The Indian IT Industry: An Investigation into the Sources of Growth of the Modern Indian Growth Miracle

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Abstract

India became successful in information technology despite its poor physical infrastructure and unstable policy regime. This essay examines and evaluates the causes of growth and the role of the information technology (IT) sector in the economic development of India. In addition, this essay will investigate the effects of past and present policies, infrastructure and education in the success of the IT sector with a focus on the software industry. This will be done in the following manner: 1) a description of modern India analyzing a number of macroeconomic and human development indices in a comparative fashion; 2) a history of India's economic policies from independence to present with an emphasis on industrial and trade policy and education; 3) a discussion of the economic reforms that began in the 1980s; 4) an analysis of the policies that led to the birth of the IT industry in India; 5) a discussion of the evolution of national policy in the software industry; 6) a documentation of the growth and importance of the IT sector; 7) an application of modern endogenous growth theory (such as learning by doing) to explain the emergence of the IT industry as the engine of growth in modern India.

Introduction

India, located in South Asia is the seventh largest country with a population of 1.02 billion and largest liberal economy in the world. India's economy is comprised of subsistence farming, modern agriculture, handicrafts, as well as manufacturing and service industries. The service industry accounts for more than half of the Indian economy's output yet employs less than one quarter of its labor force. In the ten year period since 1996, the average growth rate exceeded 7 % reducing the number of those living under the poverty line by 10 percentage points.

In 2006, India experienced an 8.5% growth rate in its gross domestic product (GDP) raising the GDP-per capita purchasing power parity (PPP) to $3,700. This was largely the result of a boom in the Indian software services industry. When looking at GDP composition, the service sector comprised of about 60% to GDP while the agricultural sector comprised 19.9% and the industrial sector 19.3%. In 2006 the labour force was 509.3 million people, only 28% of which were employed in the service sector, while the agriculture employed 60% and industry employed 12% (CIA 2007).

India has developed a two tier economy: one part of the economy is the globally competitive knowledge economy, driven by the information technology (IT) sector hiring the brightest of the middle class; the other part of the economy compromising of the agriculture and manufacturing sectors employs the poorly educated labour force.

Those employed by the manufacturing and agricultural industries are relatively worse off in comparison to those employed in the service sector. In rural India, the land is being farmed continuously without rest reducing the productive capacity of the land. This loss of productive capacity is forcing many farming families

below the poverty line. Rural India has very poor human development indicators relative to the large number of highly qualified professionals and internationally established industrial groups located in urban areas.

Indian economic development has spread unevenly across its regions. Economic growth and the improvement in human development have been much faster in the southern and western regions than in the northern regions. For example, Bombay in 2001 (16.4 m), Bangalore (5.7 m), and Chennai (6.4m), all cities in the south and western parts of India, are doing well in terms of economic growth (EIU 2006 A). These regions have experienced a faster rate of urbanization compared to the rest of India, where 60% live in villages with a population of less than 5,000. The urban population contributed to only about 28% of the population in 2001(EIU 2006B).

This growth in large cities is the result of India's transformation into a knowledge economy. In the first millennium (CE) India's achievements in philosophy, the sciences, maths and astronomy were extraordinary. People referred to it as "The knowledge society". It produced a third of global output. In the 1500s (CE) its relative share of global GDP declined 25 percent as China and Western Europe's shares began to expand. As seen in [Figure A] India's GDP further declined under British rule, following the rise of the United States and the collapse of the Monghul Empire. India was a latecomer to the Industrial revolution and desired to be apart of the new knowledge revolution. (Dahlman and Utz 2005).

India's "Knowledge Revolution" refers to the rise of high technology industries and the global emphasis on information and communication technologies. Knowledge development and dissemination has been a key source of growth in the global economy. Countries that want to enter the competitive global economy need to

participate in the knowledge driven supply chains and markets, which are known to be technology based (Dahlman and Utz 2005).

India can achieve a great future in economic growth based on the knowledge. In [Figure B], where, taking total factor productivity (TFP) growth to be a proxy for a nation's learning capability, knowledge is used efficiently, a higher GDP can be achieved. In [figure 1-2]projections 1, 2, 3, and 4 plot real GDP per worker in US dollars assuming different TFP growth rates from 2002 to 2020. Under scenario 4 India could increase its GDP per capita. This implies that in 2020 India's GDP per capita would be 50% greater than in projection 1 (Dahlman and Utz 2005).

Chapter 1

Current Economic Overview of India

India's annual real GDP has increased compared to earlier years [see Figure 1-1]. From 1970-1980 the growth rate was relatively modest at 3.59% [see Figure 1-2]. After 1980 the growth rate of GDP rose to 5.80%. In the 1990's, India's economy was one of the fastest growing economies in the world. Despite a slow down between 1990-2000, it was still growing at a fast pace at 5.5%; and in 2000-2007 it was doing very well with a real GDP growth rate of 6.9 % [figure 1-2]. India is doing extremely well today compared to its neighbours, where annual GDP growth rates are about 4%. This does not mean that its neighbours are developing poorly since the average annual real GDP growth for developing countries between 2000-2007 is 3.66%. India's experiencing relatively fast growth in its GDP in comparison to developed economies such as Unites States and Germany real GDP growth rates which have decreased since the 1970's [see Table 1-1].

Similar remarks apply to India's GDP per capita. The latter can be seen in [Figure 1-3]. From 1950 to 1980, it was increasing at a moderately high rate of 5.78%. But after 1980 the growth of GDP per capita started to increase at the exceptional rate of 9.49% for the period 1980-1990 and 5.42% for the period 1990-2000 [see Figure 1-4]. When compared to United States growth rate of GDP per Capita, India grew faster except between 1950-1980 [see Figure 1-5]. If India had maintained its growth rate of GDP per capita steady at 5.42% for 46.6 years, India's GDP per Capita would have reached the level of United States at 2003.

Since 1990 the Human Development Report has published the Human Development Index (HDI) that looks beyond GDP to a broader definition of well-being of the population. The HDI provides a composite measure of three dimensions

of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrolment at the primary, secondary and tertiary level) and having a decent standard of living (measured by purchasing power parity (PPP) income). The index is not a perfect measure of human development but it does provide a broadened image of human progress and the complex relationship between income and well-being. India's HDI value is 0.611 and ranks 126th out of 177 countries. The index of countries with high human development is 0.8 or above, while for countries with medium development it is between 0.5 and 0.799, and for countries with low development it is less than 0.5. Countries with high human development have a gross national income per capita of US $ 9,076 or more. Countries classified as having reached a middle level of human development have gross per capita incomes between US $ 736-9,075 and countries classified as having only obtained low levels of human development countries have gross per capita incomes of 735 or less. According to [Table 1-2], it is only since 1990 that India began to be classified as having medium human development with an index of .515. Since 1990 there have been improvements in human development (with the index rising to .0611). India is considered to have medium development in terms of living a long and healthy life, being educated and having a decent standard of living (UNDP 2006).

India is doing much better than its neighboring countries such as Bangladesh and Pakistan [see Table 1-3]. India is out performing these countries in terms of education enrollment, literacy, and GDP; but is doing about the same in life expectancy. China is doing very well in information technology sector. When comparing China to India, India has more similarities with China than with its neighbours. China is currently doing better than India in terms of human

development. India is developing at a faster rate [see Table 1-4]. China attained a medium level of human development in 1975 before India. However, India is catching up with China having attained medium level of human development in 1990. It would not be surprising if India attains high level of human development before China.

The Human Poverty Index for developing countries (HPI-1), focuses on the proportion of people below a threshold level. HPI-1 represents a multi-dimensional alternative to the $1 a day (PPP US$) poverty measure. HPI-1 like the HDI measures in the same dimensions in terms of living a long and healthy life, having access to education, and a decent standard of living. It classifies severe deprivation in health by the proportion of people who are not expected to survive age 40. Education is measured by the adult illiteracy rate. A decent standard of living is measured by the average number of people without access to an improved water source and the proportion of under weight children younger than 5. These values are seen in Table 1-5. With an HPI-1 value of 31.3, India ranks 55th among 102 developing countries. India is doing better than its neighbors but not better than China which ranks 26th. There are fewer people living on less than one dollar a day 16.6 % compared to India 34.7%. They are even more in India living on less than $2 a day 79.9% compared to China at 46.7%. India is also providing sustainable access to improved water sources (14 % do not have access to improved water supply).

The decline in India's population growth rate has greatly contributed to India's successful human development record [see Figure 1-6]. The annual growth rate of population from 1975 to 2004 was 1.9 of and is it expected to decline to 1.3 from 2004-2015. The decrease in the growth rate of the population is largely owing to a fall in the fertility rate which was 5.4% in 1970-1975, and decreased to 3.1 in 2004-2005. The percentage of the population expected to be over 65 will be greater in 2015

reaching 6.2 % compared to 5.2 % in 2004 and the population of those under 15 will decrease from 32.5% today to 28 % in 2015 [see Table 1-6].

After having curbed population growth, India has had more resources to spend on education. In [Table 1-7], in 1991 the government of India committed to spending 3.7 % of its GDP on education much more than China 2.2% and between 2002-2004 India spent 3.3% of its GDP. As for the percentage of total government expenditure spent on education it was about the same in China and India.

The adult literacy rate has increased from 49.3 % in 1989 to 61.0 % in 2003 and the youth literacy rate has also increased from 64.3% to 76.4 % which can be seen in [Figure 1-7] and [Figure 1-8]. The illiteracy rate is decreasing [Figure 1-9]. There has been an overall growth in primary, secondary and tertiary enrollment [see Figure 1-10 and Figure 1-11].

There has been a substantial increase in the use of modern communications. However, the rise has not been as dramatic as in China. In 1990, 6 out of 1000 Chinese had telephone mainlines and 0 had cellulars and internet access. In 2004 these figures changed to 241 telephone mainlines, 258 cellulars subscribers and 73 internet users in China. In India the number of telephone mainlines increased from 6 to 41 in 2004. For cellular subscribers the number increased from 0 to 44 and internet users from 0 to 32 out of 1000 Indians. Thus it is seen that China’s use of modern communications is greater than India's with a ratio of more than 2 times per 1000 of internet users and more than 6 times per 1000 cellular subscribers [see Table 1-8].

Greater technology use by a population leads to higher demands for energy and strains on the environment. Since China’s use of modern communications has increased dramatically, it is expected that electricity consumption per capita (Killowatt-hours) will rise. In China it has increased from 307kwh in 1980 to

1440kwh in 2003. In India the electricity consumption per capita (kilowatt-hours) has increased from 173 in 1980 to 594 in 2003. India is consuming more electricity per capita than its neighbours, which is to be expected since their modern communication usage has been higher. Higher consumption has lead to an increase in their carbon dioxide emissions, which have doubled from 0.5 to 1.2 within 23 years 1980-2003. However, carbon emissions are significantly greater in China [See Table 1-9].

Chapter 2

Industrial and Trade Policy from Independence until the Reform Period

After Independence (1948) many developing countries took on new policies in order to achieve a greater level of devolvement. Many of the developing countries memories of colonialism resulted in suspicion of the economic goals of industrialized international countries. Post-colonial governments initially had 1) the desire and drive for modernization; 2) the interpretation of industrialization as the route to modernization; 3) the belief in "import substitution" as a necessary policy to provide protection for a new "infant" Industries; 4) distrust in the private sector and the market and the belief that government, as a paternalistic benevolent guardian, should take the leading role in development; and 5) related to (4), a distrust to the international economy and pessimism that exports from developing countries could lead to economic growth (Krueger 1995).

Emphasis was given to import substitution industrialization, believed to be the leading engine for growth in the economy. As the first Prime Minister Jawaharlal Nehru said at the time:

> " No modern nation can exist without certain essential articles which can be produced only by big industry. Not to produce these is to rely on imports from abroad and thus to be subservient to the economy and foreign countries. It means economic bondage and probably also political subjugation ….Big industry must be encouraged and developed as rapidly as possible, but the type of industry thus encouraged should be chosen with care. It should be heavy and basic industry, which is the foundation of a nation's economic strength and on which other industries can gradually be built up. The development of

> electric power is the prerequisite for industrial growth. Machine-making, ship-building, chemicals, locomotives, automobiles and the like should follow…"(Krueger 1995:2502).

Most consumed manufactured commodities in developing countries at the time were imported. Policy makers had concluded domestic producers should be protected from imports. It was believed with protection from foreign competition domestic industries would be able develop (Krueger 1995).

Governments held distrust in markets and private producers which they found to be economically irrational. They saw rural moneylenders, landlords and traders as making greedy profits by hurting others. Some governments in developing countries introduced price controls, rationing, investment licensing, direct ownership and operation, and other mechanisms in order not to allow that any profits be gathered by business owners at the expense of society. These new regulations increased the economic cost of carrying out economic activities, resulting in shortages of goods and loss of commodities, hindering economic growth (Krueger 1995).

Once India gained independence from Britain in 1948, the leaders at the time, such as Nehru, were influenced by socialist ideas. These ideas supported the view that government intervention should be used to help create balanced economic development and help the poor. Nehru believed that industrialization was extremely important and that state ownership of key industries and granting "industrial license" to other industries would lead to growth (Byres 1994).

In 1948, the Indian government passed legislation giving it monopoly in armaments, specific rights to develop minerals, atomic energy, ship building, telephone, telegraph equipment and air craft manufacturing. Any private company in

that field was given ten years until the government took ownership. The Indian government took charge of most industries, such as those that produce primary and intermediate goods. However, some private companies still operate today as private companies. Private sector production was restricted to the production of consumer goods (IBC 1995). Restrictive governmental controls in the industrial sector took various forms, such as restrictions from entering a large number of industries, which became reserved for the public sector. Time wasting procedures were put in place in order for firms to exit the industry. Price and distribution controls were put on industry products. These controls lead to inefficiency in the economy, in particular in the industrial sector (GoI 2005).

In 1951 the Indian government enacted legislation (Industrial Development and Regulation Act) stating that any enterprise wishing to manufacture new products or seek expansion of its existing current operations must obtain government authorization. This was done so that smaller scale enterprises and public sector producers could produce certain items, and not have the large enterprises enter certain industries when producing items that are reserved for smaller and public sector enterprise. This was strengthened through the 1969 Monopolies and Restrictive Trade Practices (MRTP) Act, which also allowed the government to know all the investment and structure of all firms with more than Rs200 million (IBC 1995).

The government set forth sectoral priorities which prioritized certain industrialized sectors. Prioritized industrial sectors had easier access to imports, and faster bureaucratic processing, access to direct public investment, and provision of finance from state financial institutions.

In terms of import and export policy, the government used: import bans, quotas, tariffs, exchange rate regulation, regulations on royalties, agreement lengths,

and restrictions exports controlled the import of foreign technology. Furthermore, the government extended control over production, use of foreign exchange and price controls on commodities such as steel, cement, chemicals, coal and much more. The legal framework that allowed the government to do this was provided by the industries (Development and Regulation) Act of 1951 and the Essential Commodities Act of 1955. In the late 1950's, controls were persistent in the industry regulating investments, prices of commodities, flow of foreign exchange, and imports and exports (IBC 1995).

In terms of foreign investment policy, the government used the Foreign Exchange Regulation Act (FERA). The FERA restricted foreign companies investments in Indian based companies to 40 percent or less. Unless the Indian based company was export oriented.

The outcome of these policies was the segregation of the Indian economy from the world economy. Even though all these policies were put in place with the intent of solving specific problems, policy makers failed to take into account the externalities that the policies produced. For example, set prices of commodities and services such as transportation and food flow, were put in place with the intent of helping the poor. This reduced the amount of goods and services produced. Policy makers responded to the resulting shortages in goods and services by imposing price ceilings. This contributed to the creation of black markets producing commodities (IBC 1995).

Chapter 3

Economic Reforms of 80s and 90s

As a developing nation, India has poor infrastructure, high transaction costs and poor financial services that are in need of modernization. India's globally competitive IT sector is regarded as the cornerstone of its recent economic development. The success of India's IT sector is largely in part a result of its government prioritizing its development with a goal of making India a major exporter of software services and software workers in the world within a time frame of ten years. This was facilitated by the large portion of the population that was well educated and skilled in the English language. It has the world second largest population English-speaking professionals in the world, second only to the United States (GoI 1999). To have achieved this goal, the government has supported the development of an English education system with an emphasis on the sciences and maths.

Government subsidies in combination with a high degree of government intervention within the economy facilitated the development of the Industrial sector as mentioned in a UNIDO report:

> "Notwithstanding the reassessment of the role of government in the economy and society that took place during the 1980's, there is now a broad consensus among development thinkers and practitioners that a "capable government", able to perform key functions effectively, is a precondition for development" (UNIDO1993: 3).

The government as policy makers sets the rules, laws, and regulations within the domestic economy. Being a major consumer of the IT goods, it benefits from its position to influence the supply of IT products. The governments' large role in infrastructure as well as empowering of the small private firms helps the growth of its economy. The government plays a role in supervising and coordinating social services such as education and health care (World Bank 1996).

According to the World Development Report (1998), government intervention should be balanced with an eye on social fundamentals (education, healthcare, infrastructure, etc…) to make development sustainable. For the government to succeed it must work with the private sector businesses to develop and encourage private industry. India believed that economic reform was needed to liberalize their economy.

This belief stemmed from the economic problems India was facing in the mid 70's and early 80's. Economic liberalization gradually took place in the late 1970's and early 80's. In the late 1970s trade regime policies were liberalized under the Janata government. In the early 1980's, Prime Minister Indira Ghandi, initiated a new regime of industrial policies (Byres 1994). There was a reduction on import quotas and tariffs, an abandonment of price controls and a reduction in restrictions on expansion, entry into industries and a abolishment of some its licensing regulations.

Economic reforms to liberalize the economy took a very slow pace in the mid 1970's. The reforms were lacking in boldness and were slow to be implemented even when they were pointed in the right direction (Byres 1994). The new regime of industrial policies in early 1980's was introduced by Indra Ghandi, and was continued in 1984 by Rajiv Gandhi's government when he came to power. In 1985, Ghandi introduced the New Economic Policy.

The most striking change to India came in May-June 1991 when P.V Narasimha Rao's Congress (I)'s government introduced a package of reforms aimed at economic liberalization. The goal was to bring in a new era in India's political economy by overturning the old. It was intended that these policies would bring about a transition from a protected and secluded economy to an export and open oriented economy in attempting to transform the economy's institutions and functions starting at the roots and working its way out to the branches. These polices were intended to integrate India into the world economy, and make Indian industries more competitive.

The Finance Minister, Manmohan Singh, was a prominent economist and former opponent of economic liberalization. Montek S. Ahluwalia, an economist who was the Finance Secretary and had past experience working at the World Bank, was the architect of India's economic reforms. He brought forth the notion of a trickle-down wealth effect in hopes of reducing poverty, should economic growth occur in any sector (Byres 1994). To achieve this goal, changes were made to the following policies:

Trade Policies

India had an inward-oriented, import trade regime, which interfered with growth. The new trade policy regime had few barriers to trade encouraging the country to produce domestically and export, which has allowed for the recent economic growth. There was a change in import policy by switching some items outside the purview of import licensing. Exporters were given entitlements equal to 30 to 40 percent of their export earnings in the form of EXIM scrip against which even restricted items were allowed to be imported (GoI 2005). Also the government changed the export incentive payment of cash compensatory to tradable import allowance that is around 30 percent of export value. In 1991-1992 there was a

reduction in the tariffs by first having a reduction of import duties from more than 300 percent to 150 percent (GoI 2005).

Eight months after introducing the first liberalization to trade, the government introduced another set of policy changes in areas of trade and capital flow. The EXIM scrip was abolished in 1992 because of the currency convertibility changes and was replaced by a new system of partial convertibility of the rupee on the current account. Under the new system, the earned foreign exchange remittances earned through exports of goods and services can be converted into rupees in which 40 percent of the foreign exchange remitted can be converted at the official exchange rate, while 60 percent at a market determined rate. The foreign exchange, which was converted at the official interest rate, became available to meet the foreign exchange requirement of imports such as oil products, defense, fertilizers, and life changing drugs. Also import license was no longer required for most items, thus a lot of items became freely importable (GoI 2005).

Policies on Capital Flows

The government allowed for more foreign direct investment. The government: approved foreign technology collaboration; allowed for some industries with export earnings to have 51 percent foreign equity; delinked technology transfer from equity investment to impart flexibility in sourcing of technology imports; and, in cases where foreign exchange flows through foreign equity, there was automatic clearance for import of capital goods. Also, foreign investors gained wider access to Indian society because they were allowed to use their trade marks and be appointed as agents, technical, and management advisors. This was due to amendments to the Foreign Exchange and Regulation Act (FERA) (GoI 2005). Furthermore, they were allowed to borrow and accept deposits from the public and invest up to 100% in some sectors,

but not all, banking, print media and telecommunications being still restricted. These investments in India allowed the rate to double annually from 1991-1999 (NE 2007).

Industrial Deregulation and Administrative Price Policy

There were policies set to reduce state control. The licensing of industries for expansion and other restrictions such as having specific industries manufacture certain goods were removed. Most controlled prices on industrial products were abandoned. There was a lowering of corporate taxes in excise and sales duties and an extension of the rationalized modified value-added tax (MODVAT) system. Also, the rules that were enforced under the Monopolies and Restrictive Trade Practices Act were removed. Restrictions on the private sector were reduced, increasing the role of the private sector in the economy. These changes made India's industrial sector more competitive both domestically and internationally (GoI 2005).

Chapter 4

IT Sector Policy

Since Independence India had a technology policy. It was seen that science and technology is useful for national reconstruction, economic resurgence and maintenance of national security. A scientific policy resolution was put into place in 1958 by Prime Minister, Jwarharlal Nehru. This policy emphasized self reliance and the building of domestic technological capability (Ahmad 1985). The policy emphasized the following:

(1) It promoted the teaching of science and scientific research in all level of schools, emphasizing the importance of science in higher education.

(2) It encouraged the participation of both men and women in science and technology fields, and created a social environment where this became possible.

(3) It allowed Research and Development institutions to function with the greatest autonomy to allow creative though.

(4) It integrated the teaching and practice of science and technology within Indian society. It was believed that creative people in the labour field would generate wealth.

(5) It harnessed modern scientific and technological advances so that rapid progress could be made in field of agriculture, and health care.

(6) It encouraged the high levels of innovation and research and development in industry, promoted close and productive interactions between private and public institutions.

(7) It integrated science and technology into Indians daily lives in order to enhance India's global competitiveness.

(8) To use science and technology as a vehicle for international cooperation and collaboration.

Under the fifth Prime Minister, Rajiv Gandhi, the interest in developing new technology was further emphasized by creating the new science advisory council, by setting up certain technology missions for the country, and by taking direct charge of the Department of Science and Technology, Electronics, Atomic Energy, and Space (Heeks 1996).

The National Agenda of Governance, which was the government's policy blueprint, had authorized the government to take the necessary policy initiatives that would help India reach its goal of becoming a superpower in information technology sector. To reach this goal a commitment in their national agenda was made clear by Prime Minister Shri Atal Bihari Vajpayee setting it as one of his top five priorities (EoI 2007).

This was evident On April 28, 1998 In his speech at the CII annual session when he announced "This is one area where India can quickly establish global dominance. India can be fully competitive in this area with tremendous payoffs in terms of wealth creation and generation of high quality employment." He created a national task force for information technology, which formulated the draft national information policy.

On May 22, 1998 the Prime Minister's office announced the creation of an additional national task force for software development. The government gave 5 main tasks and 15 terms of reference to the information technology task force, which included important representatives from government, industry and academia (EoI 2007).

TASKS

The various tasks of the National Task Force on Information Technology and Software Development are as follows :

This Task Force will formulate the draft National Policy on Informatics whose aim will be to enable India to emerge as an Information Technology superpower within the next ten years. It will submit the draft policy to the Prime Minister in three months.

The Task Force will recommend an appropriate empowered institutional mechanism to implement this policy as a national mission with the participation of the Central and State Governments, industry, academic institutions, and the society at large.

This Task Force will recommend, within one month, immediate steps that the Government needs to take to remove bottlenecks and give a big boost to India's Information Technology industry.

This Task Force will prepare a Vision Statement that will excite and energize the people of India,creating the faith in them that Information Technology vitally aids personal growth and national growth. It will also suggest a strategy for the effective articulation and dissemination of that Vision, so as to create an ethos, an ambience, a mindset, and a work culture consistent with the needs of the emerging knowledge-driven global civilisation.

This Task Force will prepare a blue print for making the adoption of Information Technology into a national movement, with a wide network of empowered task forces at all governmental and non-governmental levels.

TERMS OF REFERENCE

The terms of reference of the National Task Force on Information Technology and Software Development are as follows :

Recommend a strategy for the extensive use of Information Technology in all areas of national economy - agriculture, industry, trade and services - as a critical input in making India a global economic power.

Prepare the design for building a world-class physical, institutional and regulatory IT infrastructure,which is appropriate for India. This design will embrace the growing convergence of telecommunications, computers, consumer electronics and the media infrastructure (minus its content).

Towards this end, determine the means for creating a National Informatics Infrastructure (NII) backbone, bridging it to the Local

Informatics Infrastructure (LII) and the Global Informatics Infrastructure (GII). The design of the NII will be dynamic, taking into account the rapidly changing nature of Information Technology.

Recommend how NII can be created at an optimal cost by using the existing resources of the various wings of Government such as the Department of Telecommunications, Prasar Bharati, Railways, Power Grid Corporation of India, etc.

Suggest measures for achieving a massive expansion in the use of the Internet by all sections of society, especially in business and education, and development of Indian content on the Internet.

Recommend a strategy for boosting the learning and use of Information Technology in Indian languages. the policy will suggest measures to promote the development of software, especially educational and commercial software, in Indian languages.

Develop a strategy for a twenty-fold increase in India's software and other IT service exports in the next ten years. In particular, the Policy will focus on the development of world-class software products and brands that can quickly establish global dominance.

Suggest measures to catalyze the growth of exports through the extensive use of -Commerce and EDI(Electronic Data Interchange).

Suggest ways in which the use of IT can be maximised in the Government at all levels, so as to makes its functioning people-friendly, transparent and accountable.

Develop a strategy for dramatically increasing the PC density in the country and, to that end, ensure that every household and commercial establishments that has a telephone also has a computer. The strategy will aim to facilitate the availability of computer hardware, software and connectivity at the lowest possible cost.

Device a strategy for establishing a strong and internationally competitive domestic manufacturing base for computers, computer components and peripherals.

Design a training and manpower development plan involving Government agencies, private business, voluntary organizations, educational institutions and others to quadruple the number of IT professionals in the country in the next two years. The Task Force will suggest a plan to implement the commitment made in the National Agenda for Governance to ensure universal computer literacy in all secondary schools in the country. The plan will also aim at making available IT education to all those sections of the economy where it serves as a productivity multiplier.

> Develop a strategic plan to raise the necessary financial resources to realize the objectives of the National Informatics Policy. This plan will rely on innovative means of funding that minimize government outlay.
>
> Suggest an appropriate legal frame work for the creation of an IT-based society, with due focus on intellectual property rights (IPR), secrecy, security and safety of information.
>
> Recommend how India can leverage its global competitiveness in InfoTech to play a prominent role in the development of IT in other countries, especially those that are underdeveloped (EoI 2007).

The task force's goal was devise key reforms for the development of a knowledge economy and identify the necessary financial investments required to transform India into a knowledge economy. Within a month the task force completed its task. The task force submitted an IT action plan with 108 recommendations which covered issues relating to telecommunications, finance, commerce, electronics, revenue, banking, and human development (EoI 2007).

Much attention was focused on software exports. The action plan made recommendations that were aimed to develop the Indian exporter IT industry to make it globally competitive. The software sector is recognized as the most important element of their IT industry.

Much attention was given to the software industry because it is not just another industry, but a very important part of their new technology based economy. There are two broad categories of software: one as being used to manage components of computer operating systems such as input and output operations; the other is application software which is designed to apply computer techniques to perform administrative tasks for organizations (Narsimhan 1994). Being one of the most important technologies that a highly diversified range of products and services embody, it is becoming an all-embracing technology. Thus, its value is growing within the modern world (Heeks 1996). As mentioned in 1993 World Bank Report,

"Computer software has become the lifeblood of business, industry and government" (58).

Chapter 5

Evolution of the Indian Software Industry

To understand the Indian software industry today, one has to understand the four crucial periods that contributed to the growth of the industry:

Pre-1984: Self reliance in Hardware capability was achieved by government policy and a major event for the software firms was when IBM exited in protest against Foreign Exchange Regulation Act (FERA) rules.

1985-91: Import licensing policy de-regulation coincided with an increase in demand for software programmers as multinational firms moved to client-server systems for mainframe. Also in 1986 software policy was made independent from hardware policy.

1992-99: The government expanded liberalization, the growth of the internet, world wide demand for software, and allowed for large scale entry by large multinational firms into the domestic markets. Also the Indian government saw value in developing the infrastructure of telecommunications and low cost access to the internet via the Software Technology Parks of India (STPI) scheme.

2000-present: The demand for software decreased overall. While it has increased for outsourcing that is bringing consolidation to the Industry (Athereye 2005).

In 1968, a report that was submitted to the government recognizing that there was a need for a software industry in the country for two reasons. The first reason was that when building up the capabilities of technology in information technology; software capability is needed. Secondly, the export of software was seen as profitable when it comes to foreign exchange earnings (NASSCOM 2000). At the time, India's policy regime was restrictive and self oriented, thus not much exchange took place (Harindranath1995).]

In the 1970's, development and growth was seen in the software industry when the Department of Electronics (DoE) announced it as an export commodity and an industry software policy (NASSCOM 2000). A "Software Export Scheme" was established in 1972. It included the following elements:

1) Investment in public sector and Research and development projects involving software development.

2) In Universities and other learning institutions the Government encouraged and initiated computing and soft-ware related training courses and this training policy has continued to expand.

3) Indian companies have been given most of the public sector contracts for software development

The Software Export Scheme allowed for imports of hardware for the use of software export service only if the price of it was recouped by the importer within five years through foreign exchange earnings. This had no beneficial effect on India's software industry because the performance of exporters remained poor. In 1976 the policy became more relaxed. The tariffs on hardware imports were reduced from 100% to 40%. Software exporters were promised faster clearance of their application; and banks were advised to help software producers by extending their loans. Non-residents of India were allowed to import computers for the purpose of software export and take on 100% of the commitment of output produced. Also export incentives were made available for software such as location of production in export processing zones (EPZs) (Athereye 2005).

A dramatic event that happened during the pre 1984 was the departure of IBM in 1977 against the FERA rules, which was when the Indian government required that they have partial ownership of foreign firms operating in their country with the goal to

dilute its equity holding by 40%. This created an import substitution opportunity for manufactures of domestic computer and a demand for programmers to write software for the computers produced domestically. Also just before IBM exited the country and it became known by the country that IBM might exit, a company named Computer Maintenance Corporation (CMC) was established in 1976 to service IBM computers that were owned domestically; small computer companies were started by entrepreneurs who were ex IBM employees. The demand for programming skills became evident when foreign firms depended on software conversion programmers written by Indian software programmers and when there became an interest in building of nuclear and space capabilities (Athereye 2005).

For a functioning IT sector, telecommunication infrastructure is important. Poor infrastructure is a barrier for technological development and in many poor developing nations since they do not have adequate telecommunication, satellite and other alternative communication networks (Hanna 1995). Basic infrastructure such as stable electricity, and good communication networks were required for software production within India became available in some regions due to their relationship in being an advantage to the software industry. Dehli was a favored region for the software industry because of the proximity to government services. The first exporting zones were created in Bombay-Pune because of good infrastructure and Banglore because of their space and electronics research labs. These regions had some advantages compared to other regions in terms of software production and many business houses firms established their services in these regions [see Table 5-1]. Software production was established by entrepreneurs who established their own private firms and business houses such as, IBM ex employees who started to enter into the industry at the time [see Table 5-2]. Some success was achieved in software

production by these firms because they brought together teams of software programmers that provided software systems to foreign firms (Athereye 2005).

By 1981, it became clear that the policy aimed at the software industry was more focused with procedural aspects that would reduce computer imports rather than encourage software exports. This became evident when an import duty on hardware was raised to encourage use of domestic computers. As stated in the policy "[T]he revised policy and practices place emphasis on the generation and export of software using the existing computing capacity in the country, rather than on the import of computers, let alone the import of a particular type computer, for such software generation (Athereye 2005: 23).

In 1984 as regards to state controls and foreign investment, software became recognized as an industry. This major change was due to the new government under Prime Minister Ghandi who in the new computer policy of that year, for software purposes permitted the import of hardware at low tariff levels, which encourage further production of software (Harindranath 1995). This policy could be called ' freewheeling, flood in, flood out policy', liberalized imports which 'flood in' for the purpose of 'flood out ' software exports (Heeks, 1996).

Also software production was encouraged further by the establishment of the Software Promotion Agency, and firms were permitted to use their export earning that could be used for a foreign exchange permit to buy a range of goods such as more computers, with the condition that their export earnings are 50% or above of the obligation in the given year (Harindranth 1995). This new policy made access to foreign exchange easier. As a result exports foreign exchange earnings reached target Rs. 3000m or US $250 million by 1989-90 (Heeks 1996).

1985-91

It was in 1986 when software was allowed to grow independently of hardware even though the government aimed to set satellite based international data links that allowed software production from domestic facilities in 1984 (Harindranath 1995). In the mid 80's there was a spread of computerization in the United States and Europe in their everyday lives in which networking computer became very important in business and individuals daily life and it allowed large and small amounts of data to be stored. Thus there was a large demand for software services (Athereye 2005). The software was not only exported physically on paper but also through satellite data link and consultancies delivered abroad at the costumer's site.

Hardware prices around the world fell dramatically making it cheaper to import. Since hardware was cheaper to import, personal computers spread. The number of operational computers was estimated to of grown from 3,500 systems to 26,560 systems from 1983-1987. This created a larger market for software firms and increasing entry into the sector by business house subsidiaries and entrepreneurs as seen in [Table 5-2] because there was an expectation there would be a rise in the demand for software products. This also allowed software firms set up in the early 80's such as Infosys to mature. Firms that were set up as hardware firms began to use their technical resources toward software production (Athereye 2005).

It was established that foreign owned firms in the country could sell their output as exports and not in the domestic market and that only companies with forty percent of foreign equity could develop software for the domestic market (NASSOM 1999). But sales on software sales were limited due to poor infrastructure. In 1988 under DOE, the concept of software technology parks (STPs) took shape in export processing zones, to take advantage of tax breaks that were given to areas with

adequate infrastructure. This gave firms more reason to invest in software companies, knowing that there were communication facilities and power generation that software and facilitate exports. Marketing of Indian exports of electronics was done by the Computer Software Export Promotion Council in 1988. After the introduction of an insurance scheme that protected clients in software companies against malpractice (Heeks 1996). In 1990, software industry export profit was no longer taxed.

1991 to 1999

In 1991 there was a reduction in telecommunication charges for satellite links, obligation free and duty free import of telecommunication equipment into Export Processing Zone (EPZs) and Software Technology Parks (STPs) (Heeks 1996). There was the depreciation of the rupee and the liberalization of financial capital. The Indian Rupee was made convertible on trade accounts in 1993, which was necessary for liberalized trade. Also access to foreign exchange was made easier due to the liberalization of financial flows. The depreciation of the rupee accounted for more than half of the export growth in between 1990-1993 [see Table 5-3]. The depreciation of the rupee kept wage in dollar term down when there was a rise in software salaries in the domestic economy (Athereye 2005).

Another important change that occurred was the foreign subsidiary establishment via expatriate links between foreign markets and local markets. This created a new business model for software services: the offshore model. Now there were companies located in foreign countries providing technical services for lower costs. The new entry of software foreign firms, who implemented software on the site of computerization, demonstrated profitability for local leading firms who were trusted by these foreign firms with specific and non critical tasks (Athereye 2005).

DoE launched the IS09-000 certification scheme, which allowed Indian firms to obtain from British Standards Institution quality certification based on assessments carried out by the DoE's standardization, testing and quality control Directorate (NASSOM 2000). This helped them improve their firm's reputation when it came to their foreign clients (Athereye 2005). Having a certification such as IS09-000 or SEI-CMM improved organizational efficiency in terms of software delivery. As seen in [Table 5-4] different types of firms obtained such certificates. A copyright act was improved putting forth prison sentences and fines against software pirates and those who possessed of pirated software. Also in 1995 the DoE paid more attention and updated intervention in areas of training and research and development (NASSCOM 1999). More firms entered the industry since the 1996 a 'Super Software Export' policy introduced new features in the industry that allowed more software firms enter by declaring the software industry as de-licensed, which requires no government permission is required to set up software activities. As well the introduction of ten-year tax holiday until 2010, helped boost the industry since profit received from the exports of software were exempted from Income tax, and a zero duty import of capital goods for software unit was provided by the government (NASSCOM 2000).

Chapter 6

Growth and Importance of the IT Sector

In a report by the Organization of Economic Cooperation and Development, it is estimated that in more than half of the developing countries GDP is produced by computer industries and telecommunications (OECD 1995). It was also recognized that information technology is becoming a sector that is expanding twice as fast as the rest of the world's economy.

Information technology has transformed many parts of the economy including the service industry, product development, manufacturing process, competitive strategies and procurement practices. This transformation brought new business and managerial practices, such as outsourcing, time based competition, lean production, and flexible manufacturing. These changes have made industries more competitive and technology intensive.

India's IT sector growth has been very impressive and its goal to dominate the IT work in the developed world is becoming a reality. This can be seen in the outstanding performance of high revenue of companies such as TCS, Wipro, Infosys, HCL Tech, and Satyam. Some Indian companies such as Infosys ranked behind major respectable companies such as Dell, Microsoft, Cisco (Dahlman and Utz 2005). Also companies such as Wipro and Tata are managing U.S IT networks and re-engineering business processes.

Indian IT's competitiveness can be seen from its growth. It has grown from $1.73 billion in 1994-1995 to $ 19.9 Billion in 2003-2004, which accounted for more than three percent of GDP in 2004. Software and services exports recorded revenues of $12.5 billion that same year [see Figure 6-1]. By contrast, India's domestic market accounted for only $3.4 billion in 2003-2004. The growth of IT is expected to occur

at a compound annual rate of 38 percent to reach $77 billion by 2008 which is 20 percent of India's anticipated GDP growth and 30 percent of its foreign exchange earnings. That same year it is expected to employ 2 million individuals and create another 2 million jobs. The projected status of India IT's in 2008 can be seen in [Figure 6-2].

The IT industry involves many services such as back office operations, accounting, public call centers. All are established in India and are generating wealth and employment opportunities. For example, Dakh.com is one of the services that answers questions from customers of Amazon by e-mail. The IT services and back offices work are expected to make $ 57 billion annual export earnings and employ 4 million which would amount to 7 percent of India's GDP (Dahlman and Utz 2005).

However the most important contribution in IT growth is software and software export services [see Figure 6-1]. In the export driven software industry, major projects have come into India and Indian companies have absorbed large shares of the global outsourced businesses. In terms of the software service delivery in 2002-2003 the revenues of the offshore project grew by 49 percent when compared to on-site revenues. Since India is expanding services globally tremendous revenues are being reaped (Dahlman and Utz 2005).

The software industry played the most important role in the success of IT. In the last 15 years India has emerged as a major exporter in the international economy. In the five year period 1995-2000 software sales grew over 50 percent at a compound rate. Software export earnings grew by 18 percent in 2002-2003. The IT service sector grew at the rate of 70 percent in one year alone in 2001-2002 and at the end of March 2002 it employed 106,000, of which 50,000 of those employed worked in the software sector of the IT enabled service sector (Athereye 2005).

Based on statistics the Indian software and service industry generated total revenues of $ 15.9 billion including domestic revenues of $3.4 billion in 2003-2004 [See figure b in Figure 6-1]. These numbers were expected to grow in 2004-2005 to $20.5 billion with domestic market revenue of $4.2 billion. In 2003-2004 the registered growth of the software and service industries was about 30.5 percent bringing in revenues of $ 12.5 billion and was expected to reach revenues of $16.3 billion in 2004-2005. Indian software companies have proved themselves to the world and have taken a dominant position in the world market by being able to take on longer more challenging contracts and being able to complete those contracts on time, at least cost and with high quality.

Education

Education has played an important part in the development of the IT sector. Education is very fundamental in an economy, as well educated and skilled people are essential for creating, sharing, disseminating, and using knowledge effectively. The knowledge economy requires broad skills such as problem solving, analytical skills, group learning, working in a team-based environment, and effective communication. Thus, it is crucial to develop educated and skilled workers to help the economy take part in a competitive global economy (Dahlman and Utz 2005). Since Independence, Indian education has become the responsibility of the state. The government was obliged to create and organize higher educational institutions and standards. In 1976, education became a joint responsibility of the state and the Ministry of Human Development Department of Education, through a constitutional amendment. There was a commission of education from the very beginning. It was under the chairmanship of Dr. D. S.Kothari and sixteen members of which five were foreign

experts. They also consulted a number of experts in the educational and scientific field.

The National Policy on Education (1986) and the Programme of Action (1992) education policies under the ministry of education that give priority to universal education, total literacy and the ending of gender differentials, including seeking to change the social construction of gender by educating for women's equality (Wikipedia 2007). They envisioned that free compulsory education should be provided for all children up to 14 years of age before the commencement of 21st century. The government made a commitment in 2000 that six percent of GDP must be spent on education, with 3 % on primary education. In 1979-1980 the government launched a Non-Formal Education (NFE) program for children of 6-14. This program was intended for those children who cannot join regular schools because of medical or financial conditions. These were children in poor cities and urban areas without easy access to schools. This program is still functional in 25 states and 100 % assistance is given to the NFE organizations.

India educates a large number of highly educated and skilled individuals in science, Engineering, and technicians producing 200,000 a year. To the rest of the population that large pool of highly skilled workers is only a fraction of total population. Since tertiary education is seen to be very crucial for the development of knowledge economies "tertiary education is necessary for effective creation, dissemination, and application of knowledge for building technical and professional capacity" (Dahlman and Utz 2005: 57). Assuming that tertiary education is crucial for a country to take part in information technology, India has been making efforts in establishing a top quality university system that include many higher learning institutions (Institutions of technology (IITs), Indian institution of management,

Indian institution of science, and regional Engineering colleges). Thus they are producing 200,000 scientists, engineers, and technicians a year [see Table 6-1]. The enrolment level in tertiary education has improved over the years see [Figure 6-3] (Dahlman and Utz 2005).

India had a tertiary gross enrollment ratio greater than china, until 1999 when china surpassed India. Even though India is no match for countries such as Korea with 82 percent enrollment rate in tertiary education Indian is doing better than it was in the past and that is reason they are producing skilled workers (Dahlman and Utz 2005).

Education is improving in India and there are large numbers enrolled in schools due to the focus on education and due to greater spending on education [see Figure 6-4]. This could be because in the early 1990's there were was an increase in contributions to the private school sector in terms of expenditures on education by households because parents believed that their children would get better quality education there. The government contracted with the National Institutes of Information Technology (NIIT) to provide over 300,000 training computers in 663 government schools. This provided computer education classes (Dahlman and Utz 2005). Around this time in 2002 the NIIT has provided computer training to more than 750,000 students around 2,000 government schools in high populated cities in Tamil Nadu, Karnataka, Punjab and West Bengal. Once these high school students graduate they will be more likely to enroll in higher learning institutions due to improvements in the quality of their secondary education. India presently has 1,740 different types of educational institutions which produce software professionals [see Table 6-2].

In India large companies are expanding computer training opportunities for Individuals and organization. This is creating more IT professionals, for example, ITU and Cisco developed Internet the training centre NIIT. Companies such as Infosys have developed their own infrastructure to insure and deliver service of quality to their customers.

India is producing about 120,000 graduates in IT a year from institutions, from institutions that focus on all aspects of IT such as Indian Institution of Information Technology in Bangalore. IT is employing about 1 million but at the same time in 2005 it was estimated that India is losing between 65,000 and 530,000 of their brightest and best IT professionals due to the brain drain.

The Diaspora and Brain Drain

When highly educated professionals come out of the Indians higher education system and cannot find suitable employment due to limited jobs in their fields or as a result of low salaries they are tempted to migrate. This leads to a brain drain, where professionals leave their country looking for better job opportunities else where. The Indian born population in the US has increased from 1960-2000 [see Table 6-3] (Dahlman and Utz 2005). It is striking how many of them obtained a high education level in the US, about 77% obtained bachelor degree of higher with 37% obtained masters, professional, or doctorate. Whereas, only 25% of United States born obtained bachelors degree or higher, with 8% acquired a masters, professional or PHD [see Table 6-4] (Athereye 2005).

Most Indians in the United States are in professional occupations [see Table 6-5]. In England alone in 2000, out of the 12292 nationals who received working permits 2616 Indians were classified as engineers and technologists and 5973 were computer analysts and programmers. Indians who are technically high skilled workers

are in demand in many countries, even in Canada, in 2000 about 5738 Indians became permanent residents as skilled workers under the point system. During Germany's Green card program which brought in professionals to participate in German force out of 6,988 visas 1403 were given to professional Indians in the period between October 2000 and April 2001 (Athereye 2005)

India seems to be losing a lot of its professionals to developed countries but the fact is that they are benefiting their country while working abroad. When emigrants migrate to foreign countries there is always a sense of attachment to their homeland. Once they are in a foreign country they tend to make more than what they were making at home and this allows them to accumulate financial wealth. With the wealth they accumulate, they tend to do business with and invest in their home countries. Thus India is gaining from its emigrants. Also emigrants act as reputational intermediaries, giving western base international businesses cultural ties to other countries. Employers are able to get information about businesses from foreign employees and about firms back home. Foreign employees are helping businesses back home. The emigrants benefits their country by sharing knowledge of how businesses in foreign countries is done and apply this knowledge in market opportunities, management know-how, languages, business contracts and so on and become entrepreneurs in their new country or back home (Athereye 2005). Emigrants are rich business asset since they are breaking barriers to international business for Indians who remain. In [Table 6-6] one can see that there is large number of emigrants who are benefiting their country.

As mentioned above that India is losing many of its IT professionals to developing countries such as the United States and Canada. It is however, benefiting

from the Diaspora since it is improving the growth and India's competitiveness in the global economy. As described by Huang and Khanna (2003):

> "After decades of keeping the Indian Diaspora at arm's length, the country is embracing it…Now, India's brightening prospects, as well as the changing attitude vis-à-vis those who have gone abroad, are luring many nonresident Indian engineers and scientists home are enticing many expatriate business people to open their wallets. With the help of its Diaspora, China has won the race to be the world's factory" (Dahlman and Utz 2005:98).

The Indian professionals abroad have benefited their country in many ways. They created networks such as Indus Entrepreneurs (TIE) which is a social and professional network in the Silicon Valley. Indians were running 9 percent of Silicon Valley and 70 percent which were in the software sector in the period of 1995-98 (Athereye 2005). These networks contributed to India's absorption of technical and managerial knowledge by linking them among different foreign markets (Dahlman and Utz 2005). There is a deeper relation now between India and foreign countries such as in Silicon Valley United sates. There are a number of firms that have their head offices in the United States and their manufacturing facility in India, generating more jobs in both countries. The so called brain drain is turning into the "brain circulation" providing and benefiting the technology scenes in both nations (Dahlman and Utz 2005:100).

Also India's government took some positive steps to make the best of the Diaspora. In December 2003 the government instituted the right to dual citizenship for people of Indian origin in the hope that this would contribute more to national

development. Even if workers leave the country they would be able to return to their country without problems and contribute to the development of their country. The government launched an initiative and web site to harness the talent of India's professionals who are working overseas in industries, research laboratories, universities, and scientific departments, as well successful entrepreneurs in technology intensive businesses and venture capitalists to encourage their collaboration in improving India's education system, research, and human resource capabilities in science and technology (Dahlman and Utz 2005).

Infrastructure

A well functioning infrastructure is needed for economic growth since poor infrastructure hinders economic performance. India's government made strong efforts to secure investment in major infrastructure projects. Thus, India mobilized public resources to spend $ 28 billion on infrastructure. The major improvements are in the telecommunications sector, and in road constructions.

It is known that poor infrastructure is a barrier to technological development. For a well functioning Information technology sector, telecommunication infrastructure is very crucial. In India telecommunications are inadequate. There are few alternatives and providing infrastructure by the government is necessary (Hanna 1995). Indian communications are in such a poor state. Communications in India are best not described. With the world's most archaic, inadequate, overloaded, and inefficient telephone systems you can safely forget about facsimile, electronic mail or any kind of integrated services for quite some time to come (LAl 1986).

Infrastructure "is generally a set of interconnected structural elements that provide the framework supporting and entire structure" (Wikipedia 2006). It is most understood as roads, utilities and airports. The elements that can be referred to as

infrastructure are municipal infrastructure or simply public works. These include transportation, potable water, reservoir, airports, canals, railroads, tunnels, piplines, dams, international harbours, schools, hospitals and mines. Also infrastructure may be referred to as information technology, formal and informal channels of communication. Formal channels such as software development tools and informal channels are usually shared opinions by members of a common group (Wikipedia 2006).

Most of the infrastructure mentioned above can be considered public goods. Public goods are non-excludable and non-rival in nature, which mean that by having one individual use the good does not reduce the usage of that good. It can be seen that infrastructure creates proper social conditions that facilitate growth for the nation which can be explained by the increase in economic growth and improvement in human condition in the big cities such as Delhi, Bangalore, Bombay and Chennai compared to villages.

The government prefers to invest in infrastructure which is known to provide structural organization for corporations and cities. It makes economic sense to make improvement in places where there are already large educated populations, established businesses and government services (EIU 2006C).

India has been trying to invest in all types of infrastructure. India's railways are impressive having the world’s most extensive railway network, at 63,221km. It employs 1.5 million staff. India’s roads are badly maintained. The government spent US $ 5.8 billion in 2005/2006. Also in 2002 the government introduced a seven phase National Highways Development Programmed in order to improve about 65,000 km of national highways. The programme came up with Golden Quadrilateral (GQ) project which goal was to expand more than 13,000 km of highway enlarge four and

six lane highways in two key areas, between India's four metropolitan centers, Delhi, Mumbai, Chennai and Kolkata. About 90 % of the project was accomplished that same year by mid 2006. The government plans to increase the funds that will be spent on roads within seven to eight years, with a budget of US $49 Billion (EIU 2006C).

The government improved India's major ports which handle 75% of all cargo. They have poor port governance and inefficient customs clearing which allow for high costs. They also have high turnaround time at the port which they improved from 8.5 days in 1997/1998 to 3.5 days in 2005/2006. The government established Tariff Authority for Major Ports (TAMP) to have fair and fixed port charges which are collected by private providers. The government in order to attract new technology promotes joint ventures between their major ports and minor foreign ports.

The telecommunication sector grew rapidly due to government focus. Mobile phone connections have increased dramatically from 3.2m in the end of 2000 to 45m in the end of 2004. The number of telephones provided by private operators has also increased from 22.8 million to 125 m within six years 1999-2005 (fixed line and mobile). This increase can be seen in [Figure 6-5 and Figure 6-6]. At the end of 2005, 5.4 m out of the 6m villages had a public phone. One can see that communications became easier. Prices have also declined for example a call from Delhi to Bombay fell from 65 cents in 2000 to 5 cents in 2004. The government is committed to the improvements and expansion of teledensity and to promote the telecoms industry [Figure 6-7] (Dahlman and Utz 2005). However internet activity is low compared to other countries with six users per 1,000 people (EIU 2006C).

In 1995 the internet became available to the public due to international telecom organizations such as Videsh Sancher Nigam Ltd, or VSNL. There are now a

few regional and three national internet providers that are offering services to the public (Heeks 1998).

In 1999 the government introduced the New Telecom Policy whose objective is to have telephone on demand by 2002 and at reasonable prices. The goal was to establish reasonable telecommunication services to the villages by 2002. The government sought to have internet access in all district headquarters by 2000 and by 2002 develop high speed Data Multimedia capability in any city with a population of over 2 million. The government recognized that it would not be able to achieve these targets alone since it was short of resources to do so. Private investment and the involvement of the private sector were needed. Thus, the public and private sectors worked together to facilitate India's vision of becoming a superpower and develop a world class telecom infrastructure in the country.

The government set a Broadband Policy in 2004 with the aim to make communication services more affordable with the incentives for the private sector and create additional infrastructural and employment opportunities. Since it is expensive to start new information technology infrastructure, the policy encouraged the growth of infrastructure through various coexisting technologies such as fiber optic technologies, cable satellite, digital subscriber lines on copper loop, cable television network and terrestrial wireless technologies (Dahlman and Utz 2005). .

The New Telecom Policy's aim is to create an environment that is competitive and attract investment in the sector to promote the creation of communication infrastructure. The goals is to achieve teledensity of 7 by the year 2005 and 15 by the year 2010; and improve rural density from 0.4 to 4 by the year 2010. They wanted to provide equal opportunities in rural and urban areas in terms telecommunications in order to enable India to become truly a global player

(EoI,1999).

Major initiatives have been taken in the IT sector. National long distance Telephony has been opened. As well the international long distance telephony has been open for the private sector on April 1 2002. Basic and cellular operators can set up their own long distance services in licensed service areas. Basic services have been opened for unlimited competition. No licensing is required for manufacturing in telecom sector.

The government sees software as a focus for growth of exports, thus they announced the software technology (STP) scheme. The scheme was implemented through the software technology parks of India. Features of the scheme are:

- Approvals are given under Single Window Clearance Mechanism
- 100% Foreign Equity is permitted
- All the imports in the STP units are completely duty free
- Import of Goods on loan, free of cost & lease basis is permitted
- Re-export of Capital Goods brought on loan/lease/free of cost is permitted
- Domestic purchases are completely excise duty free
- Domestic purchases are eligible for the benefit of deemed exports to the suppliers
- The sales in Domestic Tariff Area (DTA) are permissible up to 50% of the value of Exports
- STP units are exempted from corporate income tax up to Year 2010.
- The Export Obligation on the STP units is as follows
- Export Performance for five years: the unit should be positive net foreign exchange earner (GoI 2001).

Software parks have been greatly beneficial to the IT sector specially the Software part of the economy sector because software companies especially exporters faced telecommunication problems, actual telecommunication links and poor quality of transmission. It is very important for software units to have a good quality data communication links in order to send information between on another and to their

clients around the world. The government set up many different technology parks in the most populated cities where there were more business and educational facilities. In every city there was a different IT park that provided different services.

Chapter 7

Growth Theory, Information Technology and Indian Growth

7.1 Historical growth rates and reforms

As mentioned before, prior to 1980, India's real GDP growth was modest, probably due to policies put in place after the Second World War by Nehru. However, as explained earlier these policies failed to deliver economic growth. In the late 1970's under the Janata government economic liberalization began. There was no major impact on real GDP growth. However, additional reforms adopted by Indira Gandhi in the early 1980s and were pursued in 1984 by Rajiv Gandhi's government. India underwent relatively high growth from 1980-1990 of 5.8%. This was much greater than the 3.4% average growth rates of developing countries during that period of time. India is becoming one of the fastest growing developing economies in the world. A further wave of reforms were introduced in 1991 when P.V Narasimha Rao's congress (I) government brought about a package of reforms aimed at economic liberalization.

Even though the rate of growth decreased from 5.8% in the years 1980-1990 to 5.5% in 1990-2000 India was still developing at a rate greater than 4.7%, similar to the growth rate of developing economies. In the words of Das (2000)

> "In July 1991…..the announcement of sweeping liberalization by the minority governments of P.V Narasimha Rao….opened economy… dismantled import controls, lowered import controls, lowered custom duties, and devalued currency. Virtually… abolished licensing controls on private investment, dropped tax rates, and broke public sector monopolies… [W]e felt as though our second independence had arrived: we were going to be free from a rapacious and domineering state".

Greater economic liberalization was achieved during the 1990s. However the growth rate was not much different from that of the 1980s. This proves that India's experienced success took place early on since the very beginning of economic reforms had an enormous effect on India's long run economic destiny. Small economic policy reforms have since had a large effect on growth. In fact growth has been even higher from 2000 to 2007 with an average real GDP growth rate of 6.9 % (DeLong 2001).

This can be further seen by applying growth accounting and examining the growth of total factor productivity during those periods. Growth accounting permits to separate India's growth in real GDP into changes in factor inputs, capital K and labour L and changes in total factor productivity, A. Solving for the growth rate of A

we have $gA = gY - \alpha gK - \beta gL$ where the growth rate of Y is $gY = \frac{Y1 - Yo}{Yo}$ .Where alpha is elasticity of labor and beta is elasticity of capital.

According to IMF report, total factor productivity (TFP) seems to fluctuate with real GDP growth. It is seen when India's growth was 3.9% in 1970-1980, its TFP growth was negative at -0.5%. When the growth rate of GDP rose to 5.80% during the 1980s TFP growth also rose to 2.49%; and when GDP fell slightly from 1990-2000, TFP growth fell to 1.57% (Rodrik 2004).

India can be said to have experienced a growth miracle. A growth miracle can be defined as a period of sustained high growth. This chapter seeks to explain, on the basis of growth theory, the role played by the information technology industry and by policy reforms in producing the Indian growth miracle.

7.2 The Solow Growth Model

We begin by using the Solow Growth model. This model assumes that a fixed fraction of output is saved. Population and technology are growing at constant

exogenous rates. In equilibrium saving equals investment. A fundamental dynamic equation is derived according to which net capital accumulation is equal to the difference between total savings and replacement investment. In the steady-state, net capital (per efficiency of labour units) accumulation is zero so that income per capita is rising at the rate of technological progress.

According to the Solow growth theory, differences in income per capita can be explained by differences in propensities to save. Countries with higher saving/investment rates are usually richer than those with lower investment and saving rates (Jones 1998). But this is not always the case according to Parente and Prescott. They argue that actual differences in savings rates across countries are small. In conclusion, it is not possible to explain actual differences in income per capita on the basis of savings propensities.

When this policy reform occurred it raised the propensity to save, the steady-state capital stock and output rise. The growth rate rises temporarily, putting in motion a process of capital accumulation. However, as the economy approaches the new steady-state, the growth rate falls. Thus, the Solow model fails to explain a growth miracle (Demers 2007A.)

7.3 Parente-Prescott

Parente and Prescott developed a growth model which incorporates different types of capital and differences in productivity across countries. According to Parente and Prescott (2002), poor countries are poor because they have low productivity. In turn, low productivity is the result of economic policies. However, the precondition for a country to undergo a growth miracle is the existence of a large stock of useable knowledge. Poor countries are unable to use this knowledge and thus, are poor relative to the industrial leader because of the existence of barriers to the adoption of

new technologies. For example monopoly interests that block the adoption of new technologies. Poor countries do not need to develop new technologies or to innovate by investing in research and development to improve their standard of living. They need only to remove the barriers to the adoption of new technologies.

The adoption of policy reforms or policy liberalization has occurred at different times in India especially beginning with the reforms of Indira Gandhi reduces barriers and allows the country to increase its knowledge stock, thus increasing its total factor productivity (TFP). As a result, high growth rates occur which result in a growth miracle.

The effective application of ideas developed elsewhere requires investment in both physical and other types of capital as well as an understanding of the cultural sustainability of the foreign ideas. If barriers are non-existent, investments will be made. When people invest they are willing to consume less today in order to consume more in the future. This theory predicts a period of high investment and rapid convergence to a higher steady state following the elimination of some barriers in acquiring new technology. Japan and Korea are good examples of such growth miracles (Demers 2007C).

7.4 Solow Growth Model with Human Capital Accumulation

To understand India's growth further, we discuss the role of human capital in growth. Mankiw Romer and Weil have taken one approach to extending the Solow model and analyzed the implications of different propensities to save and of different levels of education and skills that they can use to further increase their output (Demers 2007B.)

Another model is proposed by Robert Lucas (1993) in his analysis of learning by doing (Demers 2006A). To incorporate Lucas's idea we use the following

notation: Y is output which is produced by a combination of physical capital, K, with skilled labour, H. According to the Cobb Douglas Production function

$$Y = K^{\alpha} (AH)^{1-\alpha}$$

A is labour-augmenting technology that grows exogenously at rate g, which is the parameter representing the growth rate of technology. It takes time for individuals to learn new skills in order for economy to accumulate human capital. Individual's time spent learning is introduced by u. L is total amount of labour used in production in the economy. So unskilled labour learning skills for time u generates skilled labour H.

$$H = e^{\psi u} L$$

where ψ is positive constant. If u=0 then H=L — that is, labour is unskilled. So by increasing u, a unit of unskilled labour increases the effective units of skilled labour H. To see how much, take logs and derivates of equation to see

$$\frac{d \log H}{du} = \psi$$

This equation states that a small increase in U increase H by percentage ψ (or ψ x100). Thus, an extra year of schooling increases wages earned by individuals by about 10 percent (Jones 1998).

Lucas's conclusion is that richer countries (those that have higher steady-state incomes) have higher saving rates, spend a larger percentage of time accumulating skills (h), have low population growth (n) and have higher levels of total factor productivity (A). As we have seen India has adopted policies that have lowered the population growth rate and raised the percentage of time spent accumulating skills. These policies have increased the steady-state income per capita of India.

7.5 Human Capital Accumulation and Learning by Doing

As Robert Lucas observed, human capital accumulation also occurs at work, as we know from the fact that experienced workers and managers earn more than inexperienced ones. This aspect of human capital accumulation -- on the job training -- could also be (and has been) modeled as a time-allocation decision. Alternatively, in a multiple good world, one could think of on-the-job-accumulation -- learning by doing -- as associated with the type of process one is engaged in. That is, one might think of some activities as carrying with them a high rate of skill acquisition and others, routine or traditional ones, as associated with a low rate.

The mix of goods a society produces will affect its overall rate of human capital accumulation and growth. If an industrial sector develops without access to foreign markets, the country cannot grow by moving its workforce to another higher learning sector. It needs to be able to sell the surplus to foreign markets where income per capita is higher. Therefore, openness and access to foreign markets is essential to a learning based growth episode. In the Lucas model growth may proceed at a constant rate for decades (See Lucas (1993)(Demers 2006B).

Each of the four East Asian economies of Taiwan, South Korea, Singapore and Hong Kong went, in a matter of a few decades, from being primarily an agriculture-based economy with little trade with other economies to industrial-goods based export economies. Their stunning growth in those decades of 70s, 80s and 90s provides us considerable empirical evidence of how skills learnt in producing new and usually more technologically sophisticated goods, leads to human capital accumulation and higher GDP growth rates. Learning by doing was and is the most significant source of human capital accumulation in those economies since investment

in education and other indicators pertaining to literacy were similar to those of similar countries like Philippines which could not achieve the same rates of rapid growth.

Hence, using the examples of the East Asian growth miracle and the role of human capital accumulation, especially learning by doing, we may attempt to analyze similar rates of rapid growth in India. Indian exports largely comprised of agricultural goods and to some extent industrial goods until the 1980s. The first round of reforms came with the government of Rajiv Gandhi in the early 80s, while a second and more comprehensive set of reforms were undertaken by the government of Narashima Rao in the early 90s.

Along with these reforms came the birth of the information technology sector in India. We focus on the IT sector in particular because, unlike the East Asian economies, India's exports changed from being dominated by agricultural to being dominated by software and Business Process Outsourcing (BPO) services. In the early 1980s, several European airlines started using Delhi as a base for back office operations, British Airways being one of them. In the second half of the 1980s, American Express consolidated its JAPAC (Japan and Asia Pacific) back office operations into New Delhi. Soon, they were joined by General Electric and the industry expanded rapidly. By 2002, all major Indian software organizations were into BPO.

The rapid growth of this sector can be attributed to important factors – cooperation and encouragement by consecutive Indian governments and the readily available pool of inexpensive and English-speaking Indian workers. But our focus is on the fact that the introduction of the provision of relatively simple IT services at first and slowly progressing into more sophisticated services such as software developing and the handling the operations of entire IT departments of major Western

multinational company has allowed Indian workers to gain skills in this sector. In other words, this is an ideal illustration of how learning by doing has played a significant role in human capital accumulation. The literacy rate, primary and secondary enrolment and average educational attainment of India are all similar to countries with income levels in the same range. Yet, the opportunity to work in say, an outsourcing firm, has enabled Indian workers to learn on the job and raise their skill level which has contributed much more to human capital accumulation than any increases in other factors such as school.

Conclusion

India is developing at an exceptional rate with a two tier economy. One part of the economy is the globally competitive knowledge economy, which is driven by information technology and hires the brightest of the middle class. The other part of the economy is the agriculture and manufacturing sectors that employ the poorly educated labour force.

This essay was an attempt to find and analyze the reasons behind the phenomenal growth rates of India in recent times and especially the contribution by the IT sector in this regard. From 1970-1980 the growth rate was relatively modest. But after 1980 GDP started to increase at a higher rate. The annual Real GDP growth rate in 1980-1990 was 5.80% compared to 3.59% in 1970-1980. In the 1990's India's economy was one of the fastest economies in the world relative to developing economies such as its neighbours Pakistan and Bangladesh. Even though it slowed down between 1990-2000, it was still growing at a good pace with 5.5%; and in 2000-2007, it had a Real GDP growth rate of 6.9%.

India has also been doing better in most other aspects in comparison to neighbours and countries at similar stage of development. It has been improving faster in the Human Development Index and Human Poverty Index. Also, the degree of use of modern communications has thoroughly permeated the economy.

However, as described earlier in our discussion about post-independence policy, India had not initially been on this growth path. The newly independent economy's policies were based on the belief in industrialization as the route to modernization. In turn, the latter was based on "import substitution" as a necessary policy to provide protection for a new "infant" industries, on the distrust of the private sector and of the market, on the belief in the government, as a paternalistic benevolent

guardian that should take the leading role in development and finally on a distrust of the international economy and a belief of export pessimism.

What happened as a result was that India managed to grow at a modest rate comparable to most other economies at similar stages of development but was left far behind export-oriented newly industrializing economies like South Korea and Taiwan.

In mid 70's and early 80's some experts believed that India's economy was facing problems due to ineffective policies that needed to be reformed. Expert panels such the Alexander Committee, the Sondhi Committee, and the Jha commission got together to re-evaluate existing policies and suggested that the only way to help India's economy was policy liberalization. The liberalization of policies was gradually introduced in the late 1970's and early 80's. In the late 70',s trade regime policies were liberalized under the Janata government. In the early 80's, Prime Minister Indira Ghandi initiated the new regime of industrial policies. There was a reduction of import quotas and tariffs, deregulation of prices, and less restrictions on expansion and entry of industries by abolishing some of the licensing regulations.

Under the fifth Prime Minister, Rajiv Gandhi, science, technology and the interest in new technology was further emphasized by creating a New Science Advisory Council. In 1998, the office of Prime Minister Atal Behari Vajpayee, issued a notification which constituted a national task force on information technology and software development. The policy emphasized the promotion of the teaching of science and scientific research. This policy allowed the Research and Development institutions to function with greater autonomy and accountability, and to harness modern scientific and technological advances. The policy also encouraged the higher levels of innovation, research, and development in the industry. Vajpayee's policy effectively promoted close and productive interactions between private and public

institutions, and the integration of science and technology with all spheres of national activity. This served to enhance India's global competitiveness, and has ensured the continued development of national infrastructure, the safeguarding of national security, and the use of science and technology as a vehicle for international cooperation and collaboration. The results of the policy have permitted India to share material and intellectual resources in order to achieve common goals.

To understand the role of the IT sector, we needed to look at its evolution. The IT sector went through an evolution of several stages. Before 1984, self reliance in Hardware capability was achieved by government policy and a major event for the software industry occurred when IBM exited in protest against Foreign Exchange Regulation Act (FERA) rules. Between 1985 and 1991, import licensing policy de-regulation coincided with an increase in demand for software programmers as multinational firms moved to client-server systems for mainframe. In 1986 the software policy was made independent from hardware policy. In the 1990s, the government introduced large scale liberalization allowed, the growth of the internet, experienced a growth in worldwide demand for software and large scale entry by large multinational firms. Also the Indian government's policy saw significance in attempting to develop the infrastructure in telecommunications and lower cost access to the internet via the STPI scheme. Finally, in the current decade, the demand for software decreased while the demand for outsourcing has increased which is bringing consolidation to the industry.

In trying to explain India's growth rate, we examined in turn the basic Solow growth model, the Parente Prescott model, the Human capital model of Lucas and the learning by doing model of Lucas. A large upward jump in steady state growth path is caused by change in economic policy or in the economic environment and this causes

a large increase in economic growth. It was seen that in the 1980's India's structural changes accelerated economic growth and had a large effect on India's long run economic destiny. This means that the government has to a subsidize capital accumulation; otherwise there will be too little capital accumulation. This explains that India's regional growth is due to higher investment and government subsidies in these specific regions.

Then, using the examples of the East Asian growth miracle and the role of human capital accumulation, especially learning by doing, we analyzed the similar rates of rapid growth of India. Indian exports largely comprised of agricultural goods and to some extent industrial goods till the 1980s. The first round of reforms came with the government of Rajiv Gandhi in the early 80s, while a second and more comprehensive set of reforms were undertaken by the government of Narashima Rao in the early 90s.

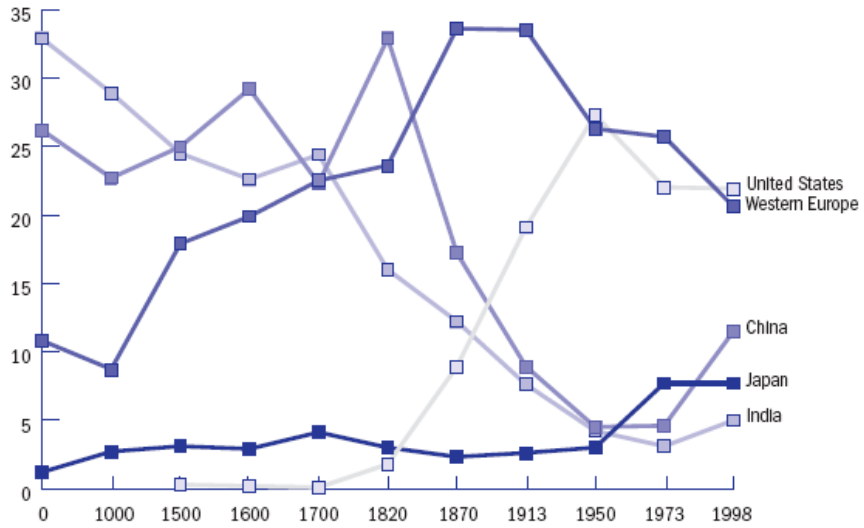
The rapid growth of this sector can be attributed to important factors – cooperation and encouragement by consecutive Indian governments and the readily available pool of inexpensive and English-speaking Indian workers. But our focus is on the fact that the introduction of the provision of relatively simple IT services slowly at first and progressing into more sophisticated services such as software developing and the handling the operations of entire IT departments of major Western multinational company has allowed Indian workers to gain skills in this sector. In other words, this is an ideal illustration of how learning by doing has played a significant role in human capital accumulation. The literacy rate, primary and secondary enrolment and average educational attainment of India are all similar to countries with income levels in the same range. Yet, the opportunity to work in say, an outsourcing firm, has enabled Indian workers to learn on the job and raise their

skill level which has contributed much more to human capital accumulation than any increases in other factors such as school.

In conclusion, we may say that India's growth can mainly be attributed to the growth and importance of the IT sector and the associated human capital accumulation.

Figure A

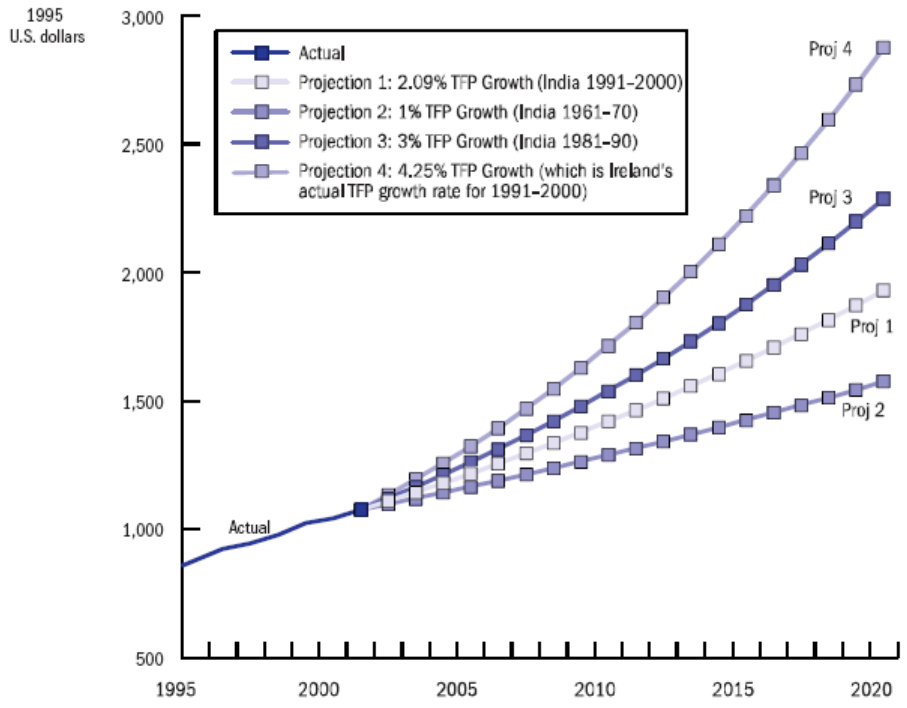
India: Percentage Share of Global Gross Domestic Product, Years 0–1998



Source: (Dahlman and Utz 2005)

Figure B

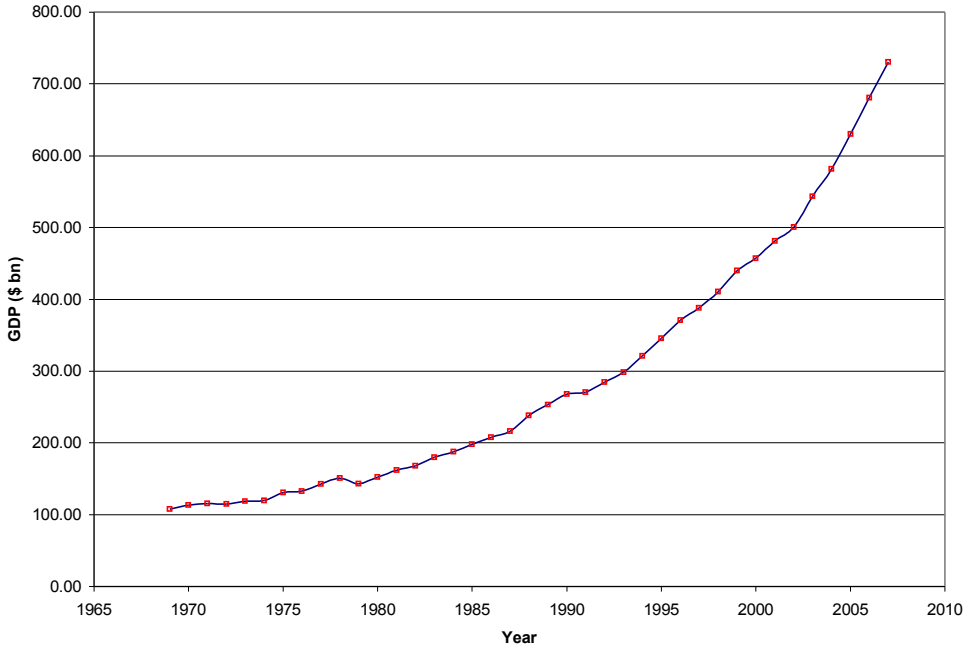
India: Real Gross Domestic Product Per Worker, Alternative Projections, 1995–2020



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. Annex 1 provides the theoretical framework for these TFP projections.

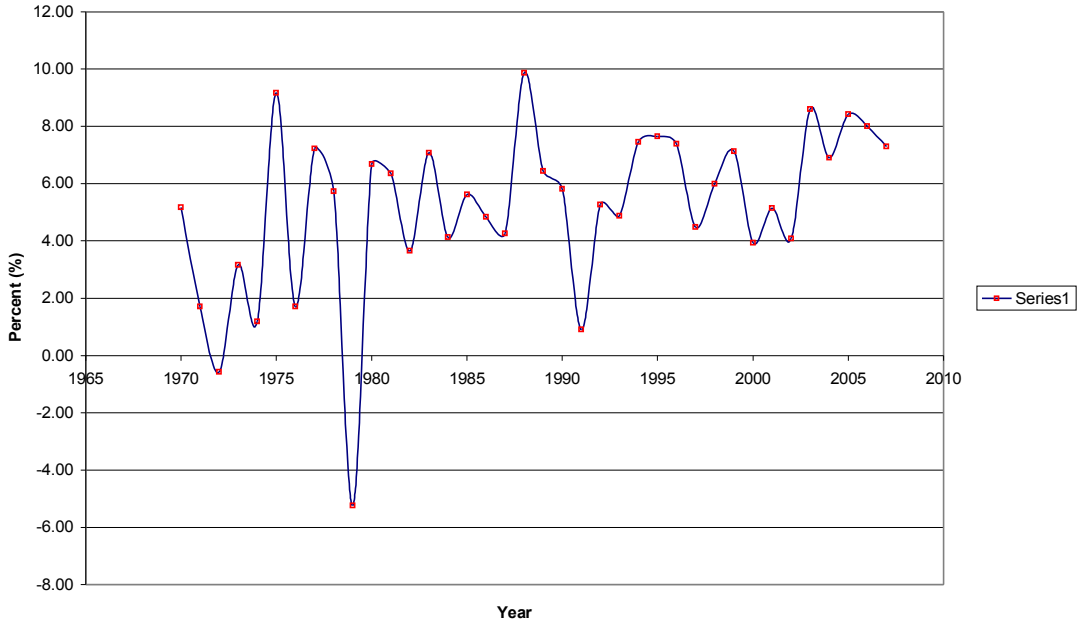
Source: (Dahlman and Utz 2005)

Figure 1-1: Real Gross Domestic Product of India,1969-2007



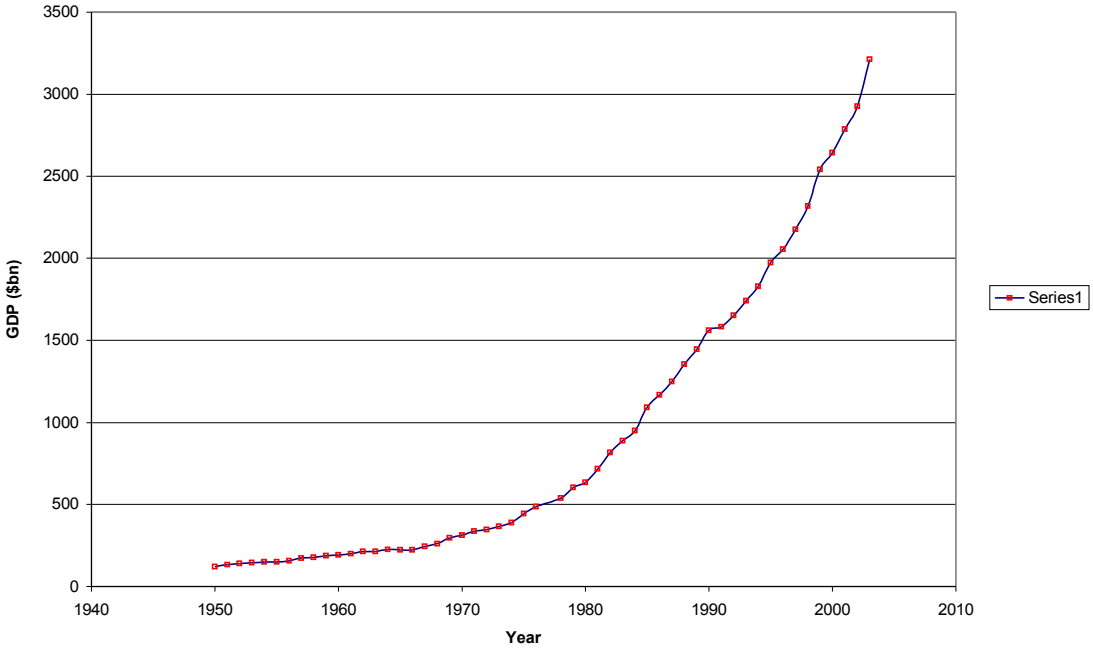
Source:(Economic Research Service 2006)

Figure 1-2: Growth Rate of Real Gross Domestic Products of India, 1970-2007



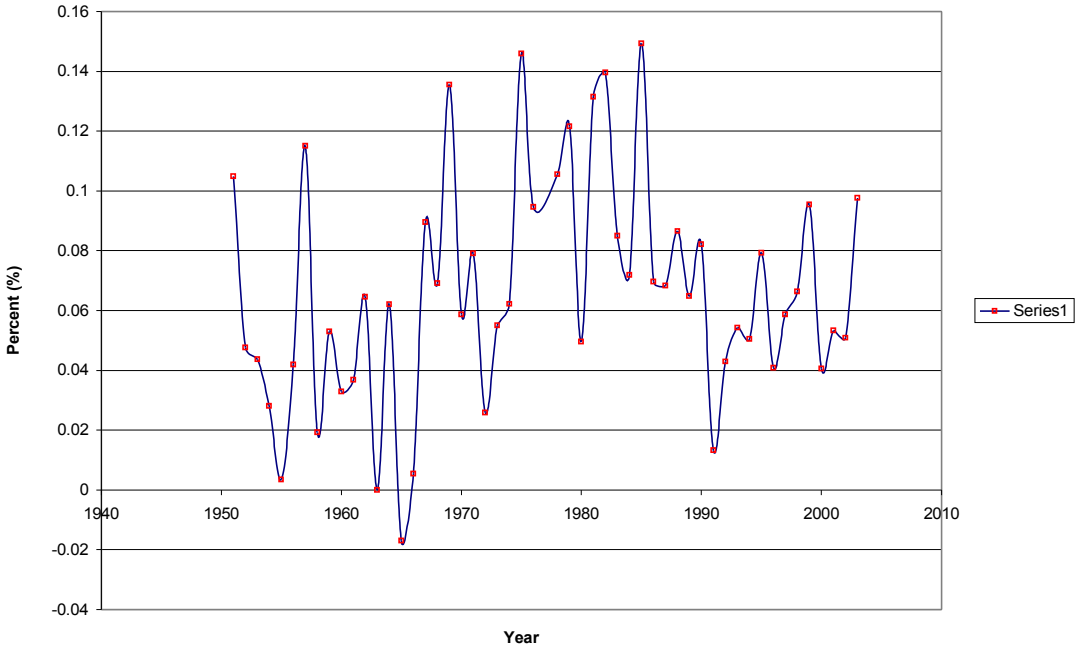
Source: (Economic Research Service 2006)

Figure 1-3: Real Gross Domestic Product per Capita in India,1950-2003



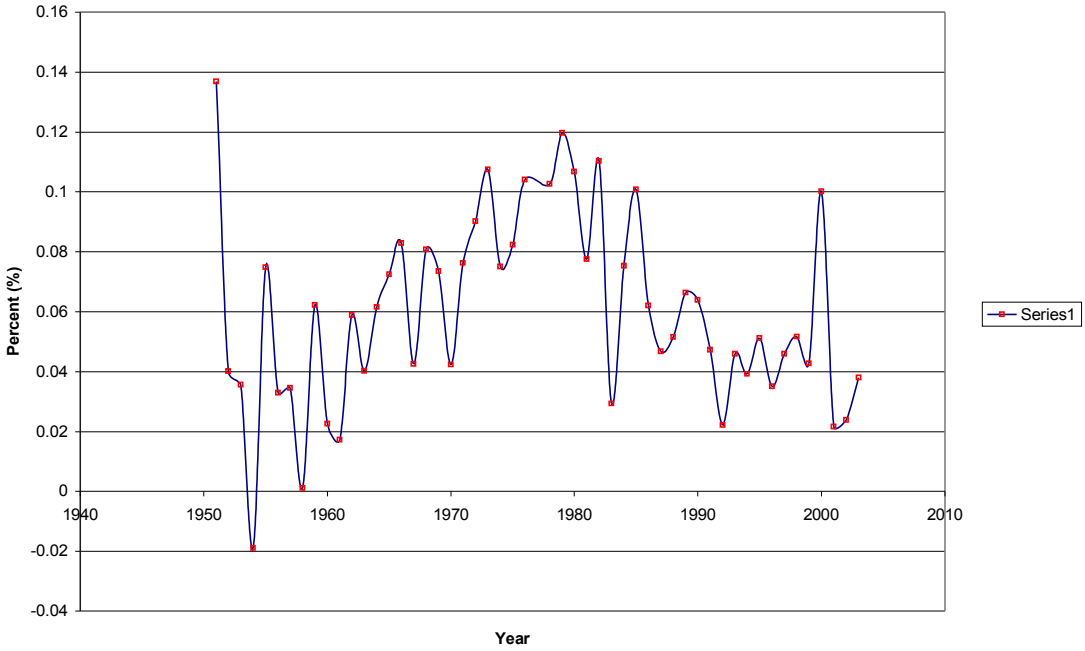
Source: (Penn world Tables 2006)

Figure 1-4: Growth Rate of Per Capita GDP in India, 1950-2003



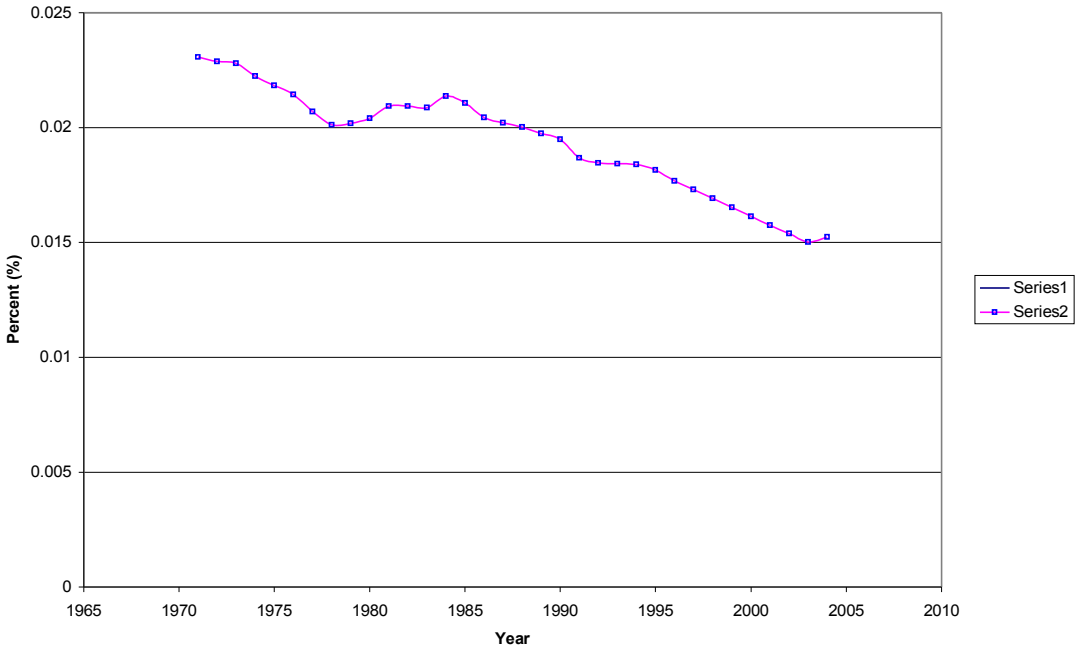
Source: (Penn world Tables 2006)

Figure 1-5: Growth Rate of Per Capita GDP in US, 1950-2003

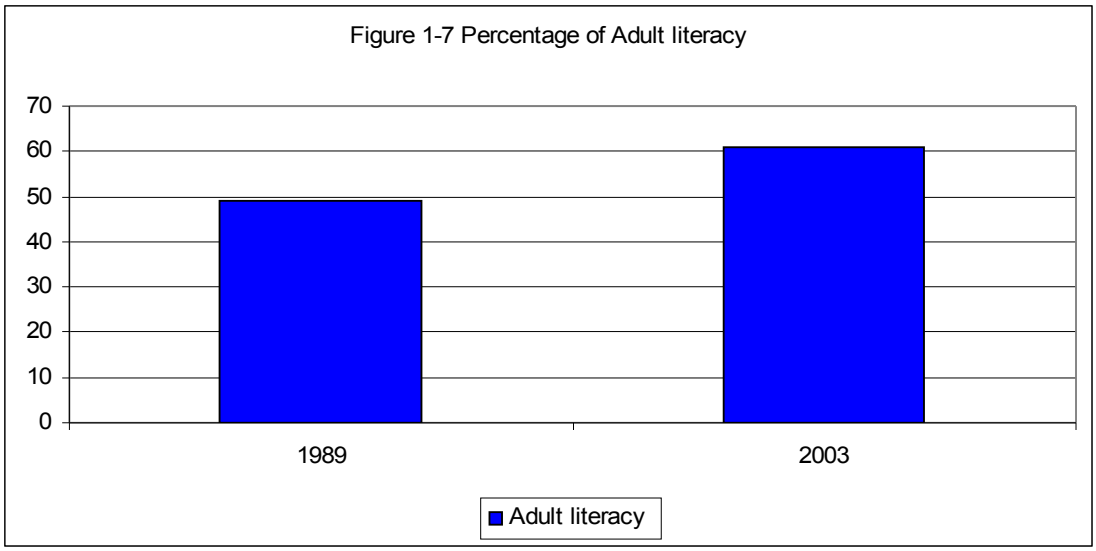


Source: (Penn world Tables 2006)

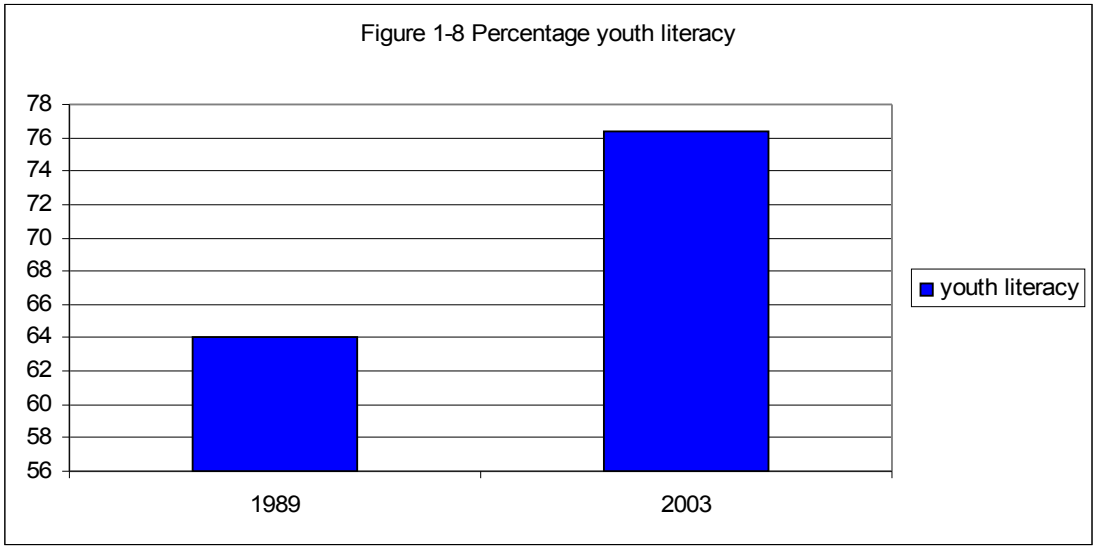
Figure 1-6 : Population Growth Rate of India 1970-2004



Source: (Penn world Tables 2006)



Source: (UNDP 2006)



Source: (UNDP 2006)

Figure 1-9: Illitaracy Rate 1985-2003

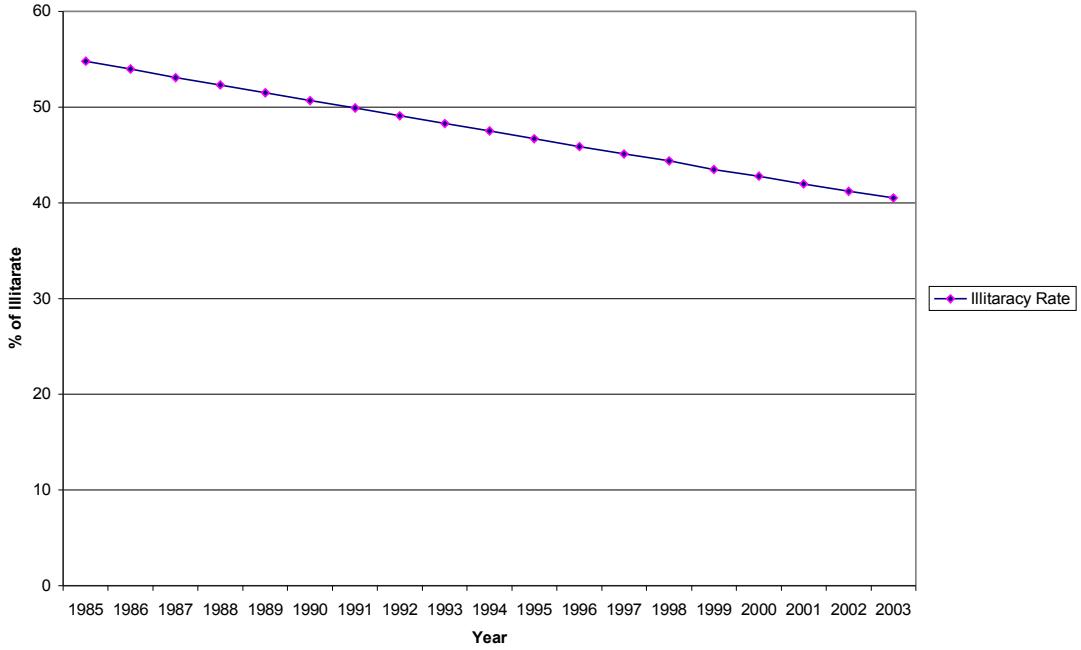
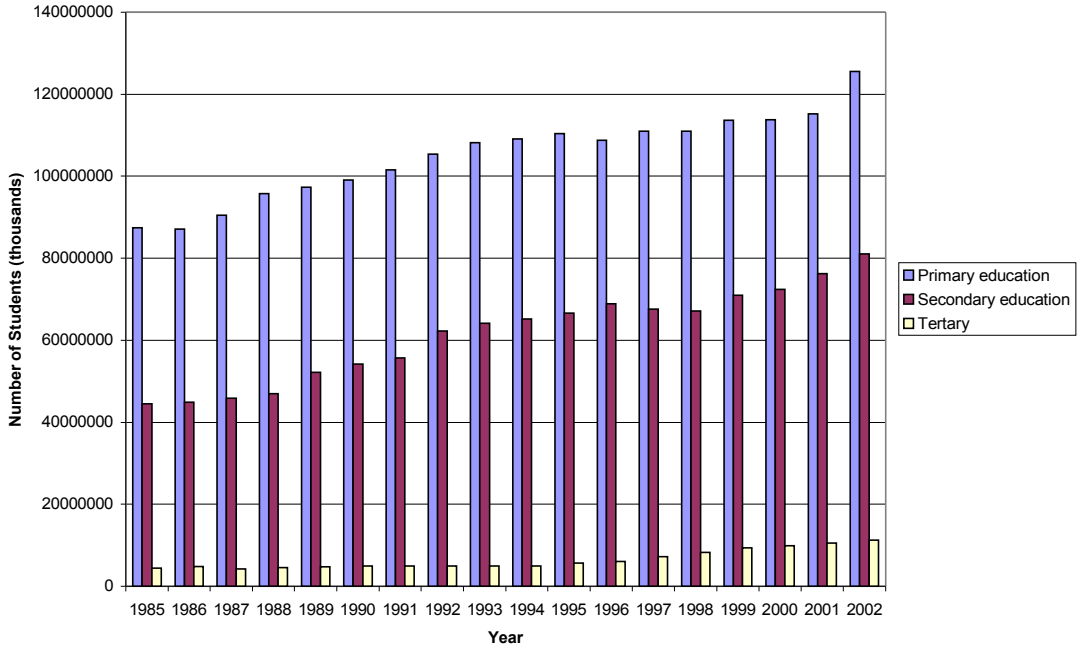
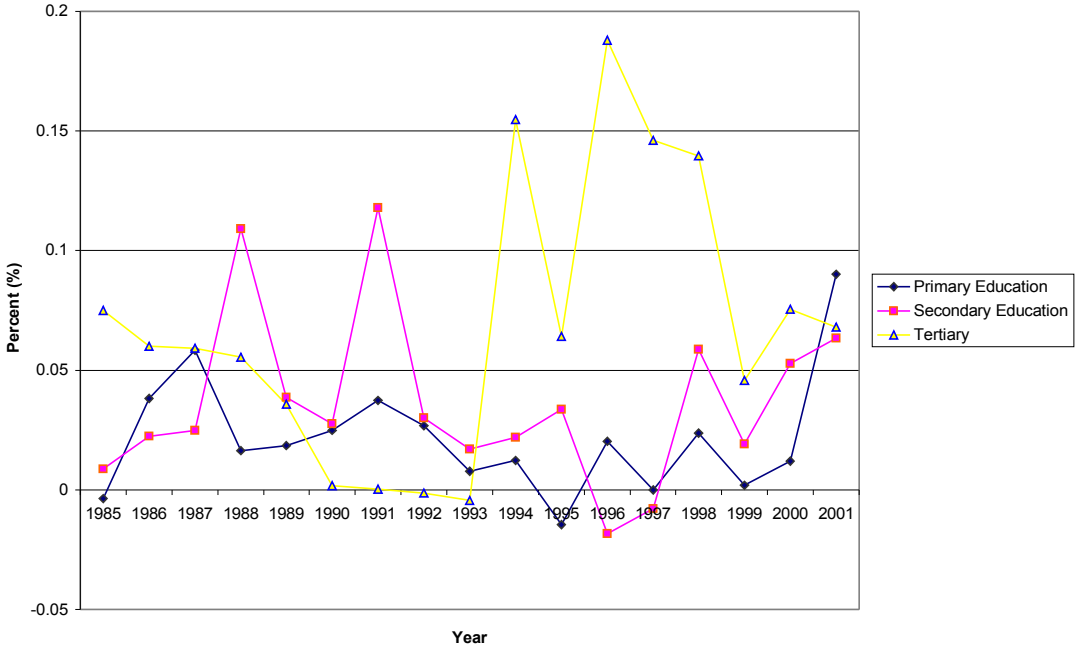


Figure 1-10: Education Enrollement 1985-2002



Source: UNDP 2006

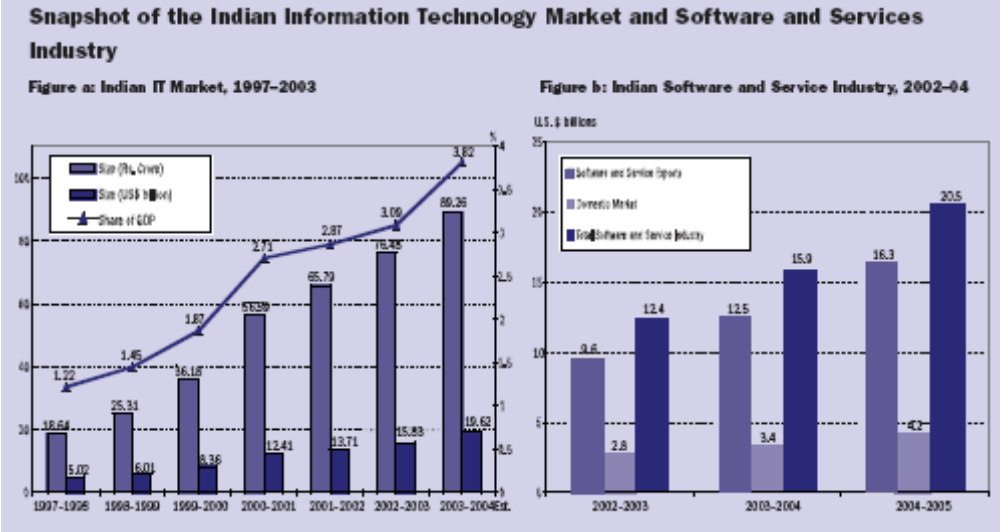
Figure 1-11: Growth Rate of Education Enrollement 1985-2001



Source: (UNDP 2006)

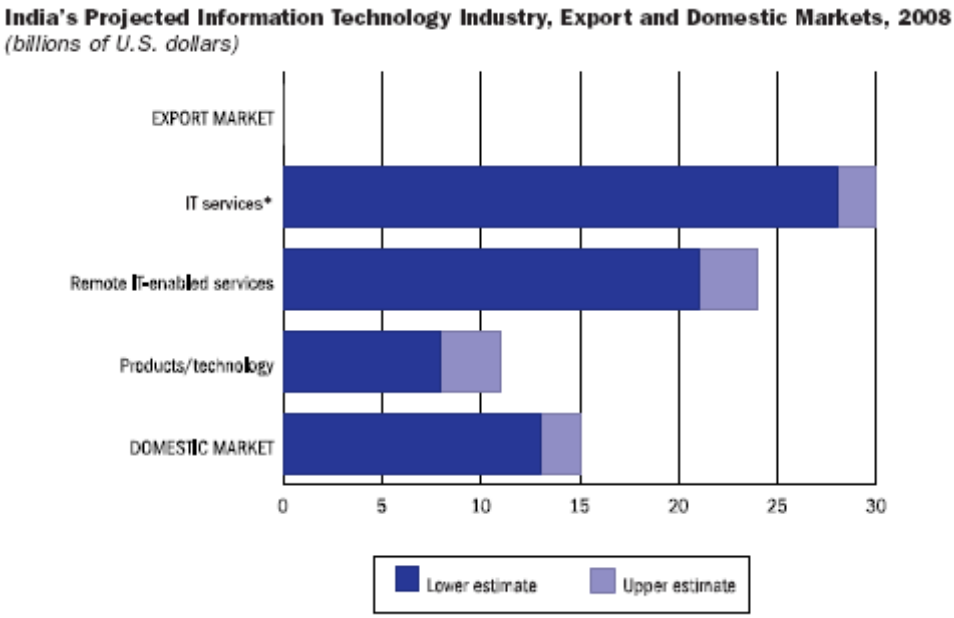
Figure 6-1

Snapshot of the Indian Information Technology Market and Software and Services Industry



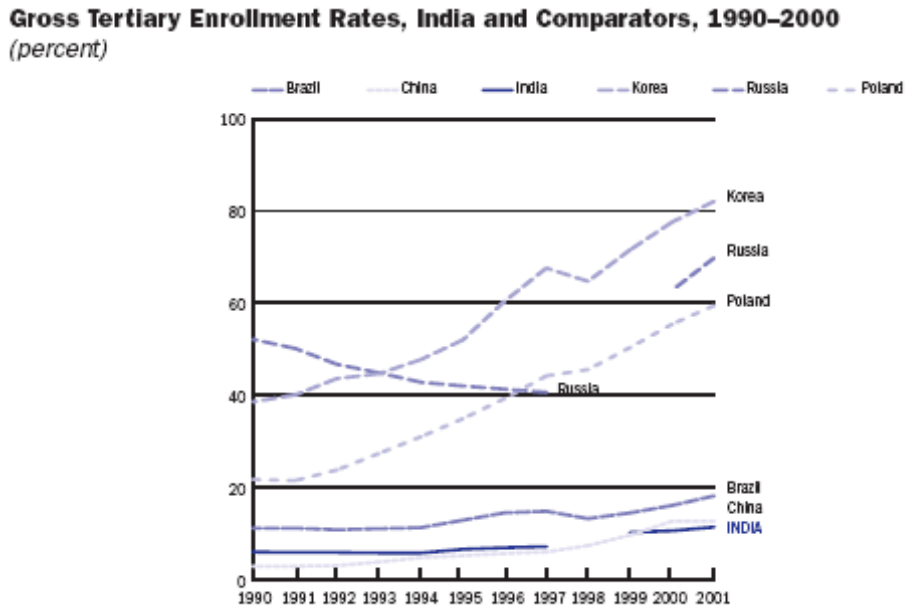
Source: (Dahlman and Utz 2005)

Figure 6-2



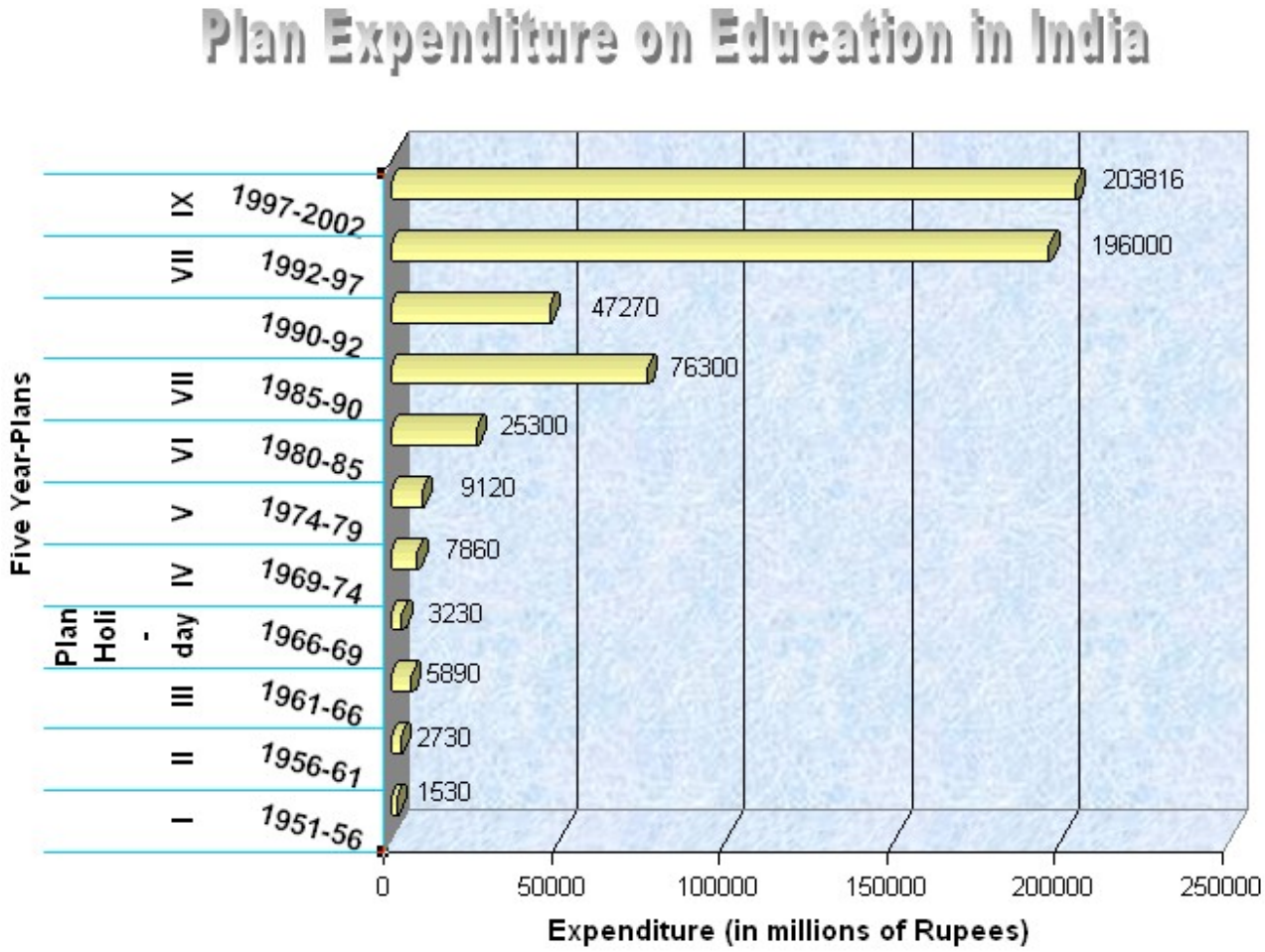
Source: (Dahlman and Utz 2005)

Figure 6-3



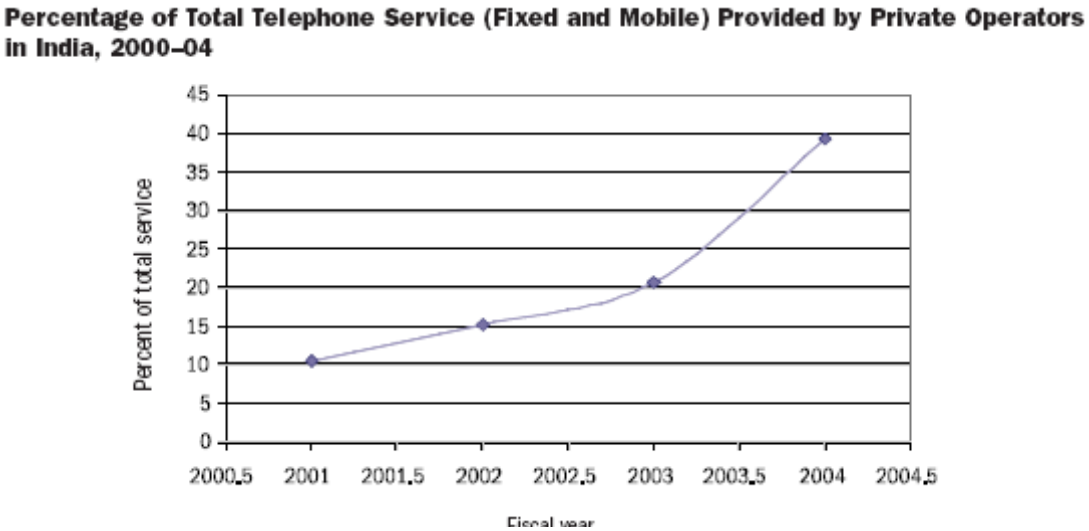
Source: (Dahlman and Utz 2005)

Figure 6-4



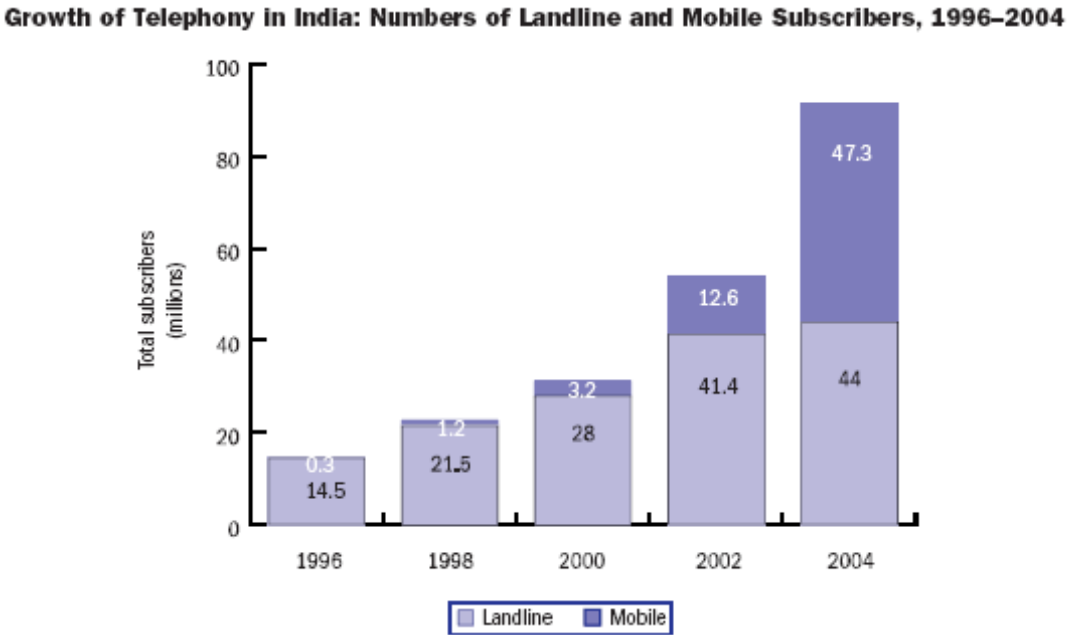
Source: (wikipedia 2007)

Figure 6-5



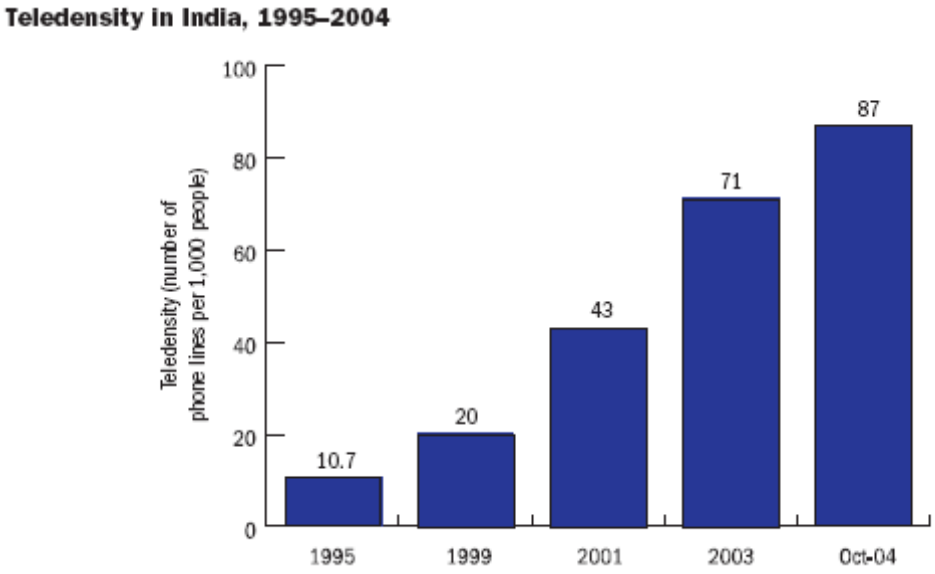
Source: (Dahlman and Utz 2005)

Figure 6-6



Source: (Dahlman and Utz 2005)

Figure 6-7



Source: (Dahlman and Utz 2005)

Table 1-1

Countries Rates of Economic Growth, 1970-2007
Annual Real GDP Growth

Country	-19701980	1980-1990	1990-2000	2000-2007
India	3.59421	5.806532	5.50888	6.926008
Bangladesh	1.60251	3.72922	4.801341	3.892201
Pakistan	5.857767	6.289158	3.955667	3.747522
U.S	3.252616	3.195698	3.274108	1.949449
Germany	3.096103	2.194434	1.829194	0.707693
Japan	5.857767	4.102117	1.407495	1.18257
World	4.098272	3.251631	2.844252	1.367636
Developed	3.738785	3.05764	2.486229	1.567571
3.66241	4.765076	3.467622	5.932159	Developing

Source: (Economic Research Service 2006)

Table 1-2

India's Human Development Index Trends

Human development index, 1975	0.413
Human development index, 1980	0.439
Human development index, 1985	0.477
Human development index, 1990	0.515
Human development index, 1995	0.548
Human development index, 2000	0.577
Human development index, 2004	0.611

Source: (UNDP 2006)

Table 1-3

Human Development Index

HDI rank [a]		Human development index (HDI) value	Life expectancy at birth (years)	Adult literacy rate [b] (% ages 15 and older)	Combined gross enrolment ratio for primary, secondary and tertiary schools (%)	GDP per capita (PPP US$)	Life expectancy index	Education index	GDP index
		2004	2004	2004	2004 [c]	2004			
81	China	0.768	71.9	90.9	70	5,896 [x]	0.78	0.84	0.68
126	India	0.611	63.6	61.0	62 [g]	3,139 [p]	0.64	0.61	0.58
134	Pakistan	0.539	63.4	49.9	38	2,225	0.64	0.46	0.52
137	Bangladesh	0.530	63.3	.. [l]	57 [h]	1,870	0.64	0.46	0.49

Source: (UNDP 2006)

Table 1-4

Human Development Index Trends

HDI rank	1975	1980	1985	1990	1995	2000	2004
81 China	0.527	0.560	0.596	0.628	0.685	0.730	0.768
126 India	0.413	0.439	0.477	0.515	0.548	0.577	0.611
134 Pakistan	0.365	0.388	0.420	0.463	0.493	0.511	0.539
137 Bangladesh	0.347	0.366	0.391	0.422	0.454	0.510	0.530

Source: (UNDP 2006)

Table 1-5

Human and Income Poverty: Developing Countries

	Human poverty index (HPI-1)		Probability at birth of not surviving to age 40 [a, †]	Adult illiteracy rate [b, †]	Population without sustainable access to an improved water source [†]	MDG Children under weight for age [†]	MDG Population below income poverty line (%)		
		Value	(% of cohort)	(% ages 15 and older)	(%)	(% under age 5)	$1 a day	$2 a day	National poverty line
HDI rank	Rank	(%)	2000–05	2004	2004	1996–2004 [c]	1990–2004 [c]	1990–2004 [c]	1990–2003 [c]
81 China	26	11.7	6.9	9.1	23	8	16.6	46.7	4.6
126 India	55	31.3	16.6	39.0	14	47	34.7	79.9	28.6
134 Pakistan	65	36.3	16.1	50.1	9	38	17.0	73.6	32.6
137 Bangladesh	85	44.2	15.9	.. [f]	26	48	36.0	82.8	49.8

Source: (UNDP 2006)

Table 1-6

Demographic Trends

	Total population (millions)			Annual population growth rate (%)		Urban population (% of total) [a]			Population under age 15 (% of total)		Population ages 65 and older (% of total)		Total fertility rate (births per woman)	
HDI rank	1975	2004	2015 [b]	1975–2004	2004–15 [b]	1975	2004	2015 [b]	2004	2015 [b]	2004	2015 [b]	1970–75 [c]	2000–05 [c]
81 China	927.8 [d]	1,308.0 [d]	1,393.0 [d]	1.2 [d]	0.6 [d]	17.4	39.5	49.2	22.0	18.5	7.5	9.6	4.9	1.7
126 India	620.7	1,087.1	1,260.4	1.9	1.3	21.3	28.5	32.0	32.5	28.0	5.2	6.2	5.4	3.1
134 Pakistan	68.3	154.8	193.4	2.8	2.0	26.3	34.5	39.6	38.9	34.1	3.8	4.2	6.6	4.3
137 Bangladesh	73.2	139.2	168.2	2.2	1.7	9.9	24.7	29.9	35.9	31.4	3.6	4.2	6.2	3.2

Source: (UNDP 2006)

Table 1-7

Commitment to Education: Public Spending

	Public expenditure on education				Current public expenditure on education by level [a] (% of all levels)					
	As % of GDP		As % of total government expenditure		Pre-primary and primary		Secondary		Tertiary	
HDI rank	1991	2002–04 [b]	1991	2002–04 [b]	1991	2002–04 [b]	1991	2002–04 [b]	1991	2002–04 [b]
81 China	2.2	..	12.7	..	..	..	..	..	..	..
126 India	3.7	3.3	12.2	10.7	..	..	..	..	..	..
134 Pakistan	2.6	2.0	7.4	..	..	..	..	..	..	..
137 Bangladesh	1.5	2.2	10.3	15.5	..	39.0 [c]	..	49.5	..	11.5

Source: (UNDP 2006)

Table 1-8

Technology: Diffusion and Creation

	MDG Telephone mainlines [a] (per 1,000 people)		MDG Cellular subscribers [a] (per 1,000 people)		MDG Internet users (per 1,000 people)		Patents granted to residents (per million people)	Receipts of royalties and licence fees (US$ per person)	Research and development (R&D) expenditures (% of GDP)	Researchers in R&D (per million people)
HDI rank	1990	2004	1990	2004	1990	2004	2004	2004	2000–03 [b]	1990–2003 [b]
81 China	6	241	(.)	258	0	73	..	0.2	1.3	663
126 India	6	41	0	44	0	32	1	(.) [c]	0.8	119
134 Pakistan	8	30	(.)	33	0	13	..	0.1	0.2	86
137 Bangladesh	2	6	0	31	0	2	..	(.)	..	..

Source: (UNDP 2006)

Table 1-9

Energy and the Environment

	Traditional fuel consumption (% of total energy requirements)	Electricity consumption per capita (kilowatt-hours)		MDG GDP per unit of energy use (2000 PPP US$ per kg of oil equivalent)		MDG Carbon dioxide emissions Per capita (metric tons)		Share of world total [b] (%)
HDI rank	2003	1980	2003	1980	2003	1980	2003	2003
81 China	4.6	307	1,440	1.3	4.5	1.5	3.2	16.5
126 India	19.8	173	594	3.3	5.3	0.5	1.2	5.1
134 Pakistan	23.5	176	493	3.5	4.2	0.4	0.8	0.5
137 Bangladesh	51.5	30	145	10.8	10.4	0.1	0.3	0.1

Source: (UNDP 2006)

Table 5-1

Entry Dates and the Regional Location of Firms

Location	Pre-1980	81-84	85-91	92-99	2000-2001	Number of firms	Share in Revenues	Share in employment
Bangalore	3	3	19	50	15	126	23.7	24.52

Mumbai/Pune	9	11	32	63	8	149	32.47	30.12
(Pune)	(1)	(0)	(8)	(17)	(2)	(35)	(2.24)	(3.97)
Chennai	3	5	9	34	6	67	13.20	15.29
Dehli: of which	5	4	25	63	17	156	23.49	15.48
(Noida)		(1)	(6)	(18)	(4)	(34)	(18.26)	(5.75)
(Gurgaon)			(1)	(9)	(2)	(25)	(1.16)	(1.80)
Hyderabad		1	6	29	8	63	5.22	9.07
Calcutta			9	8	4	26	0.66	0.48

Notes 1: The first five columns are computed from NASSCOM[1] after excluding government departments, liaison offices and firms with missing data on years of establishment (N= 449). Firms that provide IT-enabled services were also excluded.
2. The last three columns have alarger number of firms(N=658) as they include firms which have missing data on year of establishment. As consequence employment and revenue share add to less than 100.
Source: (Athreye 2005).

Table 5-2

Entry Dates and Composition of Firms

Type of entrant	*Pre-1980*	*1981-1984*	*1985-1991*	*1992-1999*	*2000-2001*	*Number of firms*	*Share in revenues*	*Share in employment*
Business house firms	*10*	*2*	*10*	*60*	*5*	*112*	*26.24*	*26.89*
Multinational enterprises	*1*	*3*	*24*	*80*	*20*	*128*	*11.29*	*16.28*
US-Indian	*0*	*0*	*10*	*38*	*10*	*58*	*7.87*	*7.87*
Entrepreneurial firms	*1*	*1*	*4*	*13*	*3*	*22*	*1.44*	*0.85*
Entrepreneurs with prior IT experience	*11*	*8*	*46*	*129*	*35*	*229*	*36.99*	*34.10*
Others	*7*	*2*	*5*	*26*	*3*	*44*	*8.08*	*7.97*
All firms						*657*		

Notes:1. Share of employment and revenue do not add up to 100 because of missing data of the year of establishment. Total number includes firms with missing data on year of establishment
2.Ten multinational subsidiaries were established in 1991, and twenty-five were established following the second wave of liberalization of foreign investment rules in 1995-96.
Source: (Athereye 2005).

Table 5-3

Decomposing the Annual Growth of India Software Exports

Period	Total Growth (%)	Real Growth (%)	Exchange Rate (%)
1987-1993	46	28	18
1987-1990	41	29	12

1990-1993	52	28	24

Source: (Athereye 2005).

Table 5-4

Incidence of Certification among Various Types of Entrants in 1999-2000

Entrant type	Business house subsidies	Multinational enterprises	US-Indian	Entrepreneurial firms	Entrepreneurial (professional IT)
Relative incidence of certification	1.18	1.54	1.53	1.00	0.64

Notes: (1) Firms that had any type of certification, ISO or SEI-CMM were counted.
(2) Relative incidence is computed as: Proportion of firms in each category that had certification/average proportion of firms in the industry that had certification. A relative incidence greater than 1 indicates that subgroup had an average certification that was higher than the industry average, which was 0.274.
Source: (Athereye 2005).

Table 6-1

Scientific and Technical Personnel from Indian Universities by Level of Qualification

Field	Year	Graduates	Post Graduates	Doctorates	Total
Science	1979	99,749	17,638	2,262	119,649
	1989	134,366	24,591	3,044	162,001
	1995	139,257	23,807	3,155	166,219
Engineering and Technical	1979	18,364	3,155	506	22,025
	1989	28,927	4,560	560	34,047
	1995	32,250	3,667	546	36,463

Source: (Dahlman and Utz 2005)

Table 6-2

Categorized by Type of Educational Institute, 1999

Educational Institution	Number
National Institutes (IIT & IISC)	06
Engineering Colleges	32
Universities offering bachelor degrees	320
Colleges offering Diplomas	755
Others	594
Total	1740

Source: (Dahlman and Utz 2005)

Table 6-3

Indian-born Population in the United States

India	1960	1970	1980	1990	2000
Number	12.296	51.000	206.087	450.406	1,022.552
Percentage of domestic population	0.003	0.0009	0.030	0.053	0.101

Source: (Dahlman and Utz 2005)

Table 6-4

Educational Attainment of US-born and India-born Populations in the United States (2001 March CPS) (Age > 25) Percentage share

Education level	US-Born	India-Born
Less than high school	13	6
High school	34	8
Some college	27	9
Bachelor degree	17	40
Masters	7	40
Doctorate	1	4

Source: (Athereye 2005).

Table 6-5

Occupation of the US-Born and Indian born population in the United States (average of 1999-2001 March CPS)

Occupation	US-Born	Indian-Born
Executive, administrative, and managerial	15	17
Professional specialty occupation	15	42
Engineers	1	7
Mathematical/computer specialists	1	16
Other	70	41

Source: (Athereye 2005).

Table 6-6

Leveraging the Diaspora: Indicators of Emigrant Connectedness in Silicon Valley

	Country of Birth			
	India	China	Taiwan	
How many of your friends have returned To their country of birth to start a company?(% share)				
10 or more	4	6	17	
1-9	73	68	70	
None	23	26	13	
How often have you traveled to your country of birth For business purposes, on average, in the past three year?				
Never	48	56	36	
Once a year	39	31	38	
3-4 times a year	9	8	20	
5+ times a year	4	5	6	
Percentage of respondents reporting regular exchange of information with friends, classmates, or business Associates in the country of birth				
Jobs or business opportunities in the United States	27	23	16	
Jobs or business opportunities in home country	17	12	8	
Technology	33	20	19	
Have you ever helped business in your country of birth By serving as an advisor or arranging a contact? (% shares)				
Advisor	34	24	15	
Contract	46	42	34	
Percentage of respondents who have invested their own Money in start-ups or venture funds in their country of birth (% shares)				
More than once	10	4	12	
Only once	13	6	5	
Would you consider returning to live in your country of birth in the future? (%shares)				
Somewhat likely	20	29	18	
Quite likely		25	14	7

Source: (Athereye 2005).

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