WBI Development Studies

India and the Knowledge Economy

Leveraging Strengths and Opportunities

OVERVIEW

Carl Dahlman
Anuja Utz

Finance and Private Sector Development Unit
of the World Bank's South Asia Region
and
The World Bank Institute

The World Bank
Washington, D.C.

Currency Equivalents

(Exchange Rate Effective April 7, 2005)
Currency Unit: Rupees (Rs.)
US$1 = Rs. 43.79
Rs. 1 = .0228 US$

Abbreviations and Acronyms

BPO	business process outsourcing
CBFL	computer-based functional literacy
CSIR	Council of Scientific and Industrial Research
FDI	foreign direct investment
GDP	gross domestic product
HLSG	High-Level Strategic Group
ICT	information and communications technology
IIT	Indian Institutes of Technology
IPR	intellectual property rights
IT	information technology
KAM	Knowledge Assessment Methodology
KEI	Knowledge Economy Index
MNC	multinational corporation
NASSCOM	National Association of Software and Services Companies
NGO	nongovernmental organization
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
REC	Regional Engineering College
S&T	science and technology
TFP	total factor productivity
TRIPS	Trade-Related Aspects of Intellectual Property Rights
USPTO	United States Patent and Trademark Office
WTO	World Trade Organization

Overview

One of the world's largest economies, India has made tremendous strides in its economic and social development in the past two decades and is poised to realize even faster growth in the years to come. After growing at about 3.5 percent from the 1950s to the 1970s, India's economy expanded during the 1980s to reach an annual growth rate of about 5.5 percent at the end of the period. It increased its rate of growth to 6.7 percent between 1992–93 and 1996–97, as a result of the far-reaching reforms embarked on in 1991 and opening up of the economy to more global competition. Its growth dropped to 5.5 percent from 1997–98 to 2001–02 and to 4.4 percent in 2002–03, due to the impact of poor rains on agricultural output. But, thanks to a lavish monsoon that led to a turnaround in the agriculture sector, India's economy surged ahead to reach a growth rate of 8.2 percent in 2003–04. This is very much in line with growth projections cited in India's Tenth Five-Year Plan, which calls for increasing growth to an average of 8 percent between 2002–03 and 2006–07 (India, Planning Commission, 2002a). Such sustained acceleration is needed to provide opportunities for India's growing population and its even faster-growing workforce.

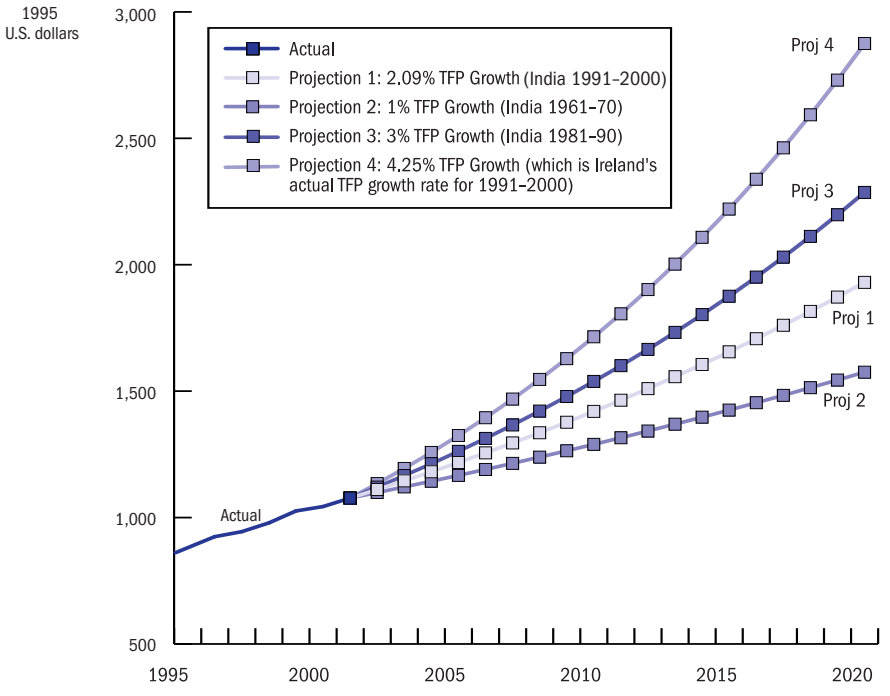
Embarking on a new growth path. India has a rich choice set in determining its future growth path. Figure 1 shows what India can achieve by the year 2020, based on different assumptions about its ability to use knowledge, even without any increase in the investment rate. Here, total factor productivity (TFP) is taken to be a proxy for a nation's learning capability.

Projections 1, 2, 3, and 4 plot real gross domestic product (GDP) per worker (1995 U.S. dollars) for India assuming different TFP growth rates from 2002 to 2020. Projection 4 is an optimistic scenario that is based on the actual TFP growth rate in Ireland in 1991–2000. Ireland is an example of a country that has been using knowledge effectively to enhance its growth. All things being equal, the projected GDP per worker for India in scenario 4 in 2020 is about 50 percent greater than in scenario 1. Knowledge can make a difference between poverty and wealth.

Which growth path India embarks on in the future will depend on how well the government, private sector, and civil society can work together to create a common understanding of where the economy should be headed and what it needs to get there. India can no doubt reap tremendous economic gains by developing policies and strategies that focus on making more effective use of knowledge to increase the overall productivity of the economy and the welfare of its pop-

FIGURE 1

India: Real Gross Domestic Product Per Worker, Alternative Projections, 1995–2020



Note: For all four projections, capital, labor, and human capital are assumed to grow at their 1991–2000 average annual growth rates for India, that is, 5.41, 2.23, and 0.58 percent, respectively. For the growth-TFP decomposition to be more precise, labor force figures rather than total population are used as a measure of the amount of "labor" available for use as a factor of production in the Indian economy. According to World Bank databases, in 2001 India's GDP (in 1995 U.S. dollars) was $495 billion and its population was 1.03 billion, of which only 461 million were in the labor force. As such, India's GDP per capita in 2001 was approximately $480, whereas GDP per worker was around $1,070.
Source: Knowledge for Development Program.

ulation. In so doing, India will be able to improve its international competitiveness and join the ranks of countries that are making a successful transition to the knowledge economy.

Embracing the knowledge economy. The time is very opportune for India to make its transition to the knowledge economy—an economy that creates, disseminates, and uses knowledge to enhance its growth and development. The knowledge economy is often taken to mean only high-technology industries or information and communication technologies (ICTs). It would be more appropriate, however, to use the concept more broadly to cover how any economy harnesses and uses new and existing knowledge to improve the productivity of agriculture, industry, and services and increase overall welfare. In India, great potential exists for increasing productivity by shifting labor from low productivity and subsistence activities in agriculture, informal industry, and informal service activities to more productive modern sectors, as well as to new knowledge-based activities—and in so doing, to reduce

poverty and touch every member of society. India should continue to leverage its strengths to become a leader in knowledge creation and use. To get the greatest benefits from the knowledge revolution, the country needs to press on with the economic reform agenda that it put into motion more than a decade ago and continue to implement the various policy and institutional changes needed to accelerate growth.

Advantage India. India has many of the key ingredients for making this transition. It has a critical mass of skilled, English-speaking knowledge workers, especially in the sciences. It has a well-functioning democracy. Its domestic market is one of the world's largest. It has a large and impressive Diaspora, creating valuable knowledge linkages and networks. The list goes on: macroeconomic stability, a dynamic private sector, institutions of a free market economy, a well-developed financial sector, and a broad and diversified science and technology (S&T) infrastructure. In addition, the development of the ICT sector in recent years has been remarkable. India has created profitable niches in information technology (IT) and is becoming a global provider of software services. Building on these strengths, India can harness the benefits of the knowledge revolution to improve its economic performance and boost the welfare of its people.

This book provides a "big picture" assessment of India's readiness to embrace the knowledge economy and highlights some of the key constraints and emerging possibilities confronting India on four critical pillars of the knowledge economy:

- Strengthening the economic and institutional regime
- Developing educated and skilled workers
- Creating an efficient innovation system
- Building a dynamic information infrastructure.

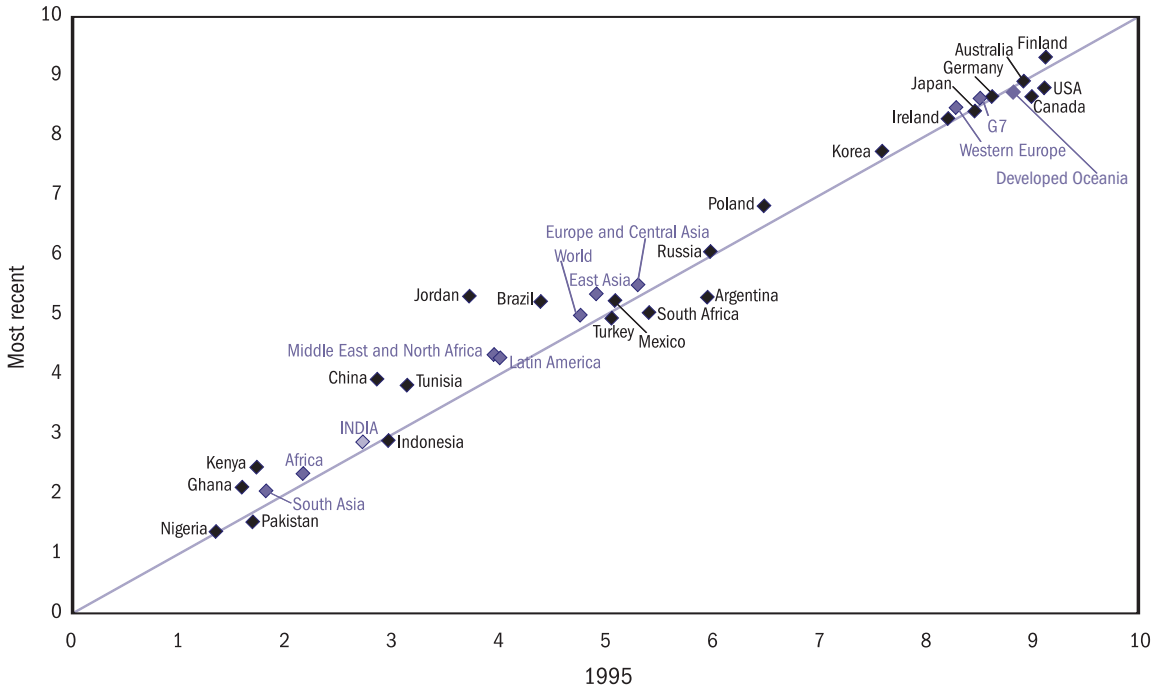
Figure 2 benchmarks India's relative global position in the global knowledge economy based on a methodology using three indicators for each of the above four pillars. It shows that India is at the top of the bottom third of the global distribution and that its relative position has improved a little in the last decade. However, this book highlights India's tremendous potential to make dramatic improvements in its overall knowledge readiness.

It stresses that to be competitive in the global knowledge economy of the twenty-first century, India should continue to focus its efforts on further reforming its overall economic and institutional environment and improve its overall trade and investment climate. Addressing issues in this domain will be key, because it sets the overall incentive framework needed to improve performance across the economy. The book further underlines that for India to leverage its strengths and opportunities on a global scale, it needs to undertake significant reforms and investments in building education and skills, strengthening its innovation system, and further bolstering its information infrastructure. To create and sustain an effective knowledge economy, India must undertake systemic integration of reforms in the above four domains to strengthen its competitive advantage.

The following are some of the key issues that India needs to address in each of the four pillars to spur growth and innovation and, in so doing, increase economic and social welfare.

FIGURE 2

Knowledge Economy Index: India, Comparators, and the World, 1995 and Most Recent Period



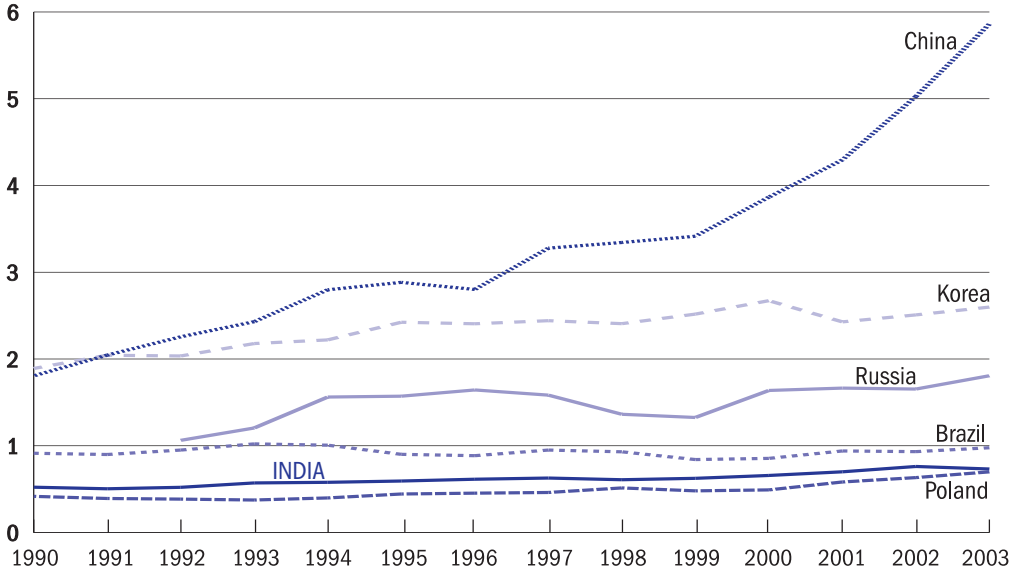
Note: Countries in the northeast section of the figure are the global leaders. Countries above the 45-degree line have improved their position in the knowledge economy index (KEI) for the most recent period for which data are available relative to their position in 1995 (or closest available date in the mid-1990s) and vice versa for countries below the line.
Source: World Bank, "Knowledge Assessment Methodology," http://www.worldbank.org/kam.

Strengthening the Economic and Institutional Regime

Taking advantage of the knowledge revolution's potential hinges on effective economic incentives and institutions that promote and facilitate the redeployment of resources from less efficient to more efficient uses. This fundamental pillar of the knowledge economy provides the overall framework for directing the economy. Important elements of the economic and institutional regime include macroeconomic stability, competition, good regulatory policies, and legal rules and procedures conducive to entrepreneurship and risk taking. A key feature is the extent to which the legal system supports basic rules and property rights.

India's economic and institutional regime has several strengths: flourishing entrepreneurship and free enterprise; a strong infrastructure for supporting private enterprise; capital markets that operate with greater efficiency and transparency than, for example, those in China; an advanced legal system; and an independent judiciary. Property rights are fairly secure, and the protection of private ownership is strong. The rule of law generally prevails. Corporate governance has also improved dramatically.

FIGURE 3
Share of World Merchandise Exports, India and Comparators, 1990–2003
(percent)



Source: World Bank staff analysis undertaken using World Bank internal database.

India has other intrinsic advantages, such as macroeconomic stability, a large domestic market, and a large and relatively low-cost and skilled workforce. It also has a critical mass of well-educated workers in engineering and science and, unlike China, abundant raw materials. All this should allow the country to emerge as a major hub for manufacturing and service industries.

Despite India's recent economic growth, a number of barriers exist, such as the multiplicity of regulations governing product markets, distortions in the market for land, and widespread government ownership of businesses that have been inhibiting GDP growth, according to some estimates by about 4 percent a year. Removing these barriers and fostering a stronger investment climate would allow India's economy to grow as fast as China's—10 percent a year—and create some 75 million new jobs outside agriculture.

India is still a relatively closed economy compared with other Asian economies, in which exports account for a much larger share of GDP (33 percent in China and 38 percent in the Republic of Korea, compared with only 15 percent in India in 2003). Although this means that India is somewhat protected from global trends, the downside is that it does not benefit from stronger foreign competitive pressures to improve performance or from the ability to draw on more cost-effective foreign inputs, such as capital goods, components, products, or foreign investment, which embody more advanced knowledge. As a result, India is losing market share to its major competitors, especially China (Figure 3), where reforms have moved ahead much more rapidly; therefore, to speed up trade reform and be able to export, Indian firms need to be allowed to import the materials and technology they need.

BOX 1

Foreign Direct Investment: A Tale of Two Countries

India has not attracted anywhere near the amount of FDI that China has. Huang and Khanna (2003) note that this disparity reflects in part the confidence international investors have in China's prospects and their skepticism about India's commitment to free market reforms. But the FDI gap is also a tale of two Diasporas. China has a large and wealthy Diaspora that has long been eager to help; in contrast, the Indian Diaspora has been much less willing to invest back home. India, however, has managed to spawn a number of firms in the most cutting-edge, knowledge-based industries (in software, Infosys and Wipro and, in pharmaceuticals and biotechnology, Ranbaxy and Dr. Reddy's Laboratories). In 2002, the Forbes 200, an annual ranking of the world's best small companies, included 13 Indian firms, but just four from mainland China.

China has been far bolder with external reforms, but has imposed substantial legal and regulatory constraints on indigenous, private firms, mainly to prevent private domestic businesses from challenging China's state-owned enterprises. India has developed much stronger infrastructure to support private enterprise. Its capital markets operate with greater efficiency and transparency than do China's. Democracy, a tradition of entrepreneurship, and a decent legal system have given India the underpinnings necessary for free enterprise to flourish. The question remains: If India has so clearly surpassed China at the grassroots level, why is India's superiority not reflected in the numbers? Part of the reason may be that India's economic reforms only began in earnest in 1991, more than a decade after China began liberalizing. India has had to make do with a national savings rate half that of China's and 90 percent less FDI. Moreover, India is a sprawling, messy democracy; China, on the other hand, has enjoyed two decades of relative tranquility and has been able to focus almost exclusively on economic development. The real issue, of course, is not where China and India are today, but where they will be tomorrow. The answer will be determined in large measure by how well both countries utilize their resources.

India also needs to boost foreign direct investment (FDI), which can be a facilitator of rapid and efficient transfer and cross-border adoption of new knowledge and technology. FDI flows to India rose by 24 percent between 2002 and 2003, due to its strong growth and improved economic performance, continued liberalization, its market potential, and the growing competitiveness of Indian IT industries. Even so, in 2003, India received $4.26 billion in FDI, compared with $53.5 billion for China (Box 1)! But India's stock is rapidly rising: the *Foreign Direct Investment Confidence Index* by A. T. Kearney (2004) shows that China and India dominate the top two positions in the world for most positive investor outlook and likely first-time investments, and are also the most preferred offshore investment locations for business process outsourcing (BPO) functions and IT services.

Successful economic development is a process of continual economic upgrading in which the business environment in a country evolves to support and encourage increasingly sophisticated ways of competing. A good investment climate provides opportunities and incentives for firms—from microenterprises to multinationals—to invest productively, create jobs, and expand. As a result of investment climate improvements in the 1980s and 1990s, private investment as a share of GDP nearly doubled in China and India. But India needs to continue to foster a good investment climate that encourages firms to invest by removing unjustified costs, risks, and barriers to competition. One reason for India's less competitive markets is excessive regulation of the entry and exit of firms, which face stiffer requirements for obtaining permits and take much longer to get under way than do the firms in many other coun-

tries. Restrictions on the hiring and firing of workers are also a major obstacle to doing business in India. In addition, enforcing contracts is a major problem: for example, it takes more than a year to resolve a payment dispute.

So, to strengthen its overall economic and institutional regime, India should continue to address the following related to its product and factor markets and improving its overall infrastructure:

- Speeding up trade reform by reducing tariff protection and phasing out tariff exemptions. This will help Indian firms gain access to imports at world prices and would also help to encourage exports further.
- Encouraging FDI and increasing its contribution to economic growth by phasing out remaining FDI restrictions and increasing positive linkages with the rest of the economy.
- Stimulating growth of manufactured and service exports. In so doing, India could drive down global costs in services, just as China drove down global costs in manufacturing.
- Strengthening intellectual property rights (IPRs) and their enforcement. India has passed a series of IPR laws in the past few years, and their enforcement will be key to its success in the knowledge economy.
- Simplifying and expediting all procedures for the entry and exit of firms, for example, through "single window" clearances.
- Reducing inefficiencies in factor markets by easing restrictions on hiring and firing of workers.
- Improving access to credit for small and medium enterprises.
- Addressing problems in the use and transfer of land and updating bankruptcy procedures.
- Ensuring access to reliable power at reasonable cost by rationalizing power tariffs and improving the financial and operational performance of state electricity boards.
- Addressing capacity and quality constraints in transport by improving public sector performance and developing speedy, reliable door-to-door transport services (roads, rail, and ports) to enhance India's competitiveness.
- Improving governance and the efficiency of government, and encouraging the use of ICTs to increase government's transparency and accountability.
- Using ICTs for more effective delivery of social services, especially in health and education, empowering India's citizens to contribute to and benefit from faster economic growth.

Developing Educated and Skilled Workers

Education is the fundamental enabler of the knowledge economy. Well-educated and skilled people are essential for creating, sharing, disseminating, and using knowledge effectively. The knowledge economy of the twenty-first century demands a set of new competencies, which includes not only ICT skills, but also such soft skills as problem solving, analytical skills, group learning, working in a team-based environment, and effective communication. Once required only of managers, these skills are now important for all workers. Fostering such skills requires an education system that is flexible; basic education

TABLE 1
India: Educational Attainment of the Total Population Age 15 and Older, 1980–2000

		Population over age 15 (1,000s)	No schooling (percent)	Highest level attained: First level Total	First level Complete	Second level Total	Second level Complete	Post-secondary Total	Post-secondary Complete	Average years of school
				(percentage of the population age 15 and over)						
India	1980	423,306	66.6	12.6	4.7	18.5	5.4	2.4	0.7	3.27
	1990	542,391	55.8	20.5	7.6	20.5	5.6	3.3	1.7	4.10
	2000	680,072	43.9	28.2	10.5	23.8	6.5	4.1	2.2	5.06

Source: Barro and Lee (2001).

should provide the foundation for learning, and secondary and tertiary education should develop core skills that encourage creative and critical thinking. In addition, it is necessary to develop an effective lifelong learning system to provide continuing education and skill upgrading to persons after they have left formal education in order to provide the changing skills necessary to be competitive in the new global economy.

A strong basic education system is a necessary precondition to underpinning India's efforts to enhance further the productivity and efficiency of its economy. China's experience in this area is instructive as its emphasis on secondary education has provided it with a firm basis for expansion of manufacturing activities on a global scale. Investments in basic education are thus fundamental for countries to improve the productivity and the quality of labor and deliver the manpower needed for their development efforts. India has made substantial progress in increasing literacy and increasing primary and secondary enrollments and overall education attainment (Table 1). But the country still accounts for one-quarter of the world's 104 million children out of school. The participation of girls in the 6- to 14-year-old age group in elementary education is low. And considerable gaps exist in access to secondary education, particularly for girls. But, the Indian leadership is very committed to increasing educational attainment. The national program for universal elementary education, Sarva Shiksha Abhiyan or Education for All, was initiated in 2001, and the constitution was amended in 2002 to make elementary education a fundamental right of every child. In addition, some private Indian companies such as Tata are using advances in ICTs to deliver education more efficiently (Box 2).

India also possesses a large pool of highly educated and vocationally qualified people who are making their mark, domestically and globally, in science, engineering, IT, and research and development (R&D). But they make up only a small fraction of the population. To create a sustained cadre of "knowledge workers," India will need to develop a more relevant educational system and reorient classroom teaching and learning objectives, starting from primary school. The new system would focus on learning, rather than on schooling, and promote creativity. It would also improve the quality of tertiary education and provide opportunities for lifelong learning.

BOX 2

Reducing Illiteracy: The Computer-Based Functional Literacy Program

The computer-based functional literacy (CBFL) program initiated by Tata Consultancy Services of the Tata Group tries to overcome illiteracy through the innovative use of IT. It has the potential to help resolve India's adult illiteracy problem and to make 90 percent of India functionally literate in three to five years. The CBFL project uses a mixture of methods—teaching software, multimedia presentations, and printed materials—to teach an uneducated person to read in a fraction of the time it takes to do this by conventional means. It employs animated graphics and a voiceover to explain how individual letters combine to give structure and meaning to various words. The project focuses exclusively on reading and teaches a person to read within a span of 30 to 45 hours spread across 10 to 12 weeks. The emphasis is on words, rather than letters, and the process is styled to suit the learner. Because the program is multimedia driven, it does not need trained teachers. This also reduces the cost of eradicating illiteracy. The TCS course uses puppets as the motif in the teaching process and has been designed from material developed by the National Literacy Mission, established by the Indian government in 1988 to help eradicate adult illiteracy, and is tailored to fit different languages and even dialects.

In terms of results, those coming through the program can acquire a 300–500 word vocabulary in their own language and dialect. This is enough for everyday requirements, such as reading destination signs on buses, straightforward documents, and even newspapers. The program sets people on the path to acquiring other literacy skills, including writing and arithmetic ability. Such infrastructure could also make similar material available, for example, concerning healthcare or agriculture.

The program's potential in India can be gauged by its success in Andhra Pradesh, where it is now operational in 415 centers and has helped at least 8,500 people. Looking ahead, setting up a network to monitor the project and its growth and to share information and get feedback is important. The project should also expand throughout the country, because no one organization can solve India's illiteracy problem by itself. It requires participation of multiple actors, including the government, private sector companies, and nongovernmental organizations (NGOs).

Source: The Tata Group (2005).

Tertiary education is critical for the construction of knowledge economies. India currently produces a solid core of knowledge workers in tertiary and scientific and technical education, although the country needs to do more to create a larger cadre of educated and agile workers who can adapt and use knowledge. Efforts have been put into establishing a top-quality university system that includes many world-class institutions of higher learning that are competitive and meritocratic, such as Indian Institutes of Technology (IITs), Indian Institutes of Management, Indian Institute of Science, and the Regional Engineering Colleges (RECs). Despite these efforts, not all publicly funded universities or other educational institutions in India have been able to maintain high-quality standards or keep pace with developments in knowledge and technology. Major steps are thus needed to ensure that India's institutions meet high-quality national (and if such services are exported, international) standards. Measures are also needed to enhance the quality and relevance of higher education so that the education system is more demand driven, quality conscious, and forward looking, especially to retain highly qualified people and meet the new and emerging needs of the economy.

In the area of scientific and technical education, even though India produces almost 200,000 scientists, engineers, and technicians a year, it has not been obtaining the full eco-

nomic benefit from this skill base, because of the mismatch between education and the labor market. The professional workforce that is emerging from India's higher education system often cannot find suitable employment due to a growing gap between their knowledge and real practice and to limited job opportunities in their fields, coupled with low salaries. Many professionals also leave the country in search of better opportunities, which leads to brain drain. This calls for an urgent effort to promote policy and institutional reforms in scientific and technical education for both public and private institutions to improve the quality and skills of India's current and future pool of technical manpower.

Skills matter more than ever in today's more competitive global market. In large countries such as India and Brazil, where the vast majority of people are unskilled and uneducated, the capabilities of the majority of the population must be enhanced for the economy to show substantial improvements. Firms and farmers alike must be able to learn and develop new skills. While not losing sight of the need for secondary and tertiary education, governments should improve the skill and education levels of the mass of people through primary and vocational education. The success of countries such as China in achieving higher growth reveals the importance of a workforce with a basic education that can be trained. This leads to the issue of skills development and training. When technology is changing, enterprises must invest in worker training to remain competitive. India too will need to develop various job training programs to be globally competitive. These programs must be flexible, cost-effective, and able to adapt quickly to new skill demands generated by changing markets and technologies.

In addition, India should develop a system of lifelong learning, which encompasses learning from early childhood through retirement and includes formal learning (schools, training institutions, and universities), nonformal learning (structured on-the-job training), and informal learning (skills learned from family members or people in the community). In the lifelong learning model, people are motivated to learn on a continuing basis, are equipped with the skills to engage in self-directed learning, given access to opportunities for learning throughout their lives, and offered financial and cultural incentives to participate in lifelong learning.

Some of the main issues in strengthening India's education system, therefore, include the following:

- Improving efficiency in the use of public resources in the education system, and making the education system as a whole more responsive to market needs, as well as ensuring expanded access to education that fosters critical thinking and learning skills for all, not just the elites.
- Enhancing the quality of primary and secondary education, including tackling issues related to quality and relevance, with special emphasis on ameliorating teacher vacancies and absenteeism, reversing high dropout rates, and correcting inadequate teaching and learning materials and uneven levels of learning achievement. This is especially important for India to meet the goal of providing eight years of schooling for all children by 2010.
- Ensuring consistency between the skills taught in primary and secondary education and the needs of the knowledge economy; introducing materials and methods to teach students "how to learn," rather than stressing occupation-specific knowledge.

- Reforming the curriculum of tertiary education institutions to include skills and competencies for the knowledge economy (communication skills, problem-solving skills, creativity, and teamwork) that also meet the needs of the private sector.
- Raising the quality of all higher education institutions, not just a few world-class ones (such as the IITs).
- Improving the operating environment for education, especially higher education, which calls for a shift in the role of the government from managing the administrative aspects of higher education institutions to becoming an architect of education standards and regulations, including improving and monitoring the quality of academic programs, establishing accreditation standards and procedures, ensuring equity, and coordinating a system with multiple players and multiple pathways to learning.
- Embracing the contribution of the private sector in education and training by relaxing bureaucratic hurdles and putting in place better accreditation systems for private providers of education and training.
- Establishing partnerships between Indian and foreign universities to attract and retain high-quality staff and provide opportunities for students to receive internationally recognized credentials.
- Increasing university-industry partnerships to ensure consistency between research and the needs of the economy. This will include reforming the university curriculum to include the development of skills and competencies that better meet the needs of the private sector.
- Using ICTs to meet the double goals of expanding access to and improving the quality of education.
- Investing in flexible, cost-effective job training programs that are able to adapt quickly to new skill demands generated by changing markets and technologies, aligned with the needs of firms.
- Developing a framework for lifelong learning, including programs intended to meet the learning needs of all, both within and outside the school system. This will also require greater coordination across the different government bodies responsible for various components of the education and training system and development of procedures for recognition of what is learned in different parts of the system.
- Making effective use of distance learning technologies to expand access to and the quality of formal education and lifelong training.

Creating an Efficient Innovation System

The innovation system in any country consists of institutions, rules, and procedures that affect how it acquires, creates, disseminates, and uses knowledge. Innovation in a developing country concerns not just the domestic development of frontier-based knowledge. It relates also to the application and use of new and existing knowledge in the local context. Innovation requires a climate favorable to entrepreneurs, one that is free from bureaucratic, regulatory, and other obstacles and fosters interactions between the local and outside busi-

ness world and with different sources of knowledge, including private firms, universities, research institutes, think tanks, consulting firms, and other sources. Tapping global knowledge is another powerful way to facilitate technological change through channels such as FDI, technology transfer, trade, and technology licensing.

In India, with its relatively small formal sector, a very important part of its innovation system relates to how modern and more efficient practices can be diffused to the greatest number of users. This applies to both domestic and foreign knowledge. India has done a remarkable job of diffusing knowledge and technology, especially in agriculture. As a result of the "green revolution," India has transformed itself from a net importer to a net exporter of food grains. India's "white revolution" in the production of milk has helped it to achieve the twin goals of raising incomes of rural poor families and raising the nutrition status of the population. India should continue to build on its innovative domestic strengths and undertake efforts to improve the productivity of agriculture, industry, and services even further. This includes strengthening technology diffusion institutions, such as those related to agricultural extension and industrial extension, productivity-enhancing organizations, and technical information agencies. In India, where large disparity exists between the most and least efficient producers in any sector, considerable economic gains can also be harnessed from moving the average domestic practice to the best domestic practice, not to mention best international practice. This will require a host of efforts, including improving the system for technical norms and standards—such as product quality, work safety, and environmental protection—that can facilitate the proper diffusion of know-how. Efforts also need to be made to improve the dissemination of technology by strengthening competition so that the most efficient firms expand and improve performance, establishing and enforcing appropriate laws, encouraging more trade among Indian states, allowing for economies of scale and scope, and facilitating the diffusion of best products through price- and quality-based competition.

India also needs to increase its efforts to tap into the rapidly growing stock of global knowledge through channels such as FDI, technology licensing, importation of capital goods that embody knowledge, as well as advanced products, components, and services. Compared with countries such as China (Table 2), India is particularly weak at making effective use of these resources. These channels are important, given the rapid expansion of global knowledge. Even large advanced economies such as the United States are increasingly acquiring knowledge from beyond their borders.

To its credit, India has been taking bold steps to strengthen its R&D infrastructure, developing technological innovations and altering the mind-set of its people toward better creation, acquisition, and use of technology. It is endowed with a critical mass of scientists, engineers, and technicians in R&D and is home to dynamic hubs of innovation, such as Bangalore and Hyderabad. It also has vast and diversified publicly funded R&D institutions, as well as world-class institutions of higher learning, all of which provide critical human capital.

India is also emerging as a major global R&D platform; about 100 multinational corporations (MNCs) have already set up R&D centers in the country, leading to the deepening of technological and innovative capabilities among Indian firms. Several Indian companies,

TABLE 2
Comparative Innovation Performance: India and China, Selected Variables, Most Recent Period

Variable	India	China
Gross Foreign Direct Investment as % of GDP (average 1993–2002)	0.60	5.40
Royalty and license fees payments/mil. pop. (2002)	0.33	2.43
Royalty and license fees receipts/mil. pop. (2002)	0.01	0.10
Science & engineering enrollment ratio (% of tertiary level students) (2002)	25.00	43.00
Researchers in R&D/million (1997)	98.85	583.88
Total expenditures for R&D as % of GDP (2001)	0.78	1.09
Private sector spending on R&D (2003)	3.50	3.80
Manufactured trade as % of GDP (2002)	13.02	41.84
High-tech exports as % of manuf. exports (2002)	5.00	23.00
Scientific and technical journal articles/mil. pop. (1999)	9.23	9.31
Availability of venture capital, scale of 1 to 7 (2003)	3.80	3.00
Patent applications granted by the USPTO/mil. pop. (2003)	0.33	0.33
University–company research collaboration, scale of 1 to 7 (2003)	3.20	4.20
State of cluster development, scale of 1 to 7 (2003)	4.10	3.70

Note: For Researchers in R&D and Researchers in R&D/million, data for China are for 2001. The higher the value for the data in the Knowledge Assessment Methodology (including qualitative variables), the better a country's performance on that variable.
Source: World Bank, "Knowledge Assessment Methodology," http://www.worldbank.org./KAM.

such as Ranbaxy and Dr. Reddy's Laboratories, have also started forming R&D alliances with global firms. Such collaboration presents several benefits for Indian industry, because the linkages among local firms, universities, and research institutes and the worldwide R&D network of multinationals further integrate India into global technology development. Such R&D activities have also been useful in inculcating a commercial culture among scientists, helping them to apply knowledge for productive ends. The outsourcing of high-end R&D to India is yet another new trend that is evident from the large number of established R&D outsourcing centers in India, from IT and telecom to automotive and pharmaceuticals sectors. India is also developing public-private partnerships to harness the potential of traditional knowledge to meet health and welfare needs and to reduce poverty (Box 3).

Despite these accomplishments, India spends only a small fraction of its GDP on R&D. It gets very little in worldwide royalty and license fee receipts. Regarding scientific and technical articles in mainstream journals (per million people), India matches the performance of China, but the contributions of both countries are very low compared with those of developed countries. FDI, although increasing, is also rather low by global standards. The majority of the R&D-related inward FDI in India materialized only after the economy had been liberalized. This FDI, however small, has been creating a new competitive advantage for the country, especially in the IT domain and in industries, such as automotive. Availability of venture capital is also rather limited in India, but some signs of vibrancy are evident, and a notable venture capital investment market is emerging.

In addition, India's share of global patenting is small; therefore, despite having a strong R&D infrastructure, India is weak on turning its research into profitable applications. But, an increasing trend is discernible in the number of patents granted to companies by the Indian Patent Office, indicating greater awareness of the importance of knowledge and the

BOX 3

Leveraging Traditional Knowledge with Modern Science and Exploiting Public-Private Partnerships for Drug Development in India

In India, a new drug against a chronic skin disease called psoriasis is now under development through an industry-research laboratory partnership. The new drug, a purified extract from the leaves of a plant long used in traditional medicine, is now awaiting approval for clinical trials in patients with psoriasis after successful completion of toxicity trials in healthy volunteers. Lupin, a major drug company, and the Council for Scientific and Industrial Research (CSIR) are working to transform this herbal extract into a scientifically validated modern drug against psoriasis. It is estimated that the global market size for drugs against psoriasis is about $3 billion.

The candidate drug against psoriasis is part of an effort to develop new drugs from traditional knowledge through "reverse pharmacology." The conventional approach in seeking out new drugs involves identifying new molecules, testing their efficacy on laboratory animals, and then moving to humans. Traditional medicine has long used herbal extracts on patients. Reverse pharmacology is aimed at validating such extracts through rigorous science. Over the past two years, scientists at Lupin's R&D center and CSIR's Central Drug Research Institute have studied the constituents of the herbal extract in detail, identified the "active molecule" that is believed to act on the psoriasis, and worked out standardized techniques to extract it from the plant. In September 2004, the drug went through phase I clinical trials in healthy volunteers designed to evaluate its side effects. The company has now sought phase II clinical trials to formally test its efficacy through a rigorous scientific trial. If all goes well, a new drug against psoriasis may be on the market in two years. If that happens, the time to develop a new drug would have shrunk from 10 years to less than 5 years. The success of this initiative highlights how well India is positioned to develop pharmaceutical products of global importance in a cost-effective way.

Source: Excerpted from Mudur (2005).

value of protecting it through patents. Among Indian patents, the drugs and electronics industries have shown a sharp increase in patenting in recent years. In addition, several Indian firms have registered their innovations with the United States Patent and Trademark Office (USPTO). The number of U.S. patent grants to the CSIR, for example, increased from just six in 1990–91 to 196 in 2003–04. This shows that the focus of research is shifting to patentable innovations, indicating better conceptualization of research. The recent amendments to the Indian Patent Act adopted in a move toward adhering to the intellectual property norms under Trade-Related Aspects of Intellectual Property Rights (TRIPS) have also boosted confidence among international players.

In India, some 70 percent of R&D is performed by the central and state governments, an additional 27 percent by enterprises (both public and private sector industries), and less than 3 percent by universities and other higher education institutions. In contrast, in most countries in the Organisation for Economic Co-operation and Development (OECD), the private sector finances 50–60 percent of R&D, because it increasingly has the finance, knowledge, and personnel needed for technological innovation. Firms play an even bigger role in R&D in Ireland, Japan, Korea, and Sweden. Universities also undertake research to a much larger extent in developed countries and have stronger linkages with the corporate world.

India should thus take steps to improve its innovation system further, not only by taking advantage of new knowledge created at home, but also by tapping knowledge from abroad and disseminating it for greater economic and social development. It should also improve the efficiency of public R&D and increase private R&D, as well as encourage greater university-industry linkages.

Some of the key issues to address in this domain include:

- Tapping into the growing stock of global knowledge more effectively and providing incentives for international technology transfer through trade, FDI, licensing, and personnel movements, along with informal means through imitation, reverse engineering, and spillovers.
- Attracting FDI more effectively, given the importance of FDI in the generation and dissemination of global knowledge and the role that they can have in domestic R&D. This should include removing regulations on foreign investment and encouraging FDI in R&D into the country.
- Encouraging members of the Diaspora and renowned expatriates to contribute further to innovative activities by appointing them to the management boards of national research institutes, universities, and so on to facilitate the design of university programs that better suit corporate requirements.
- Motivating scientists and engineers from India working in the United States and other developed countries to enter into alliances with multinational companies and establish firms or labs to undertake R&D on a contract basis in India.
- Auditing and monitoring S&T efforts and institutional performance to identify what works well and then redeploying resources to programs that have a proven track record of success.
- Using the savings to strengthen university-industry programs by means of matching grants and other initiatives, including encouraging academics to spend sabbaticals in relevant industries so that their research meets the needs of the productive sector.
- Finding alternative sources of funding for R&D, especially as the government reduces its budgetary support for research programs. In some countries such as China, academic institutions are launching commercial ventures of their own or in collaboration with the corporate sector.
- Allowing national research institutes to collaborate with domestic and foreign firms to forge closer links with industry. One way of encouraging scientists to work closely with industry, and in so doing improving linkages between technology development and application, would be to provide incentives such as bonuses and a share of royalties from products created through their research.
- Paying adequate salaries and creating a proper working environment for scientists and engineers that provides them with access to capital equipment, instruments, and other infrastructure needed for R&D. Failure to compensate researchers adequately and lack of a supportive environment will only exacerbate the problem of brain drain.
- Restructuring and modernizing universities and publicly funded R&D institutions by giving them flexibility, freedom of operation, and financial autonomy.

- Increasing the intake of students into science and engineering, given the competition for recruitment of trained personnel; this may require adding colleges and universities (such as IITs or others modeled after them).
- Developing entrepreneurial skills and management training for S&T professionals to encourage them to undertake business activities.
- Encouraging the private sector to invest in R&D.
- Strengthening R&D by companies so that they can have a more demand-driven and market-oriented approach with closer collaboration among researchers, partners, and customers in developing new products and services that can be speedily brought to the market.
- Developing communication and other infrastructure for R&D, and creating an attractive environment to motivate R&D investments, including favorable tax, and other incentives.
- Establishing science and technology parks to encourage industry-university collaboration. Such parks might attract R&D work from both foreign and domestic firms if the parks are situated close to reputable academic institutions.
- Encouraging venture capital, which can also be used as an incentive for commercialization of research.
- Effectively enforcing and implementing IPRs to create confidence among domestic and foreign innovators on protection of their innovations in the country.
- Promoting a national fund to support grassroots innovators, with the aim of building a national register of innovators, converting innovations into viable business plans, and disseminating knowledge of indigenous innovations, especially for job creation.
- Strengthening the emerging new model of reverse drug design to produce innovations in a more cost-effective way based on leveraging traditional knowledge with modern science and exploiting public-private partnerships.

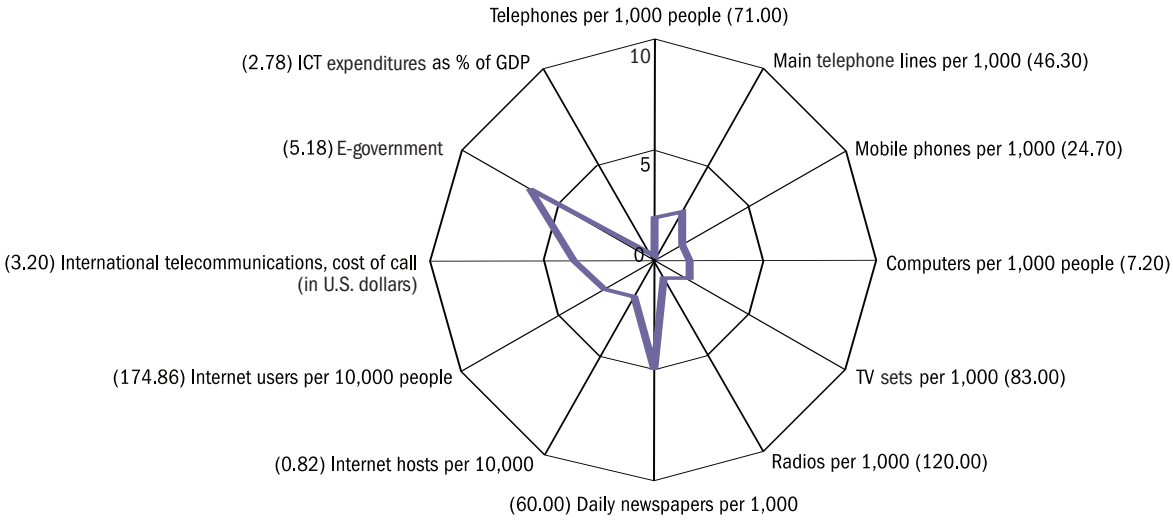
Building a Dynamic Information Infrastructure

Rapid advances in ICTs are dramatically affecting economic and social activities, as well as the acquisition, creation, dissemination, and use of knowledge. The use of ICTs is reducing transaction costs and lowering the barriers of time and space, allowing the mass production of customized goods and services. With ICT use becoming all-pervasive and its impacts transformational, it has become an essential backbone of the knowledge economy. The information infrastructure in a country consists of telecommunications networks, strategic information systems, policy and legal frameworks affecting their deployment, and skilled human resources needed to develop and use it.

India's telecommunications sector has registered rapid growth in recent years, spurred by reforms to open markets, and introduced more competition. Many domestic and international private sector entrants are now providing consumers with high-quality services at low prices. As a result, some spectacular successes have resulted: more than 47 million people had mobile phones at the end of 2004! Fierce price competition has resulted in Indian mobile telephony becoming one of the cheapest in the world. This has been a boon, especially to

FIGURE 4

India's Scorecard on Information and Communications Technologies, Selected Variables, Most Recent Period



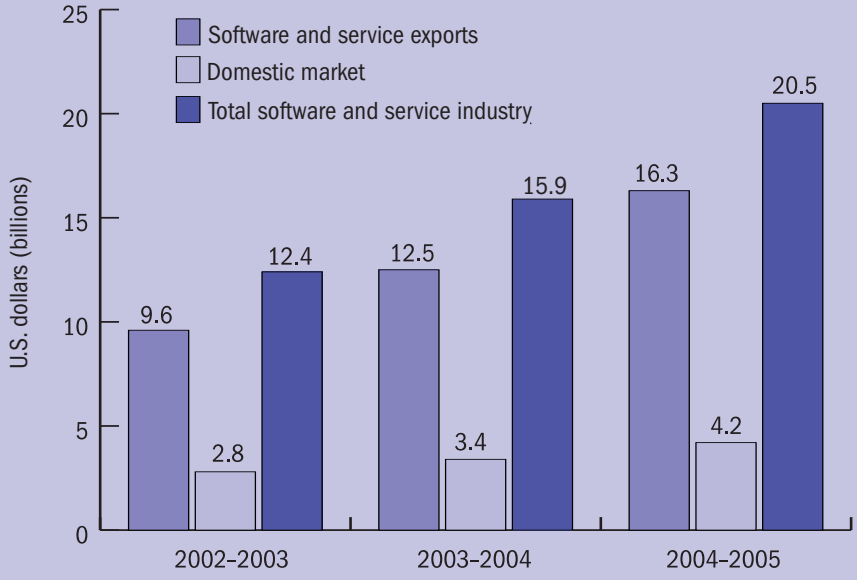
Note: Values in parentheses denote actual values for India for the most recent period for which data are available. Each of the 80 variables in the KAM is normalized on a scale of 0 to 10 for 128 countries. The fuller the scorecard, the better poised a country is to embrace the knowledge economy. But an economy should not necessarily aim for a perfect score of 10 on all variables because the scorecards may be shaped by the particular structural characteristics of an economy or by trade-offs that characterize different development strategies.
Source: World Bank, "Knowledge Assessment Methodology," http://www.worldbank.org/kam.

people in India's 600,000 rural villages, which have had no access to communication through traditional means, such as fixed lines. But now, from fishermen at sea and brokers ashore in Kerala to farmers in Punjab—people in industry and farming are embracing wireless technology for economic activity, to do business, and to increase their profit margins. While India's progress has been very impressive, the rest of the world is also advancing rapidly (Figure 4). Thus, even greater efforts should be made to make the information technologies available to more people throughout India.

India can also boast of remarkable and impressive global achievements in the IT sector. According to the National Association of Software and Services Companies (NASSCOM), the Indian IT market has grown from $1.73 billion in 1994–95 to $19.9 billion in 2003–04, accounting for about 3.82 percent of India's GDP in 2003–04 and providing employment for almost a million people. India's IT services are moving up the value chain, and India is now undertaking new and innovative work, such as the management for clients of IT-related business processes (Box 4). It is making an impact also in IT consulting, in which companies such as Wipro, Infosys, and Tata are managing IT networks in the United States and re-engineering business processes. In fact, Infosys was ranked the ninth most respectable IT company in the world in 2004, behind Hewlett-Packard, IBM, Dell, Microsoft, AP, Cisco, Intel, and

BOX 4

Snapshot of the Indian Software and Service Industry



The figure shows total revenues of the Indian software and services industry in 2003–04 of $15.9 billion, including domestic revenues of $3.4 billion. The Indian software and service industry is likely to grow to $20.5 billion in 2004–05, with domestic market revenues of $4.2 billion. Indian software and services exports registered a growth of 30.5 percent in 2003/04, clocking revenues of $12.5 billion, and are likely to witness a 30–32 percent increase to reach revenues of $16.3 billion in 2004–05. North America, which accounts for more than 55 percent of global IT spending, represented approximately 70 percent of Indian software exports in 2003–04; Europe ranked second at 22.25 percent of total exports. North America remains the dominant market for ITES-BPO services, accounting for more than 80 percent of ITES-BPO business in India.

Some initiatives to make India a sustainable hub for ITES should include instituting single-window clearances for the ITES industry, such as call centers, tele-education, telemedicine, and telemarketing; ensuring ease of operations and start-up assistance for ITES units through support from local authorities and state governments; setting up degree-level courses for ITES industry as well as ITES training infrastructure, and involving industrial training institutes and polytechnics for call center management; creating an "India Brand" marketing fund for promoting India as a preferred destination for the ITES sector; and establishing a suitable venture capital fund and developing special incentives to promote entrepreneurship and teleworking, especially for women in this sector.

Sources: NASSCOM (http://www.nasscom.org), NASSCOM's IT Industry Factsheet 2004 (http://www.nasscom.org/download/IndianITIndustryFactsheet.doc), and India, Planning Commission (2002b).

Oracle. In chip design, Intel and Texas Instruments are using India as an R&D hub for microprocessors and multimedia chips.

The success of the IT industry on the whole influenced competitiveness in other sectors as well by building confidence in Indian industry, enhancing the country's brand equity in

the world, and offering entrepreneurial opportunities on a global scale. In the future, it is expected that India will make inroads in areas such as financial analysis, industrial engineering, analytics, and drug research.

Several factors have contributed to India's success in the IT industry, including the existence of a highly skilled, English-speaking workforce coming out of India's engineering schools and earning lower wages than their European and U.S. counterparts; low dependence of IT on physical infrastructure; the Indian Diaspora; and the introduction of current account convertibility and easing of controls and regulations in the early 1990s. The Indian government, in keeping pace with up-to-date technological advancements, announced its Broadband Policy in 2004 to provide an impetus to broadband and Internet penetration in the country.

Various forecasts have also been made on where the IT industry is heading. According to the World Economic Forum's (WEF) *Global Information Technology Report 2002–03* (2003), India's IT industry is expected to grow at a compounded annual rate of 38 percent to reach $77 billion by 2008—contributing to 20 percent of India's anticipated GDP growth in this period and 30 percent of its foreign exchange earnings. By that year, it is also expected to employ more than 2 million people and indirectly create another 2 million jobs! But one of the key inputs to achieving sustained growth and exports in the IT sector will be the availability of high-quality professionals in adequate numbers. India needs to maintain and enhance its competitive advantage of having abundant, high-quality, and cost-effective human resources. The country must ensure the right mix of technical, business, and functional skills in the workforce to meet the needs of individual business segments and customer markets. This requires harmonization of the demands of industry with the supply of trained manpower coming from Indian educational and training institutions.

As a result of the IT explosion and impressive progress in the telecommunications and ICT sector, it is no surprise that usage of ICTs has been growing in the country. But explosive growth of ICTs has mainly been concentrated in urban areas. As the telecommunications sector moves to a more commercial and competitive environment, the government should implement practical policies to enhance the reach of IT to groups not well served by the market. The real challenge is to promote the effective application and use of ICTs throughout the economy to raise productivity and growth, not just in a few pockets. Ensuring that the benefits of ICTs are shared by all requires an enabling environment for ICTs. Critical elements include increasing access to ICTs through widespread availability of telephones, increasingly including mobile phones, computers, and connectivity to the Internet; enhancing ICT literacy and skills among the population, more so in the rural areas; and developing ICT applications that can provide much-needed social, economic, and government services to citizens. Box 5 showcases some examples of innovative E-government initiatives that could be replicated and scaled up throughout the country.

Some steps in enhancing India's information infrastructure include the following:

- Enhancing regulatory certainty and efficiency to facilitate new services that will enable India to reap the benefits of the convergence of existing and new technologies and enable the sector to contribute more to economic growth.

BOX 5

Three E-Government Initiatives Hold Promise in India

The following examples illustrate the kind of promising e-governance initiatives under way in India:

Bhoomi: online delivery of land titles in Karnataka. The Department of Revenue in Karnataka has computerized 20 million records of land ownership for 6.7 million farmers in 176 *taluks* (administrative unit under a district) in the state. Farmers previously had to seek out the village accountant to get a copy of the record of rights, tenancy, and crops, a document needed for many tasks such as obtaining bank loans, with accompanying delays, harassment, and bribes to be paid. Today, for a modest fee of Rs.15, a printed copy of this document can be obtained online at computerized land-record kiosks (Bhoomi centers) in 140 *taluk* offices. In the next phase, all the *taluk* databases will be uploaded to a Web-enabled central database. The record of rights, tenancy, and crops would then be available online at Internet kiosks, even in rural areas. (See http://www1.worldbank.org/publicsector/egov/bhoomi_cs.htm and http://www.revdept-01.kar.nic.in/Bhoomi/Home.htm.)

Land and property registration in Andhra Pradesh. Land registration offices throughout Andhra Pradesh now operate computerized counters to help citizens complete registration requirements within an hour instead of several days, as was necessary under the earlier system. The lack of transparency in property valuation under the old system resulted in a flourishing business of brokers and middlemen leading to corruption. Antiquated procedures, such as manual copying and indexing of documents and their storage in paper form in ill-maintained backrooms, have all been replaced, showing the benefits of IT in improving citizen-government interface. (See http://www1.worldbank.org/publicsector/egov/cardcs.htm.)

Empowering dairy farmers through a dairy information and services kiosk. In recent years, the milk cooperative movement initiated by India's National Dairy Development Board has led to a substantial increase in milk production in India. Two main reasons for this increase are more efficient collection of milk and higher profits for producers, both of which have been influenced by IT. The milk buying process has been automated at 2,500 rural milk collection societies. The Dairy Information Services Kiosk makes it possible for cooperatives and farmers to manage a database of all milk cattle and access a dairy portal with information about valued services. This demonstrates the willingness of rural farmers to invest in technology, provided it can deliver real value (see http://www1.worldbank.org/publicsector/egov/diskcs.htm.)

Source: Authors' research.

- Boosting ICT penetration by resolving regulatory issues in communications and reducing and rationalizing tariff structures on hardware and software.
- Increasing the use of ICTs as a competitive tool to improve the efficiency of production and marketing in areas such as supply chain management, logistics, information sharing on what goods are selling in the markets, responding to rapidly changing market needs, and so on.
- Moving up the value chain in IT by developing high-value products through R&D, improving the quality of products and services, marketing products and building brand equity to position the "India" brand name further, including by strengthening marketing channels with strategic global links, expanding the focus outside the United States to emerging markets in Asia, the Pacific, Japan, and so on.
- Providing suitable incentives to promote IT applications for the domestic economy, as the focus currently seems to be mainly on IT services exports. This includes developing local language content and applications.

- Putting in place suitable human resource development and training initiatives, starting at the primary school and moving on to the tertiary levels to meet the expected growth of IT and other productive sectors of the economy.
- Updating syllabuses in computer engineering, electronics, and IT in various technical institutions to meet the demands of industry (curriculum in other branches of engineering should also be broadly based to include IT subjects).
- Massively enhancing ICT literacy and skills among the population at large through conventional and nonconventional means, so that people can begin to use ICTs to derive benefits, both economically and socially.
- Creating opportunities for local communities to benefit from ICTs by providing support (seed money for local innovation on low-cost and appropriate technologies), enhancing private investment in ICT infrastructure, and promoting national and international support for rural community-based access. Strengthening partnerships among government agencies, research and academic institutions, private companies, and nongovernmental organizations (NGOs) to ramp up the ICT infrastructure and achieve faster penetration of ICTs.
- Further developing and scaling up (in joint public-private initiatives where feasible) ICT applications, such as community radio, fixed/mobile phones, smart cards, Internet, and satellite television, to bring the benefits of connectivity to rural communities all across the country and improve the delivery of services to rural populations.
- Sharing successful applications of ICT, for example, in e-government among different Indian states. This also requires scaling up successful ICT initiatives to bring the benefits of connectivity to rural communities all across the country.
- Creating a suitable environment for the effective use of ICTs to permeate the entire economy and lead to flourishing competition and business growth. This calls for the government to continue with the economic reform agenda put in place in the past decade.

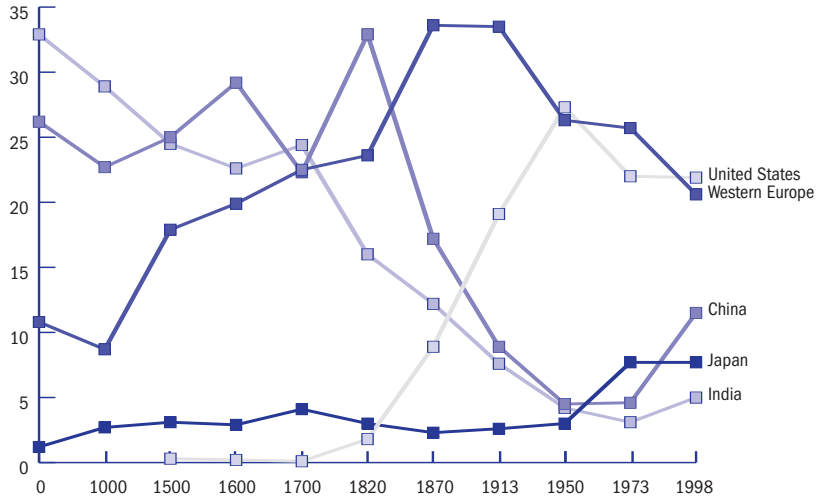
Looking Ahead

The notion of a knowledge economy is not new or foreign to India. India's past achievements in science, philosophy, mathematics, and astronomy reinforce the notion that the country has for millennia been a leading "knowledge society." In economic terms, India was the world's largest economy in the first millennium, producing a third of global GDP (Figure 5). By 1500 its share had declined to 25 percent, as China overtook it and Western Europe's share began to expand rapidly. India's share continued to fall after 1700 due to the collapse of the Moghul Empire, the costs of adjusting to British governance, and the rapid increase in the share of Western Europe, followed by the spectacular rise of the United States. India was a latecomer to the industrial revolution. It cannot afford to miss the knowledge revolution!

Today, Indian policy makers are keenly aware of the challenges and opportunities that India faces in different sectors and are already starting to implement some of the key actions that are necessary to bolster India's effective transformation to the knowledge economy. Various reports, including the Indian Planning Commission's reports on *India as*

FIGURE 5

India: Percentage Share of Global Gross Domestic Product, Years 0–1998



Source: Maddison (2001).

Knowledge Superpower: Strategy for Transformation (2001) and *India Vision 2020* (2002c); the President's (Dr. A. P. J. Abdul Kalam's) 2002 strategy *India 2020: A Vision for the New Millennium* (Kalam and Rajan 2002); and the High-Level Strategic Group's *India's New Opportunity, 2020* (AIMA 2003) (Box 6) underline ways to address India's transition to the knowledge economy.

India, thus, has already developed a vision and strategies to address its transition to the knowledge economy. In the main, its initiatives have, however, largely been developed around the three functional pillars of the knowledge economy (education, innovation, and ICTs). But to get the maximum benefits from investments in these areas, these initiatives must be part of a broader reform agenda, because some elements of India's current economic and institutional regime are constraining full realization of India's potential. India will, for example, not reap the full benefits of its investments in increasing education, ramping up ICTs, or even doing more R&D, unless its broader institutional and incentive regime stimulates the most effective use of resources in these areas, permits their deployment to the most productive uses, and allows entrepreneurial activity to flourish to contribute better to India's growth and overall development.

It is hoped that this book will help stimulate, through a consultative process, a greater sense of the importance of the emerging policy agenda on the knowledge economy in India. India's effective transformation to a knowledge economy calls for it to act in many different policy domains, deepening, complementing, or reorienting ongoing reforms to use knowl-

BOX 6

"India Inc.": Moving to Action

The report developed by the High-Level Strategic Group (HLSG) is different in that it first analyzed why India, despite having sufficient knowledge of what needs to be done, often fails to "make it happen." The collective experience of HLSG members suggested that the inability to make things happen faster, with alignment, is the main reason why India misses opportunities. On further study, it was felt that the lack of speed was generally a result of an implementation model that enforces compliance rather than obtaining commitment. As a result, the energy in the process peters out.

To obtain commitment from all stakeholders, the HLSG embarked on a path that designs and guides the process of involvement and action using the report as a stimulus. The report thus takes an innovative approach to developing what it calls "India Inc." and is based on two principles that have been found to be highly effective in situations involving disparate interest groups: first, creating an appreciation of the opportunities that exist and prioritizing areas for action, and second, aligning processes and participants (implementation partners) toward a common goal.

With this in mind, the HLSG identifies changes required at the macro level and recommends solutions in three broad areas: marketing India, educating and training the Indian workforce, and connecting India (through telecoms, IT, airports, and so on). For each of these areas, HLSG then identifies concrete action steps the central government, state governments, and the corporate sector can take. The HLSG concludes that in each of these domains, the concerned agencies must now be vigorously engaged in many sectors, and the private sector and government agencies must continue to work together or begin to work together more effectively to ensure that India Inc. wins.

Source: AIMA (2003).

edge efficiently and sustaining development in the long term to achieve inclusive growth. India needs to recognize that many policy reforms leading to a knowledge-based economy will not yield results overnight. It will thus need to make some tough choices in the short term; yet, other reforms will be of a medium- to long-term nature.

It is clear, however, that going ahead with such an ambitious agenda in India first and foremost requires raising massive awareness and consultation among all interested stakeholders in government, the private sector, and civil society on the need and plans for such a transformation. Creating a shared vision among all parties on ways to accelerate India's progress toward the knowledge economy is thus important, as well as commitment on the part of all stakeholders to stay the course in order to manage such a transition effectively. Effective leadership will be key to articulating this vision, through the involvement of all stakeholders. It also requires that the country develop a "virtuous" cycle between growth and the reform process.

Moving to a knowledge economy, however, is not only about stimulating such a reform agenda from the top. What will be needed is trial-and-error experimentation on what works in a bottom-up fashion and what does not work in the Indian context as well as scaling up successful bottom-up initiatives. The process requires that India constantly monitor its achievements and adjust its strategy in light of changing conditions.

Launching a Process

To make this agenda even more action oriented, an important signal needs to be given, as is amply demonstrated by the experience of other countries such as Ireland and Korea. A concrete way to begin this process would be to designate a national "knowledge" champion to advance the knowledge economy agenda in India by integrating the economic reform agenda with initiatives already taking place in more functional areas.

A very appropriate national champion to coordinate and orchestrate the necessary knowledge-related actions across the various domains would be the Prime Minister's office. In fact, the Prime Minister recently proposed the setting up of a Knowledge Commission to leverage various knowledge networks to make India a knowledge engine of the world. This function could, for example, organize a Knowledge Economy Task Force, headed by the Prime Minister and comprising stakeholders from government, the private sector, academia, think tanks, research organizations, and NGOs. The main objective of the task force would be to determine ways of coordinating action involving diverse stakeholders to tackle key reforms in the four pillars of the knowledge economy, and sequence the investments necessary to move India successfully into the knowledge economy of the twenty-first century. Some examples of cross-cutting knowledge economy issues that the task force could address include:

- In the past decade, India has undertaken major economic reforms; as a result, its growth rate has increased from 3.5 percent in the 1950s to 1970s to approximately 6 percent between the 1980s and 2002. During much of this period, however, China has been growing at about 10 percent. What are the fundamental reforms needed to unleash India's tremendous entrepreneurial potential and benefit from more active participation in the global knowledge economy to achieve this higher rate of growth sustainably? What actions are necessary to bring a much larger proportion of the population into the modern sector? What special initiatives have to be undertaken to marshal knowledge to improve the livelihoods of the poor?
- India has the advantage of a highly skilled human resource base, which has gained world renown. It also has world-class institutions that train this world-class manpower, but on a limited scale. What would it take to ramp up such institutions even further so that India can become a leader in education and training, not only in IT and software, but also more generally in high-skill areas that can provide greater outsourcing services to the world?
- An increasing number of multinational corporations are currently working with Indian firms to contract and subcontract high-end R&D. How can India become a global leader in innovation in its own right, not only in IT-related areas in which it has carved out a global niche, but also in other knowledge-intensive industries, such as pharmaceuticals and biotechnology?
- India is a leading exporter of IT services and software, but has not yet fully harnessed the potential of ICTs at home to reduce transaction costs and improve efficiency. As it has a large local market and many needs, what will it take for India to exploit this capability on a larger scale domestically and help the country leapfrog even more rapidly into the knowledge economy of the twenty-first century?

Dealing with the kinds of illustrative issues highlighted above requires prioritization and working with many different interest groups, which is not an easy task; thus, some guiding principles for the Knowledge Economy Task Force would include the following:

- Defining priorities and establishing budgets
- Adopting systemic, integrated approaches for the different policy planks at all levels of government
- Mobilizing state governments, which are key to the Indian economy and its modernization
- Multiplying experiments and publicizing concrete initiatives that clearly exemplify the move to a knowledge-based economy.
- The role of the Prime Minister's office would be to put in place a robust mechanism to facilitate, monitor, and scale up successful initiatives.

In sum, India is well positioned to take advantage of the knowledge revolution to accelerate growth and competitiveness and improve the welfare of its citizens and should continue to leverage its strengths to become a leader in knowledge creation and use. In the twenty-first century, India will be judged by the extent to which it lays down the appropriate "rules of the game" that will enable it to marshal its human resources, strengths in innovation, and global niches in IT to improve overall economic and social development and transform itself into a knowledge-driven economy. Sustained and integrated implementation of the various policy measures in these domains would help to reposition India as a significant global economic power, so that it can rightfully take its place among the ranks of countries that are harnessing knowledge and technology for their overall economic development and social well-being.

A Final Note

This book presents an objective view of India's position in the global economy. It recognizes India's achievements, but sees a tremendous potential that is yet to be achieved. What is needed is an India-led process to coordinate and integrate reforms, combining those in the economic and institutional regime with the many initiatives that are being undertaken in the more functional areas covered in many Indian strategy reports. This can only be done through a domestic process of consultation and stakeholder awareness-raising to get buy-in on the kinds of reforms required to implement the actions that can leverage India's potential. We hope this book serves to help catalyze that process.

Overview Sources

(For complete references see full report.)

AIMA (All India Management Association). 2003. *India's New Opportunity, 2020: Report of the High-Level Strategic Group.* Prepared with the Boston Consulting Group. Mumbai and New Delhi, India.

Barro, Robert J., and Jong-Wha Lee. 2001. "International Data on Educational Attainment: Updates and Implications." *Oxford Economic Papers* 3: 541–63.

Huang, Yasheng, and Tarun Khanna. 2003. "Can India Overtake China?" *Foreign Policy.* July-August.

India, Planning Commission. 2001. *India as Knowledge Superpower: Strategy for Transformation.* New Delhi.

———. 2002a. *Tenth Five-Year Plan 2002–2007.* New Delhi. http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html.

———. 2002b. *Report of the Steering Committee on Communication and Information for the Tenth Five-Year Plan (2002–2007).* New Delhi. http://planningcommission.nic.in/aboutus/committee/strgrp/stgp_candi.pdf.

———2002c. *India Vision 2020.* New Delhi. http://planningcommission.nic.in/reports/genrep/pl_vsn2020.pdf.

Kalam, A. P. J. Abdul, and Y. S. Rajan. 2002. *India 2020: A Vision for the New Millennium.* New Delhi: Penguin Books India.

Maddison, Angus. 2001. *The World Economy: A Millennial Perspective.* OECD, Paris.

Mudur, G. S. 2005. "Reverse Drug Design." *The Telegraph.* 17 January. Calcutta, India. http://www.telegraphindia.com/1050117/asp/knowhow/story_4249252.asp.

The Tata Group. 2005. "40 Hours Is All It Takes to Teach an Indian to Read." http://www.tataliteracy.com.