SAARC
Business Leaders Conclave

South Asia Regional Integration and Growth

Improving Technology, Skills and Innovation in South Asia

Prof. Carl J. Dahlman
Georgetown University

Draft Research Paper for Comments
Improving Technology, Skills and Innovation in South Asia

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INTRODUCTION

In the last twenty years the South Asian countries have been growing faster than the rest of the world. However the international environment is becoming more competitive and demanding. In addition higher education and innovation are becoming more critical for countries to be able to benefit from the increasingly globalized international environment. Therefore South Asian countries have to improve their skills and innovation capabilities. This paper assesses the position of South Asian countries and proposes some of the key actions that they need to take to strengthen their technology and innovation capabilities to improve their economic performance and welfare.

This first section presents some basic information on the five South Asian countries covered in this paper to provide some context for the subsequent discussion. The second section summarizes some of the new elements of international competitiveness. The third section examines the situation of the South Asian countries in the international context, comparing the region to other regions and the situation of each of the five South Asian countries. The fourth summarizes some of the key trends in education, and assess the situation of the South Asian countries in some detail. The fifth does the same for their innovation situation. The sixth section complements the foregoing analysis with broader economic data to make an overall assessment. The seventh section proposes key actions to improve economic performance and welfare.

This paper covers the five largest South Asian countries. They range from Sri Lanka and Nepal which have around 20 million inhabitants each, to India, the second most populous country in the world with slightly more than one billion people. In terms of GDP per capita four are in the World Bank’s low income

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1 This paper examines the situation of five of the South Asian countries: Bangladesh, India, Nepal, Pakistan and Sri Lanka. Unfortunately it was not possible to include Bhutan or the Maldives because of data limitations.
category (per capita income less than $765 in 2003) with Nepal at the very low income level, to Sri-Lanka, which just makes it into the lower middle income category ($766-$3,035). [Table 1]

Table 1: Population, GDP, and Exports 2003

<table>
<thead>
<tr>
<th></th>
<th>Population (millions)</th>
<th>GDP (billions)</th>
<th>GDP/Capita</th>
<th>Merchandise Exports (millions)</th>
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<tr>
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<td>55</td>
<td>400</td>
<td>6942</td>
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<tr>
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<td>571</td>
<td>540</td>
<td>55982</td>
</tr>
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<td>78</td>
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<td>11930</td>
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<td>18</td>
<td>930</td>
<td>5125</td>
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<td>World</td>
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<td>5510</td>
<td>7578698</td>
</tr>
</tbody>
</table>

Source: World Bank, *World Development Indicators 2005*, Table 1 pp.22-24; Table 4.5, pp. 214-216.

Each of the five has had rates of growth above the world average for the last two decades, with Pakistan having the highest rate of growth in the decade of the 1990s, and India the highest in 1990-2003 period. (Table 2). In fact in the last years India has achieved a spectacular rate of growth of 8%.

Table 2: Growth of Gross Domestic Product

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Bangladesh</td>
<td>3.7</td>
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<td>5.7</td>
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<tr>
<td>World</td>
<td>3.3</td>
<td>2.8</td>
</tr>
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</table>

WDI Table 4.1, pp 198-201.

To put them in the global context is it instructive to compare their shares in the global population with those in global GDP and trade. Because they are low income countries, their share in global GDP is much lower that that in global population. At the higher end, Sri Lanka’s share in global GDP is 17% of its share in population, while that of Nepal is just 5%. With respect to exports, Sri Lanka’s share of global exports actually exceeds it share of global GDP by 40% indicating it is an export driven economy. The shares of the four other countries range from just 44% (India- the least export oriented) to 70% (Pakistan). While the share of exports in global exports between 1990 and 2003 increased by 80% for Bangladesh, and 40% and 45%, respectively for Sri Lanka and India, Pakistan and Nepal just maintained their relative shares.
Table 3: Percentage Share in World Totals

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>02.20</td>
<td>00.16</td>
<td>00.09</td>
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<td>India</td>
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<td>00.30</td>
<td>00.05</td>
<td>00.07</td>
<td>00.05</td>
</tr>
</tbody>
</table>

Source: Computed from WDI 2005

In terms of the share of exports of goods and services in GDP, only in Sri Lanka, with 36%, is above the world average of 24% (Table 4). India is particularly low at just 14%, in fact, one of the lowest in the world even in spite of its considerable service exports particularly in the information technology services for which it is so well known world wide. With respect to merchandise exports, the majority in all countries are manufactured products. With the exception of India and Sri Lanka the share of manufacture in merchandise exports exceeds the world average. However, only a very small percentage of them are high technology products.

Table 4: Various Indicators of Trade Structure

<table>
<thead>
<tr>
<th>Country</th>
<th>Export Goods &amp; Services/GDP</th>
<th>% Manufactured Exports</th>
<th>% High Tec in Man. Xs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>6</td>
<td>14</td>
<td>77</td>
</tr>
<tr>
<td>India</td>
<td>7</td>
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<td>Nepal</td>
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<td>Pakistan</td>
<td>16</td>
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<td>Sri Lanka</td>
<td>29</td>
<td>36</td>
<td>54</td>
</tr>
<tr>
<td>World Av.</td>
<td>19</td>
<td>24</td>
<td>72</td>
</tr>
</tbody>
</table>

Source: WDI 2005, Table 4.9, pp. 230-2; Table 4.5 pp. 214-216; Table 5.12, pp. 314-316.

**THE NEW COMPETITIVE CONTEXT**

The world is in what could be called a knowledge revolution. There has been a speed up in the production and dissemination of knowledge based, in part on advances in information processing and communications technologies, as well more general advances in the science base and in our ability to codify knowledge. The rapid reduction of transportation and communications costs made possible by technological progress in all means of transportation and information technologies, combined with liberalization of trade in goods and services are leading to a rapid increase in the volume of goods and services that are traded. Between 1990 and 2003 the share of imports and exports in GDP increased from 38% to 48% of
global GDP. In addition, 27% of global value added is being produced by multinational corporations (MNCs), meaning that nearly one-third of world GDP is produced by corporations spanning multiple markets and national jurisdictions\(^2\). This is actually an underestimate of the degree to which global production is interlinked because it does not include all the indirect effects through the integration of supply and distribution chains. MNCs are also the key agent in the creation of knowledge since the R&D done by multinationals accounts for the large majority of R&D done by the private sector, and private R&D has become larger the public R&D as a result of the decrease in global defense budgets that occurred after the end of the cold war.

Combined with the trend towards liberalization of product, service, and financial markets, greater globalization means increasing global competition. Capital markets move capital to where they expect the highest risk adjusted returns, while MNCs redirect their resources in line with the global dynamics of markets, driven by size and growth potential, and the creation of endowments, among which knowledge stands out. Thus countries like China and India have become magnets in the creation of major new platforms in the exports of production and services.

The nature of competitiveness is also changing. Traditionally it was based on lower capital or labor costs, or of other local inputs, including infrastructure services, while also depending on the economic and business environment. Although these fundamentals continue to play a key role, given the very rapid rate of development and dissemination of new knowledge globally and the pressure to restructure, there are important new elements, including the ability to:

- rapidly re-deploy resources in order to capture new opportunities.
- ensure the quality, skills and flexibility of labor force (and management)
- keep up with rapidly changing technological and organizational advances
- move to higher value parts of value chain (research/design; and marketing, branding, managing of customer information)
- make effective use of information technologies to reduce transactions costs and improve capacity to respond quickly to changing opportunities and threats

As a result there is increased attention across countries on improving their overall business environment and the flexibility and speed of their economies to respond to rapidly changing circumstances, improving education and skills systems, improving their innovation systems and their information infrastructure. With the

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\(^2\) Based on calculations from UNCTAD, *World Investment Report*, various issues.
exception of India, the South Asian countries are not so well placed to take advantage of these changes in the competitive environment because they lack the critical mass of high skilled human resources and technological capability necessary to do so.

SOUTH ASIAN COUNTRIES IN THE CONTEXT OF THE KNOWLEDGE ECONOMY

a. World Bank Knowledge Assessment Methodology

The World Bank Institute has developed a useful benchmarking tool which helps to rank countries in terms of their readiness to use knowledge for their development.\(^3\) The methodology consists of examining a country’s global rank ordering in four pillars. The four pillars are:

- An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship. This is critical because it affects not only the incentive to improve performance, but also the ease with which better knowledge can be put into practice.
- An educated and skilled population that can create, share, and use knowledge well. This is critical because as argued above, this is the key enabler to make effective use of knowledge as well as to produce it.
- A dynamic information infrastructure that can facilitate the effective communication, dissemination, and processing of information. This has become critical for access to knowledge and to reduce transactions costs.
- An efficient innovation system of firms, research centers, universities, consultants and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.

The rationale for including the economic incentive and institutional regime as one of the pillar of the knowledge economy is that it sets the broader framework for the more structural pillars. In addition, an economy needs to have the flexibility to adjust to the rapidly changing opportunities created by the rapid development and

\(^3\) See [www.worldbank.org/kam](http://www.worldbank.org/kam) The KAM is designed to help countries understand their strengths and weaknesses in making the transition to the knowledge economy. The KAM provides a preliminary knowledge economy assessment of a country, which can form the basis for more detailed sector-specific work.
dissemination of new knowledge. An effective economic and institutional regime that permits such rapid adjustment is critically important.

The KAM consists of a set of 80 structural and qualitative variables that serve as proxies for the aforementioned four pillars (roughly 20 per pillar) that are critical to the development of a knowledge economy. The comparison is undertaken for a group of 128 countries which includes most of the developed OECD economies and over 90 developing countries. A reduced index of the KAM called the knowledge economy index (KEI) based on three indicative variables in each of the four pillars has been developed to give a quick summary index of a countries overall position.4

b. Relative Position of South Asian Countries

Figure 1 presents the KEI for the six developing regions, the G7 and Western Europe, as well as some key developing countries and the five South Asian countries for which we have data. Several interesting aspects stand out. First, as a whole the developed countries (with the notable exception of Finland) have lost some of their relative ranking as some middle income countries have made faster relative progress. Second, some developing countries such as Brazil, China and Jordan have made significant relative improvements. Other middle income countries such as Argentina and South Africa have lost ground.5

South Asia does worse than the other developing regions except Africa. Within South Asia, India does the best, although it does not show any improvement over time. Its higher knowledge economy index is largely due to its high index on innovation (see Figure 2 and Table 5 which give the breakdown in the composition of the indices and their change over time) given the large absolute size

4 The actual indicators used for each of the pillar are as follows-- Economic and institutional regime: tariff and non-tariff barriers, regulatory quality, and rule of law. Education and human resources: adult literacy rate (percent age 15 and above), secondary enrollment, and tertiary enrollment. Innovation system: researchers in R&D, patent applications granted by the U.S. patent and Trademark Office (USPTO), and scientific and technical journal articles (all weighted per million people). Information infrastructure: telephones per 1,000 persons, computers per 1,000 persons, and Internet users per 10,000 persons.

5 Countries can lose ground in one of two ways. They may have an actual decline in an indicator or they may not improve an indicator as fast as other so they fall behind relative to the rest of the world. In South Africa for example both elements are at work. In secondary education, the actual enrollment rates declined. In the ICT indicators, even though South Africa made significant improvements in the penetration ratios increasing some by a factor of six times, the rest of the world moved much faster so South Africa fell behind relative to the rest of the word. The charts also show that Africa as a whole is particularly weak in the innovation pillar variables.
of scientists and engineers in R&D as well as the absolute volume of scientific and technical publications.  

Sri Lanka is the second highest among the South Asian countries, and it shows some improvement over the period. The biggest improvement is in the economic incentive and institutional regime, where it gets the highest ranking among the South Asian group. It made significant improvements in the ICT index where it moves from second to first. And while it makes a small improvement in the innovation index, it actually loses ground in the education variable even though it still remains the highest in education among the group.

Pakistan, Bangladesh, and Nepal all lose ground in the aggregate KEI. Most notable is the sharp fall in the economic incentive regime in Nepal which considerably pulls down it overall average. Nepal also loses in the ICT indicator. Pakistan also loses in the economic incentive, and in the ICT indicator as well as in the education indicator, and ends up with the lowest score among the group in the later. Bangladesh slips most in the innovation index and also slips in the economic incentive regime, but makes some gains in the ICT and smaller gain in the education index.

See the Annex for individual basic scorecards with changes between the two periods for each of the countries. The annex also includes more detail data on the economic incentive and institutional regime as well at the information and communications indicators as they are not the main focus of this paper.

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6 All the indicators in the methodology were scaled by population. However because knowledge is not consumed in its use, for the innovation variables the indicator was also computed based on absolute values, which is how it is reported here. In the full KAM database it is possible to use the innovation variables normalized by population.
Figure 1: Overall KEI 1995 Vs Most Recent

Note: The horizontal axis represents the relative position of the country or region in 1995. The vertical axis represents the position in the most recent year (generally 2000-2003). The graph is split by a 45 degree line. The most advanced countries are on the northeastern section of the diagonal. But the position relevant to the diagonal is also critical. Those countries or regions that are plotted below the line indicate a regression in their performance between the two time periods. Countries or regions that are plotted above the line indicate improvement. Countries or regions that are plotted on the line indicate stagnation. The KAM methodology allows the user to check performance in the aggregate Knowledge Economy Index (KEI) or Knowledge Index (KI), as well as the individual pillars that define them: Economic Incentive Regime, Education, and ICT (Information Communications Technologies), and the Innovation index. This figure has been computed using the unweighted variables for the innovation index.

Source: World Bank, KAM 2005
Figure 2: Comparison of KEI component parts for World Regions with South Asian Countries (most recent in top line, compared to 1995 bottom line for each group)

Note: The top bar chart represents the most recent aggregate KEI score for a selected region or country, split into the four KE pillars. The bottom represents the index in 1995. Each color band represents the relative weight of a particular pillar to the overall country’s or region’s knowledge readiness, measured by the KEI. The first line for each country is its position in the most recent year for which data is available (generally 2002-2003). The second line is for 1995. (This figure has been computed using the unweighted variables for the innovation index.)

Source: World Bank, KAM 2005
Table 5: Knowledge Economy Indicator and Components: Changes 1995 to Most Recent

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</tr>
</thead>
<tbody>
<tr>
<td>G7</td>
<td>8.55</td>
<td>7.65</td>
<td>9.49</td>
<td>8.21</td>
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<td>2.29</td>
<td>4.38</td>
<td>2.44</td>
<td>1.62</td>
<td>0.70</td>
</tr>
</tbody>
</table>

These numbers are the normalized rankings. For the raw scores see the database.

Source: World Bank, KAM 2005

GLOBAL TRENDS IN EDUCATION AND THE SITUATION OF SOUTH ASIAN COUNTRIES

a. Global Trends in Education and Training

Education is the fundamental enabler of the knowledge economy. Well-educated and skilled people are key to creating, sharing, disseminating, and using knowledge effectively. Critical is no longer just basic or even secondary education, but higher education and the constant upgrading of skills. This is a challenge for all countries. There is also increasing competition for people with high level skills which makes their education and effective employment a central aspect of development strategy.

The development of a knowledge economy demands a flexible education system. It begins with basic education that provides the foundation for learning; continues with secondary and tertiary education that develops core, including technical skills; and encourages creative and critical thinking that is key to problem solving and innovation, extending into a system of lifelong learning. Such system is one that encompasses learning from early childhood to retirement and includes formal training (schools, training institutions, and universities) and nonformal learning (on-the-job training, and skills learned from family members or people in the
community). The basic elements of such a system are comprehensiveness, new basic skills (acting autonomously, using tools interactively, and functioning in socially heterogeneous groups), multiple pathways and multiple providers.

Thus, the knowledge revolution means that higher levels of education are needed to keep up with and make effective use of rapidly changing knowledge. It also means that high level scientific and technical manpower is needed to create new knowledge. But because the half life of knowledge is getting shorter and we all have to learn new skills, it also means that there is a need for a system of continuous training in order to constantly up-skill or re-skill people who have already passed through the formal educational system.

Countries are therefore paying more attention to education as part of their development and competitiveness strategy, putting great efforts into increasing the levels of educational attainment. Between 1990/91 and 2002/3, for instance, enrollment rates at the secondary level increased from 55% to 71% and from 16% to 26% at the tertiary level. For high income countries, in particular, the increases were from 94% to 107% and from 47% to 66% for the secondary and tertiary levels, respectively. For Korea, an economy that has traditionally placed a very high value on education and is now well known as a knowledge economy, the increase in tertiary enrollment rates was from 39% to 85%, which put it second only to Finland (with 86%), the other well known knowledge-based economy (World Bank WDI 2005).

Related to the need to keep up with new skills and functions – in computer literacy, communication skills and the ability to work in groups - is the need for constant up-skilling and re-skilling of persons who have already left the formal educational system. This is reflected in the very high percentage of adults who are taking additional courses at work, in specialized institutions, or even going back to tertiary institutions for formal education (in Finland, this is true for over 50% of adults). This is also reflected in the number of students at universities who are older than the typical university age cohort of 18 to 24 years old. In the U.S., over 40% of undergrads are over 25 years of age. In Australia, New Zealand, Denmark,

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7 In most countries, in spite of rapid expansion of higher education, the relative wage differences between college graduates and high school grades is not narrowing. This is surprising given the very large increase in supply. The explanation for this is that rapid technological change and higher education are complementary. Higher education is becoming increasingly important to take advantage of the rapid advances in knowledge.
Norway and Sweden, over 20% of first time entering students were over the age of 27 in 2000.\textsuperscript{8}

In addition there is a trend for an increasing number of private educational institutions all the way from nursery schools to the university level which have arisen to fill in the needs not adequately addressed by public education. Firms are undertaking increasing amounts of in-house training to give their workers the skills they need to compete. In addition, some of the larger firms are even setting up their own in-house universities to provide the most advanced specialized skills needed to be competitive. Firms are also more proactive in approaching universities and specialized training centers to get them to develop specific training programs to meet their needs.

Equally noteworthy is the increasing use of information-based technologies, which has been gathering speed as the technology has improved and more experience acquired on its use. In the U.S., 16% of tertiary level students are taking at least one course on line, and 40% of those are full time on line. E-learning is expanding very rapidly and much is being provided by non-traditional universities (new entrants, including publishers and mass media). E-education, by crossing boundaries, has also facilitated the internationalization of education. In 2004 there were 1.9 million students in tertiary education outside their home countries, which combined with a growing tendency for foreign universities to set up facilities abroad, is increasing competition in the education sector world-wide.

Finally, there is also increasing competition for high level human capital across countries because there is clear understanding that to be globally competitive and to be able to innovate, countries need high level human resources. It is telling, for example, that while there is no free trade in labor, the exception is for highly trained persons, where even the U.S. has had more liberal immigration policies and developed a program for the temporary immigration of specialized manpower in the ICT sector.

\textbf{b. Education and Skills in South Asian Countries}\textsuperscript{9}

South Asian countries are in a weak position in terms of education and skills. As a group they have high illiteracy rates, low enrollment ratios at the secondary and

\textsuperscript{8} OECD, \textit{Education at a Glance 2004}.

\textsuperscript{9} The spider charts in presented in this paper show the position of the region or country relative to all the other countries in the world. Being on the outside perimeter indicates ranking among the top 10% of countries in the world, being at the center of the circle indicates ranking in the bottom 10%.
tertiary levels, very low average educational attainment among the adult population, extremely low percentage of professional and technical workers among the labor force, low quality of math and science education, little staff training even among firms in the modern sector, and a very serious problem of emigration of the highly skilled workers.

As can be seen from the spider charts for individual countries there is considerable variations among the five countries. Nepal and Bangladesh are much weaker on all the variables. Pakistan ranks some what better. Sri Lanka and India score much higher. Sri Lanka has the highest literacy, enrollment rates, and average educational attainment. However India is ranked higher in terms of the quality of science and math education, extent of staff training and availability of management education. India has the world renowned Indian Institutes of Technology and Indian Institutes of Management which produce world class graduates. These institutes, along with many other lesser known regional colleges, have given India a critical mass of highly skilled people. These high quality English speaking human resources are a large part of the reason why India has been able to develop the information technology export services which have moved up from simpler back office functions and call centers to software design and innovation services. Many of the highly skilled Indians have immigrated to the US and Europe in search of higher paying jobs. However some of this brain drain has been turned into a brain gain as they have started to outsource highly skilled services from India.10

This strong high skilled ICT service sector has not developed in the other South Asian countries because of their smaller scale and less prevalence of English in their education systems. However it should be noted this is a very small sector in India relative to its total population, and that the average levels of educational attainment in India are very low. Therefore improving education and skills is challenge for all the South Asian countries.

10 For more on education and skills in India including the rise of the high technology service exports see Dahlman and Utz, *India and the Knowledge Economy*, 2005.
Figure 3: Education Scorecards for South Asian Countries

South Asia, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (57.00)
- Wast Educated Peope Do Not Emigrate Abroad (2.46)
- Availability of Management Education (4.22)
- Average Years of Schooling (4.15)
- Secondary Enrollment (4.49)
- Extent of Staff Training (3.45)
- Tertiary Enrollment (3.18)
- Quality of Science and Math Education (3.74)
- Life Expectancy at Birth, years (64.66)
- Prof. and Tech. Workers as % of the Labor Force (8.00)
- Internet Access in Schools (2.68)
- Public Spending on Education as % of GDP (2.59)

India, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (60.03)
- Wast Educated Peope Do Not Emigrate Abroad (2.83)
- Availability of Management Education (5.06)
- Average Years of Schooling (5.06)
- Secondary Enrollment (6.87)
- Extent of Staff Training (3.00)
- Tertiary Enrollment (10.58)
- Quality of Science and Math Education (5.50)
- Life Expectancy at Birth, years (63.20)
- Prof. and Tech. Workers as % of the Labor Force (4.10)
- Internet Access in Schools (3.80)

Bangladesh, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (41.99)
- Wast Educated Peope Do Not Emigrate Abroad (3.00)
- Availability of Management Education (2.55)
- Average Years of Schooling (2.55)
- Secondary Enrollment (4.86)
- Extent of Staff Training (2.30)
- Tertiary Enrollment (6.07)
- Quality of Science and Math Education (2.90)
- Life Expectancy at Birth, years (62.19)
- Prof. and Tech. Workers as % of the Labor Force (3.88)
- Internet Access in Schools (1.85)
- Public Spending on Education as % of GDP (2.02)

Pakistan, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (47.10)
- Wast Educated Peope Do Not Emigrate Abroad (2.46)
- Availability of Management Education (4.10)
- Average Years of Schooling (3.65)
- Secondary Enrollment (25.93)
- Extent of Staff Training (3.00)
- Tertiary Enrollment (3.55)
- Quality of Science and Math Education (6.00)
- Life Expectancy at Birth, years (63.80)
- Prof. and Tech. Workers as % of the Labor Force (5.22)
- Internet Access in Schools (3.00)
- Public Spending on Education as % of GDP (1.80)

Nepal, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (44.01)
- Public Spending on Education as % of GDP (3.40)
- Average Years of Schooling (2.43)
- Life Expectancy at Birth, years (59.98)
- Secondary Enrollment (19.07)
- Tertiary Enrollment (5.37)

Sri Lanka, Normalization Group: All
- Adult Literacy Rate (% age 15 and above) (52.88)
- Wast Educated Peope Do Not Emigrate Abroad (2.26)
- Availability of Management Education (4.10)
- Average Years of Schooling (5.87)
- Secondary Enrollment (30.77)
- Extent of Staff Training (3.50)
- Tertiary Enrollment (5.32)
- Quality of Science and Math Education (4.20)
- Life Expectancy at Birth, years (73.00)
- Prof. and Tech. Workers as % of the Labor Force (9.00)
- Internet Access in Schools (2.90)
- Public Spending on Education as % of GDP (1.31)
GLOBAL TRENDS IN INNOVATION AND SITUATION OF SOUTH ASIAN COUNTRIES

a. Global Innovation Trends

Innovation is becoming a critical element of competitiveness and growth as there is greater mobility of factors, products, services and knowledge. A larger percentage of a country’s economic growth can be attributed to more effective use of knowledge, even in developed countries. Countries behind the global frontier can dramatically increase their performance by improving their ability to innovate.

Expenditures on R&D globally have been increasing, particularly the share contributed by the productive sector. In OECD countries the share of R&D in GDP averages around 2.2% and 70% to 80% is undertaken by the private sector. In developing countries the share of R&D in GDP tends to average below 1% and 70% to 90% tends to be undertaken by the public sector. The R&D effort undertaken by private firms is oriented toward commercially relevant applications while the R&D effort undertaken by the government is usually more oriented toward basic knowledge and military research. As noted earlier, multinational corporations are the main producers of commercially oriented knowledge and they are also the main disseminators of such knowledge throughout the world. That is why it is important for developing countries to attract foreign investment that is relevant to their development strategies.

The innovation system plays an important role in acquiring, creating, adapting and disseminating knowledge, which is crucial for success in the knowledge economy. It consists of the network of institutions, rules, and procedures that affect how the country acquires, creates, disseminates, and uses knowledge. Innovation in a developing country does not just concern domestic development of knowledge on the global “frontier.” It also concerns the application and use of existing knowledge to the local context. For the countries of South Asia, which are still far behind the global frontier in many sectors, tapping into and making effective use of existing global knowledge will have a greater economic impact than directing most of its resources to develop frontier knowledge, no matter how prestigious the latter may be.

The concept of “innovation” encompasses not only “technological innovation,” that is, diffusion of new products and services of a technological nature into the economy, but equally includes non-technological forms of innovation, such as
“organizational” innovations. The latter includes the introduction of new management or marketing techniques, adoption of new supply or logistic arrangements, and improved approaches to internal and external communications and positioning.

The concept of a national innovation system rests on the premise that understanding the linkages among the various actors involved in innovation are key to improving a country’s technology performance. These actors include private enterprises, universities, research institutes, think tanks, consulting firms, and others. The innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a broader system. Linkages can take the form of joint research, personnel exchanges, cross-patenting, licensing of technology, purchase of equipment, and a variety of other channels.

b. Innovation in South Asian Countries

As a region the South Asian countries do better on the innovation pillar than on any of the others, and that is largely because of the capabilities of the large countries, India in particular, but also Pakistan and to a lesser extent Bangladesh. The main strength comes from the large absolute number of scientist and engineers in R&D as well as the number of scientific and technical journal articles. Bangladesh also has a strength in the very high science and engineering enrollment ratios in higher education, although that is diluted by the very low tertiary enrollment rates.

Another area of relative strength is a strong state of cluster development, although this is mostly concentrated in India (where it includes not just IT services but pharmaceuticals, textiles, and metal engineering industries), Pakistan (medical instruments, sporting goods, textiles and garments), and Sri Lanka (textiles and garments).

The overall formal R&D effort of the South Asian countries is very small. R&D expenditures as a share of GDP average 0.48%, with a high of only 0.78% in India. In general, the vast majority of the research done in the South Asian economies is done in public R&D labs. An area where India shows some strength though is in

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11 The Innovation scorecards have a small glitch in that the variables on the cost of registering a contract and on the cost to register a business were inversely scaled. In their case, the higher the cost, the lower the ranking shown. To be consistent with the scaling of all the other variables they should have been scaled inversely—the higher the cost, the lower the ranking. This inversion should be taken into account in interpreting the high rankings on the two variables in this section.
patenting. India has a large public research network and recently there have been some reforms which are strengthening the incentive regime to produce more commercially relevant output.

The private sector, with the exception of some of the larger Indian groups, does very little research. In addition the relatively little research done by the public sector is not commercially relevant, and there are poor mechanisms to get it out to the productive sectors. It is also generally quite burdensome to start up new businesses particularly technology based business which also face the additional challenge or raising funds for risky new technology projects. The overall business environment is somewhat more supportive in Sri Lanka.

Another area of weakness of the innovation system in South Asian countries is the poor links between university and company researchers. This is a little stronger in India than in the other countries, but is still quite weak by the standards of developed countries.

However, it should be noted not all innovations are done through formal research. In all countries there are informal innovation efforts. In India some of this effort is being collected through an organization called the HoneyBee network which has documented over 12,000 small indigenous innovations, mostly in the agricultural sector. Furthermore, the government is beginning to pay attention to supporting and scaling up this indigenous effort.

All five countries with a partial exception of Sri Lanka, however do not draw very much on global knowledge. This is revealed by the very low share of foreign direct investment to GDP which is just a fraction of 1% for all countries except Sri Lanka (where it is 1.4%), and by very low formal purchase of foreign technology as shown by very low royalty or licensing fee payments ( $0.33 per person in India where it is the highest followed by $0.12 in Pakistan, and virtually nil in the others) This contrasts with the situation of East Asian countries where the average share of gross direct foreign investment as a share of GDP is 8.26%, and the average royalty and licensing fees per population are $30.82. In addition, again with the exception of Sri Lanka, the share of manufactured trade (imports and exports as proxy for access to embodied knowledge and pressures to keep up with global technology) in GDP is less than 25% (and in India it is only 13%) compared to an average of 99% for East Asian countries.

In short, although the South Asian countries do relatively better on the innovation pillar than on the other, they still have relatively small R&D effort relative to their
needs. Also the little that they do is not well integrated into the production system. In addition, as will be stressed below, they have a majority of the population in traditional subsistence sectors of the economy and very little of this effort gets out to them except for some work on agricultural research and extension. Finally, these countries are not drawing very much or very effectively on the rapidly growing stock of global knowledge.
Figure 4: Innovation Scorecards for South Asian Countries

South Asia (most recent)
- (2.33) Private Sector Spending on R&D
- (1.45) High-Tech Exports as % of Manuf. Exports
- (0.93) State of Cluster Development
- (2.90) Availability of Venture Capital
- (3.75) Admin. Burden for Start-Ups
- (3.78) Scientific and Technical Journal Articles/1mil pop
- (195.00) Scientific and Technical Journal Articles
- (48.16) Cost to Enforce a Contract (% of GNI per capita)
- (75.28) Cost to Register a Business (% of GNI per capita)

India (most recent)
- (3.38) Private Sector Spending on R&D
- (0.50) High-Tech Exports as % of Manuf. Exports
- (4.14) State of Cluster Development
- (3.81) Availability of Venture Capital
- (4.05) Admin. Burden for Start-Ups
- (9.23) Scientific and Technical Journal Articles/1mil pop
- (654.00) Scientific and Technical Journal Articles
- (34.34) Cost to Enforce a Contract (% of GNI per capita)
- (10.60) Cost to Register a Business (% of GNI per capita)

Bangladesh (most recent)
- (2.60) Private Sector Spending on R&D
- (1.20) High-Tech Exports as % of Manuf. Exports
- (2.20) State of Cluster Development
- (0.91) Patent Applications Granted by the USPTO
- (1.32) Patent Applications Granted by the USPTO
- (2.00) Availability of Venture Capital
- (3.30) Admin. Burden for Start-Ups
- (1.15) Scientific and Technical Journal Articles/1mil pop
- (148.00) Scientific and Technical Journal Articles
- (44.20) Cost to Enforce a Contract (% of GNI per capita)
- (Cost to Register a Business (% of GNI per capita)

Normalization Group: All
OVERALL ASSESSMENT

The South Asian countries are significantly behind the global frontier in education and innovation, and ICT. While their GDP growth has been higher than the world average, they also have high population growth rates. Competing on the international stage is becoming more demanding.

There is considerable diversity among the five South Asian countries analyzed in this paper. India is clearly ahead in its skills, technology and innovation capability because of its much larger size and the critical mass in the absolute number of highly skilled population, number or researchers in R&D, resources allocated to R&D and the vast network of public research laboratories, universities, and large private companies that are already undertaking research. Nepal is at the other extreme because of its very small population, much lower per capita income, and much less developed technology infrastructure.

Keeping in mind these differences in scale and in the degree of development of their human and technological infrastructure, there are still some generic actions that all the countries can take. These will be treated under five headings although the details under each will have to be adjusted to the specificities of each country. However there is an over riding reality which cuts across all these recommendations that needs to be addressed. It is that in all South Asian countries the modern sector is just a small part of their economies. Two thirds or more of their population are rural and agriculture is still a large part of economic activity. The share of agriculture in GDP ranges from 19% in Sri Lanka to a high of 41% in Nepal, compared to the world average of just 4%. In addition with the exception of Sri Lanka (where it is only 8%) the share of the population below one dollar a day is in the double digits, ranging from 13% in Pakistan to 38% in Nepal. Furthermore the South Asian countries have very high illiteracy rates ranging from 29% to 50% for men and from 51% to 74% for women.

Table 6: Various Proxy Indicators of Traditional Sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Rural</th>
<th>Agricultural</th>
<th>Below $1/day</th>
<th>Illiteracy M-F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>73</td>
<td>22</td>
<td>36</td>
<td>50-69</td>
</tr>
<tr>
<td>India</td>
<td>72</td>
<td>22</td>
<td>35</td>
<td>32-55</td>
</tr>
<tr>
<td>Nepal</td>
<td>87</td>
<td>41</td>
<td>38</td>
<td>38-74</td>
</tr>
<tr>
<td>Pakistan</td>
<td>66</td>
<td>23</td>
<td>13</td>
<td>Na</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>76</td>
<td>19</td>
<td>8</td>
<td>29-51</td>
</tr>
<tr>
<td>World Average</td>
<td>51</td>
<td>4</td>
<td>na</td>
<td>20-27</td>
</tr>
</tbody>
</table>
This means that there needs to be a massive effort to increase the educational and technological level of the large population that is still not integrated into the modern sector. This population tends to be largely the rural population, although it also includes a large portion of the urban population which is eking out a marginal subsistence in urban slums in the informal urban sector. This will have be major focus of policy action and will be built into the recommendations for actions that follow.

An additional recommendation will be the value of networking and cooperation among the South Asian Countries.

**KEY ACTIONS**

**a. Improving the Economic Incentive and Institutional Regime**

Although Sri Lanka does better than the others, South Asian countries need to improve their economic and institutional regime. This includes increasing the depth and flexibility of capital and labor markets, strengthening social safety nets and competition policy, improving governance and the rule of law, all of which part of the basics of development. From the knowledge economy perspective, an additional area which needs to be improved is these countries participation in international trade. Imports of capital goods, components and products embody a lot of knowledge. Exports also force companies to reduce costs and improve quality which stimulate greater technological effort. With the exception of Sri Lanka, where the ratio of exports and import of goods to GDP is 57%, the share of trade in goods to GDP is below the weighted world average of 42% in 2003. The share in India is one of the lowest in the world at only 21% (WDI 2005). India is missing out in the benefit of specialization and exchange and access to global knowledge. China, where the trade in goods is 60% of GDP has benefited greatly from this greater global integration. Clearly there is room to lower tariff and non-tariff barriers in the South Asian economies to create more competitive pressure to improve performance as well as to get greater access to embodied global knowledge.

**b. Strengthening education and skills**

As noted earlier, education and skills are critical for countries to be able to make effective use of new knowledge, let alone to develop new knowledge. Here the challenges for South Asian countries are enormous. They have five challenges. First, they have to expand literacy. All five countries have female illiteracy rates
over 50% and male illiteracy rates from 29% to 50%. Clearly they all have to undertake major literacy drives.

Second, they have to expand basic formal education to the large number of children who are not in school and who drop out. Primary enrollment rates are still less than 100%, and primary completion rates are even lower. The share of grade 1 students reaching the 5th grade is only 61% for males and 65% for females (WDI 2005). At the same time they have to expand secondary education. Secondary enrollment rates average just 49%.

Third, they also have to expand higher education where enrollment rates average just 6% compared to a world weighted average of 26%. Fourth, they have to improve the quality of education at all levels. Most have outdated curriculums and do not teach the basic skills needed by students to continue to learn throughout their lives no matter at what level they leave formal education. Finally they need to develop ways of effectively retraining adults who have left formal education, but need new skills demanded by rapidly changing technology.

Hard choices of priorities on budget allocations will be need to be made as public sector budgets are clearly insufficient. Moreover, it is necessary to move on the various fronts as they are all critical and none can be completely unattended. Thus ways have to be found to make more resources available for the challenge.

Three types of actions can be helpful. One is to increase efficiency in the use of existing budgets. In all countries there are many inefficiencies and waste in educational expenditure. Better monitoring and incentive mechanism need to be put in place.

The second is to make effective use of the private sector. This includes charging tuition for private education, particularly at the higher educational level. China, for example, has increased enrollments at the entering class at the tertiary level by 50% per year since 1997 and has been able to increase the enrollment rates from 6.5% in 1997 to 21% today. It did this in part by raising student tuitions to cover from 25% to 40% of public tertiary education costs. It also includes allowing entry of private providers of education, again especially at the higher education level since the government has the obligation to provide basic education as a public good. In China there are now over 4 million students in non-government institutions.
The third is to use the potential of new technologies to extend access and improve quality of education. In India for example Tata Consulting has developed a computer based functional literacy program based on a multimedia program with animated characters and voiceover that allows students to acquire a 300 to 500 word vocabulary in their own language or dialect in 30 to 45 hours. It is being piloted successfully in Andra Pradesh and has the potential to help make a large proportion of India functionally literate in just a few years. There is also great potential to add new internet and satellite based educational delivery mechanism to more traditional radio or television based distance education programs.

\[\text{c. Tapping into Global Knowledge}\]

All five countries could do better at tapping into global knowledge in addition to greater trade with the rest of the world. All could benefit by trying to attract more direct foreign investment. India in particular has great potential. Surveys of investor such as those done be A T Kearny find that executives rank India as a top potential destination. However little of this investment materializes for various reasons. One is that many sectors are still reserved for the State and other are only partially open. The second is the poor power and road infrastructure. The latter, in particular, inhibits investments that have to move goods in and out of the country. By contrast, investment in the services area which need only good internet bandwidth such as back office functions, call centers, engineering services, and software are not as inhibited because all they really need are good telecommunications and backup power. Liberalization of foreign investment restrictions and more proactive policies to attract foreign investment need to be put in place. Recall that the multinational corporations are the main producers and disseminators of applied knowledge.

South Asian countries also are not very active in purchasing foreign technology. Licensing payments per million population are extremely low, compared to East Asian countries. (av of $0.16 in South Asia vs $30.82 av in East Asia). Overly restrictive technology transfer policies which inhibit purchase of foreign technology need to be relaxed.

\[\text{12 See Dahlman and Utz. India and the Knowledge Economy, 2005.}\]
\[\text{13 Cisco for example has developed a full day by day internet based curriculum to teach math in Arabic from kinder garden to 12\textsuperscript{th} grade which is being piloted in Jordan in 400 discovery schools through a joint program with the Ministry of Education. It has also developed online training programs for skills ranging from installing local area networks of its own systems to basic plumbing and electricity for workers in the UK.}\]
Another means of tapping into foreign knowledge that needs to be strengthened is attracting back nationals who have gone abroad for studies and have acquired not only academic knowledge but practical experience from working in foreign countries. All the South Asian countries have a significant diaspora that can be tapped. Economies such as Korea and Taiwan started doing this two decades ago with great success. China has also launched major programs to attract its diaspora by offering attractive incentives and special high tech parks dedicated exclusively for returning nationals. While India has begun to do some of this, it is still far behind China, and other countries in South Asia are even further behind.

Finally much more can be done by South Asian countries to take advantage of the extensive amount of technical information and knowledge that can be tapped through technical publications and databases, especially now with the advent of the internet. Some of the issues here are how to reap economies of scale in subscriptions to and dissemination of such information.

\textit{d. Creating Knowledge}

As noted, the five South Asian countries, with the partial exemption of India, are relatively weak in creating knowledge. Part of the reason for that is the still relatively weak pressure for improving performance for the economy as they generally are less open to international trade (although Sri Lanka is an exception here). It could be argued that they all need to increase expenditures on research and development. However, before pushing for an increase in public resources for R&D (as the bulk of spending is currently done by the government) it would be appropriate to improve the use of the resources that are currently being allocated. The productivity of the public resources allocated to R&D is very low. It is necessary to improve the efficiency in the allocation of public resources to R&D. Some of the mechanisms that should be strengthened in the allocation of public funds for research are competitive bidding, peer review, and more monitoring and accountability in the use of the funds. In addition it is necessary to improve the micro incentive regimes in the public R&D labs to that they are use their resources more efficiently to focus on the needs of the respective economies.

It is also necessary to get the private sector to do more research of its own. Increasing competitive pressure in the economies should help. In addition the government should stimulate more private research by strengthening various incentive mechanisms including: matching R&D grants, tax subsidies for increases in R&D, and special programs to foster collaboration between public R&D labs,
private firms and universities (for example by earmarking some of the matching grants for programs that actually involve such collaborations.)

The later should also include a review to remove disincentives for university researchers to do collaborative work with industry. Instead there should be strong incentives for public laboratory and university researchers to work with industry by allowing them to share in the benefits of the technologies developed through consultancy contracts and profit sharing in royalties. In addition there should be a special emphasis on publicly funded research to address the needs to the very large part of the population in all these countries that still lives at close to the subsistence level. These should include preventive health programs as well as programs to help them make more effective use of their limited resources, as well as how to extend to them the benefits of information technology by developing low cost ICT solutions for them.

In addition in all countries more can be done to set up special mechanisms and institutions to foster greater technology spin-off from public research labs and universities. These mechanisms should include technology transfer offices in the public labs and universities, science based industrial parks, and business incubator programs. These will make more sense in the larger economies such as India, Pakistan and Bangladesh than in Nepal and Sri Lanka, although Sri Lanka is making efforts in this direction even in spite of its small size. In addition for the start-up of new technology based firms it is necessary to help them develop realistic business plans and provide them assistance in getting capital as it is very difficult for start-ups with no assets to get loans from the banking sector.

It is also necessary to integrate these policies to allocate more resources to research and to strengthen the research infrastructure and collaboration among the main innovation agents with policies to develop the high level scientific, engineering, and technical persons who are to create new knowledge. This should also include strengthening business and entrepreneurship programs for scientists and engineers so that they are more attuned to identifying business opportunities.

In addition the governments also have to strengthen programs to support grass root innovations and to support the scale up and broader dissemination of these innovations, as is being done by the Indian government.
e. Disseminating Existing Knowledge, Especially to the Very Large Traditional Sectors in Each Country

This is perhaps the most important area given the very large percentage of the total population in these economies that has not yet benefited from the modern economy. In addition this does not have the risk involved in the creation of new knowledge. It is the application and adaptation of already existing knowledge. In some cases there is the issue of purchasing existing proprietary knowledge. However there is a tremendous amount of knowledge in the public domain that is not being used. This may be due to lack of information on its existence, lack of understanding of its relevance, lack of education or skills to make use of it, or lack of access to complementary inputs or supporting infrastructures and institutions to use it efficiently. A combination of these factors explains why it is not so easy for developing countries to catch up with developed countries, or for poor people to use knowledge that may be very relevant for them. The most relevant actions to address the lack of use of knowledge differ according to the nature of the problem (Table 7). They range from the more straightforward action of increasing access to information, to the need to build up domestic institutions and domestic capabilities, in terms of people’s skills and ability to make effective use of knowledge.

<table>
<thead>
<tr>
<th>Nature of Problem</th>
<th>Actions to Solve It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of information of existence of knowledge</td>
<td>Provide more technical information through print, radio, television and internet</td>
</tr>
<tr>
<td>Lack of understanding of its relevance</td>
<td>Educate people on the value and relevance of different types of knowledge and how to look for an access it</td>
</tr>
<tr>
<td>Lack of education or skills to be able to use it</td>
<td>Beyond general education train people with the specific skills necessary to use the knowledge</td>
</tr>
<tr>
<td>Lack of access to complementary inputs or supporting infrastructures and institutions to be able to use it.</td>
<td>Provide easier access to finance Provide extension services and other technical assistance to demonstrate the proper use of the new knowledge and to support its application. Remove regulations that make it difficult to access the knowledge or to start up new business or activities with it Provide a supportive environment in terms of good rule of law and contract and enforceability of contracts.</td>
</tr>
</tbody>
</table>

But while it is easy to say this needs to be done, it is quite difficult in practice. There are various mechanisms that need to be strengthened to disseminate knowledge. They include technical information services; extension services in
agriculture, industry and services, productivity organizations, strengthening the metrology, standards and quality control infrastructure. These should be given stronger priority than they are usually given by most governments who tend to focus too much on developing new knowledge rather than supporting the broader dissemination of knowledge to the large population in their economies who is still in the traditional sectors.

Also it should be noted that the kinds of knowledge that are needed for development are not just hard technical knowledge such as how to manufacture engines or produce steel or fertilizers, or petrochemicals. Also important are organizational and managerial knowledge—how to set up transportation or distribution systems, and not just for goods, but also for services. Some examples are: how to set up effective tax collection and revenue administration systems for government, or how to provide effective health and education services, or business services.

**NETWORKING AND COLLABORATION AMONG SOUTH ASIAN COUNTRIES**

A sixth action recommendation is to set up a system for networking and collaboration among the South Asian countries in the areas of education and training as well as in technology and innovation... As noted, in spite of their differences, there are many generic actions which are similar across the South Asian countries, and all the countries share the need to find more effective ways to extend education and technology to the large part of their population which is outside the modern economy. Sharing the experiences that each country has in dealing with the issues identified would be very beneficial to others. In addition countries that are less advanced in a particular area could learn from those who have more experience of successful programs in that area. There is also scope for collaboration across countries in tackling similar issues, and even in doing joint research on common problems. An excellent example of such knowledge sharing across a region as well as a formal framework for joint research is given by the European Community’s program in education and in research.

The EU has set itself in Lisbon in 2000 the ambitious target to become the most competitive and dynamic knowledge based economy of the world capable of sustainable economic growth with more and better jobs and greater social cohesion by 2010. To achieve this has developed number of program to transform education and training. These include sharing of experiences and working towards common goals and learning from what works best elsewhere. It also includes programs to
encourage mobility of students teachers and researchers among the countries in the EU and with countries outside the EU, as well a programs for metal recognitions of degrees across the EU.

It has even more ambitious collaboration programs in the area of research. The 6th Framework Program for research was launched in 2002 with a budget of 17.5 billion Euros (about 5.5% of the total R&D effort of the EU countries), subsequently increased to 19.2 billion Euros. It aims to foster joint research across countries and between firms, universities and enterprises. It includes the creation of 25 technology platforms as well as an open method of coordination across the EU to contribute to policy learning and policy integration by encouraging and facilitating mutual exchange of knowledge and best practice. 14

While the EUs programs are extremely ambitious and may be to more than what is feasible at the current time for South Asian countries as they do not yet have the formal integration of the EU community, these programs do indicate the importance of cross country collaboration and learning within a region, as well as the rationale for funding of research across national boundaries. Clearly it would make sense to start some of this cross country sharing of experience and learning among the South Asian countries, and even consider some more formal exchange and joint funding programs. Hopefully this is an initiative that could be seriously considered at this regional workshop of South Asian government and business leaders.

In conclusion there is a great need to upgrade technology, skills and innovation in South Asian economies to help them improve their productivity and growth potential and to increase the welfare of their people. Fortunately there is useful experience of the kinds of policies, mechanisms, and institutions that can be used to do this. The first thing that is needed is to raise awareness among policy makers, the business community, and the population at large of what can be done. Hopefully this conference will be a good occasion to raise awareness. The second step, which hopefully could come out of a meeting such as this, is to launch some concrete programs that begin to make a difference in order to demonstrate what can be done. The third is to publicize the scale up of the successful project. Hopefully this conference can be the beginning of that process.

14 For more information see the EUs website and look under the various education and research programs- www.eurunion.org/legislat/ste.htm
ANNEX

Basic Scorecards for South Asia and Five Countries

South Asia (most recent and 1995), Normalization Group: All

- GDP Growth(%) (4.42)
- Human Development Index (0.57)
- Tariff & Nontariff Barriers (2.80)
- Regulatory Quality (-0.51)
- Rule of Law (-0.34)
- Researchers in R&D (28737.50)
- Scientific and Technical Journal Articles (1953.00)
- Patent Applications Granted by the USPTO
- Internet Users per 10,000 People (87.13)
- Computers per 1,000 people (6.34)
- Telephones per 1,000 People (48.84)
- Tertiary Enrollment (6.18)
- Secondary Enrollment (49.16)
- Adult Literacy Rate (% age 15 and above) (57.06)
- Patent Applications Granted by the USPTO (90.25)

India (most recent and 1995), Normalization Group: All

- GDP Growth(%) (5.80)
- Human Development Index (0.60)
- Tariff & Nontariff Barriers (2.00)
- Regulatory Quality (-0.34)
- Rule of Law (0.07)
- Researchers in R&D (95428.00)
- Scientific and Technical Journal Articles (9217.00)
- Patent Applications Granted by the USPTO (355.00)
- Internet Users per 10,000 People (174.86)
- Computers per 1,000 people (7.20)
- Telephones per 1,000 People (71.00)
- Tertiary Enrollment (10.58)
- Secondary Enrollment (48.47)
- Adult Literacy Rate (% age 15 and above) (61.03)

Bangladesh (most recent and 1995), Normalization Group: All

- GDP Growth(%) (5.20)
- Human Development Index (0.51)
- Tariff & Nontariff Barriers (2.00)
- Regulatory Quality (-1.05)
- Rule of Law (-0.78)
- Researchers in R&D (6097.00)
- Scientific and Technical Journal Articles (148.00)
- Patent Applications Granted by the USPTO (1.00)
- Internet Users per 10,000 People (17.98)
- Computers per 1,000 people (3.40)
- Telephones per 1,000 People (15.60)
- Tertiary Enrollment (6.07)
- Secondary Enrollment (46.88)
- Adult Literacy Rate (% age 15 and above) (41.09)
In this figure the innovation variables are not scaled by population but kept in terms of their absolute size. The rationale for this is that critical mass is important in terms of the innovation variables, because knowledge is not consumed in its use so there are real economies of scale. On this chart the large developing countries, particularly China, India, Brazil, and Russia move up to the northwest quadrant with the developed economies.
South Asia (most recent)

- Telephones per 1,000 People: 40.94
- Main Telephone Lines per 1,000: 26.12
- Mobile Phones per 1,000: 20.72
- Computers per 1,000 People: 6.54
- TV Sets per 1,000: 83.40
- Radios per 1,000: 193.00

Normalization Group: All

India (most recent)

- Telephones per 1,000 People: 71.00
- Main Telephone Lines per 1,000: 45.30
- Mobile Phones per 1,000: 24.70
- Computers per 1,000 People: 7.20
- TV Sets per 1,000: 83.00
- Radios per 1,000: 120.00

Normalization Group: All

Bangladesh (most recent)

- Telephones per 1,000 People: 15.63
- Main Telephone Lines per 1,000: 5.53
- Mobile Phones per 1,000: 10.10
- Computers per 1,000 People: 3.40
- TV Sets per 1,000: 80.00
- Radios per 1,000: 38.00

Normalization Group: All
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