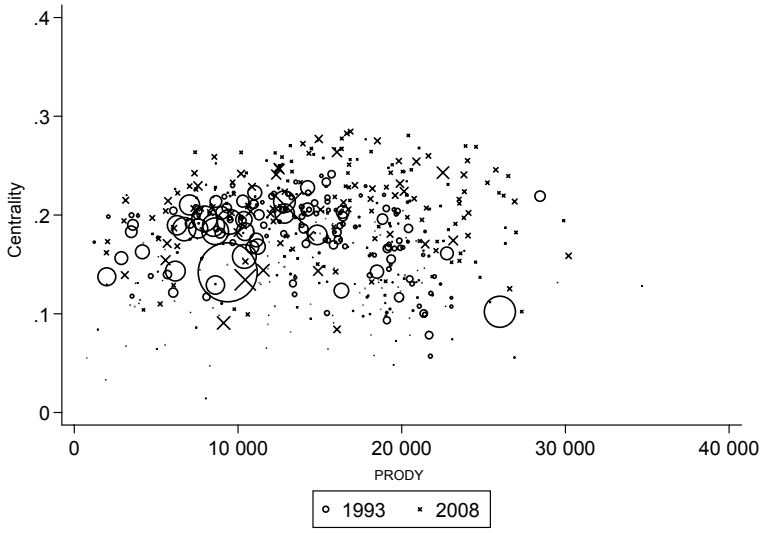
Source: Author's computations based on COMTRADE data.
Note: The size of the indicator is proportional to the value of exports.

Figure 13. Product space (1993 versus 2008): Bhutan



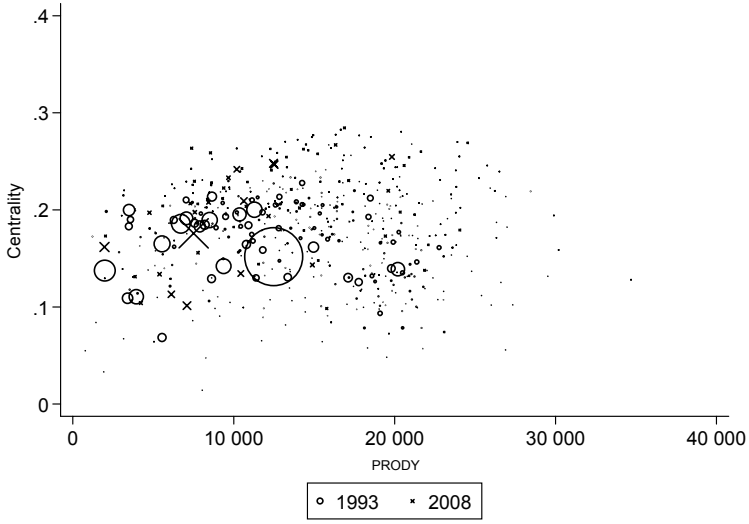
Source: Author's computations based on COMTRADE data.

Figure 14. Product space (1993 versus 2008): India



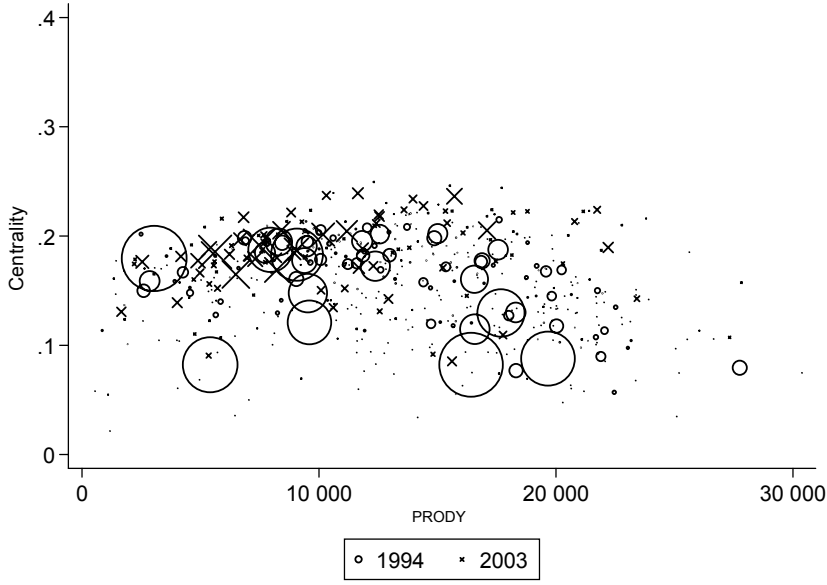
Source: Author's computations based on COMTRADE data.

Figure 15. Product space (1993 versus 2008): Sri Lanka



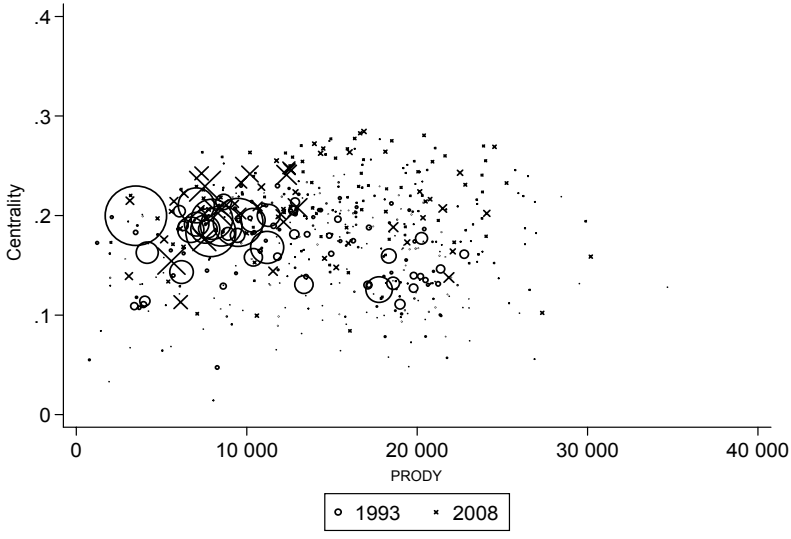
Source: Author's computations based on COMTRADE data.

Figure 16. Product space (1993 versus 2003): Nepal



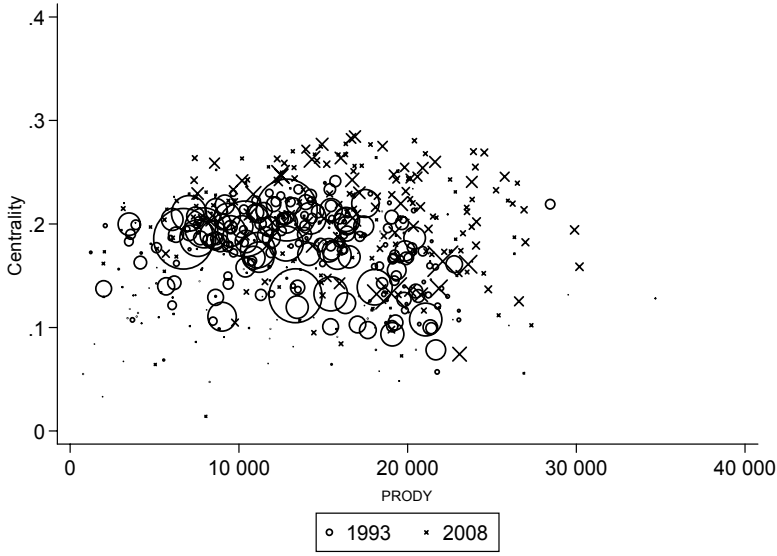
Source: Author's computations based on COMTRADE data.

Figure 17. Product space (1993 versus 2008): Pakistan



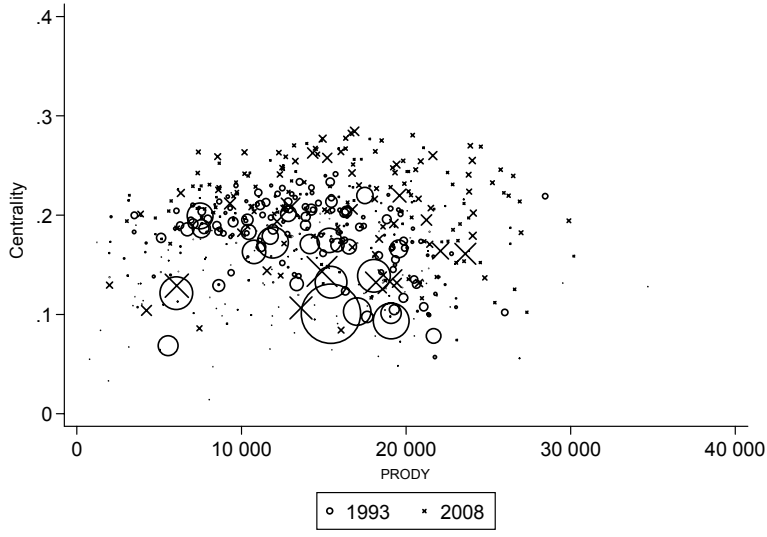
Source: Author's computations based on COMTRADE data.

Figure 18. Product space (1993 versus 2008): China



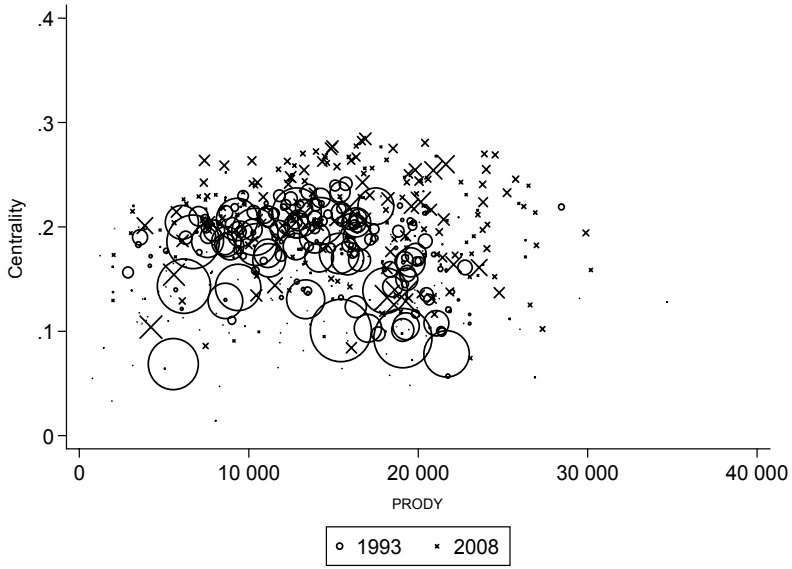
Source: Author's computations based on COMTRADE data.

Figure 19. Product space (1993 versus 2008): Malaysia



Source: Author's computations based on COMTRADE data.

Figure 20. Product space (1993 versus 2008): Thailand



Source: Author's computations based on COMTRADE data.

The share of the service sector has been increasing at a high rate in many of the South Asian economies to the extent that some authors suggest that these countries could achieve sustainable growth by skipping the industrialization phase. However, this is unlikely since there is a positive association between the level of sophistication of the production structure and economic growth and it is less likely that the service sectors are proximate to many high-value products. Moreover, there are limitations on generating employment in the high-skilled sectors, such as information technology, when the vast majority of the labour force is unskilled.

IV. CONCLUDING REMARKS

This study describes the structural transformation process in South Asian economies. The fact that per capita GDP has been high in recent years in most of these countries is due to impressive growth in the industry and service sectors. In terms of stability, the service sector growth has been most stable and agricultural growth the most unstable. For most South Asian countries the share of services in GDP exceeds the shares of manufacturing and agriculture sectors. However, agriculture constitutes the main source of employment in South Asia, absorbing the highest proportion of the labour force, namely between 40 and 60

per cent. Despite the rising share of services in India, only 25 per cent of total employment is provided by this sector.

Apart from analysing the sectoral shares of output and employment, the structure of exports of these economies is examined making use of a methodology developed in the recent literature on trade and growth. Based on this methodology a measure or index of export sophistication for each of the countries' export baskets is derived. As shown in the literature, a country's initial level of export sophistication is a significant factor in an economy's future growth. In this paper, it is found that in general, the level of sophistication is low for exports from South Asian economies compared to some of the East Asian ones, such as China, Malaysia and Thailand. However, export sophistication has been rising over the years in all the countries and the rise is remarkable particularly in the case of India and the rate is comparable to the East Asian countries. The low level of diversification of exports is one of the reasons for the slow structural transformation of these economies in terms of export sophistication.

The potential for future export sophistication for each of the countries depends on how close the current export basket is to currently unexported products, in particular, to high-value products. The proximity of a country's current exports to high-productivity products is determined by the ease with which factors of production used in the production of the former can be adapted for production of the latter. It is found that for all the countries the proximities or the density of the current export basket around high-value products is lower compared to the same around low-value products.

The average of the density of the export basket around the set of all unexploited products is obtained by a summary measure called open forest. Growth in export sophistication is found to be positively related to the initial level of open forest, controlling for the initial level of income. Among the South Asian countries, open forest is highest for India and lowest for Bhutan followed by Bangladesh.

Over time in most countries, exports moved towards products of high values and high degrees of centrality as measured by the proximities to other products in the product space. In general, government policy can play an important role in developing countries in accelerating the process of diversification into sophisticated products. Governments, in collaboration with the private sector, can identify strategic areas where innovations can be encouraged by adopting conducive infrastructure and trade policies. However, attempting to upgrade to sophisticated production structure through distortional policies may not be advisable as it may not be sustainable. What is important is to help develop capabilities and comparative advantage for sustainable growth.

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DO AGRICULTURAL HOUSEHOLDS SHARE RISKS IN THAILAND? EVIDENCE FROM THAI SOCIO-ECONOMIC PANEL SURVEY DATA

*Aeggarchat Sirisankanan**

For this paper, three waves of the Thai Socio-Economic Panel Survey data which cover the years 2005-2007, are used for the first time to examine risk sharing through many specifications. The findings show that the null hypothesis of full insurance against income shock is rejected for the whole country case together with a group consisting of a sample from the Central, Eastern and Western regions. This rejection, nevertheless, is supported by the existence of evidence of partial insurance for the whole country case. Unlike income shock, a specific adverse shock, which uses the illness of the household head as a proxy, is fully insured by households for all region groups except a group consisting of a sample from the Central, Eastern and Western regions.

JEL Classification: O12, Q12, R20.

Key words: Income shock, risk sharing, consumption smoothing, Thai household panel data.

I. INTRODUCTION

Risk is an inevitable fact of life for people in most developing countries. In Thailand, a large number of households, mainly agricultural households, often face various risks similar to the ones prevalent in other developing countries. Consequently, their lives are vulnerable to risk.[1] However, even with the absence of a complete credit and insurance market as a result of the well known problem of asymmetric information (Stiglitz and Weiss, 1981), these agricultural households have been using a variety of alternative mechanisms to protect their lives from adverse risks in ways that similarly done in most developing countries.

* Faculty of Accountancy and Management, Mahasarakham University, Khamriang Subdistrict, Khatarawichai District, Maha Sarakham 44150, Thailand (Tel: 66 4375 4321, fax: 66 4375 4422; e-mail: aeggarchat@yahoo.com).

[1] Vulnerability is the likelihood that at a given time in the future, an individual will have a level of welfare below some norm or benchmark (Hoddinott and Quisumbing, 2003).

Alderman and Paxson (1992) categorize alternative mechanisms into two main mechanisms. The first is risk management, which includes crop and field diversification, income source diversification, sharecropper tenancy and migration of family members. The second is risk coping, which can be classified as those that smooth consumption intertemporally through borrowing, selling assets, savings and remittances, and those that smooth consumption across space (households), through risk sharing. In addition to those two mechanisms, because most developing countries might face both the incompleteness of formal insurance and the limitations of informal insurance mechanisms, governments may also take action in terms of public safety net programmes, such as crop and unemployment insurance and microcredit programmes, to improve people's welfare.

Among the variety of mechanisms, the focus of this paper is on risk sharing due to six reasons. First, there is still the incompleteness of a credit and insurance market in Thailand, especially in rural areas (see the details in Siamwalla and others, 1990; Kaboski and Townsend, 2005). Second, consumption smoothing (over time) may be very costly in circumstances characterized by the difficulty in borrowing (Kinsey, Burger and Gunning, 1998). Third, most risk management options (ex ante actions) might also be costly, so that the households would be sacrificing income, on average, in order to assume a less risky stream of income (Bardham and Udry, 1999). Fourth, public safety nets are very costly and may crowd out other informal mechanisms (Cox and Jimenez, 1995; Jensen, 2004). Fifth, some households are often too poor and weak to use both risk management mechanisms and consumption smoothing over time strategies. Finally, with the acceptance of *The Moral Economy of the Peasant*, a book written by James Scott in 1976, together with well known Thai cultural traits, such as generosity and charitableness, especially in rural society, it is interesting to examine these abstracts through risk-sharing behavior. The study of Ravallion and Dearden (1988) indicates that as developing economics become more urbanized, there is a decline in the distributional significance of the moral economy. Therefore, if this statement is true, risk-sharing behavior in Thai agricultural households may decline.

Excluding the original study of Mace (1991) and Cochrane (1991), which uses data from the United States of America, in most studies, the full insurance model is tested by using data from developing countries. Among them are the following: Townsend (1994), Ravallion and Chaudhuri (1997) and Morduch (2002) for India; Jalan and Ravallion (1999) for China; Gertler and Gruber (2002) for Indonesia; Fafchamps and Lund (2003) for the Philippines; and Weerdt and Dercon (2006) for Tanzania. Despite different methodologies and data sources, full insurance is rejected in these studies. This includes the study of Townsend (1995), which also uses data from Thailand.

However, even though a fully Poreto-efficient allocation of risk within communities is rarely achieved[2] (Bardhan and Udry, 1999), partial risk sharing could still possibly be an important method of consumption smoothing (Alderman and Paxson, 1992). The existence of some level of risk sharing at least implies that idiosyncratic risks are shared at some level among community members.

Motivated by the existence of at least partial risk sharing, a study conducted by Townsend in Thailand (Townsend, 1995) is reexamined with a stronger technique and more insight. This paper, nevertheless, is different from the study of Townsend in several specifications. First of all, three waves of Thai Socio-Economic Panel Survey data that cover the years 2005-2007 are used for the first time, and thus allow a look at behavior of the households over time as well as control for unobserved household heterogeneity. Secondly, instead of using an amphoe (district) unit as an observation unit, as is the case with most risk-sharing studies, household units are used in this paper. Thirdly, as were earlier noted in the prospect of the existence of the moral economy, including well known Thai cultural traits, Thai agricultural households that mostly dwell in rural areas and thus are expected to have the greatest possibility of risk-sharing behavior (Ravallion and Dearden, 1988) are specified in this paper. Fourthly, since perfect risk sharing or full consumption insurance is rarely found, testing for partial consumption insurance within the same community is carried out. Finally, with concern for the problem of endogeneity and measurement errors in income variable, the instrument variable technique is applied the test.

As with most empirical studies, the null hypothesis of full insurance against income risk is rejected for the whole country and most regions in this paper. This rejection, nevertheless, is complemented by the existence of evidence of partial insurance and community risk sharing. In the next section, the theoretical framework of modeling consumption across space is outlined. Section III contains a description of the empirical specifications and data used, and section IV contains a discussion on the empirical results. In section V, the conclusion and the policy implications are set forth.

[2] In a Pareto-efficient allocation of risk within community, households face only aggregate risk. Idiosyncratic income shocks are completely insured within the community.

II. BACKGROUND

General derivations of risk-sharing models can be found in Mace (1991), Cochrane (1991), and Townsend (1994). Here only a brief derivation is provided. Let $i = 1,..., N$ index the households that live in the village. There are T periods, indexed by t. The state of nature S is indexed by s, and π_s is the probability of occurrence in each state of nature. Suppose that the utility function, which is presumed to be additively separable across time and states, for each household i is

$$\sum_{t=1}^{T} \delta^t \sum_{s=1}^{S} \pi_s U_i(C_{ist}, Z_{ist}) \tag{1}$$

where δ^t is the discount factor, and C_{ist} and Z_{ist} are the consumption and preference shock respectively of household i if state s occurs in period t.

A Pareto-efficient allocation of risk within the village can be found when a social planner efficiently allocates consumption across households. It is done by maximizing the weighted sum of the utilities of each of the N households, where the weight of household i in the Pareto programme is $\omega_1, 0 < \omega_i < 1, \sum \omega_1 = 1$:

$$\max_{C_{ist}} \sum_{i=1}^{N} \omega_i \sum_{t=1}^{T} \delta^t \sum_{s=1}^{S} \pi_s U_i(C_{ist}, Z_{ist}) \tag{2}$$

subject to the resources available in the village at each point in time in each state of nature:

$$\sum_{i=1}^{N} C_{ist} = \sum_{i=1}^{N} y_{ist} \forall_s, t \tag{3}$$

$$C_{ist} \geq 0 \ \forall_i, s, t \tag{4}$$

equation (3) is the set of village resource constraints. Equation (4) represents the non-negative constraints, which will not bind if the village has any resources in each period along each possible point in history (Bardhan and Udry, 1999). In addition, it is assumed that Y_{ist}, which is the income of the household i in state s at time t, consists of an individual-specific fixed effect μ_i, an aggregate shock μ_{st} and an idiosyncratic shock ν_{ist}:

$$Y_{ist} = \mu_i + \mu_{st} + \nu_{ist} \tag{5}$$

If a derivative with respect to C_{ist} and C_{jst} is taken, the first order conditions for the problem maximize (2) subject to (3) and (4) yield:

$$\omega_i U'_i(C_{ist}, Z_{ist}) = \omega_j U'_j(C_{jst}, Z_{jst}) = \lambda_t \quad \forall_{i,j,st} \tag{6}$$

where λ_t is the Lagrange multiplier on the village resource constraint, i.e. the marginal utility of income. Equation (6) says that, with a perfect risk-sharing condition, total village resources in any period are distributed across households so as to equate the weighted marginal utility of consumption across households. Furthermore, the social planner cannot transfer resources from one household to another and improve the weighted sum of their utility; at the optimum any further transfers reduce social welfare (Morduch, 2002).

If it is assumed that a household's preference is a constant absolute risk aversion (CARA) utility function with the form:

$$U_i(C_{it}, Z_{it}) = -\frac{1}{\sigma}\exp^{-\sigma(C_{it}-Z_{it})} \tag{7}$$

where σ is the Arrow-Pratt measure of absolute risk aversion, equation (6) may be expressed, after subtracting logarithmic transformation of equation (7) with its averaging over the *N* individuals and rearranging, as

$$C_{it} = \bar{C}_t + \left[\frac{1}{\sigma}(log\omega_{it} - log\bar{\omega})\right] + (Z_{it} - \bar{Z}_t) \tag{8}$$

Equation (8) indicates that there are three important implications. First, households' consumption depends on the average consumption of the village, a time-invariant household fixed effect which depends upon the relative weight of the household in the Pareto programme and preference.[3] Second, after controlling for average consumption, change in household income (ΔY_{is}) does not affect its own consumption. Third, perfect risk sharing only protects against idiosyncratic rather than aggregate risk.

Nevertheless, it should be noted that from the second welfare theorem, it is known that the Pareto-efficient allocation of risk can be supported by a competitive equilibrium with a complete contingent market. However, the notion that such a rich set of competitive markets exits is incredible because any risk-pooling mechanism may not overcome the information and enforcement problems associated with insurance contracts. Consequently, a complete set of markets will not exist and the competitive equilibrium will not be Pareto-efficient. Therefore, to achieve efficient (or nearly efficient) risk pooling other mechanisms, such as gifts and transfers may be implemented to support it (Bardhan and Udry, 1999).

[3] Differencing can eliminate a time-invariant household fixed effect implicit in equation (9), while the preference term can also be eliminated if it is assumed that preferences do not change with time.

III. EMPIRICAL SPECIFICATIONS AND DATA DESCRIPTION

Empirical specifications

Empirical specifications for a risk-sharing test generally depend on assumed preferences. However, if the CARA utility function is assumed as in the previous model derivation and after first differencing equation (8) to eliminate a time-invariant household fixed effect, the primary empirical specification for the CARA utility function of the form may be expressed as:

$$\Delta C_{it} = \beta_1 \Delta \bar{C}_t + \beta_2 \Delta Y_{it} + \mathrm{u}_{it} \tag{9}$$

where ΔC_{it} and ΔY_{it} are the change in household consumption and income, respectively. ΔC_t is the change in average consumption and u_{it} is the disturbance term that includes the time-varying component of both household and aggregate preference shocks and might also include measurement errors from the consumption and income data.[4]

However, to complement with the scope of three waves of Thai Socio-Economic Panel Survey data, the formal specification for equation (9), which is exploited in the paper, may be rewritten as follows:[5]

$$\Delta C_{itv} = \sum_{tv} \delta_{tv}(D_{tv}) + \beta \Delta Y_{itv} + \xi \Delta S_{itv} + \delta X_{itv} + \Delta \varepsilon_{itv} \tag{10}$$

where S_{itv} the idiosyncratic shocks (the preference shifters). D_{tv} is time-community dummies (round and community dummies interacted) which capture changes in the resource constraints faced by the community at different times. In other words, they are a proxy for the aggregate, community-level shocks to income. X_{htv} is a vector of household or household head's characteristics. $\Delta \varepsilon_{htv}$ is a household-specific error term capturing changes in the unobservable components of household preferences and δ, β are vectors of parameters to be estimated. If there is perfect risk sharing within the village then household income will have no effect on consumption after controlling for common time-community (village) effects, i.e., $\beta = 0$.

[4] Alternatively, even if in several studies, the first different approach to test as sharing is used, the data are short panel data (three wave panel data); thus in this study the fixed effect estimator, which has been used by Kazainga and Udry (2006).

[5] Several authors also utilize equation (10) for a test of risk sharing. They are: Ravallion and Chaudhuri (1997); Jalan and Ravallion (1999); Morduch (2002); Skoufias (2003); Skoufias and Quisumbing (2003); Harrower and Hoddinott (2004); and Kazianga and Udry (2006).

Additionally, concerning the problem of endogeneity and measurement error on income variable, the instrumental variable technique for equation (10) is applied. This study follows the technique used in the studies of Fafchamps, Udry and Czukas (1998), Jacoby and Skoufias (1997) and Kazianga and Udry (2006). The income equation in those studies has been set as follows:

$$Y_{irt} = \alpha_1 X_{irt} + \alpha_2 R_{rt} \otimes Q_{irt} + \gamma_{rt} + \lambda_i + u_{irt} \quad (11)$$

However, if $\gamma_{rt} = \alpha_r R_{irt} + \tilde{Y}_{rt}$ is defined and assume that $\tilde{Y}_{rt}$ is uncorrelated with X_{irt} and Q_{irt}, equation (11) can be rewritten as

$$Y_{irt} = \alpha_1 X_{irt} + \alpha_2 R_{rt} \otimes Q_{irt} + \alpha_r R_{rt} + \lambda_i + (\tilde{\gamma}_{rt} + u_{irt}) \quad (12)$$

where Y_{irt} is the farm profit, R_{rt} is the deviation of rainfall from the long-run regional mean and this deviation squared, Q_{irt} is the farm characteristics that are the determinants of income, such as the demographic structure of the household and detailed information on its landholdings and their quality (Fafchamps, Udry and Czukas, 1998). X_{irt} is a set of household characteristics. γ_{rt} is a village-years fixed effect and u_{irt} is the disturbance term. The Kronecker product ($\otimes$) generates interaction terms.

Using the estimated income from equation (12), another specification for the paper is

$$\Delta C_{itv} = \sum_{tv} \delta_{tv}(D_{tv}) + \beta \Delta \hat{Y}_{itv+} \xi \Delta S_{itv+} + \delta \Delta X_{itv} + \Delta \varepsilon_{itv} \quad (13)$$

where $\hat{Y}_{itv}$ is the estimated income.

Generally, perfect risk sharing or full consumption insurance is hardly ever found. Therefore, another specification usually may be used to test for partial consumption insurance among households within the same community. This specification is based on the idea that in a purely autarkic world, where there is no pooling of resources and risk sharing, the average community income ($\overline{Y_{vt}}$) should have no impact on consumption of any one household. Evidence that average community income has a significant role in household consumption (i.e., $\gamma \neq 0$) is consistent with the hypothesis that some risk sharing is taking place within communities (Skoufias and Quisumbing, 2003). Therefore, to test for partial consumption, the insurance equation (13) may be written as:[6]

[6] Differently with Skoufias (2003), in this study village-year dummies variables are also controlled in this equation to capture all common shock at the village level since there may be some shocks within the village which the village mean income cannot capture, such as those that are characterized as being cultural or religious.

$$\Delta C_{itv} = \alpha + \beta \Delta Y_{itv} + \gamma \Delta(\overline{\hat{Y}_{vt}}) + \xi \Delta S_{itv} + \delta X_{itv} + \Delta \varepsilon_{itv} \quad (14)$$

where $\Delta(\overline{Y_{tv}})$ is the change in average community income. Applying then the instrument variable, equation (14) may be written as:

$$\Delta C_{itv} = \alpha + \beta \Delta \hat{Y}_{itv} + \gamma \Delta(\overline{\hat{Y}_{vt}}) + \xi \Delta S_{itv} + \delta \Delta X_{itv} + \Delta \varepsilon_{itv} \quad (15)$$

Data description

The main data source for this paper comes from the Thai Household Socio-Economic Panel Survey collected by the National Statistical Office (NSO). Due to the problem of endogeneity and measurement error on income variables, as well as using crop farmers as the sample household, time series regional rainfall data gathered by the Meteorological Department in the Ministry of Information and Technology are used for estimating income.

The Thai Household Socio-Economic Panel Survey is similar to Thai Socio-Economic Surveys (SES). It reports socioeconomic data of sample households who were interviewed repeatedly from 76 provinces throughout the country both inside and outside municipal areas over the three-year period 2005-2007. Approximately 6,000 households were chosen in the first round and those households contributed a response rate of about 96.2 per cent and 93.1 per cent in the second and third rounds, respectively. This panel data set thus yields about 18,000 sample households over the three-year period 2005-2007. However, because risk sharing among crop farmers is tested in the paper, about 5,650 crop farmer households were selected from the three survey years. These households were matched to the nearest weather station, which reported regional rainfall data during the period 1988-2007. Therefore, only 83 weather stations from the 115 stations were selected.

The main variables used in this paper are summarized in table 1. Consumption is total expenditures, which includes expenditure on all goods and services. Total income is the summation of farm profit and nonfarm income in terms of wages, salaries and benefits while village income is the average income of households who dwell in the same subdistrict. All of those income and expenditure variables were obtained by asking households in the year before the survey. Additionally, all money variables are also adjusted by the provincial consumer price index (PCPI) provided by the Internal Commercial Department in the Ministry of Commercial in each year of panel data.

Table 1. Means and standard deviations of main variables for the entire samples

Variables	Variable description	Means	Std. dev.
Income	Farm profit and nonfarm income	133 383.800	168 439.600
Consumption	Total expenditures	94 651.400	81 884.530
Nonmember_transfer	Transfer receipts from nonmember households	15 848.870	52 011.080
Owned_land	Land of households which is not rented land, public land or conserved forest	16.396	48.790
Unowned_land	Rented land and public land including conserved forest	4.550	42.231
Dev_rain	The deviation of rainfall	45.570	226.972
Dev_rain_squared	Squared of the deviation of rainfall	53 583.950	108 914.200
Head_illness	Illness of household's head	0.018	0.136
Head_age	Age of household's head	52.276	13.059
Head_age_squared	Squares of age of household's head	2 903.380	1 431.461
Members 0_5	Number of household's members under 6-years-old	0.317	0.549
Males 6_11	Number of household's males members aged between 6 and 11 years	0.235	0.478
Females 6_11	Number of household's females members aged between 6 and 11 years	0.208	0.453
Males 12_17	Number of household's males members aged between 12 and 17 years	0.217	0.458
Females 12_17	Number of household's females members aged between 12 and 17 years	0.211	0.453
Males_primary	Number of household's males members aged between 18 and 64 years and have a primary level of education	0.804	0.629
Females_primary	Number of household's females members aged between 18 to 64 years and have a primary level of education	0.913	0.567
Males_secondary	Number of household's males members aged between 18 to 64 years and have a secondary level of education	0.297	0.524
Females_secondary	Number of household's females members aged between 18 to 64 years and have a secondary level of education	0.219	0.446

Table 1. *(continued)*

Variables	Variable description	Means	Std. dev.
Males_postsecondary	Number of household's males members aged between 18 to 64 years and have a postsecondary level of education	0.088	0.303
Females_postsecondary	Number of household's males members aged between 18 to 64 years and have a postsecondary level of education	0.142	0.378
Members_65up	Number of household's members who are older than 64 years	0.336	0.619

Sources: The three wave Thai household panel data, 2005-2007 were collected by the National Statistical Office (NSO). Time series regional rainfall data were gathered by the Meteorological Department in the Ministry of Information and Technology.

Notes: 1. Data used in this study are annual data.
2. Unit of all money variables is baht and unit of land variable is rai (1 rai: 1,600 square meters).

Owned land, unowned land and soil's quality are included in the income equation to construct the instrument variable. Unowned land includes rented land, public land, conserved forest and other land while soil's quality are the dummy variable and was set to be 1 if the household's residence is located in the North-Eastern or Southern regions which have low quality of soil (Kanchanakul, Puthavatarat and Hultrakul, 2000). Illness and experience of the household head are also included in the income equation to control household head's characteristics. Age of household head is used as a proxy variable of household head's experience. The number of household members classified by gender, age and educational level are control variables in income equation. However, these household member's characteristic variables as well as illness of household head (which is equivalent to an idiosyncratic shock) were also included in consumption equation for testing on risk sharing.[7] The deviation of rainfall from its long-term average and its squared are also included in the model in conjunction with the panel data on household income to estimate income of crop farmer households. These rainfall variables are constructed by annual regional rainfall data obtained by summing monthly regional rainfall data that is reported by each regional weather station.

[7] A specified adverse shock is used to be an alternative test of complete risk sharing because it can account for a measurement error in income. However, due to data limitations, only illness of household head is included in model 8.

IV. EMPIRICAL RESULTS

By following specifications, an estimate of income to be used as an instrument variable was made. It was then used to test the risk-sharing model in the next stage.

Income equation

Fixed effect income regression is tested by separating results for the whole country and each region as shown in table 2. Owned land has a positive significant impact on a household's income in most regions. The impact of most individual rainfall variables and its interaction is highly significant for the whole country even though the impact of these variables on household income is different for each region. The impact of rainfall deviation on household income in the whole country and its square is significant in the North-Eastern region and in a group consisting of a sample from the Central, Eastern and Western regions whereas this has not been found to be evident in other regions. Rainfall deviation and its interaction with owned land and unowned land yields a negative significant impact at the 1 per cent and 5 per cent levels only in the North-Eastern and Northern regions, respectively, while the interaction term between rainfall deviation and age of household head provides a negative low significance on household income in the Southern region. This means that rainfall may not only affect income directly but also affect it through household characteristics. More specifically, income of household with household characteristic is a negative sensitivity to rainfall variations.

Consequently, with this evidence, the hypothesis that these individual rainfall variables are jointly insignificant is rejected at the 1 per cent level for the whole country, North-Eastern and a group consisting of a sample from the Central, Eastern and Western regions. These results thus still support the claim that rainfall variation may be one of the determinants of agricultural household's income in most regions.

Table 2. Fixed effect income regressions

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Owned_land	204.656 (74.979)***	418.871 (543.859)	585.647 (676.505)	101.010 (33.367)***	2 390.422 (835.398)**
Unowned_land	-20.984 (65.944)	-787.761 (677.432)	-742.239 (2 505.049)	40.671 (75.935)	14.369 (1 048.843)
Dev_rain	485.024 (159.392)***	-100.016 (130.162)	-1 200.979 (1 064.290)	132.9676 (86.838)	-127.245 (133.151)
Dev_rain_squared	-0.345 (0.106)***	0.073 (0.160)	-1.720 (1.805)	0.722 (0.214)***	-0.438 (0.171)***
Owned land_xi_dev	-1.007 (0.334)***	-1.104 (1.193)	-1.166 (2.176)	-0.566 (0.143)***	-2.738 (1.904)
Unowned land_xi_dev	-0.191 (0.983)	-1.742 (0.954)**	0.056 (5.046)	-1.052 (1.194)	0.108 (3.406)
Head_age_ xi_dev	-0.576 (0.674)	0.202 (1.486)	-2.267 (1.331)*	-1.038 (0.935)	2.427 (2.521)
Soil fertility_xi_dev	-458.516 (177.354)***	-	-	-	-
Cons	12 996.530 (68 567.570)	85 769.9 (134 714.000)	438 502.100 (294 323.300)	-40 978.240 (74 975.200)	-219 212.200 (211 614.500)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.053	0.053	0.001	0.126	0.310
F-tests	2.9e+07***	2.0e+04***	3 338.881***	1.4e+04***	2.3e+04***
Test 1	5.460***	1.250	1.230	8.410***	5.000***
Test 2	10 602.580***	2.1e+07***	61 410.870***	486.430***	230.560***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central, Eastern and Western regions (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3. * significant at 10%; ** significant at 5%; *** significant at 1%.

4. Test 1: rainfall variables jointly insignificant. Test 2: subdistrict-year dummies jointly insignificant.

5. Regressions also include demographic variables (household head's illness, age of household head, age of household head square, boys, girls, adult males with different education levels, adult females with different education levels and elders) but coefficients are not reported.

6. The interaction term between soil fertility and deviation of rainfall is dropped in each regional regression because there is a perfect multicollinearity problem.

Test of full insurance

The estimates of equation (13) for household consumption are separately shown between the whole country and each region in table 3. Similar to most empirical studies, including, among them, Cochrane (1991), Townsend (1994), Jalan and Ravallion (1999), Morduch (2002), Skoufias (2003), Harrower and Hoddinott (2004) and Kazianga and Udry (2006), the null hypothesis of full insurance against income risk is rejected in the whole country and in a group consisting of a sample from the Central, Eastern and Western regions. Consequently, the regression result indicates that there may be partial insurance in those two groups of samples. This partial insurance implies that there is either village- (tambon or subdistrict) level insurance in some part, or some self-insurance by households, (Morduch, 2002). For the whole country, the results show household consumption is quite well insured because the coefficient of household income is close to zero. In comparing the whole country with the group results from the Central, Eastern and Western regions, which hypothesized that there is partial insurance, it has been found that household consumption appears to be better insured in the group from the Central, Eastern and Western regions than the whole country. This may be explained by the hypothesis that the poor are less likely to be insured and they tend to have limited access to credit and insurance (Jalan and Ravillion,1999). In the case of Thailand, household income in the group of sample from the Eastern and Western regions is much higher than in other regions on average. Thus, it is very possible the households in the group of sample from the Eastern and Western regions are likely to better insured. Surprisingly, it has been found that household consumption appears to be completely insulated for income shock in the Northern, Southern and North-Eastern regions.[8] This is consistent with Skoufias and Quisumbing (2003) and Weerdt and Dercon (2006) in some specifications.

In addition to testing for full insurance through the investigation of the co-movement between household consumption and household income, also examined is the impact of a specified adverse shock, which is proxied by illness of household head on household consumption as an alternative test of complete risk sharing. The result shows that this type of shock appears to be fully insured against for households in the whole country and in the Northern, North-Eastern and Southern regions. Illness of household head has a negative significant effect on household consumption at the 1 per cent level only in a group consisting of a sample from the Central, Eastern and Western regions. This indicates that households in this region are unable to insulate their consumption from this type of shock. The different impacts of illness of household head on household consumption in the study are consistent

[8] There is the possibility that the independence between the consumption of Thai agricultural households and their income may be a result of the use of other forms of insurance, such as saving withdrawal, borrowing or remittances. The study of Paxson is one which indicates that Thai farmers use a high amount of savings to smooth their consumption when they face income shock (Paxson, 1992), However, based on the risk-sharing model, this empirical evidence may be a result from the sharing of risk across households in terms of transfer money and gift exchange. This leaves the key issue for a further study.

Table 3. Fixed effect regressions: test of full insurance
Dependent variable: household consumption

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Household income	0.309	-0.133	-0.100	0.109	0.284
	(0.129)***	(0.118)	(0.182)	(0.092)	(0.088)***
Head_illness	4 570.283	3 749.926	-10 560.470	11 354.540	-43 595.890
	(6 483.751)	(13 222.160)	(26 744.620)	(7 912.934)	(17 267.96)***
Head_age	159.658	2 547.191	2 712.594	776.8065	153.505
	(958.024)	(2 422.168)	(4 008.304)	(1 179.998)	(5 881.397)
Head_age_squared	-9.384	-33.101	-28.744	-18.203	-9.154
	(9.055)	(23.480)	(29.105)	(14.515)	(50.866)
Members 0 to 5 years	6 399.187	8 719.286	4 678.814	5 268.024	-1 840.715
	(3 820.598)*	(10 283.230)	(11 572.510)	(4 728.101)	(9 883.996)
Males 6 to 11 years	13 720.150	13 606.770	14 974.900	16 558.610	2 443.156
	(4 822.269)***	(9 573.259)	(20 730.450)	(5 892.327)***	(12 028.510)
Females 6 to 11 years	5 803.340	20 894.120	2 484.927	4 640.645	1 718.453
	(4 642.818)	(12 401.630)*	(14 636.510)	(5 073.987)	(17 234.550)
Males 12 to 17 years	20 058.610	28 864.630	695.848	21 033.150	40 028.240
	(4 708.957)***	(10 568.010)***	(22 525.600)	(5 982.711)***	(878.116)***
Females 12 to 17 years	11 690.080	24 275.540	20 647.870	17 239.420	2 699.685
	(5 582.994)***	(12 618.000)**	(14 667.380)	(6 270.551)***	(15 029.970)
Males_primary	8 833.406	16 803.090	14 494.680	11 318.990	25 315.320
	(4 121.504)***	(7 108.349)***	(15 444.910)	(4 367.579)***	(9 047.579)***
Females_primary	22 073.310	37 188.350	13 413.670	26 020.910	4 053.710
	(5 422.586)***	(9 875.146)***	(20 144.050)	(6 766.872)***	(10 718.710)
Males_secondary	12 761.280	28 227.160	23 507.570	17 074.640	20 308.220
	(5 227.232)***	(8 937.611)***	(16 788.930)	(5 693.220)***	(9 401.300)***
Females_secondary	18 701.060	28 667.570	7 647.770	33 561.760	-17 649.570
	(1 073.1230)***	(12 000.780)***	(17 325.440)	(9 407.552)***	(14 783.910)
Males_ postsecondary	22 316.830	18 193.470	26 551.280	24 311.480	20 527.880
	(6 627.638)***	(8 209.834)***	(19 069.290)	(9 440.335)***	(16 487.380)
Females_ postsecondary	29 665.210	39 971.180	62 397.060	31 107.360	26 409.400
	(6 148.652)***	(10 050.610)***	(21 222.680)***	(8 291.428)***	(13 196.05)***
Members_more than 65 years	13 462.990	26 519.530	15 835.310	15 032.900	18 816.390
	(6 666.089)***	(9 363.561)***	(17 385.230)	(9 947.209)	(14 441.190)
Cons	8 204.477	-8 301.896	54 919.420	959.0695	44 763.890
	(30 502.610)	(69 477.300)	(143 304.400)	(8 620.4970)	(166 923.700)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.134	0.173	0.139	0.231	0.263
Sargent and Hansen test	9.5e+06***	7 516.057***	2.3e+04***	1.6e+04***	1.5e+05***
F-test (subdistrict-year dummies-jointly insignificant)	169.520***	309.690***	1 316.470***	67.500***	640.440***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central, Eastern and Western region (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3.* significant at 10%; ** significant at 5% ; *** significant at 1%.

with several studies, such as Skoufias and Quisumbing (2003), Harrower and Hoddinott (2004) and Weerdt and Dercon (2006). Contrary to both income shock and a specific adverse shock, it is important to note that the F-statistic on the village (tambon or subdistrict)-years dummy variables all lead to a rejection of the null hypothesis that aggregate shocks do not matter. These indicate that illness of household head, which is only one type of our specific adverse shocks, has little significant impact on household consumption in Thailand, while aggregate shock appears to be very important in explaining fluctuations in consumption.

Unlike the impact of adverse shocks, there is overwhelming evidence of the relationship between household consumption and a set of household characteristic variables in most regions. For the whole country, most household characteristic variables, except a household member who is female and aged 6 to 11, is significant at the 1 per cent level, while this evidence is also found in Northern and North-Eastern regions even though there is a slight difference for the case of a household who is under the age of 12. On the contrary, there is a little evidence of the relationship between household consumption and a set of household characteristic variables in the Southern region, while this relationship appears moderately in a group consisting of a sample from the Central, Eastern and Western regions.

Test of partial insurance

Consequently, with the test of full insurance, it is hypothesized that there may be partial insurance in the whole country together with a group consisting of a sample from the Central, Eastern and Western regions. This is issue is investigated further. The estimated coefficients of an average village (tambon or subdistrict) income, which is the focus of this section, are reported in table 4. As expected, the estimates provide evidence that favours partial insurance and community risk sharing in household consumption in the whole country except the Southern region. An average village income has a positive statistically significant relationship with household consumption at the 1 per cent level at the whole country level. This is consistent with the hypothesis that some risk sharing is taking place within villages in the whole country, or in the other words, an income shock is shared among village members. Most of the studies which have tested under conditions of both full insurance and partial insurance found this consistency between these two tests, such as Skoufias (2003), Skoufias and Quisumbing (2003) and Harrower and Hoddinott (2004). Moreover, it should be noted that there is clearly consistency between the test of full insurance and test of partial insurance in the whole country. Regarding the test of full insurance, it has been found that household consumption appears to have some level of insurance, and thus it is implied that there may be some form of village-level insurance. The result on test of partial insurance in this section fully supports this evidence in which the coefficient of average village income is large and statistically significant at the 1 per cent level for households in the case of the whole country. This reaffirms that income shock is evidently shared among village members at the country level.

Table 4. Fixed effect regressions: test of partial insurance
Dependent variable: household consumption

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Household income	0.063	-0.133	-0.197	0.111	0.219
	(0.049)	(0.118)	(0.198)	(0.092)	(0.116)**
Village income	0.746	-0.639	0.465	-1.062	0.311
	(0.094)***	(0.475)	(0.296)	(0.532)***	(0.189)
Head_illness	2 710.283	4 007.476	-15 206.470	11 296.870	-37 907.580
	(6 332.196)	(13 202.340)	(27 042.000)	(7 907.665)	(18 695.480)***
Head_age	820.001	2 455.669	2 825.185	492.290	1 208.402
	(932.555)	(2 394.856)	(3 999.444)	(1 228.063)	(5 815.170)
Head_age_squared	-14.620	-31.972	-32.173	-15.447	-16.384
	(8.919)	(23.241)	(29.141)	(15.067)	(50.094)
Members 0 to 5 years	6 015.335	8 731.267	433.592	5 320.903	-1 036.266
	(3 802.687)	(10 169.380)	(12 324.110)	(4 734.428)	(9 883.974)
Males 6 to 11 years	16 064.230	13 379.310	12 331.860	16 615.710	5 337.735
	(4 734.467)***	(9 486.657)	(20 972.710)	(5 896.787)***	(12 600.650)
Females 6 to 11 years	7 216.988	20 857.640	-461.695	4 890.910	3 452.751
	(4 608.834)	(12 364.400)*	(14 964.490)	(5 087.448)	(17 163.610)
Males 12 to 17 years	21 173.290	28 736.850	1 028.411	21 338.160	38 444.740
	(4 669.328)***	(10 553.670)***	(22 190.660)	(5 974.286)***	(8 569.041)***
Females 12 to 17 years	18 006.700	24 226.760	22 335.440	17 124.850	5 678.464
	(4 734.245)***	(12 603.250)**	(14 777.080)	(6 284.119)***	(15 667.400)
Males_primary	14 709.740	16 941.490	14 430.750	11 489.950	25 317.770
	(3 241.850)***	(7 104.540)***	(15 316.440)	(4 384.011)***	(8 721.746)***
Females_primary	27 811.780	37 216.230	15 401.310	26 202.280	8 318.381
	(4 735.693)***	(9 867.953)***	(20 288.940)	(6 791.092)***	(11 963.310)
Males_secondary	19 521.880	28 312.260	19 311.820	17 115.870	19 415.430
	(3 841.777)***	(8 929.856)***	(18 092.360)	(5 693.713)***	(9 431.872)***
Females_secondary	28 282.280	28 643.570	12 575.680	33 636.520	-10 391.090
	(6 459.481)***	(12 001.660)***	(17 640.700)	(9 415.484)***	(17 403.400)
Males_postsecondary	25 397.870	18 091.830	16 141.010	23 735.890	22 362.160
	(6 183.559)***	(8 192.295)***	(22 618.480)	(9 500.940)***	(16 732.120)
Females_postsecondary	35 366.230	39 922.970	68 511.120	31 103.910	26 683.330
	(5 605.895)***	(10 048.450)***	(21 966.420)***	(8 284.478)***	(13 016.050)***
Members_more than 65 years	17 496.280	26 771.430	17 312.710	13 984.500	20 339.190
	(6 331.307)***	(9 342.133)***	(17 415.600)	(10 088.570)	(14 665.660)
Cons	-89 371.530	77 978.820	-12 561.970	116 632.900	-39 150.430
	(33 233.400)***	(94 858.410)	(136 998.800)	(72 004.350)	(171 916.000)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.018	0.141	0.010	0.114	0.227
Sargent and Hansen test	7.0e+06***	1.2e+04***	5.2e+04***	1.7e+04***	1.6e+05
F-test (subdistrict-year dummies-jointly insignificant)	11 975.090***	309.970***	16 567.950***	58.900***	573.290***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central,Eastern and Western regions (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3. * significant at 10%; ** significant at 5%; *** significant at 1%.

On the contrary, even though the result on test of full insurance shows that there may be partial insurance in a group consisting of a sample from the Central, Eastern and Western regions, no evidence of risk sharing within villages is found in these regions. This is similar with the findings associated with the studies of Skoufias and Quisuming (2003) and Harrower and Hoddinott (2004) in which they imply that these types of households were more autarkic in their behavior, relying more on entry into other income activities than in pooling risk with other village members. It also has been found that there is significant co-movement between household consumption and average village income in the North-Eastern region even if its sign is negative and the result on a test of full insurance finds no significant relationship between household consumption and household income. This is hardly surprising considering that the studies of Skoufias (2003) and Skoufias and Quisumbing (2003), as well as Harrower and Hoddinott (2004) also found this type of evidence. If the sign is positive for the case of the North-Eastern region, Skoufias (2003) indicates that there is the possibility of some circumstances in which this type of evidence can occur, for example, in the case in which many shocks are common and everybody resorts to self-insurance.

As with the test of full insurance, an investigation of the impact of a specific adverse shock which is proxied by illness of household head on household consumption is conducted. The regression result is not different from the test of full insurance in which illness of household head has a negative significant effect on household consumption in a group consisting of a sample from the Central, Eastern and Western regions while this type of shock appears to be fully insured against households in other regions. On the other hand, since aggregate shocks cannot be insured or smoothed out by households within a village, aggregate shock captured by the village (tambon)-years dummies still appear to be very important in explaining fluctuations in consumption also in this test. At this point, therefore, it may be concluded that household consumption co-moves with the aggregate resource constraint in every region, while both income shock and the specific adverse shock have little significant impact on household consumption in Thailand. To complete this test, a set of household characteristic variables are also examined. The regression shows a similar result with the test of full insurance. A set of household characteristic variables, especially the variable of household members who are over the age of 11, appear evidently in the relationship with household consumption in most regions while there is little significant relationship between these two variables in the Southern region.

V. CONCLUSION

Most informal insurance mechanisms often provide only inadequate protection. For the mechanisms that can provide adequate protection, the cost associated with them might be overly costly for poor households. The theory of perfect risk sharing predicts, nevertheless, that if villages perfectly pool their incomes to share risks, the household's

own income realization should not affect consumption patterns and all idiosyncratic shocks should be removed. For this paper, the three waves of Thai Socio-Economic Panel Survey data during the years 2005-2007 are used to investigate the existence of risk sharing among Thai agricultural households through three tests, namely the test of full insurance, test of partial insurance and test of risk sharing through risk-sharing instruments, respectively.

The null hypothesis of full insurance against income risk is rejected in the whole country together with a group consisting of a sample from the Central, Eastern and Western regions. Household consumption appears to be better insured in a group consisting of a sample from the Central, Eastern and Western regions than in the case of the whole country. Surprisingly, it has also been found that household consumption appears to be completely insulated for income shock in the Northern, Southern and North-Eastern regions. Unlike income shock, a specific adverse shock that is proxied by illness of household head is fully insured against for households in the whole country, North, North-Eastern and Southern regions. Only households in a group consisting of a sample from the Central, Eastern and Western regions appear to be unable to insulate their consumption for this type of shock. Consequently, with the test of full insurance, the further study supports the existence of evidence of partial insurance and community risk sharing in the whole country, except for a group consisting of a sample from the Central, Eastern and Western regions. Illness of household head still has a negative effect for household consumption only in a group consisting of a sample from the Central, Eastern and Western regions in this second test.

Even if it has been found that most regions completely insure their consumption, the households in the whole country and a group consisting of a sample from the Central, Eastern and Western regions are not completely insulated from income shock. Thus, to implement the results as policy, the government should promote and support community activities, including the participation of households within the community to contribute to the community's social capital, and then to increase the level of risk sharing. Morduch (2002) indicates that economists have considered villages to be a natural insurance unit. The problems of imperfect information and costly enforcement that hinder broad-based insurance markets can be alleviated at the village level. Setting up risk sharing within communities might therefore be one of the most economical and efficient investments to create a social protection system. Nevertheless, to effectively create this system, the government should identify which households are less insured or are weak in the face of adverse shocks, as in the investigation of this study, rather than searching for only those who are poor.

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THE INTERPLAY BETWEEN GROWTH AND DEVELOPMENT: EVIDENCE FROM INDIAN DISTRICTS

*Jyoti Prasad Mukhopadhyay and Nilanjan Banik**

In this paper we examine the nexus between growth and development using a recursive structural equation system which, to the best of our knowledge, has not been tried so far to examine such relationships in the Indian context. Another novel feature of our study is that we use district-level data to capture greater heterogeneity at a substate level. We use the growth rate of per capita income (PCI) as an indicator of economic growth, and the infant mortality rate (IMR) and literacy rate as the development outcomes. We find that IMR and literacy rate have a positive and statistically significant effect on the growth rate of PCI. Our results also show that the growth rate of PCI has a positive and statistically significant effect on IMR and the literacy rate. Further sensitivity analysis is performed to test the robustness of these findings.

JEL Classification: C31, R12.

Key words: Growth, development, structural equation system, seemingly unrelated regressions (SUR).

* Jyoti Prasad Mukhopadhyay (corresponding author), PhD scholar, Institute for Financial Management Research (IFMR), 24 Kothari Road, Chennai, India (e-mail: jyoti.mukhopadhyay@ifmr.ac.in); and Nilanjan Banik, Professor, Institute for Financial Management Research (IFMR), 24 Kothari Road, Chennai, India (e-mail: nil@ifmr.ac.in). A preliminary version of this paper was presented at the following conferences: 3rd International Conference on Applied Econometrics at IBS Hyderabad (2011), 48th Annual Conference of the Indian Econometric Society (TIES) in Puducherry (2012), BREAD-IGC-ISI Summer School in Development Economics at Indian Statistical Institute, New Delhi (2012), International Conference on "India's Development Strategy: Discourses on Past, Present and Future" at Jamia Millia Islamia, New Delhi (2013) and Annual conference 2013 of the Scottish Economic Society, Scotland, United Kingdom of Great Britain and Northern Ireland. We are grateful to the participants of these conferences for their helpful comments and discussions. We are also thankful to K.L. Krishna, Anurag Narayan Banerjee, Basudeb, Sharon Barnhardt and three anonymous referees for their valuable comments which helped us immensely in improving the earlier version of the paper. All remaining errors, if any, are our own.

I. INTRODUCTION

Growth and development are interdependent but there is a difference between them. While growth is a unidimensional concept measured purely on the basis of growth of per capita gross domestic product (GDP) or income, development is a multidimensional concept and refers to improvement in the quality of life of an average citizen of a country or region. The two-way causality between economic growth and human development is widely recognized in the literature on growth and development. In the Indian context, the impact of economic growth on development and vice-versa has been studied (Zaidi and Salam, 1998; Kurian, 2000; Dholakia, 2003; Ghosh, 2006) mostly using non-contemporaneous state-level data in a standard single-equation regression framework where growth is considered to be exogenous in analyzing its impact on development, and vice-versa. These studies typically regress future development outcomes (future growth figures) on past growth outcomes (past development outcomes) with appropriate time-lags. This is done to avoid the problem of endogeneity arising from reverse causality between growth and development. However, the reverse causality phenomenon in this context opens up the scope for building a structural equation model to analyse such relationships where both growth and development outcomes are considered to be endogenous. To the best of our knowledge, structural equation modelling to examine growth-development nexus has not been tried in the Indian context. This paper fills this void in the literature by building a recursive structural equation model where both growth of per capita income (PCI) and development outcomes are treated as endogenous variables.

In this paper we examine the two-way causality between growth of PCI, and development outcomes measured in terms of infant mortality rate (IMR), a proxy for health outcome, and literacy rate, as a proxy for education. Another value addition of this study is that we use district-level data to capture greater heterogeneity at a substate level. We argue in this paper that state-level data represents only an average level of outcomes and hence fails to capture both increasing divergence and spatial disparity at a substate level (district level).[1] Thus district-level data are expected to capture a more robust relationship between growth and development, in comparison to state-level data. We find that IMR and literacy rate positively affect the growth rate of PCI. Our results also show that the growth rate of PCI has a positive and statistically significant effect on IMR and the literacy rate. The rest of the paper is organized as follows. Section II discusses the growth-health-education triad based on the existing literature on the interdependence among economic

[1] Chaudhury and Gupta (2009) point out that "sub-state level estimates are extremely useful in identifying pockets of impoverishment or prosperity across the length and the breadth of the country. Even in a state like Gujarat with commendable growth performance in terms of level of living, poverty or inequality, we find districts like Dangs, which was among the most critically poor regions of India in 2004-05. Such incidents would have escaped our attention had we restricted ourselves to state-level averages only."

growth, health and educational outcomes. Section III discusses the literature on the growth-development nexus specifically in the context of India. Section IV sets up the recursive structural equation system, and briefly discusses the methodology for identification, and estimation of the structural parameters. Section V describes the data sources. Section VI presents the empirical results, and section VII concludes.

II. THE ECONOMIC GROWTH-HEALTH-EDUCATION TRIAD: A BRIEF SURVEY OF LITERATURE

Economic growth generates the resources that are vital for improving health and educational outcomes. On the other hand, improvement in the quality of life augments labour productivity and hence economic growth. Growth causes a surge in PCI and thus paves the potential way for further development. Using cross-country data, studies find a positive association between PCI and life expectancy at birth (LEB) (Preston, 1975; Pritchett and Summers, 1996; Banik, 2009).[2] Using cross-sectional data at the country level (98 countries), Barro (1991) finds evidence of a positive association between the initial stock of human capital (measured by the school enrolment rate in 1960) and the real per capita GDP growth rate for the period 1960-1985. However, correlation analysis does not tell us anything about the direction of causation but only shows strong association (linear) between two variables. Studies (Behrman and Deolalikar, 1988; Duraisamy, 1998; 2001) that use micro-level (farm level or household level) data find convincing evidence of the direction of causation: from growth to development outcomes and vice-versa. For example, initially, using household-level data from Tamil Nadu, and later on using data from the Human Development Index (HDI) Survey conducted nationwide by the National Council for Applied Economic Research (NCAER)-HDI, Duraisamy (1998; 2001) finds that an increase in income or total consumption expenditure reduces morbidity.

According to modern growth theory (Romer 1990; Mankiw, Romer and Weil, 1992) human capital and health are two important determinants of economic growth in the long run. If citizens of an economy are healthy then they can work harder and assimilate knowledge more efficiently, which translates to higher productivity and growth (Grossman, 1972; Bloom and Canning, 2000). Using a country-level panel dataset, Barro (1997), and Barro and Sala-i-Martin (2004), examine the effect of health on the growth rate of real per capita GDP and find that LEB, as an index of health, has a positive and statistically significant impact on the annual growth rate of real per capita GDP. At a micro level, studies find that improved health and nutritional outcomes positively affect labour productivity, more so in case of

[2] Preston (1975) covers three time periods – 1900s involving 10 countries, 1930s involving 38 countries, and 1960s involving 57 countries. The correlation coefficient between the logarithm of per capita national income and life expectancy was 0.885 during the 1930s, and 0.880 during the 1960s. Pritchett and Summers (1996) use data from more than 100 countries (184 countries in most regressions), and find a strong association between PCI and LEB.

poor households (Strauss, 1986; Deolalikar, 1988).[3] Modern growth theory (Romer, 1990; Mankiw, Romer and Weil, 1992) in which technological progress and long-run growth rate are endogenously determined broadened the concept of capital by incorporating human capital into the growth accounting equation. Thus, there is a close relationship between the stock of human capital and economic growth. In the Indian context, Trivedi (2002) finds that secondary school enrolment rate has a statistically significant effect on PCI in the long run. At a micro level, using data from rural households in Tamil Nadu and other parts of India, studies such as those by Kalirajan and Shand (1985), Rosenzweig (1995), and Foster and Rosenzweig (1995), show that education has a positive effect on agricultural productivity. Literate farmers are more adept at adopting modern technology.

Existing evidence also suggests interdependence of health and educational outcomes. Health can potentially affect educational outcomes in two ways. First, healthy children are less likely to miss schooldays. They also have better learning and cognitive abilities and hence they are expected to have better educational outcomes (higher school completion rates, higher average years of schooling, etc.). Schultz (1999) finds that better health positively affects efficiency of human capital formation at the household level in Africa. Others such as Bleakley (2003), and Miguel and Kremer (2004), find that targeted health improvement programmes such as deworming of children cause better educational outcomes (read, reduced absenteeism) in South America and Kenya, respectively. Second, increased longevity or a reduced morbidity rate can encourage individuals to invest more in human capital as healthy individuals are likely to realize higher returns from education (Kalemi-Ozcan, Ryder and Weil, 2000). Using data from 52 different countries, Bils and Klenow (2000) find that improved life expectancy positively affects investment in education. On the other hand, there is a growing body of literature on the causal relationship between education and health outcomes. Individuals with higher levels of schooling adopt better health behaviour and lifestyle practices, and hence experience better health outcomes. In an evaluation of primary school construction conducted by the Indonesian Government between 1973 and 1979, Breierova and Duflo (2004) find that households with higher mean years of education have a lower incidence of child mortality. By looking at schooling and adult mortality data from the United States of America between 1976 and 1996, Deaton and Paxson (2001) find a similar negative relation.

The literature on the growth-health-education triad is huge and still growing. The preceding paragraphs are in no way complete but present the crux of the whole story. From the discussion on the growth-health-education triad so far, it is evident that development should not be perceived merely as an end but also as an important means to augment

[3] Strauss (1986) uses household-level data from Sierra Leone, and Deolalikar (1988) uses International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) data from rural South India.

growth. This gives rise to the reverse causality between growth and development, which is the subject matter of this paper. Next we discuss very briefly studies that examine the growth-development nexus in the Indian context.

III. GROWTH AND DEVELOPMENT IN INDIA: THE EVIDENCE SO FAR

It is evident that the progress of India in terms of the income growth rate has been remarkable since post-1991 reforms. Since 1991, real GDP growth picked up to an average of around 6 per cent. There has been a further surge in income growth from 2003. Average growth was 8.8 per cent from 2003/04 to 2007/08, translating into per capita income growth of 7.3 per cent. More specifically, growth was 8.5 per cent in 2003/04, 7.5 per cent in 2004/05, 9.5 per cent in 2005/06, 9.7 per cent in 2006/07 and 9.0 per cent in 2007/08.[4] The reason for faster growth is attributed to broad-based economic reforms.[5] To make this growth process inclusive, Government started intervening in the market through various social welfare programs (e.g. Integrated Rural Development Program (IRDP), Swarnjayanti Gram Swarozgar Yojana (SGSY), Sarva Shiksha Abhiyan (SSA), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), National Bank for Agriculture and Rural Development (NABARD)-led Self-Help Groups (SHG) based microfinance). So far so good. But what has happened to development? Studies looking at growth-development nexus in the Indian context can be divided into two groups. The first group of studies look at the growth-development nexus in a time series context, whereas, the latter group focuses on cross-sectional analysis and classifies districts and/or states into forward or backward groups of varied degree on the basis of some development indicators without quantifying the linkages between the growth and the development indicators over a period of time.

To examine growth-development nexus, Dholakia (2003) considers triennium average per capita state domestic product (SDP) as a measure of economic development, and HDI at the state level. Considering the time period between 1977 and 1997, he finds evidence of two-way causality between economic development and human development.[6] Similar

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4 India, Ministry of Finance, *Economic Survey* (New Delhi, various years).

5 Economic reforms basically refer to liberalization of economic activities and encouraging globalization by bringing down tariffs. Other components of economic reforms, namely fiscal adjustments, macroeconomic stabilization, strengthening private property rights and exchange rate reform, also have an important bearing on income growth.

6 Dholakia (2003) considers a lag of eight years for examining the impact of human development on economic development. For examining the impact of economic development on human development he considers a lag of two years. The paper considers the Human Development Index, Human Poverty Index, inequality adjusted per capita consumption expenditure, literacy rate, intensity of formal education, expectation of life at the age of one year, and infant mortality rate, as the indicators of development.

studies such as Ghosh (2006),[7] and Roy and Bhattacharjee (2009), considering state-level data on HDI for the period between 1981 and 2001, find evidence of beta-convergence (States with lower HDI growing faster than those with higher HDI), and not sigma-convergence (cross-sectional dispersion of HDI in was non-decreasing). In a single equation framework, and using OLS as a method of estimation, Ghosh (2006) examines the effect of growth on development by regressing the development indicators at time, t, on average PCI value of the preceding five years (t-5). He finds that coefficient of PCI is positive and statistically significant. In a separate regression, he analyses the reverse causality running from human development to economic growth by regressing triennium average value of PCI on HDI indicators lagged by three years. He finds evidence of the positive and statistically significant effect of human development on economic growth. Kurian (2000) considers female literacy as an important "index of development" and he finds that Indian states belonging to the "forward group of states" such as Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu, have female literacy above the national average female literacy rate.[8]

In a cross-sectional framework, Mehta (2003) finds that a given state may perform extremely well on all indicators but there may be districts within that state that are among the most deprived in the country, or a state may have very high levels of attainment on certain specific development indicator(s) but not on all of them.[9] The study by Debroy and Bhandari (2003) identifies the most backward districts benchmarking them on the attainment of Millennium Development Goals (MDGs) set by the United Nations Development Programme (UNDP) in terms of six measures of socioeconomic progress: poverty, hunger, literacy rates, immunization, IMR and gross elementary rates. According to this study, the worst performing districts are located in Bihar, Uttar Pradesh, Jharkhand, Orissa, Madhya Pradesh, Assam, Maharashtra, West Bengal and Chhattishgarh, with a few districts from Arunachal, Karnataka and Tamil Nadu thrown in.

From the discussion so far, it is evident that disparities are more pronounced at a substate (district level). However, the existing studies examining the growth-development nexus in India use state-level data, and also fail to capture the reverse causality between growth and development in a structural equation system. This paper fills this gap in the literature where we use district-level data and analyse the nexus between growth and development in a recursive structural equation framework.

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7 Ghosh (2006) uses HDI, literacy rate, and expectation of life at birth, as development indicators.

8 Kurian (2000) on the basis of 1991 Census data of Government of India concludes that in addition to female literacy rate, the forward group of states has performed better in terms of other development indicators such as sex ratio (females per 1000 males) and level of infrastructure development. In fact, the "backward group of states" such as Assam, Bihar, Rajasthan, Uttar Pradesh and West Bengal, has fallen behind when measured in terms of these indicators.

9 Mehta (2003) finds that most of the severely deprived districts are located in Orissa, Bihar, Madhya Pradesh and Uttar Pradesh, which also rank high in terms of income poverty.

IV. EMPIRICAL MODEL AND ESTIMATION STRATEGY

As a measure of economic growth, we consider the compound annualized growth rate[10] of PCI between 2001 and 2005. We consider the infant mortality rate (IMR) and literacy rate as indicators of development. These chosen indicators also serve as a proxy measure of health outcome and the stock of human capital. The rationale behind considering these variables for our analysis is evident from the preceding review of literature. To examine the interaction between growth and development indicators we consider the following recursive structural equation model:

$$growth_i = \alpha_0 + \alpha_1 \, ln(PCI2001_i) + \alpha_2 \, ln(IMR2001_i) + \alpha_3 \, ln(literacy2001_i) + \varepsilon_{1i} \quad (1)$$

$$ln(IMR2007_i) = \beta_0 + \beta_1 \, growth_i + \beta_2 \, ln(literacy2001_i) + \beta_3 \, ln(hospitaldisp2001_i) + \varepsilon_{2i} \quad (2)$$

$$ln(literacy2011_i) + \gamma_0 + \gamma_1 \, growth_i + \gamma_2 \, ln(IMR2007_i) + \gamma_3 \, ln(schoolscoll2001_i) + \varepsilon_{3i} \quad (3)$$

where, subscript *i* stands for the *i*th district, *growth* denotes the growth rate of PCI between 2001 and 2005; *PCI2001* denotes PCI in 2001; *IMR2001* and *IMR2007* denote IMR in 2001 and 2007, respectively; *literacy2001* and *literacy2011* denote the literacy rate in 2001 and 2011, respectively; *hospitaldisp2001* denotes the number of hospitals and dispensaries per one lakh[11] population in 2001, and *schoolcoll2001* denotes the number of schools and colleges, per one lakh population in 2001. Variables are measured in logarithmic (natural, base = e) terms because it is a standard practice especially for variables which are skewed in either direction (Flegg, 1982; Anand and Baernighausen, 2004).

In the above-specified system of equations, $growth_i$, $IMR2007_i$ and $literacy2011_i$ are the endogenous variables which enter recursively into the system of equations. All other variables are considered to be exogenous. The parameters of particular interest are the coefficients of the exogenous development indicators (α_2 and α_3) in Eq. (1); the coefficient of the endogenous growth variable (β_1) and the coefficient of the exogenous development indicator (β_2) in Eq.(2); and coefficients for the endogenous growth and development variables (γ_1 and γ_2) in Eq.(3).

Given Eqs. (1), (2) and (3), the next step is to identify and estimate the structural parameters α's, β's and γ's. Since the system is recursive or triangular, all the parameters are identified (Gujarati, 2004).[12] We have considered a very simple recursive model where variables affecting growth such as access to road, institution and governance, are not

10 Annual compound growth rate is also used by Ghosh (2008).

11 One lakh = 0.1 million.

12 Gujarati (2004), pp. 764-766.

controlled for but these omitted variables can very well influence the endogenous variables namely, growth, IMR and literacy. As a result we conjecture that the errors are correlated across Eqs. (1), (2) and (3) (Maddala and Lahiri, 2009).[13] In other words we assume that the variance-covariance matrix of errors ($\sum$) is not diagonal. Since the errors terms are correlated, Eqs. (1), (2) and (3) cannot be estimated using equation-by-equation ordinary least square (OLS). In this context OLS estimators are inconsistent. Hence we estimate the system of equations using two alternative methods to check for the robustness of our estimates and we also report OLS estimates for the sake of comparison.

In the first method, we estimate Eq. (1) using simple OLS as there is no endogeneity problem (all regressors are exogenous). Then we use the estimated value of *growth* from Eq. (1) as an instrument for *growth* in Eq. (2) and estimate it using simple OLS. This allows us to circumvent the problem of endogeneity due to non-zero covariance between *growth* and the error term (ε_2). Similarly, we estimate Eq. (3) by OLS and use estimated *growth* obtained from Eq. (1) and estimated *ln(IMR2007)* obtained from Eq.(2) as instruments for *growth* and *ln(IMR2007),* respectively. This method is in the spirit of two-stage least square (2SLS) and hence we report them under the heading 2SLS in table 2. The structural Eqs. (2) and (3) contain original values of *growth* and *ln(IMR2007)* and not their estimated values and hence we correct second-stage OLS standard errors following the procedure suggested by Greene (2011).[14]

However, this 2SLS method of estimating parameters fails to correct standard errors of estimators for cross-equation correlation among error terms. This motivates us to go for the second estimation method, namely seemingly the unrelated regression method (SUR) originally proposed by Zellner (1962). Hausman (1975) first observes that in a recursive or triangular system, the determinant of the Jacobian in the likelihood function is unity, and hence it vanishes such that the likelihood function becomes identical with that of SUR. Lahiri and Schmidt (1978) show that the SUR estimation method, which is actually a Feasible Generalized Least Square (FGLS) estimator, gives consistent estimates of the parameters in triangular models. Kmenta and Gilbert (1968) show, using Monte Carlo experiments, that the FGLS estimator has the same asymptotic properties as iterated FGLS (IFGLS) originally proposed by Zellner (1962) and they recommend use of FGLS in small samples as it is also computationally efficient. We report the parameter estimates obtained using SUR under the heading SUR[15] in table 2. We also test for correlation amongst error terms across equations, that is, whether variance-covariance matrix ($\sum$) is diagonal using the test suggested by Breusch and Pagan (1980).

[13] Maddala and Lahiri (2009), p. 597.

[14] Greene (2011), chap. 8.

[15] The efficiency gain from SUR over OLS will depend on magnitude of the cross-equation correlations of the residuals and correlations among the covariates across different equations. The gains will be higher if the former is higher and it will be lesser if the latter is higher.

Finally, to check robustness of our results we perform sensitivity analysis as outlined in Levine and Renelt (1992). The idea is to see whether inclusion of additional explanatory variables affect the regression coefficients. The coefficient of a variable in the original model is considered to be robust if its sign and statistical significance do not change with inclusion of additional explanatory variables. The results are generated using the statistical software package Stata.

V. DATA DESCRIPTION

We use data on district-level PCI taken from India, Planning Commission (2010).[16] For Bihar and Orissa, we use PCI data for 2004/05 whenever data for 2005/06 are not available. PCI data for the years after 2005/06 are not available for all the districts which results in significant drop in the number of observations.[17] Also many of the districts are newly formed, and PCI data for them is not available for the earlier years.[18] Therefore, to maintain uniformity and to get a more robust result, we consider the time period 2001-2005 for PCI growth rate calculation. We consider a total of 281 districts across all the nine states where the Annual Health Survey (2010-11)[19] (AHS) was conducted, namely Assam, Bihar, Chhattishgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and Uttarakhand. These nine states together account for 48 per cent of India's population and nearly 70 per cent of Infant deaths in India (India, Ministry of Health and Family Welfare, 2011). Data on literacy and IMR for 2001, proportion of main workers in the total workforce, proportion of households not having latrine facility, average distance from the nearest town, number of factories, hospitals and dispensaries, schools and colleges[20] are taken from Census 2001 and 2011 published by Office of the Registrar General of India, Government

16 There are issues related to estimation of gross district domestic product (GDDP) and its comparability across districts of different states (Katyal, Sardana and Satyanarayana, 2001; Indira, Meenakshi and Vyasulu, 2002). Hence we verified the accuracy of the available GDDP estimates by summing over all the districts of a particular state for a particular year. The total figure thus obtained was very close (absolute magnitude of deviation was less than 1 per cent) to the estimate of state domestic product (SDP) given by the Central Statistical Organisation (CSO) for the particular state for that particular year at constant prices (1999/2000).

17 India, Ministry of Home Affairs (2011). Planning Commission does not report data on district-level PCI data for the period after 2006/07.

18 In 2000 there are 585 districts, and in 2011 there are 627 districts in India. Many of these districts are newly formed, and for some of them information about the income variable is not available. The case in point is Delhi. The Census 2001 contains information about many variables related to north, north-east, north-west, south, south-west, west, east, and central Delhi. However, during 2001, when it comes to PCI we find information only relating to Delhi as a whole, and not its constituent districts (India, Planning Commission, District of India – districts status. Available from http://districts.nic.in/dstats.aspx (accessed 2 April 2011)).

19 See http://censusindia.gov.in/vital_statistics/AHSBulletins/ahs.html.

20 Number of factories, hospitals and dispensaries, schools and colleges all are measured per one lakh population of the district.

of India. IMR figures for 2007 are taken from the Annual Health Survey 2010-11 Fact Sheets published by the Ministry of Health and Family Welfare (MOHFW), Government of India.[21]

VI. EMPIRICAL RESULTS

Estimation results

The descriptive statistics of the variables used in this study are reported in table 1. Table 1 shows that there is considerable heterogeneity (high standard deviation) across districts for most of the variables. For the sake of comparison we start our analysis by separately estimating Eqs. (1), (2) and (3) and summarize results under column 1 in table 2. Panels A, B and C correspond to estimation results of Eqs. (1), (2) and (3). First column of Panel A in table 2 shows that increased IMR has a negative effect on growth of PCI and it is statistically significant at 10 per cent level. We do not find any statistically significant effect of literacy on growth. There is also strong evidence of conditional divergence in growth rate of PCI as the coefficient of logarithmic PCI in 2001 is positive and highly statistically significant. But this finding is not robust as we will see later. Eq. (1) has no endogeneity problem[22] and hence no result is reported under the second column meant for 2SLS results. We report SUR estimation results in the third column. The third column of table 2 shows that increased IMR does negatively affect growth rate of PCI and it is statistically significant at 5 per cent level. The estimated coefficient of IMR implies that a 10 per cent decrease in IMR will increase the growth rate[23] of PCI by 0.12 percentage points. The coefficient of literacy also turns out to be statistically insignificant even in SUR results. Thus we find strong evidence of the positive effect of improved health outcome on growth although we do not find any statistically significant effect of the stock of human capital (read literacy rate) on growth. This is perhaps because the effect of literacy on growth happens only in the long run. Also, existing evidence suggests that the quality of human capital also matters for growth (Hanushek and Wobmann, 2007). In India studies have found that students are not learning enough in schools and hence the quality of education remains abysmally low (ASER Centre, 2013).

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[21] The reference period of IMR estimates published in the fact sheets is 2007-09 and hence we consider the published IMR figures as figures for 2007 in our analysis.

[22] *IMR2001* and *literacy2001* are suspected to be endogenous in Eq. (1). Endogeneity tests using percentage of household having telephone connection and percentage of household having bathroom facility as instrumental variables, failed to reject the null hypothesis of no endogeneity (X^2 test statistic value is low).

[23] Note: growth rate is measured in decimals.

Table 1. Summary statistics

Variable	Min	Max	Mean	Median	SD[a]	N
Growth rate of PCI (2001-2005)[b]	-0.12	0.18	0.03	0.03	0.033	282
Ln(PCI2001)	8.14	10.76	9.27	9.28	0.419	282
Ln(IMR2001)	3.00	4.98	4.20	4.21	0.297	253
Ln(IMR2007)	2.94	4.63	4.07	4.07	0.257	282
Ln(Literacy2001)	3.41	4.38	4.04	4.08	0.213	281
Ln(Literacy2011)	3.75	4.47	4.23	4.25	0.129	281
Ln(No. of hospitals and dispensaries)	2.89	4.69	3.76	3.74	0.349	281
Ln(No. of schools and colleges)	4.20	6.27	4.99	4.93	0.450	281
Ln(Prop.main workers)[b]	-11.22	-7.78	-9.91	-9.94	0.591	280
Ln(No. of factories)	3.55	6.06	4.76	4.77	0.418	281
Households without latrine facilities (%)	2.61	4.55	4.25	4.38	0.346	282
Ln(distance)	2.61	6.38	5.13	5.22	0.644	258

Source: Authors' own calculations.
Notes: [a] SD means standard deviation.
[b] Measured in decimals.

As regards Panel B, under OLS, we find that the growth of PCI improved IMR in 2007 as the sign of the estimated coefficient of growth was negative and it was statistically significant at the 1 per cent level. The same is true in the case of 2SLS and SUR results also. The estimated coefficient of the growth variable in SUR model implies that if growth rate increases by 1 percentage point then it leads to a reduction in IMR of approximately 3.22 per cent. Under OLS and SUR, we find that districts with higher literacy rates in 2001 experienced lower IMR in 2007 (the sign of the estimated coefficient of literacy in OLS and SUR was negative and statistically significant). A 1 per cent increase in the literacy rate leads to an approximately 0.24 per cent reduction in IMR. However, this is not true in the case of 2SLS. Our results also show that better access to health-care services measured in terms of number of hospitals and dispensaries per one lakh population has a favourable impact on health outcomes, that is, it reduces IMR. The coefficient of the number of hospitals and dispensaries per one lakh population measured in logarithmic terms is statistically significant at the 5 per cent level under SUR.

As regards Panel C, under both OLS and SUR, we find that the growth of PCI positively affects literacy rates. Districts that grew faster during 2001-2005 in terms of PCI also experienced higher literacy rates in 2011. The coefficient of PCI growth is positive and statistically significant at 10 per cent and 5 per cent levels in OLS and SUR, respectively. An increase in the growth rate by 1 percentage point causes the literacy rate to increase

Table 2. Estimation results

Covariates	Coefficient		
	(1) OLS	(2) 2SLS	(3) SUR
Panel A: Dependent variable: *PCI growth rate (2001-2005)*			
Ln(PCI2001)	0.017***		0.016***
	(0.005)		(0.005)
Ln(IMR2001)	-0.011*		-0.012**
	(0.006)		(0.006)
Ln(Literacy2001)	0.0008		0.012
	(0.009)		(0.009)
Constant	-0.087*		-0.113***
	(0.049)		(0.051)
N	253		253
R^2	0.09		0.08
F	7.68		11.36
Prob > F	0.000		0.000
Panel B: Dependent variable: *Ln(IMR2007)*			
Growth rate of PCI (2001-2005)	-3.079***	-8.182***	-3.227***
	(0.593)	(3.150)	(0.549)
Ln(Literacy2001)	-0.123*	-0.012	-0.240***
	(0.067)	(0.109)	(0.079)
Ln(No. of hospitals and dispensaries)	-0.104*	-0.096	-0.106**
	(0.062)	(0.099)	(0.050)
Constant	5.051***	4.730	5.537***
	(0.301)	(0.514)	(0.282)
N	253	253	253
R^2	0.18	-	0.17
F	11.35	4.81	25.47
Prob > F	0.000	0.002	0.000

Table 2 *(continued)*

Covariates	Coefficient		
	(1) OLS	(2) 2SLS	(3) SUR
Panel C: Dependent variable: *Ln(literacy2011)*			
Growth rate of PCI (2001-2005)	0.571*	-8.724	0.801***
	(0.315)	(9.063)	(0.307)
Ln(IMR2007)	-0.106***	-1.528*	-0.177***
	(0.027)	(0.835)	(0.032)
Ln(No. of schools and colleges)	0.021	0.006	0.016
	(0.021)	(0.007)	(0.018)
Constant	4.537***	10.681	4.842***
	(0.164)	(3.733)	(0.166)
N	253	253	253
R^2	0.09	-	0.07
F	13.90	-	20.50
Prob > F	0.000	0.003	0.000

Source: Authors' own calculations.
Notes: For OLS, robust standard errors are in parentheses.
* Significant at 10% level, ** significant at 5% level, *** significant at 1% level.

by 0.8 per cent. 2SLS results, however, do not show such a positive relationship. Panel C results also show that improved health outcomes measured by reduced IMR (2007) lead to improved educational outcomes measured by increased literacy rates (2011). The coefficient of IMR (2007) is negative and statistically significant at 1 per cent, 10 per cent and 1 per cent levels under OLS, 2SLS and SUR, respectively. The estimated coefficient of IMR under SUR implies that a reduction in IMR by 1 per cent increases the literacy rate by approximately 0.18 per cent. We do not find any statistically significant impact of access to educational institutions on literacy rate across all the three estimation techniques. This result is counterintuitive. We argue that building schools and other educational institutions is not enough unless it is ensured that students do attend and learn in schools and teachers also do justice to teaching. However, as mentioned earlier students do not necessarily learn the basic skills of reading, writing and counting or arithmetic in schools (ASER Centre, 2013).

Finally, we test correlations amongst the errors across Eqs. (1), (2) and (3), namely, whether the variance-covariance matrix ($\sum$) is diagonal using the test suggested by Breusch and Pagan (1980). Based on this test we could reject the null of zero correlations amongst errors at the 5 per cent level of significance ($X^2 = 8.93$, p-value = 0.030). This justifies the estimation of the system of equations using SUR.

Sensitivity analysis

We re-estimate the system of equations using SUR with additional control variables and report the results in table 3. In Eq. (1), we include the proportion of main workers (as a proxy for the size of the workforce)[24] and number of factories measured in logarithmic terms (as a proxy for the level of industrialization) as additional control variables. Eq. (2) and Eq. (3) are re-estimated with proportion of households without latrine facility (as a proxy for health practices and awareness at the household level) and average distance of the villages from the nearest town (as a proxy for accessibility to educational institutions in town) as additional control variables.

We refer to the original regression as the base regression, and the model with newly added explanatory variables for sensitivity analysis as the augmented regression. Since actual magnitudes are of little interest, we report only the sign and statistical significance of the re-estimated coefficients in table 3. In Eq. (1), the coefficient of logarithmic PCI in 2001 is not robust across base and augmented regression. However, the relation between IMR and growth rate is robust across both base and augmented regression. The sign of the coefficients of additional control variables in the augmented version of Eq. (1) are as expected and are statistically significant. As regards Eq. (2), we find that the relation between the growth rate of PCI and IMR (2007) is robust and so is the relation between literacy rate and IMR. The relation between number of hospitals and dispensaries per one lakh population and IMR turns out to be fragile. The additional control variable, the proportion of households without latrine facilities, has the expected sign but it is not statistically significant. In the case of Eq. (3), we find that the positive relation between the growth rate of PCI and literacy rate (2011) is robust across both base and augmented specifications. Health outcome measured by IMR also has a positive and statistically significant effect on literacy rate and this relation is robust as the sign and significance of the coefficient of IMR are not affected by the addition of new explanatory variables. The additional control variable, log of distance from the nearest town, has the expected sign and it is statistically significant. We again perform the Breusch and Pagan (1980) test of independence of error terms across equations. The null hypothesis of zero correlations amongst errors across equations is rejected at the 10 per cent level of significance ($x^2 = 6.90$, p-value = 0.075).

[24] Main workers are those who had worked most of the time during the reference period (i.e. 6 months or more). This is a crude proxy for the size of the workforce because many workers especially in rural areas work as marginal workers (not working most of the time during the reference period).

Table 3. Sensitivity analysis summary

Covariates	Base SUR regression		Augmented SUR regression		Conclusion
	Sign	Significant	Sign	Significant	
Panel A: Dependent variable: *PCI growth rate (2001-2005)*					
Ln(PCI2001)	+	Yes	+	No	Fragile
Ln(IMR2001)	-	Yes	-	Yes	Robust
Ln(Literacy2001)	+	No	+	No	Robust
Additional control variables					
Ln[Prop. main workers)]			+	Yes*	
Ln(No. of factories)			+	Yes	
N	253			231	
Panel B: Dependent variable: *Ln(IMR2007)*					
Growth rate of PCI (2001-2005)	-	Yes	-	Yes	Robust
Ln(Literacy2001)	-	Yes	-	Yes	Robust
Ln(No. of hospitals and dispensaries)	-	Yes	-	No	Robust
Additional control variable					
Households without latrine facilities (%)			+	No	
N	253			231	
Panel C: Dependent variable: *Ln(Literacy2011)*					
Growth rate of PCI (2001-2005)	+	Yes	+	Yes	Robust
Ln(IMR2007)	-	Yes	-	Yes	Robust
Ln(No. of schools and colleges)	+	No	+	No	Fragile
Additional control variable					
Ln(distance)			-	Yes	
N	253			231	

Source: Authors' own calculations.

Notes: Augmented SUR regressions are jointly significant (Prob > F = 0.000).
The base regression is the same as the regression model reported in table 1.
The last column indicates the robustness or fragility of estimated coefficients which are significant in the base regression.
The coefficient of a variable of interest is considered to be robust if its sign and significance do not change across all augmented regressions.
* Significant at 10% level.

VII. CONCLUSIONS

In contrast to the conventional approach of investigating separately the effect of growth on development and the effect of development on growth, this study examines the interdependent nature of growth and development using a recursive or triangular structural equation system. By allowing cross-equation error terms to be correlated, we estimate the system using SUR. Our results show that health outcomes measured by IMR do affect the growth rate of PCI positively, and this relationship is robust. Inclusion of additional control variables does not change our results. Our finding is similar to that of Barro (1997). We also find the growth of PCI improves literacy rates and helps to reduce IMR. These relationships are also statistically significant, and robust after the addition of other control variables. This finding is similar to the empirical conclusions of Pritchett and Summers (1996). Thus one clear conclusion that emerges from this study is that economic growth plays a significant role in improving health and educational outcomes. Thus broad-based economic reforms that aim to augment the growth rate of an economy will also yield better development outcomes. Likewise, improved development outcomes will help to sustain economic reforms, and hence contribute to economic growth in the long run. For example, during the 1960s and the 1970s, Brazil witnessed higher growth but as the distribution of income, along with other indicators of the quality of life, such as health and education, were neglected, policymakers eventually had to follow a populist policy in fear of losing power in parliament. Since policies for broad-based development took a back seat, the larger "have not" group was neglected, and the ruling parties in Brazil were repeatedly thrown out of power. This has put a halt to Brazil's reform programmes and prevented them from achieving higher growth rates in the 1980s.

One limitation of this study is that it does not control for state-specific fixed effects. Depending on the availability of data on PCI and other development indicators for the later years (2006 onwards) at the district level, further studies can be done to account for state-level fixed effects because state policies also play an important role in determining growth and development outcomes.

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