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National System of Innovation: India

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The BRICS Project is a comparison between the National Innovation Systems of Brazil, Russia, India, China and South Africa. It is a project conducted by the Global Research Network for Learning, Innovation and Competence Building Systems – Globelics (see www.globelics.org) and RedeSist – the Research Network on Local Productive and Innovative Systems – at the Economics Institute of the Federal University of Rio de Janeiro Brazil.

Conceptually, the project is structured around the Systems of Innovation framework. The central focus of the study is the national innovation system (NIS) of the five BRICS. The notion of innovation system has in its centre the industrial, S&T and education sub-systems; but includes also the legal and political frameworks, investment and financial sub-system, as well as other spheres relating to the national and international contexts where knowledge is generated, used and diffused. The objective is to characterize and compare the NIS of the five countries pointing out convergences, divergences, and synergies, as well as identifying current and potential connections. Particular attention will be given to policy implications. Therefore, the project aims at involving, not only researchers, but also policy-makers working in national and international agencies.

Specifically the project aims at:

(a) stimulating interactions and the exchange of experiences between researchers and policy-makers interested in innovation in BRICS aiming at creating capabilities and finding joint workable solutions;

(b) characterizing the structure of BRICS´ national innovation systems, their recent evolution and perspectives;

(c) comparing the five countries innovation systems, identifying differences and similarities, common bottlenecks and complementarities;

(d) developing and using concepts and information capable of representing the Innovation Systems of BRICS;

(e) discussing policy implications and put forward policy recommendations, extracting lessons that can be useful not only for these countries but also for other developing countries.

The project is coordinated by José Cassiolato (RedeSist) and Bengt-Aake Lundvall (Aalborg University Denmark). Country coordinators are: in Brazil, José Cassiolato, RedeSist, IE/UFRJ; in India, K. J. Joseph , Centre for Development Studies, Trivandrum; in South Africa, Rasigan Maharajh, Tshwane University of Technology; in China, Liu Xielin, Chinese Academy and in Russia, Leonid Gohkberg, Higher School of Economics, Moscow.

Summary

1. National System of Innovation of India

From the colonial rulers India inherited a stagnant economy wherein the GDP growth rate was less than 2 percent during the first half of the nineteenth century and per capita income growth (0.5 percent per annum) was only one fourth of the GDP growth rate. Apart from the stagnancy in growth, in terms of the structural characteristics, it exhibited all the characteristics of an underdeveloped economy wherein agriculture accounted for 85 percent of the population and industrial sector, mostly traditional industries with hardly any presence of modern industrial sector, employed only about 10 per cent of the labour force[1]. The capital formation remained at an extremely low level of six percent with a domestic savings rate of five percent. The country was poorly endowed with human capital with illiteracy rate as high as 85 percent. With frequent incidences of communicable diseases mortality rate, especially infant mortality, remained very high, and average life expectancy was about 30 years. (Morris, 1982) noted that during the first half of 19th century Indian economy was private sector dominated with states sector contribution to GDP never exceeded more than 10 per cent. The task before the planners was obvious - to transform such a traditional, backward and stagnant economy to a modern industrial economy.

In the post-independence period the process of economic transformation was sought to be achieved through the centralized planning. This involved the setting up of an elaborate system of production, promotion and regulation of goods, services and knowledge in tune with declared policy objectives of the state. In this process, apart from upholding self reliance to be achieved at the instance of public sector, limited role was assigned to the market and there were various policy initiatives from time to time to ensure an equitable distribution of income and wealth across individuals and regions. The policy regime remained in tact till the end of 1970s. The seventies marked the emergence of a large number studies highlighting the efficiency losses associated with the import substituting industrialization. [Little, Scitovsky and Scott (1970), Balassa (1971) Kruger (1974) Bhagawati (1978)]. The success of the East Asian countries has been cited to suggest that the trade restricting, import substituting policies have failed and should be replaced with trade oriented, export promoting policies[2].

In the context of heightened euphoria created by the South East Asian tigers and the downfall of the Soviet Union leading to an erosion of confidence in central planning and state intervention in conjunction with a number of government committees calling for dilution of beaucratic controls and regulations that stifled the economy, there were a series of policy initiatives involving internal liberalization that aimed making the industrial sector more competitive and efficient. Later by the early 1990s, in the context of an unprecedented crisis in the external sector, India embarked on a series of stabilization cum structural adjustment policies heralding the beginning of an era of globalization and that culminated by the mid 1990s with the setting of WTO and India joining as a founding member. Needless to say, the series of institutional interventions undertaken to influence technology, trade, industry, labour, finance, investment and others undertaken over the last 60 years has had significant bearing, either explicitly or implicitly, on the evolution of national innovation system by their impact on the behaviour /interaction of firms with other firms and other entities and thus significantly influencing the innovation process.

[1] While the nationalist/leftist scholars attribute backwardness of the economy entirely to the colonial rule, scholars (Roy 2006) have revealed that there were sectors of growth and decline, resulting from changes brought about by colonialism and a world that was moving towards industrialisation and economic integration

[2] But it has also been argued that the underlying force of the South East Asian miracle is a more active form of state intervention [Amsden (1989) and Wade (1990)]. After critically surveying the literature on both sides Rodrik (1995 pp 2947) remarks "these books (Amsden and Wade) cannot be easily dismissed; they present a serious challenge to those who deny the usefulness of an activist industrial policy".

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1.1. Evolution of India's Innovation System

Any attempt to examine India's innovation system, has to take into consideration, the process of the colonization that the country underwent for nearly a century and a half, and the deep impact it left all aspects of the nation including the culture and psyche of the populace. While the visible processes of de-industrialisaiton that the country underwent, is quantifiable and hence can be easily analyzed, the complex relationship the country had with language, science, and developmental orientation of the coloniser, has deeper but not so visible impact in education, research, invisible structures, processes and rituals that provide the glue for the system and its impact on the deliverables of an innvation system. Gunathilake(1982) calls this process cultural blanketing and comments that its impact is substantially long term and has tremendous implications for national developmental proejcts initiated after decolonization. In this section, we would begin with an examination of the roots of Indian S&T developmental projects even during the colonial era, provide an overview of doing science in independent India subsequently. This section also would focus on building a narrative on major sectoral interventions in the Indian S,T&I journey, so as the set the stage for the examination of the constitutent elements of the innovation system.

1.2. S&T in the pre –independence era

Though India, had a well developed scientific and technological heritage, the twin processes adopted by the British viz., stunting of Indian industrial development by relegating India to the status of a raw material supplier, and development of an educational system, which focuses only on production of clerks and administrators, led to the stunting and reversal of Indian scientific growth. While a host of literature, has examined the visible impact of colonization, especially in the Indian economic and production structure (Dutt, 1908; Mukerji, 1945;Bagchi, 1962; Ganguli, 1964; Salotare,1994; Roychoudry, 1960; Desai, 1968; Kulke, 2004; Roy: 2006 amongst others), and the consequent deindustrialization and impoverishment of Indian economy, research on the impact of colonization on Science and technological system of India is too limited.

As Kumar (2005) conclusively argues though preparatory elements for the emergence of modern scientific traditions, did exist in India, the constraints and restrictions, even blanket denial that the colonial administration practiced , did not allow a robust scientific tradition to emerge in India. A crucial element of this control was in the multi-layered constraints that the colonial regime put in place especially in the education system. Though cautious observers like Ambirajan (2006) and Roy (2006) argue that once the educational structure was put in place, change and bureaucratic momentum "did propel institutions along a path, though not necessarily the charted by the initiators" (Ambirajan, 2006) , one has to acknowledge the fact that these are colonial bureaucracy. As Gunathilake (1982) contents the British education system, was in effect an attempt at cultural blanketing, an initiative carefully calibrated to serve colonial interests. As Kumar (1989) in his thesis on engineering education cites " engineering colleges existed for the Public works department and were called ' civil' engineering colleges.

The submission of the Holland Committee report after World War I and the Hill Committee report towards the end of World War II, provide interesting contrasts prove the role of British in stunting Indian science. The former indicates how slowly and grudgingly the British were prepared to go, under consistent nationalistic pressure and the dictates of the war needs, while the later was the blatant attempt to tie up India's science and development as much as possible to its former

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colonizer. In the light of the above, the belief that the British gifted Science to India, which was even held by (Nehru 1951)., as reflected in his autobiography wherein he wrote, "…To the British, we must be grateful for one splendid gift of which they were the bearers, the gift of science and its rich offspring" has to be evaluated with skepticism. This strand of thought also assumes importance in the light of the increased dependence India showed towards Britain in establishing its S&T policy and institutions[3].

1.2.1. Indigenous initiatives in S, T&I during pre-independence

The early S,T initiatives in India, especially during the 19th century, was primarily led by explorers (geographical, botanical and zoological) whose, interests converged with that of the flag and trade (Kumar, 2005). Thus while the scientific survey agencies, did economically useful science, from the point of view of the colonizer, the British education system did provide scope for the emergence of a sporadic but still historically important nationalist initiatives. Borrowing from Macleod (1986), Krishna (1992) contents that, it is these 'national' scientists who struggled to cultivate modern science within the framework of emerging nationalism the national scientists. An organised attempt at incorporating S&T as a major tool of economic development started with the establishment of Indian Association for the Cultivation of Science, in early 1869 and subsequent establishment of various other institutions[4]. The National Planning committee of the Indian National Congress formed in 1939 also emphasized the importance of the scientific outlook and the need for utilization of science in the solution of economic problems (NPC Report, 1939). The high point of increased attention to S&T and I was the Sarkar Committee, which promoted idea of establishing world class technical education, modeled in the lines of MIT, USA, which then laid the foundation for the establishment of the famed Indian Institute of Technology.

1.3. S&T in independent India- 1947- 2005

Independent India, benefited, substantially by the emergence of secular and progressive leadership, and this benefited substantially in the national thrust towards a host of initiatives to promote S,T&I in the country. Pundit Jawaharlal Nehru, the first Prime Minster of India for nearly a decade and a half dominated the Indian policy scene. Hence any attempt at examining the policy scenario, especially S&T policy scenario invariably would be dominated by Nehru[5]. Being a liberal and socialist, he believed in the paramount nature of the state, distrusted business[6], had an abiding concern for the poor, admired soviet style planning, which led to the establishment of Planning Commission, and to its subsequent primacy in the Indian economic development and finally he had full faith in the capability of Science and Technology as a path for development. It also needs to be mentioned here, that but for Pundit Nehru, the majority of Indian political establishment was at best indifferent to science or at worst even anti science (Rehman, 1980). This led to the development of an axis between Pundit Nehru, and a selected group of scientists, and consequent development of Indian science in a particular direction. An examination of the rich and

[3] Indian S&T establishment post independence was modeled on the lines of UK establishment, and British educated scientists, with their British professors, played a substantial role in providing direction to the Indian S&T scenario. The best example of British influence is the CSIR which is modeled exactly in the same lines of its English counterpart.

[4] See, Science in India, First ten years, by Ashok Parthasarathi & Baldev Singh, EPW, Vol, XXVII, No.35, 1992 and , Academic Science in India, by V.V, Krishna, STS Journal, 1994 among others.

[5] For a detailed discussion see, Science in India first ten years by Ashok Parthasarathy & Baldev Singh, Discussion Paper. NMML, New Delhi'

[6] Correspondence between Pundit Nehru and T.T.Krishnamachari, Pvt. Papers, NMML, New Delhi.

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political relevant discourse regarding this period is done by a bevy of scholars, (for instance see Krishna, 1991, Kumar 1995, Babbar, 1996, Osborne and Kumar, 1999).

The Indian economic policy as enunciated by the Nehruvian regime, exhibits three major policy strands. The primary feature is the fiscal and monetary conservatism, a second feature the emphasis on self-reliance, and the third is the distrust of the price mechanism and a preference for administrative solutions, (Joshi and Little, 1994). The last two strands being of importance to the ascendancy of the role of S&T in economic development[7]. Under Nehru, India too embarked upon a journey of freedom with the avowed objectives of, growth, prosperity, economic development and equitable distribution of wealth (Nehru, 1947), by harnessing amongst others the power of S&T, to quote SPR" the key to national prosperity, apart from the sprit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw materials and capital, of which the first is perhaps the most important"(SPR, 1958). This era (1947-64) saw, an impressive build up of institutions, expressed an affirming faith in the capability of S&T to catapult a primitive, predominantly agricultural based, illiterate, nation into an advanced country, developed reasonable production capability, and failed to some extent in terms of addressing the fundamental issues like food security, appropriate technology, technology development etc

The next two (1965-89) decades saw the country ruled again by congress Party, with the prime ministers being Indira Gandhi and later Rajiv Gandhi, barring two occasions lasting about two years, first in 1964 by Lal Bahdur Shastri, and the next in 1977 by Morarji Desai and Charan Singh. With respect to S&T these two decades witnessed the continuous growth the infrastructure, manpower also developed impressively albeit in a skewed top heavy manner, attempts were made to achieve self reliance in certain sectors, the epochal technology focus (Tyabji, 1998) continued, and a muddled but diverse industrial base was achieved. The last part of this period also the first unsure steps of liberalization, partial movement away from controls, and openly increasing dependence on foreign collaboration.

The next decade and a half (1989- till date) saw multiple prime ministers, eight to be precise, but a policy of increased liberalization was followed which culminated in the emergence of an Indian economy well integrated with the global economy, but at its own pace. The tone of liberalization though did not begin with the new economic policy (NEP) of 1991; the NEP was definitely a marker in terms of the decisive shift in the articulated ideological moorings of the state. The NEP, and New Industrial Policy (NIP) that came along side, articulated a new strategy in terms of building of national S&T & I capabilities. In line with the philosophy of leaving to the market, the state assumed that even investments in S,T& I capabilities would be left to market forces. Thus the frist decade of this era, saw reduced investment on infrastructure, and consequently a reduction in the growth of science and technology capabilities, It was only in early 2000s, that in line with international trends in increasing investments in science (coinciding with the pronouncements of the arrival of a knowledge economy), that this trend was revised, and massive investments, along with a slew of incentives came in to being to revitalize civilian S,T& I capabilities. Collectively the nearly 60 years of , and Indian S&T development saw, six industrial policy statements, one technology policy, one scientific policy, two education polices, two intellectual property bills, two competition bills (one MRTP Act, and one Competition bill), and one science and technology polices. While the examination of the impact of these policies would

[7]The role of Self reliance in S&T development is self evident. Interestingly if the price mechanism was allowed to have a free play the state would not need to push or regulate technology. Competition would force players to become technological competent .It is the belief in administrative solution which led the state to even develop science as a fiat science. Which resulted in quantitative terms improved science performance but did not provide any need for linkages between S&T and the productive and social sectors of the economy, other than defense.

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be taken up elsewhere, we will attempt to provide a pen-picture of sectoral interventions in different sectors in the following sections.

1.3.1. S&T interventions – Prestige Science or Big Science

Indian Science and Technology policy has acquitted itself, considerably well, in the big science areas. Be it in the atomic energy, or defense or space, the achievements have been considerable in terms of nuclear weapons capability, weapon systems, indigenously developed Inter continental Ballistic missile systems, GSLV capabilities, super computing capabilities, the list is endless (Gopal Raj, (various years), Memmasi, (2000), Raja Menon (Various years), Chidamabaram (1999), among others. India's atomic energy programme which has so for consumed approximately Rs. 20 billion or 13% of the aggregate R&D expenditure of the country since independence has so far produced approximately 2200 MWe of electricity by 1994 against the promised out put of at least 10,000 Mwe by 1980 itself (Parthasarathi, 2002). But the atomic energy programme acquitted itself by exploding an atomic bomb[8], thereby belying its proclaimed civilian nature. While Chidambaram (1994) would argue that India's atomic programme has come of age, and the efforts are resilient enough to meet any challenges that may arise, Parthasarthi (2001) counters that many of the proposed projects of the Indian atomic energy programme like the 2 billion rupees thermonuclear fusion reactor, or the proposed 500 M We prototype fast breeder reactor at a cost of 30 billion rupees, are wasteful, and the promised energy potential from the atomic sources need to be weighed vis a vis the other sources of energy both conventional and non- conventional. However the defense dimension of Atomic energy programme would enable the programme initiators to by-pass the conventional cost –benefit analysis.

Indian space programme, though began in 1963, a national space programme was formally organized only in 1972. The space programme had well defined objectives of applying space technology to communications, meteorology, and resources management- goals which according to Kasturirangan (1994) have guided the growth and development of Indian space programme. The space programme with nearly 30 billion rupees (or 20% of total R&D expenditure so far) of cumulative investment , has performed by well by vaulting India in to the prestigious club of nations which could launch indigenously developed GSLVs, and is into the marketing of satellite launching facilities. The INSAT range of satellites have revolutionized , communication, education, rural development initiatives, an effective Disaster Warning system, remote sensing and watershed management systems.

The Indian defense R&D completes the prestige research triumvirate defense, space and atomic research. With an investment of over 45 billion rupees (30% of cumulative R&D expenditure) the defense establishment is the single largest consumer of R&D money. It has performed effectively in the missile systems, has launched India into the Inter-Continental Ballistic Missile Club, has developed array based radar systems, a light commercial aircraft, tanks, and ammunition, sonar systems, and the spin offs from defense research to commercial R&D and product development is slowly on the rise. That strategic sector superiority is vital for a nation's survival and independence is an accepted precept now. In his masterly survey of the 'potential and promise' of Indian power, Cohen (2001) offers a balanced appreciation of both economic and military strengths in the making of a major power, posing the question: "Can India develop the technological, logistic, and military capacity to be more than a south Asian power in years to

[8] The relevance of India exploding an atom bomb to the teeming masses of hungry population has been the focus of the rich discourse, by the Indian Peaceniks, namely Arundathi Roy (1999) and many others.

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come?" Herein Cohen focuses far too much on India's military, diplomatic and political capabilities, treating economic capability only cursorily. According to Tyabji (2000) efforts in these areas, have been guided by relatively coherent policies and strong administrative support, and a substantial portion of the investment came from the state. These projects are run in the mission mode, substantially independent, well –knit producer supplier relationship, since both happen to be the state, and in sum have been spectacular successes with occasional failures.

1.3.2. S&T interventions – the social sectors

In contrast to the achievements in the big science, India's performance in the social sector has been far from satisfactory[9]. In terms of overall human development indices, India ranks a lowly 124, in the comity of nations, with nearly 350 million or one third of its population is in abject poverty, one third of the able manpower is unemployed or underemployed, not more than 45% of the population has access to clean drinking water facilities, and after five decades of independence nearly 35% of the population is illiterate. The avowed capability of science to act as a magic wand to remove superstitions, and promote rational thinking as envisaged in the SPR (1958) has been subjected to a crude realty check.

In agriculture though the production has peaked in the last decade, with nearly 60 million tonnes of buffer stock with Food Corporation of India (FCI), as EPW(2002) in its editorial points out , all is not well with the agricultural sector. While food is plenty, hunger deaths continue to be a reality. The state has become the biggest hoarder of food grains. Though green revolution was touted as the best example technological diffusion in the country is clearly exhausting itself. Yields are falling even in the nation's primary granary, Punjab. (Parthasarathi, 2001). Rao ((1996) , the famous space scientist reasons that with it population projected to cross $ 1.8 billion by 2050, India needs to double it s agricultural production from the existing 209 tonnes to nearly 450 tonnes per annum. Since the available arable land holdings are getting smaller, the only viable alternative is increased productivity. Such an attempt would call for an integrated approach, with bio-technological inputs, new generic seeds, dry land farming, pest resistant hybrid seeds and appropriate fertilizers, though Shiva (2000) would argue for a more holistic farmer centric approach. State intervention in agriculture must shift from aimless subsidization of all inputs to massive investment in research and development and extension, rural roads, rural power and support for the development of an agro-processing industry. Crop diversification and integration of value addition chains into mainstream crop husbandry are required to wean the rich farmers of north-west India away from state subsidy EPW (2002). The state spends nearly 11% of its total R&D expenditure on agricultural research and majority of it is spend through the Indian Agricultural Research Institutes (IARI) network. Private sector in the country accounts, according to one estimate, for only 15 per cent of the total research expenditure. The private sector plays a considerably larger role in other countries, notably in developed countries. The major part of agricultural research in the US, Japan, UK and Germany is, according to some estimates, accounted for by the private sector (Pal and Joshi, 1999). The basis for, and the manner in which, research priorities are decided; fragmentation of research by discipline and the neglect of coordinated multi-disciplinary research; weak interaction between researchers and extension workers; excessive centralization of planning and monitoring of research; the absence of a systematic assessment of the performance of research station recommendations on farmers' fields

[9] See Sharma, (1972), Bagchi, (1980), Rahman, (1980), Bhatt (1982), Govindharajalu, (1990), Solomon (1995), Parthasarathy, (2001), among many others.

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and feeding the results back into the research design; and the personnel policy of ICAR are among the weaknesses of internal organization which have attracted comment. There is no systematic and comprehensive compilation of innovations in spheres other than breeding, nor an objective evaluation of their efficacy and impact. Vaidyanathan (2000).

Health is another major sector where India has a mixed bag of results. In terms of the growth in infrastructure, the state has performed reasonably well. But in terms of providing health services India's performance has not at all been satisfactory. While the illogic of allocations in the health budget has been a long-standing feature, the decreasing quantum of increase in health allocation is itself a matter of concern. And as the government's own data show, it is the least developed regions which lack the minimum services which the state ought to be committed to providing to the people. But what is worrying the withdrawal of the state from its commitment to provide health care facilities for all. (EPW, 1999). Significantly, in most developed countries, the US, Canada and Britain of course, the state plays a vital and emphatic role in regulating the Medicare industry. It is this that has made quality Medicare accessible, though not as easily as necessary, to those in the lower economic strata even in the context of spiraling Medicare costs. In India, to begin with the state excluded in its planning process the private health care sector. This neglect has produced a scenario, now much written about, of a huge and largely unregulated private sector and a small, inefficient and insufficiently funded public sector in health care. Such has been the blind spot that most states have either never passed legislation separately governing Medicare institutions, or have not bothered to frame rules to apply the law. Clearly and inevitably, the Medicare industry will become formally linked to the growing international trade in services. Having acknowledged this, it is imperative that the state has to give careful thought to ensuring that a vital service like good, state-of-the-art Medicare remains accessible to those who need it within the country.

India, presents an interesting case, primarily because, it is attempting to achieve a triple transformation (Panagria, 2007), political, economic and social simultaneously, especially within a democratic political regime. Underlying the changing face of India's development story is its acknowledged capability in science, technology and innovation (S,T &I). The Indian nuclear, space, and missile segments are reasonably well advanced, the country has diverse and in some cases world class production structures especially in automobile, Information technology, communications and pharmaceuticals. In each of these sectors, the country's innovative capabilities are well acknowledged and respected. Even in the social sector, the country has leveraged its wide S&T capabilities to serve the needs of the poor. On the other hand, the country continues to have nearly 30% of its population in poverty, nearly 36% of them are illiterate and its rural connectivity is abysmal. The objective of this paper is to trace out the contours of the nation's innovation system, broadly defined, identify, crucial challenges that the system faces, and provide a setting for the sectoral issues, that would be examined subsequently in independent papers.

The paper mobilizes the national system of innovation and development framework as a conceptual tool to examine the evolution of the India's innovation system, its present status and highlight the issues to be taken up for detailed analysis. The present study intends to go beyond the narrow focus of examining the R&D and S&T institutions and organisations, informed by explicit policy pronouncement (Nelson, 1993, Oxley, 1995), to adopt a broader perspective[10], and attempt to argue that a broader set of institutions such as macro-economic policies, trade and investment policies, the policies relating to financial system and labour market among others play a significant role in the evolution of India's innovation system. Such a broad perspective, it is expected, would help locate certain unique characteristics of the national innovation system in a developing country like India and thus would contribute significantly to conceptualise innovation

[10] For a detailed discussion see Freeman (2002) Lundvall (2007) Cassialato (2006) amongst others.

system from a southern perspective. Innovation systems being a post-facto analytical approach informed by historical perspective, the paper would attempt to situate the uniqueness of India's innovation system (IIS) in its unique colonial origins[11] as well as the subsequent rich and diverse debates about the nature and direction of development to be undertaken. The paper would attempt to highlight the dichotomies that characterise the IIS, especially the implications of the fact that the state played a dominate role in shaping and directing its evolution at least for the first five decades of its existence by an extensive and intricate policy regime. The industrial structure of the country, with dominant public sector empires on hand co-existing until recently at least with a substantially large and diverse(at lease terms of number of units, employment and contribution to industrial production) small scale sector, and its contribution national innovative capability would also be an important issue that the paper would highlight on. An over view of the structure and nature of demand, especially of the social kind, and the unequal distribution of resources and infrastructure that characterise the IIS, and the corresponding levels of inequality it generates is yet another issue we intend examining. The paper will also highlight and analyse the implications of certain new developments in India like the increasing incidence of outward investment by Indian firms and India's growing participation in R&D outsourcing on India's innovation system.

Section 1

1. Sub-System: Production and Innovation

1.1. Size of the economy

With a little more than one trillion US dollar ($1.1) GDP India (measured in nominal terms) is 12th largest economy and second populous country in the world with a billion plus population. Per capita income at nominal exchange rate is estimated at US$ 1,021 keeping India still in the category of low income countries. However, when GDP is estimated at purchasing power parity at market exchange rates then the Indian economy is the fourth largest US $ 3779 billion) after US, China, and Japan. (Human Development Report, 2007-08). Yet we lag very much in the case of per capita GDP calculated according to PPP. The PPP corrected GDP per capita was only US $ 736.00, taking only 132nd position among the world economies. This poor status in per capita GDP is reflected in the case of the general Human Development Index, taking the 128th rank among countries.

[11] While acknowledging the two interface identified by recent scholars (Roy, 2006 for instance) we would firmly situate ourselves with in the nationalist tradition in terms of acknowledging the primarily exploitative nature of the relationship that characterized the colony and the colonizer.

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Table1.1 - Growth of real GNP in India

Period	*Mean Annual Growth Rate (percentages)*
1951–52 to 1959–60	3.58
1960–61 to 1969–70	3.91
1970–71 to 1979–80	3.05
1980–81 to 1989–90	5.65
1990–91 to 1999–00	5.83
1992–93 to 1999–00	6.46
2001–02 to 2005–06[a]	6.82
2006 to 2007	9.2
2001–02 to 2005–06 (2002–03 excluded)	7.55

[a] 2002–03 was a significant drought year and its inclusion raised the standard deviation of the growth rate. If 2002–03 is excluded the average growth for 2001–02 to 2005–06 would have been 7.55% and the standard deviation 1.2.
Source: Jha 2007

The Indian economy had growth at more or less stagnant rates of nearly 3 to 4 percnt during the first three decades of post independence growth. During the last two decades starting from the eighties, the output growth accelerated from the 'Hindu rate of growth' and accelerated gradually to reach at nearly 7 percent growth rate during the period 2001-06. Currently the economy is growing nearly 9 percent rate, one of the world's highest growth rate for real GNP (see table 1).

The observed growth dynamism however has been unequally distributed across different sectors. As is evident from table 2, the in terms of growth rates the highest growth was observed in the service sector followed by the secondary and primary sector. Needless to say such intersectoral variation in growth has had its influence on the emerging structure of the economy.

Table 1.2 - Growth rates: A disaggregated view

	1983 to 1987-88	**1987-88 to 1993-94**	**1993-94 to 1999-00**	**1999-00 to 2004-05**
Primary	1.45	4.80	3.46	1.86
Secondary	5.99	5.49	6.77	6.82
Service	7.62	6.37	8.35	7.65
Total GDP	5.02	5.66	6.55	6.04

1.2. Structure of economic activity

At the time of initiating development planning, India had a traditional agricultural economy with more than 60 percent of the GDP being generated from the primary sector, mainly the agricultural sector. But even during this early stage of economic development in India, a peculiarity of the economic structure was the presence of a relatively large services sector, accounting for nearly 30 percent of the GDP. The secondary sector, during that period, was in a rudimentary stage of development accounting for only about 14 percent of the GDP.

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This tertiarisation process noticed early in the developmental path of India had been on the ascension ever since. This peculiar from of structural change become more pronounced during the period starting from early 1980s. The growth rate of growth of services sector has been the highest among the sectors during the period 1983 to 2004-05 (over 7 to 8 percent throughout the period). On the other hand, the growth of the secondary sector has been lower at 5 to 7 percent, and the growth in the primary sector had almost stagnated, the growth ranging between 1 to 5 percent. The growth in the services sector had thus been crucial in kick-starting the economy from being a stagnant slow growing economy to being a fast growing one.

The growth in the service sector led to a position where more than half of the GDP generation occurred within the services sector. The share of services sector in GDP increased from 38.5 percent to 54.5 percent during the period 1983 to 2004-05 (see table 2). However during the same period the sectoral contribution of secondary sector has remained almost stagnant, recording a marginal increase of sectoral contribution from 23 percent to 25 percent. Correspondingly the share of the primary sector declined from 39 percent to 21 percent. Within the secondary sector, the manufacturing sector remained at a small share of only around 15 to 16 percent throughout the period. While in the service sector all the sub-sectors recorded a substantial share in their contribution to GDP. The largest rise in the shares was in trade, hotels and restaurants, and finance and business services.

Table 1.3 - Sectoral shares of GDP at constant prices (1993-94 prices)

	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06
1 agriculture, forestry & fishing	36.8	33.8	30.3	26.3	22.9	18.8
2 mining & quarrying	2.1	2.3	2.7	2.6	2.3	2.1
3 manufacturing	15.2	15.8	16.4	17.7	16.6	16.5
4 electricity, gas & water supply	1.7	2.0	2.3	2.6	2.5	2.3
5 construction	5.7	5.1	5.3	4.8	5.0	5.8
6 trade, hotels & restaurants	12.2	12.7	12.7	14.2	15.1	16.3
7 transport, storage & communication	6.3	6.5	6.5	7.2	8.2	10.9
8 financing, insurance, real estate & business services	7.7	9.2	10.8	12.1	13.2	13.9
9 community, social & personal services	12.5	12.6	13.1	12.6	14.1	13.4
Primary Sector	**38.8**	**36.1**	**33.0**	**28.8**	**25.3**	**21.0**
Secondary Sector	**22.6**	**22.9**	**23.9**	**25.1**	**24.1**	**24.6**
Tertiary Sector	**38.5**	**41.1**	**43.1**	**46.1**	**50.6**	**54.5**
10 total	100	100	100	100	100	100

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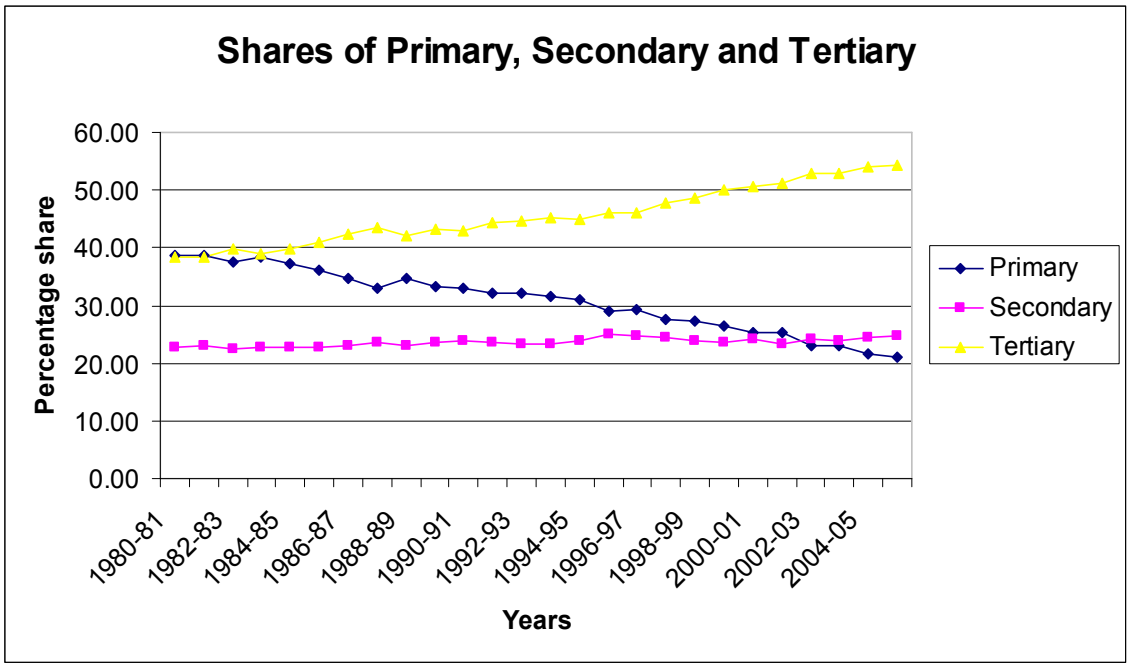
Update the table



Such a service oriented growth goes against the conventional theories of structural change put forward by Fisher (1935, 1939) and Clark (1940) and others, wherein service sector growth is associated with the maturity of the economy and preceded by the growth of primary and secondary sectors. The unique experience of service oriented shift, bypassing the manufacturing sector in India has also questioned the Kaldorian hypothesis (Kaldor 1966,1967) projecting manufacturing sector as the engine of growth, and the growth of service sector as essentially driven by intermediate services demand from the goods producing sector and final services demand by worker/consumers of the industrial/urban centres .

The unconventional service oriented growth in India, without strong inter-linkages with the goods producing sector poses a new concern on the paths of economic growth. An oft-repeated angst of the thinkers on Indian economy had been the sources of this services growth and its sustainability. Gordon and Gupta (2004) estimated the contribution of the various sources of services sector growth in India in recent years. They concluded that while demand side arguments like splintering of services, as proposed by Bhagwati (1984) and elasticity of final services demand had generally contributed to the growth of service growth, in the recent years the main contributors to services sector growth was from foreign demand and deregulation of government monopoly on a number of services.

This nature of dynamism of the service sector, it has been argued, offers a fresh set of opportunities for growth of the Indian economy. The possibility of trade in services, which was considered a non-tradable economic activity till recently provides a new opportunity for India. It is all the more so, given that services sector is labour intensive. (As we will see in the forthcoming section, the service sector has not led to a corresponding increase in the growth of employment, instead a jobless growth has been the observed trend) The demand for the service export is mainly in the form of labour services, Information Technology exports and Information technology enabled services. The new technological possibilities of services outsourcing in a number of services such as the legal services, medical transcription, and insurance services, all provide greater

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opportunities of service led growth without having to depend on the demand to arise from the inter-linkages with urban/manufacturing sector.

1.3. Regional disparities in the production structure

The acceleration in the growth of the economy however has not been uniform across regions. The initial decades of the planning era, more specifically the period till mid 1970s, witnessed a convergence in regional growth patterns leading to a considerable reduction in regional disparities. However, the surge in the growth in the early nineties also coincided with widening regional disparities. The range of SDP growth rates in the eighties was between 3.9 and 7.1 percent. But in the nineties the range widened to be between 2.5 and 7.2 percent. The measure of inter state inequality of SDP growth rate, coefficient of variation had been 14 percent in the eighties, but almost doubled to a level of 29 percent in the nineties.

Table 1. 4 - Growth rate of SDP at constant prices

States	1980-90	1990-2000	1980-2000
Andhra Pradesh	4.81	5.12	5.05
Assam	3.91	2.47	3.49
Bihar	5.20	3.46	3.85
Goa	5.71	8.23	7.47
Gujarat	5.71	8.28	6.80
Haryana	6.68	6.71	7.80
Himachal Pradesh	6.10	6.91	6.20
Karnataka	6.10	7.07	6.53
Kerala	4.50	6.00	5.97
Madhya Pradesh	5.18	5.45	5.89
Maharashtra	5.98	6.80	6.30
Orissa	5.85	3.60	3.90
Punjab	5.14	4.63	4.70
Rajasthan	7.17	6.46	6.95
Tamil Nadu	6.35	6.65	6.51
Uttar Pradesh	5.88	4.33	5.15
West Bengal	5.20	7.24	6.11
All-India	5.60	6.03	5.66
Coefficient of variation	0.14	0.29	0.22

Source: Bhatacharya and Shaktivel (2004)

The per capita SDP growth rate also show similar trends as the aggregate trends in SDP. Assam experienced the lowest per capita SDP growth in the eighties at 1.74 percent, while Taml Nadu experienced the highest growth at 4.79 percent. In the nineties Assam continued to have the lowest growth rate with an abysmally low rate of growth of 0.65 percent. The highest growth was in West Bengal and Tamil Nadu at 5.4 percent. Thus, though the average growth rate of Per capita SDP had increased from 3.36 percent in the eighties to 4.07 percent in the nineties there was a divergence in the growth rate of per capita SDP as well. This is expressed in the increase in the coefficient of variation from 22 percent in eighties to 43 percent in the nineties. Thus regardless of

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NSDP or per capita income we find that inter-regional inequality has been increasing over the years.

Table 1.5 - Growth rate of per capita SDP at constant prices

States	1980-90	1990-2000	1980-2000
Andhra Pradesh	2.56	3.62	3.09
Assam	1.74	0.65	1.38
Bihar	2.97	1.86	1.92
Goa	4.08	6.84	6.01
Gujarat	3.62	6.38	4.85
Haryana	4.12	4.42	5.32
Himachal Pradesh	4.36	5.11	4.29
Karnataka	4.00	5.27	4.63
Kerala	3.04	4.78	4.64
Madhya Pradesh	2.74	3.22	3.08
Maharashtra	3.60	5.04	4.83
Orissa	3.96	2.12	2.15
Punjab	3.19	2.71	2.73
Rajasthan	4.41	4.09	4.20
Tamil Nadu	4.79	5.40	5.10
Uttar Pradesh	3.46	1.98	2.92
West Bengal	2.93	5.41	3.99
All-India	3.36	4.07	3.54
Coefficient of variation	0.22	0.43	0.34

Source: Bhatacharya and Shaktivel (2004)

The regional disparity in the growth rate of SDP and especially so in per capita SDP has resulted in widening regional inequality of the levels of per capita SDP. Ahluwalia (2000) estimated of the inter-state gini coefficient of per capita SDP with the assumption that intra-state inequality was zero. His estimates showed that the coefficient was fairly stable up to about 1986-87, but began to increase in the late 1980s and this trend continued through the 1990s. The increase in the gini coefficient from about 0.16 in 1986-87 to 0.23 in 1997-98 is a substantial increase adding credence to the argument of widening inequality in the nineties.

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Table 1.6 - Inter-state inequality: Gini coefficients

1980-81	0.152
1981-82	0.152
1982-83	0.152
1983-84	0.151
1984-85	0.154
1985-86	0.159
1986-87	0.157
1987-88	0.161
1988-89	0.158
1989-90	0.175
1990-91	0.171
1991-92	0.175
1992-93	0.199
1993-94	0.207
1994-95	0.214
1995-96	0.225
1996-97	0.228
1997-98	0.225

Source: Ahluwalia (2000)

The service sector oriented structural change noticed at the national level is by and large reflected at the regional level as well. By the year 2004-05 all major states in India had a bulk of their State Domestic Product contributed from the tertiary sector. The regional disparity in the service sector share had been the lower and declining till 2000-01. The CV in the service sector share declined from 15.5 to 12.4 between 1980-81 and 2000-01 though there has been some increase in the recent years. On the other hand the share of the primary sector was getting increasingly regionally concentrated during the period. The CV for primary sector share increased from 19 percent to 29 percent during the three decades. The regional disparity in the manufacturing sector shares had been more or less stagnant.

The service sector oriented growth of the economy, however, has some notable exceptions. Bihar, one of the poorest States in the country and Punjab, the second richest state in the country have bulk of their SDP coming from the primary sector. For Bihar the primary sector accounted for more than 41 percent and for Punjab it accounted for nearly 39 percent. However, the major difference between the aggregate performances of these two states pertains to the innovation system specific to the agriculture sector in the regions.

Punjab, which had inherited an extensive irrigation system blessed by nature and extended by the colonial rulers, experimented with the 'green revolution', which in essence was a package of productivity enhancing seed technology, institutional changes that generated scale economies, capital intensive agricultural operations, which drove the Punjab economy to become the richest among all the Indian states till recently, when it was over taken by other industrially developed states. However, the time has come for Punjab to reckon with the challenges of the 'green revolution' which has triggered a set of environmental problems owing to over-utilization of fertilizers and overdrawing of ground water.

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Bihar on the other hand, had been one of the poorest states of the country. Misled with the problems of traditional subsistence agriculture, the region is yet to embark on the modern growth project. Even some of the fundamental institutional arrangements required for the initiation of the modern economic growth, such as the rule of law are yet to take roots. Traditional institutions of discrimination that create market rigidities in both product and factor market continue to hold sway keeping this state at a low level of economic development today.

As noted above service oriented structural change had occurred at a pre-mature stage in economic development for India. However this is not entirely true when we look at the regions within the economy. States like Tamil Nadu and Maharashtra had already acquired more than 30 percent of their SDP from the manufacturing sector by early 1980s. The share of their manufacturing sector has since then declined and their relative share of tertiary sector increased, taking them through the traditional structural change argument. Similarly states such as Gujarat, Rajasthan, Karnataka, Himachal Pradesh and Haryana, have been experiencing a rise in their secondary sector share reaching up to at least more than 25 percent of their SDP. Their secondary sector share in SDP had been increasing along with rise in the tertiary sector share, thus again confirming largely to the traditional structural change theories. However, the rest of the states, namely, Andhra Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal had a structural change similar to what was noticed at the national level, namely a shift from the primary to the service sector, bypassing the secondary sector. In fact most of these states have a secondary sector share of less than 20 percent and are stagnant at that level.

In fact some of the poorest states in India like Assam, Bihar, Madhya Pradesh, Orissa and Uttar Pradesh, still had more than one-third of third SDP coming from primary sector, at the same time these states had more than 40 percent of their SDP generated from the service sector as well, relegating the manufacturing sector to the background.

Table 1.7 - Sectoral distribution SDP across different states

	Primary				Secondary				Tertiary			
Year	1980-81	1990-91	2000-01	2004-05	1980-81	1990-91	2000-01	2004-05	1980-81	1990-91	2000-01	2004-05
Andhra Pradesh	50.7	38.4	33.1	28.3	14.4	19.8	18.9	20.1	34.9	41.8	48	51.6
Assam	56.6	53.2	42.4	36.9	13.9	13.8	13.1	13.6	29.5	33	44.4	49.5
Bihar	62.6	54.3	44.7	41.3	14	19.2	16.2	19.2	23.4	26.5	39	39.6
Gujarat	51.1	49.5	18.3	20.1	21.6	22.3	33.7	34.7	27.3	28.2	48	45.3
Haryana	55.8	47	33	28.1	17.8	22.2	25.4	25	26.3	30.8	41.6	47
Himachal Pradesh	52.2	42.7	24.8	24	17.2	21.2	33.5	34.9	30.6	36.1	41.7	41.1
Karnataka	48	36.6	32.3	20.3	20.1	23.3	22.1	25	31.9	40.2	45.6	54.7
Kerala	42.2	38.9	20.2	16.6	24.1	23.7	20.7	18.7	33.7	37.3	59.2	64.7
Madhya Pradesh	53.8	46.7	31.3	34.2	20.1	22.7	25.3	24	26.1	30.6	43.3	41.9
Maharashtra	30.1	24.3	17.7	12.8	33.4	33.4	25.8	25.8	36.6	42.3	56.5	61.4
Orissa	55.4	43.4	39	38.6	17	21.1	14.6	15.1	27.6	35.5	46.4	46.3
Punjab	47.5	46.9	42	38.7	15.5	19.1	21.4	21.5	37	34	36.7	39.9
Rajasthan	54.4	50.8	28.2	29.4	16.3	16.8	26.2	25.7	29.3	32.5	45.5	44.9
Tamil Nadu	26	23.5	28.2	29.4	33.1	32.7	26.2	25.7	40.9	43.8	45.5	44.9
Uttar Pradesh	51.6	42.5	39.2	35.3	16.4	21.1	19.2	20.1	32	36.4	41.6	44.6
West Bengal	36.6	35	28.7	24.2	24.2	22.5	20.5	18.7	39.2	42.5	50.8	57.2
CV	19.93	20.91	26.63	28.75	29.69	21.59	25.22	25.06	15.49	14.47	12.41	15.17

Source: National Accounts Statistics

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2. Structure of employment

2.1. Unemployment in India

The planners were of the view that with an envisaged GDP growth of 5 percent per annum during the initial five years plans along with an anticipated labour force growth rate of 2 percent, the unemployment could be kept under control. These expectations continued throughout the 1950s and 1960s. However contrary to expectations, the GDP growth rate lagged behind the expectations (around 3.5%) and the labour force growth exceeded (2.5 percent) leading to an increase in the rate of unemployment in the economy. Magnitude of unemployment almost doubled during 1956 to1972, from around 5 to 10 million and unemployment rate from 2.6 to 3.8 per cent (Papola, 1992).

The National Sample Survey Organisation started publishing detailed reports on the employment-unemployment situation in India since 1973. This essentially opened up the issues pertaining to different and new dimensions of unemployment and underemployment and also the changing dimensions. The male open unemployment per 1000 workers in the rural economy measured as Usual Principal Status measure had been more or less constant during the period 1972-73 to 2004-05 at approximately 2.1 percent, with the exception in the period 1987-88 when it climbed to 2.8 percent. The rise in the open unemployment rates in this period is attributed to the large scale drought and famine that stuck most rural parts of the country in this year. As can be seen the open unemployment rate in the rural areas had been comparable to the developed economies. However, what is worrying is the fact that Current Daily Status (CDS) unemployment rates, a measure of the underemployment rates in the economy has been much higher than the open unemployment rates, indicating the severity of disguised unemployment in the economy. The underemployment rates for rural males measured as CDS declined from a high of 7.1 percent to 4.6 percent in 1987-88, but showed an upward trend since then to reach 8 per cent, the highest ever recorded underemployment rates, for rural males since 1972-73. Such a rising trend in underemployment trend is visible in case of females as well. For females the CDS unemployment relates increased from the low point of 5.6 percent in the 1998-09 ? (**50th round)** to 8.7 percent in 2004-05. The rise in underemployment rates in the rural sector is associated with the widespread stagnation of the agrarian sector and the ensuing decline in rural employment opportunities.

The urban open unemployment rates are substantially higher than in the rural areas, accounting for the influx of migrants in search of employment from the rural areas. As can be seen from **table** the male open unemployment rates have declined from 6.1 percent in 1987-88 to 4.4 percent in 2004-05, while that of females increased to 9.1 percent.

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Table 1.8 - Unemployment per 1000 in labour force

		male		female	
Rural					
		UPS	CDS	UPS	CDS
61st	(2004-05)	21	80	31	87
55th	(1999-00)	21	72	15	70
50th	(1993-94)	20	56	13	56
43rd	(1987-88)	28	46	35	67
38th	1983	21	75	14	90
32nd	(1977-78)	22	71	55	92
27th	(1972-73)	-	68	-	112
urban					
61st	(2004-05)	44	75	91	116
55th	(1999-00)	48	73	71	94
50th	(1993-94)	54	67	83	104
43rd	(1987-88)	61	88	85	120
38th	1983	59	92	69	110
32nd	(1977-78)	65	94	178	145
27th	(1972-73)	-	80	-	137

Source: NSSO Employment unemployment Survey 2004-05

Level of education is found to be positively related to open unemployment in India **(see table 1.9)**. Higher the level of education, higher the level of unemployment. At levels of no literacy the unemployment rates are very low, in all categories, rural, urban male, and female. The peculiar pattern of unemployment expresses the lack of demand for skilled labour in the economy, where the general level of productive activity requires less skilled, highly labour intensive technology. The trends in the unemployment rates in the recent period from 1993-94 to 2004-05 however, shows that though the levels of demand for skilled labour is low in India , there is a rising trend in the demand for semi skilled and skilled labour in the economy. The unemployment rates among educated labour force had experienced a decline among male workers in both rural and urban areas. However educated unemployment among females tended to increase in the latter period 1999-00 to 2004-05. Thus the rising demand for skilled workers is segregated in nature, the increasing skill demand being mostly concentrated among males.

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Table 1.9 - Level of education and unemployment (per 1000 in labour force)

	1993-94	1999-2000	2004-05	1993-94	1999-2000	2004-05
URBAN	**Male**			**Female**		
not literate	11	14	12	4	6	8
Literate primary	25	30	23	45	25	41
Middle	57	56	49	157	111	121
Secondary	63	55	49	200	144	181
higher secondary	85	83	51	222	189	189
graduate& above	64	66	64	206	163	196
Secondary & above	69	66	60	206	163	194
RURAL						
not literate	3	4	4	2	2	7
Literate primary	8	11	13	10	9	24
Middle	30	28	24	53	47	59
Secondary	67	52	44	199	147	150
higher secondary	98	73	62	291	227	259
graduate& above	132	106	80	346	331	344
Secondary & above	88	68	59	249	204	231

Source: NSSO Employment unemployment Survey 2004-05

2.2. Employment: Growth and structural change

Employment growth rate in India had been very slow both in the eighties and the nineties. The total employment growth during the decade 1983 to 1993-94 was only 1.71 percent, which further declined to 1.45 percent during 1994-2000. The period 1994-2000 thus experienced a phase of 'jobless growth' in the economy indicating that the innovation system that facilitated growth dynamism of the economy has been inimical to the resource endowment of the economy. This decline in the employment growth during a period immediately following the dramatic policy shifts toward opening up and liberalization of the economy has attracted much academic attention and debate. The stagnation in employment growth, is arguably, a fall out of the trade liberalization and investment liberalization; and privatization of public enterprises. However, in the later period 1999-00 to 2004-05 the employment growth has shown a reversal in trend and it grew at the rate of 2.7 percent The employment growth in the rural areas had been much lower than that of the urban areas throughout the periods. Even when there is a decline in employment growth rate in the period 1994-2000 the rural urban difference in employment growth remains same. Moreover, the employment growth in the urban areas is mainly fuelled by surge in the employment growth of the female workers, especially in the recent past. The total female employment growth in the period 1999-00 to 2004-05 was 3.78 percent, much higher than the male employment growth. This 'feminization of work' is again arguably the fallout of opening up of the economy. The feminization of workforce is associated with the demand for cheap 'disciplined' labour, in the unorganized sectors of the economy in the wake of trade liberalization and rise of the service sector based economy , coupled with changes in the household attitudes.

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Table 1.10 - Employment growth: Usual (principal and subsidiary) status

	Annual Rate of Growth		
	1983-1994	1994-2000	2000-05
Rural males	1.58	1.33	1.79
Rural females	1.09	0.51	3.36
Rural persons	1.41	1.04	2.34
Urban males	2.82	3.10	3.26
Urban females	3.06	1.75	6.03
Urban persons	2.87	2.83	3.82
Total males	1.89	1.80	2.21
Total females	1.34	0.69	3.78
Total persons	1.71	1.45	2.70

Source: NSSO Employment unemployment Survey 2004-05

As in most developing economies the main type of employment in India is self employed. Both in the rural and urban areas more than half of male workers are engaged in self employment. Among females also nearly half of the workers are engaged in self employment. For males the next largest share of workers are engaged in casual type of employment. Nearly a third of the total employment is engaged in casual work. Casual employment represents that of employment characterized by low and flexible wage rates, impermanence of employment and vulnerable conditions of work. Regular employment, viewed from the labourer, as the least insecure type of employment is enjoyed by only a marginal share of workers in the total employment. For rural males they represented only 9 percent of total employment while in the urban areas they accounted for less than 4 percent of the total employment. However for females regular employment forms a substantial type, accounting for nearly $2/5^{th}$ of the total employment.

2.3. Casualisation

A worrying fact about the type of employment till recently, had been the unabated rise in casual employment in India. Termed as 'casualisation' of workforce, during the period 1983 to 1999-2000 there was a rapid increase in the share of this most vulnerable type of employment (see table). The stagnation in regular employment opportunities owing to the labour market rigidities attached with the organized employment, especially so after liberalization of the economy, had led to a situation wherein informal forms of employment , especially casual employment is on the rise . A welcome change in the type of employment during the last estimates of NSSO had been a reversal in the casualtisation trend, and a rise in the self employed workers category. In all categories of employment, the share of causal workers had experienced a decline of some magnitude; a corresponding increase in the share of self employed workers was noticed in all categories. It needs further explorations on the type of self employment that has increased, to ascertain on the changes in the quality of employment that has occurred in the recent past.

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Table 1.11 - Type of employment

	Rural			Urban		
	self-employed	Regular	casual	self-employment	regular	casual
males						
(2004-05)	581	90	329	637	37	326
(1999-00)	550	88	362	573	31	396
(1993-94)	577	85	338	586	27	387
(1987-88)	586	100	314	608	37	355
1983	605	103	292	619	28	353
Females						
(2004-05)	448	406	146	477	356	167
(1999-00)	415	417	168	453	333	214
(1993-94)	417	420	163	458	284	258
(1987-88)	417	437	146	471	275	254
1983	409	437	154	458	258	284

Source: NSSO Employment unemployment Survey 2004-05

2.4. Sectoral Distribution

The sectoral composition of workforce is such that, it exhibits the persistence of nature of traditional economy within India. In rural areas more than 66 percent of the male workers were involved in primary sector activities **(see table)**. In the case of females this share was more than 81 percent of the total female workers. For obvious reasons the urban share of primary workers is very low, but in its place is the overwhelming presence of the service sector, rather than the manufacturing sector. This is in defiance of the Lewisian - Ranis Fei system of development, wherein, the urban manufacturing sector was hypothesized to be absorbing the surplus labour in the primary sector. However, in India , the manufacturing sector employment accounts only for one third of the total employment even in the urban sector.

Nevertheless, in the recent past there have been some changes in the sectoral composition of employment, albeit being very slow and very less. The rural share of male workers in the late 1970s was more than 80 percent, which declined in a period of nearly thirty years to 66 percent, while the share of secondary workers increased from 9 percent in 1977-78 to 15.7 percent in 2004-05. For services sector the rise was from 10.7 percent to 18.7 percent. Yet for females the inertia to move from one sector to other had been very slow. During the thirty year period, the shift from agriculture sector had been hardly 5 percent.

For urban male the shift from primary sector to other sectors during this period was to the tune of 4 percent, while for females the shift had been more conspicuous , a decline of more than 10 percent. The resultant increase had been almost completely in the services sector, bypassing the secondary sector.

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Table 1.12 - Sectoral classification of workforce

		Rural		urban	
		Male	**female**	**male**	**female**
Primary Sector	2004-05	662	814	60	147
	1999-00	712	841	65	146
	1993-94	737	847	87	193
	1987-88	739	825	85	218
	1983	772	862	97	255
	1977-78	804	868	102	251
secondary sector	2004-05	157	108	346	303
	1999-00	126	93	330	293
	1993-94	113	91	331	295
	1987-88	113	112	343	324
	1983	102	78	344	307
	1977-78	89	71	338	327
Tertiary sector	2004-05	181	76	595	549
	1999-00	161	67	606	562
	1993-94	148	63	581	510
	1987-88	137	62	566	457
	1983	123	57	551	430
	1977-78	107	61	559	421

Source: NSSO Employment unemployment Survey 2004-05

2.5. Employment Elasticity

One of the major contradictions of the Indian economy lies in here, in the sectoral distribution of employment and income in the country especially after India embarked on the liberlisation project. While the rate of growth of GDP accelerated in the the post-reform period compared to pre-reform period, the total employment growth decelerated during this period, which essentially was primal in naming this type of growth phenomenon as 'jobless growth' in India. The total employment elasticity of output declined from 0.46 in the pre reform period to 0.32 in the post–reform period. During the period 1999-00 to 00-04 the elasticity was 0.42. The employment elasticity in all the sectors however did not record a decline, the exception being the secondary sector, marked by an increase in the employment elasticity from 0.51 to 0.61.

The service which generally has a record of high employment elasticity in other countries has a very poor employment elasticity in India, and this is in comparison to the goods producing sectors as well. To begin with, the employment elasticity of service sector has never been anywhere near unity. The maximum achieved elasticity has been 0.62 during 1987-88 to 93-94. Also, during the post reform period the employment elasticity of the service sector was even less than secondary sector, which traditionally has a high capital intensity and poor labour absorption capacity. The decline in the elasticity has been entirely due to the secular decline in the growth rate of employment along with spiraling growth rate of output in this sector. Thus, this sector quite clearly shows trends in increasing labour displacing technology and capital propelling the growth

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of this sector. This is especially true in the case of the growth of communication technology wherein the transition from analog to digital technology has displaced many workers in diverse areas. Strangely enough, as we move towards the last period the elasticity for service sector turns out to be even lower than the primary sector. This brings out the poor employment absorption capacity of the peculiar service sector growth that India is going through.

Table 1.13 - Estimates of employment elasticity

	1983 to 1993-94*	1993-94to 2004-05**	1983 to 1987-88	1987-88 to 93-94	1993-94 to 99-00	1999-00 to 2004-05
Primary	0.54	0.29	0.79	0.48	0.19	0.52
Secondary	0.51	0.61	0.88	0.25	0.42	0.84
Service	0.60	0.43	0.58	0.62	0.37	0.51
Total	0.46	0.32	0.48	0.45	0.24	0.42
Trade, commerce, restaurant etc	0.71	0.62	0.82	0.63	0.70	0.50
Transport, storage, communication etc	0.73	0.50	0.84	0.64	0.62	0.40
Other Services	0.53	0.18	0.40	0.63	-0.07	0.56
Note: * Pre-reform period and ** Post-reform period.						

Source: Joy, Minnu Rose (2008) unpublished Mphil dissertation , CDS Kerala ,India

2.6. The Informal Sector

The traditional models of theories of economic duality in developing economies had theorised the presence of an informal and formal economy, co-existing , of which the informal economy gradually disappears as the economy develops and gain maturity. However, the case in India had been quite contrary to expectations. Not only that India has a very large share of its economy being informal in nature, but also this expanding at the cost of the formal segment of the economy. Analytically, the informal economy consists of two segments, the informal sector, and the informal employment. Though they both have a large intersecting region, they are not coterminous. For instance, there could be regular workers appointed in a very small unregistered firm, or there could be contractual vulnerable type of employment in the organised sector. In India.

The National Commission for Enterprises in the Unorganised Sector had estimated the composition of employment in formal and informal forms of employment in India. OF the total employment in the agricultural sector 99 percent of the employment was in the un organised sector, and 80 percent of all employment in the non-agricultural employment was in the unorganised sector. Together they account got more than 91 percent of the total employment in the economy, consisting of 363 million workers of a total of 397 million workers. This clearly brings out the large, overwhelming informal and unorganised nature of the employment scenario in India.

Table 1.14 - Estimates of workers in formal and informal employment

	Rural			**Urban**			**Combined**		
Category	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
% unor.anised agriculture employment in total agriculture employment	98.7	99.2	98.9	97.0	97.9	97.4	98.7	99.1	98.8
% unorgansied non-agriculture employment in total non-agriculture employment	84.4	91.4	85.9	74.2	79.2	75.1	78.7	85.2	79.9

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% unorgansied employment in total	94.6	98.0	95.8	75.7	82.5	77.0	89.3	95.6	91.3
Unorganised Employment (in million)	186.14	101.97	288.11	58.34	15.64	73.97	244.47	117.61	362.08
Total Employment (in million)	196.74	104.02	300.75	77.05	18.96	96.01	273.78	122.98	396.76

Source: NCEUS 2006

In terms of the formal and informal sector of the total employment more than 86 percent of th employment was in the informal sector. In the rural areas this share was to the tune of 92 percent and in the urban areas this accounted for 66 percent of the employment.

Table 1.15 - Estimates of workers in the organised and unorganised sectors

	Rural			Urban			Total		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
unorganised Agriculture Sector (% of total agri sector)	97.9	98.1	98.0	97.8	96.7	97.4	97.9	98.0	98.0
unorganised Non-Agriculture Secotr (% of total non-agri sector)	71.7	76.7	72.8	62.7	66.4	63.3	66.6	71.5	67.6
Total Unorganised Sector (% of total employment)	90.4	95.0	92.0	65.0	71.7	66.3	83.3	91.4	85.8
Estimated workers in unorganised sector	**177.86**	**98.78**	**276.64**	**50.08**	**13.6**	**63.68**	**227.94**	**112.38**	**340.32**
Grand Total	196.74	104.02	300.75	77.05	18.96	96.01	273.78	122.98	396.76

Source: NCEUS 2006

Moreover, estimates done by Shaktivel and Joddar (2006) shows that the employment growth in the unorganised sector had been consistently higher than the organised sector, thus expanding the already large informal sector. In all the periods, except during 1993-94 to 2004-05 the employment growth of the unorganised sector was to the tune of approximately 2 percent, while in the organised sector the growth rate was around, 1.25 percent.

Table 1.16 - Growth of employment in the organised and unorganised sector

Year	organized sector	unorganized sector	Total
1983~1987-88	1.25	2.05	1.99
1987-88~1993-94	1.26	2.43	2.34
1983~1993-94	1.26	2.27	2.19
1993-94~1999-00	0.34	1.25	1.19

Shaktivel and Joddar (2006)

2.7. Informal Employment in the Organized Sector

The total persons engaged[12] in the organised manufacturing sector in 1980-81 were 7.7 million. After nearly a quarter of a century, in 2002-03 the total persons engaged increased only to 7.9million, an addition of only 0.2 million in the workforce. Among the total workers, who are production workers in the organized sector there had been a complete stagnation in employment growth. During this period the total employment in production workers had remained more or less stagnant at 6 million. However the composition of employment changed drastically during this

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period. Permanent workers or direct workers, who accounted for more than 88 per cent in the early 80s were reduced to 74 percent by 2003-03, while the share of temporary workers or contract workers , whose employment conditions are very similar to that of informal workers , increased from 12 percent to 26 percent during the same period. Thus there has been a process of informalisation of the formal sector going on in the formal sector s of the economy. The rise in the contractual employment in the organised sector is being attributed to the cost cutting strategies of the formal sector firms, and as a mechanism to overcome the institutional rigidities associated with the labour market to gain international competitiveness in the open economy.

Table 1.17 - Composition of employment in the organized manufacturing sector

	Direct Workers	Work through Contract	Total Workers (In Thousand)
1980-81	-	-	6047
1985-86	87.9	12.1	5819
1990-91	86.5	13.5	6307
1995-96	86.8	13.2	6872
1996-97	83.4	16.6	6385
1997-98	83.5	16.5	6393
1998-99	84.4	15.6	6047
1999-00	80.4	19.6	6070
2000-01	79.7	20.3	5958
2001-02	78.4	21.6	5781
2002-03	77.1	22.9	5982
2003.04	75.4	24.6	6087

Section 2

1. Sub-System: Capacity-building, Research and Technological Services

Capacity for developing and actualizing national innovation process rests on institutions, infrastructure and education. Though policy remains the glue which binds them together, inadequacy in any one of the above constituents invariably results in lopsided evolution of the innovative capabilities. This section would attempt to examine four major factors that contribute to innovation capability building. The first focus area is education, where in a detailed analysis of all the three segments namely, primary, secondary and tertiary education, as well as capability building in vocational education before during and after the actual performance of education.

The SPR noted that India's enormous resource- manpower- becomes an asset in the modern world only when trained and educated. This stand led to substantial investment in establishment of an elaborate system of education conducive for addressing not only the issue of widespread illiteracy but also the growing demand for highly skilled manpower for a growing economy. During the early years greater focus and faster growth, was recorded in the educational system at the lower level. The higher education system also caught up later. The number of engineering colleges and seats, there fore, witnessed a significant increase from 38 and 2940 in 1947 to 138 and 25000 respectively in 1970. The tempo was maintained when it further increased to 171 and 130,000 respectively in 1980. In 1960s the Indian Institutes of Technology (IITs) modeled on the

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lines of Massachusetts Institute of Technology were set up. The number of universities increased from 20 in 1947, to 150 in 1980. The level of enrolment in these universities increased from 0.15 million in 1947 to nearly five million by 1980 indicating an annual growth rate of 7.5 per cent sustained over 35 years. The stock of persons with third level education rose from 0.5 per cent of the population above age of 25 years in 1951 to 2.5 percent in 1981 wherein the total number was 7 million in comparison with 1.5 million in 1950 (IAMR different Years). Thus, going the input measure, significant effort has gone into the building up of human capital for a growing economy. In what follows, we shall explore the system in more detail with a close look at the education system at the lower and higher level.

1.1. Primary and Secondary

Given the high rate of illiteracy prevalent at the time of independence on the one hand and the imperative of skilled manpower to achieve the desired economic transformation with prime role for science and technology, the planners adopted a strategy where both primary education and higher education were promoted with an equal vigor. In the first five year plan the primary and secondary education together accounted for over 88 per cent of the total outlay for education. As we move to second plan the outlay for higher education was as high as 24 per cent (see table). Over the years with increase in the literacy level, however, there has been a steady increase the share of higher education with a corresponding decline in the share of primary education. Increasing public investment in education (from 1.5 per cent of GDP to over 3.7 percent during 1950-51 to 2003-04) and resultant built up of institutions, (number of schools increased from 0.23 million to 1.18 million, general colleges from 370 to 9427, professional collages from 208 to 2751 Universities from 27 to 304), the literacy rate increased from 18.3 per cent in 1950-51 to 64.8 per cent in 2003-04 (female literacy from 8.9 per cent to over 53.7 percent) and India emerged as a major source of skilled manpower and fertile ground for skill intensive industries.

Table 2.1 - Distribution of Plan Expenditure in Education across different plans

Five Year Plan	I	II	III	IV	V	VI	VII	VIII	IX
Primary	71.67	48.78	51.11	41.67	47.06	40.00	50.00	65.63	66.67
Secondary	16.67	26.83	26.67	25.00	23.53	35.00	30.77	25.00	22.92
Higher	11.67	24.39	22.22	33.33	29.41	25.00	19.23	9.38	10.42

Source: Tilak 2004

However, a careful examination of the data till 2000-01 on enrolment for boys and girls at the primary (1-V class) middle (Vi to Viii class) and higher/higher secondary revels that there is much more to be achieved more so in case of girls with un acceptable gender differences. The primary enrolment for girls was has not yet reached 100 per cent. At the middle class level, the enrolment for girls is only a little over 50 per cent and for boys also the observed levels has been 68%. At the higher secondary level the total enrolment is only 33 per cent with 38% for boys and 27% for girls.

Apart from the gender inequality observed at the national level, there is very high regional imbalances that exist today. With respect to the secondary education, the Taskforce for the 11th five year plan using the data for the year 2004-05 noted that Secondary Education suffers from lack of access, low participation, and from equity and quality issues. The All India average of the number of secondary and higher secondary schools per 100 sq. kilometer area is only 4 and several large

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States like Bihar, Uttar Pradesh, Rajasthan Madhya Pradesh, Chhattisgarh and Jharkhand are much below even this low national average. Similarly, the average number of schools per 0.1 million population is as low as 14 with big and populous States such as Bihar, UP, West Bengal, Jharkhand and Chhattisgarh being below this national average. Similarly, the Gross Enrolment Ratio of 39.91% itself is very low as compared to most of the Asian countries which have a Gross Enrolment Ratio of greater than 60%. Large and major States like Bihar, UP, Madhya Pradesh, West Bengal, Orissa, Chhattisgarh and Jharkhand are having lower GER than the national average. As far as equity is concerned, there is a gap between boys and girls, the GER of boys being 44.26% as against 35.05% for girls with a difference of 9.2 percentage points, as on 30.9.2004. The GER for students belonging to SC is 34.55% and that belonging to STs is even lower at 27.68%, the lowest GER being for ST girls at 21.95%.

1.2. Higher and Technical Education

The importance of building an efficient and sufficiently large infrastructure need not be overemphasized when one discusses the constituents of a NSI. As Nelson & Rosenberg (1993) says "The modern industrial research laboratory and the modern research university grew together". The importance of a strong higher education system was identified by Mowery (1993), Keck (1993) among others. In fact, Keck (1993) argues that, foundations of Germen industrial infrastructure were the strong, Humboldt inspired University system and the technical education system named Technische Hochschulen. When it comes to educational infrastructure building, various developing countries have adapted different strategies. Some like China, and Korea focused on achieving full literacy, then went on to develop application skills, and turned their attention towards fundamental, science based research only recently. Whereas countries like India focused on building an impressive higher education infrastructure, initially and focused on skill building and literacy only later.

The basic structure of technical and higher education in India can be well understood from the figure given in fig 2.1. The system is basically a three tier one with each level producing different levels of output. The first includes the premier institutions in the country whose main objective is to produce world-class manpower. Most of these institutes are completely funded by the central government Ministry of human Resource Development. The important institutions in this lists are Indian Institute of Technologies; The second level of higher education institutions come under the university education systems that consists of over 300 universities are there in India. These universities offer programs of both undergraduate and post graduate degrees. The university system in India operates with teaching and research departments of universities as well as the affiliated colleges. These affiliated colleges are of three type viz., government run, government aided and private self financing. The vocational educational system is mostly under the control of the state government with the state boards of technical education being at controlling agency and government, government aided and private polytechnics as the major educational institutions. Along with this an elaborate system has also been evolved to monitor and regulate the activities of various agents involved (see table 2.2).

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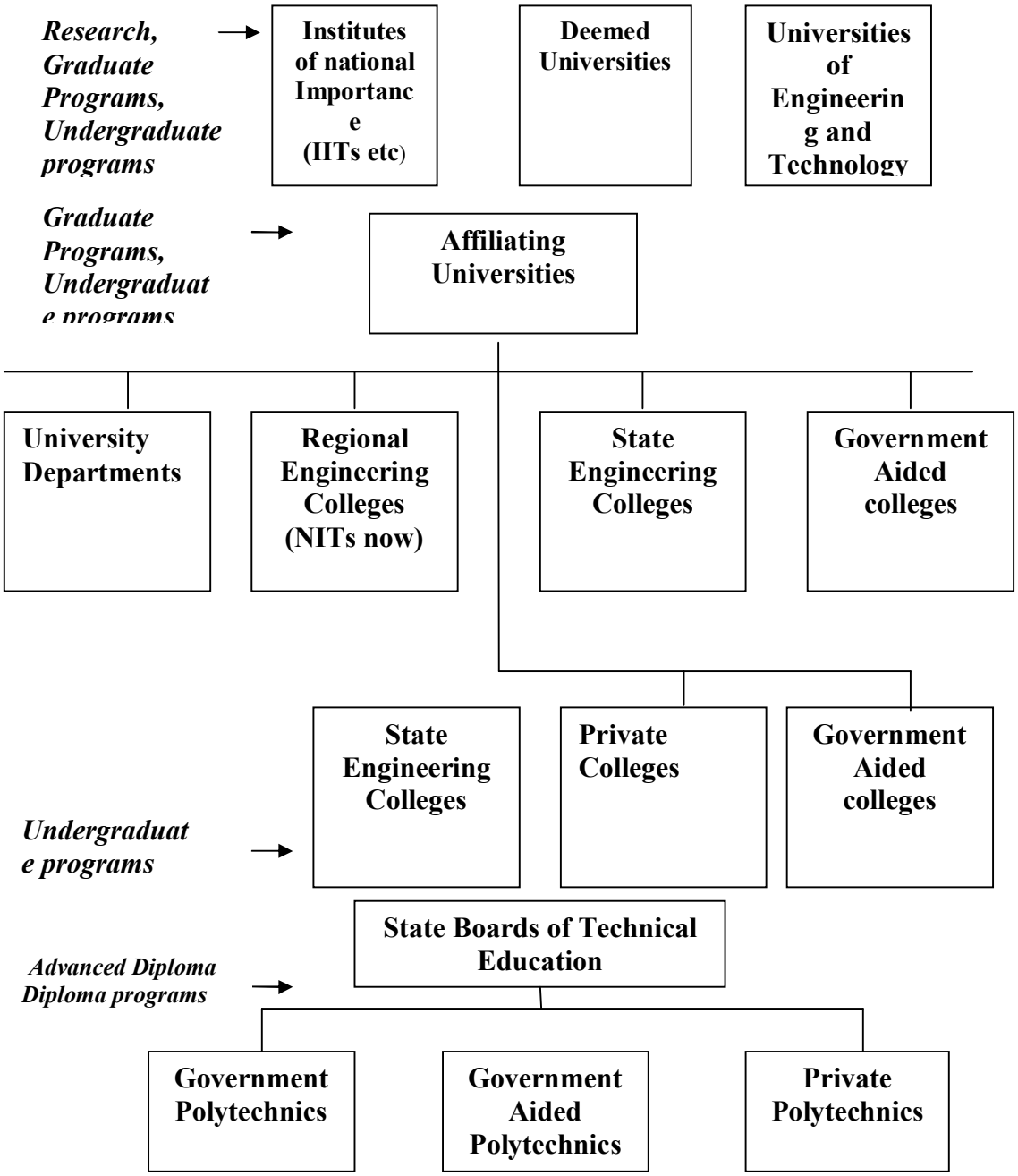
Figure 2.1 - Structure of Technical education in India



Source: World bank (2000)

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Table 2.2 - Regulatory and Statutory Bodies for Higher Education in India

Name	Main role	Overlaps with the role
University Grants Commission (UGC)	Funding, recognition of institutions and degree titles, maintaining overall standards.	Other professional councils and the Distance Education Council (DEC)
Distance Education Council (DEC) under the IGNOU Act	Funding, maintaining standards of open education	Other professional councils and the UGC
All India Council for Technical Education (AICTE)	Approval for technical institutions and limited funding role for quality improvement	UGC, DEC, Pharmacy Council of India, Council of Architecture and the State Councils for Technical Education
Council of Architects (CoA)	Registration of architects and recognition of institutions for education in architecture and town planning	AICTE
Medical Council of India (MCI)	Registration of medical practitioners and recognition of medical institutions and qualifications	State Medical Councils and the State Governments; UGC and DEC to a limited extent
Pharmacy Council of India (PCI)	Registration of pharmacists and approval of pharmacy institutions	AICTE and State Pharmacy Councils
Indian Nursing Council (INC)	Accepts qualifications awarded by universities within and outside India	22 State Nursing Councils with different Acts have registering powers
Dental Council of India (DCI)	Recommend to the Central Government for approval of dental colleges etc.	Ministry of Health
Central Council of Homeopathy (CCH)	Maintain Central Register of Homoeopaths.	State Councils
Central Council of Indian Medicine(CCIM)	Maintain central register.	State Councils
Rehabilitation Council of India (RCI)	Recognition of institutions for physiotherapy and related fields	State governments
National Council for Teacher Education (NCTE)	Recognition of teacher education institutions	DEC
Indian Council for Agricultural Research (ICAR)*	Coordinate and fund agricultural education	UGC
Bar Council of India (BCI)	Listing of Members of Bar	State Bar Councils

* Not a statutory body

The Sarkar Committee (1946) highlighted the inadequacies in manpower supply and recommended the setting up of premier educational institutes in the lines of Massachusetts Institute of Technology. Following this the government established six IITs between the period 1950-1961. The location of these IITs were selected on the basis of the geographical industrial concentration and regional equity. The resources were to be raised through three important channels, Student tuition fees, own revenue of the institute and the state support in the initial year of development.

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Later on two more IITs were created. Over the years IITs have grown substantially in numbers and became the most important supplier of manpower in the country. In the following table we give an idea about the annual turnover from IITs.

Table 2.3 - Profile of Indian Institute of Technologies

	IITBombay		**IITDelhi**		**IITKharagpur**		**IITKanpur**		**IITMadras**	
Established	1958		1961		1950		1959		1959	
Faculty	496		468		439		313		388	
Students	4252		4831		3797		3104		4731	
Departments	11		15		19		15		15	
Centres	7		9		5		4		7	
*	Adm	Deg	Adm	Deg	Adm	Deg	Adm	Deg	Adm	Deg
B.Tech	522	414	503	391	610	336	509	307	511	421
M.Tech	582	433	715	623	501	361	380	365	620	526
PhD	178	83	384	89	245	43	58	61	240	73
M.Sc.	110	111	81	70	62	76	101	69	84	86
Management	55	47	53	55	50	32	47	28	38	40
Others	22	1	39	28	135	64	0	0	0	0
Total	1469	1089	1775	1256	1603	912	1095	830	1493	1146

*Adm = Total Admission in a year, Deg = Number of Degrees Awarded
Source: Chandra 2006.

The manpower outrun from IITs contributes to the cream of skill supply in India. India stands third in the overall quality of engineers and scientists behind Israel and France (Kumar, 2001). A large part of this can be attributed to the quality of education imparted at IITs. IITs are also considered to be one of the toughest institutions in the world to get through admissions.

1.3. Emergence of new players

Till about 1980, the growth of higher education was largely confined to arts, science and commerce wherein the government apart from supporting higher education by the establishment of universities and colleges also financed institutions set up by the private sector through grant-in-aid. In the 1980s inter alia on account of the turnaround in the economy, greater opportunities on account of opening up, there was an unprecedented increase in the demand for higher relevant to the needs of business and industry. Also, there was growing middle class with the ability to pay for higher education[13]. A large number of professional institutions – engineering, medicine, management, teacher education have come up in the private sector over the last 2-3 decades. At present, in the professional stream, nearly 80 per cent of all institutions and enrolments are in the

[13] As per NSS (2003), there has been sharp hike in private spending on education over the last decade or so. The per capita private expenditure on education almost quadrupled from 1.2% in 1983 to 4.4% in 2003. In urban areas, the growth was a strapping 200% from 2.1% in 1983 to 6.3% in 2003. The rural sector showed a high growth of 262% from a mere 0.8% in 1983 to 2.9% in 2003.

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private sector. Many of these private initiatives got degree granting powers either as deemed to be universities or even full-fledged private universities through the state legislatures over the last five years (Agarwal 2006).

During this period, the private institutions proliferated, the distance education programmes gained wider acceptance, the public universities and colleges started self-financing programmes, and foreign institutions started offering programmes either by themselves or in partnership with Indian institutions and the non-university sector grew rapidly. In addition there were a number of foreign players. As per a study conducted by NIEPA, 131 foreign education providers were identified to be operating in India in 2005 enrolling around a few thousand students in the country. The study found that the majority of the foreign education providers offer vocational or technical programmes. These were mainly from the USA or the UK. These were twinning arrangements or programme-based collaborations. There is no major foreign education provider operating in India through its offshore campus or branch campus. Vast majority of students enrolled in programmes offered by foreign providers were financed from personal funding sources. A little more than a quarter also took education loans. The fee levels were usually very high (Bhushan, 2006).

1.4. Growth of enrolment

These initiatives have led to a substantial increase not in the number of institutions but also in the enrolment. The total number of higher education institutions increased from 516 at the time of independence to nearly 18,000 in 2005-06 of which universities increased from 20 to 347 (see table 2.4). More importantly, the enrolment in higher education has increased from 0.2 per cent to 10.5 per cent in 2005-05. While the observed increase in enrolment, mostly occurred since the 1980s, is remarkable, it compares very poorly with the OECD countries (55%).

Table 2.4 - Growth of higher education institutions and enrolment in India

Year	Universities	Colleges	Total HEIs	Enrolment (in million)
1947-48	20	496	516	0.2
1950-51	28	578	606	0.2
1960-61	45	1,819	1,864	0.6
1970-71	93	3,277	3,370	2.0
1980-81	123	4,738	4,861	2.8
1990-91	184	5,748	5,932	4.4
2000-01	266	11,146	11,412	8.8
2005-06	348	17,625	17,973	10.5

Source: University Grants Commission. (Universities include central, state, private and deemed-to-be universities as also institutions of national importance established both by the central and the state legislatures.)

1.5. Trends in outrun

Over the last 50 years there has been substantial increase in the outrun of students from both degree and diploma categories of engineering education. But it needs to be noted that with increased enrolment and private participation there has been a drastic decline in the out turn

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especially for degree holders where it has declined from over 60 per cent in the early 1950s to 37 per cent in 2000. There are also evidence to indicate that the trend continues.

Table 2.5 - Admission and outrun from Engineering discipline 1951-2000

	Degree			Diploma		
	Admission	Outrun	%	Admission	Outrun	%
1951	4788	2893	60.42	6216	2626	42.25
1961	15497	7026	45.34	26525	10349	39.02
1971	18207	18223	100.09	33154	17699	53.38
1981	34835	19012	54.58	61114	35487	58.07
1991	70481	44724	63.46	117835	65325	55.44
2000	197081	74223	37.66	159555	92323	57.86

Source: Compiled from IAMR, Manpower Profile India yearbook various Years

Data constraints limits us from undertaking a time series analysis of the outturn across different disciplines which is also an indication of the changing opportunities on account of the growth of different sectors. However the available data gives us insights into the overall trends across the 1990s. Focusing our analysis to the period after 1990 can be justified on the ground that certain sectors like IT has emerged as leading sector in the 1990s and its implications are to be highlighted.

Table 2.6 - Outrun of engineers: Distribution by major disciplines

Year	Civil	Mechanical	Electrical	Chemical	Electronics and Telecommunication	Production	Others	Total
1990	21.11	22.69	12.08	3.90	12.26	2.20	25.76	100.00
1991	19.04	20.70	12.07	3.88	15.08	2.49	26.75	100.00
1992	18.46	21.61	12.95	3.60	16.59	2.33	24.47	100.00
1996	11.76	18.00	10.82	3.20	24.58	2.83	28.82	100.00
1997	12.17	17.25	10.53	3.47	25.37	2.82	28.39	100.00
1998	12.68	18.59	11.52	3.78	27.34	3.02	23.06	100.00
1999	12.62	19.10	11.50	3.95	18.69	3.01	31.13	100.00
2000	12.58	19.12	11.19	3.91	18.34	2.93	31.93	100.00

Source: Complied from NTMIS, IAMR Manpower Profile India Yearbook (Various Years).

The total outrun of engineers from all the institutions in India has increased substantially during the 1990s. The increase in outrun was substantial in the case of electronics and telecommunication. Substantial increase in outrun has also been witnessed by branches like mechanical and electrical engineering. Civil engineering registered only a modest growth and that their share declined from over 21 per cnet in 1990nto 12.6 percent in 2000. Thus there appears to be an imbalance wherein there is an intense competition between the booming IT sector, driven mostly by world demand, and other sectors for skilled manpower with likely adverse implications on the growth and competitiveness of other sectors (Joseph and Harilal 2001) .

Despite the enrolment in higher education for the country as a whole increasing over the years, it varied widely across different states in India. These differences are not only linked to variation in government expenditure on higher education, but also to the per capita income, percentage of people below poverty line and the extent of urbanisation in different states.

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Generally, states with a higher enrolment in universities and colleges are those with higher ratio of urban population and a lower percentage of population below poverty line. (Anandakrishnan, 2004) (see Tables 2.7).

Table 2.7 - GER in higher education and per capita net SDP
(Various states in India for the year 2002/03)

State/Union Territory	Per capita NSDP at current prices (Rupees)	GER in 2002/03 %
Andhra Pradesh	18,661	9.51
Arunachal Pradesh	15,616	6.37
Assam	11,755	8.67
Bihar	6,015	7.3
Jharkhand	9,955	7.27
Goa	...	13.47
Gujarat	22,047	9.65
Haryana	26,632	10.56
Himachal Pradesh	22,576	12.76
Jammu & Kashmir	...	4.95
Karnataka	18,521	8.12
Kerala	21,853	9.92
Madhya Pradesh	11,438	7.66
Chhattisgarh	11,893	7.77
Maharashtra	26,386	12.3
Manipur	12,230	13.19
Meghalaya	15,983	10.94
Mizoram	...	9.51
Nagaland	...	4.33
Orissa	10,340	8.71
Punjab	25,855	8.53
Rajasthan	12,753	8.77
Sikkim	20,456	6.29
Tamil Nadu	21,433	10.91
Tripura	...	5.84
Uttar Pradesh	10,289	7.03
Uttranchal	...	12.25
West Bengal	18,756	8.21
Chandigarh	52,795	28.68
Delhi	47,477	10.94
Pondicherry	38,162	17.88
CV	56.05	45.13

Source :

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Table 2.8 - Relative expenditure on education by major states

States	Share of population %	Education expenditure as percentage of SGDP %	Per capita expenditure on education *(in Rs.)*	
			Private (2001/02)	Government (2000/01)
Andhra Pradesh	7.4	3.5	368	567
Assam	2.6	9.6	153	778
Bihar	10.7	6.2	168	44
Delhi	1.3	2.0	693	809
Gujarat	4.9	3.7	272	812
Haryana	2.1	3.2	609	737
Karnataka	5.1	4.0	245	674
Kerala	3.1	4.3	434	902
Madhya Pradesh	7.9	7.0	210	838
Maharashtra	9.4	3.5	323	1070
Orissa	3.6	5.4	182	515
Punjab	2.4	3.7	604	845
Rajasthan	5.5	5.0	225	591
Tamil Nadu	6.1	4.1	364	784
Uttar Pradesh	17	3.9	291	387
West Bengal	7.8	3.9	354	1749
All India			299	705

Source:

In terms of the number of researchers and technicians engaged in R & D activities, India has merely 119 researchers, whereas Japan has 5287 and the US has 4484 researchers per million of population. Even in absolute terms, the number of researchers in India is much smaller compared to the US, China, Japan, Russia, and Germany. The number of technicians in India is however not as small. It suggests that R & D establishments in India have more technicians per researcher compared to most of the other countries. The numbers of doctoral degrees awarded in science and engineering in India is a little over 6000 doctorates, compared to 9000 in China and 25000 in the US. It increased rapidly from a little over 1000 in 1990 to over 9000 in recent years in China. In comparison, there has been a modest increase in India. The National Science Foundation (NSF) - Science and Engineering Indicators – 2002 show that in the US, about 4 % of the science and engineering graduates finish their doctorates. This figure is about 7 % for Europe. In India this is not even 0.4 % .

Needless to say, India needs to substantially increase its enrolment at higher education. This has been further underlined by the Government appointed knowledge commission that has evolved a road map based on efficiency, expansion and equity in higher education (Knwledge Commision 2008).

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1.6. Training and Capacity building (Life long learning))

Widespread illiteracy hampers the productivity of the informal sector, despite many programs that serve this sector.7 India is home to more than a third of the world's illiterate population (UNESCO 2004), many of whom are part of the informal sector labor force.Currently literacy programs are active in almost all 600 districts in India (Planning Commission 2006). Programs to combat illiteracy, such as through the Jan Shikshan Sansthan (Institute of People's Education), have helped to reduce it: in 2001–02 almost 1.5 million people received literacy training. India's National Literacy Mission,8 established in 1988, is aiming for 75 percent national literacy by 2007. But the official literacy rate is still low at 62 percent.9 In India this translates to roughly 400 million illiterate people. Some even argue that the 62 percent includes people who are functionally illiterate and can only write their names (*Economist* 2006).

Other programs include the Jan Shikshan Sansthan and National Institute of Open Schooling, which offer opportunities to the informal sector through vocational courses and basic education programs. Programs for the informal sector are also administered by other players, including the Ministry of Rural Areas and Employment, Ministry of Small Scale Industries, Department of Women and Child Development, and Bharatiya Yuva Shakti Trust.

1.7. Technology import, FDI and R&D

During the early years of development planning, with relatively liberal policy towards foreign technology, there was a substantial increase in the number of foreign collaborations. To be more specific, until 1955, the number of foreign collaboration per annum was only of the order of 35. The pace accelerated during the second Five Year Plan with an almost a threefold increase to reach a level of 104. The third Plan period and the period until mid-sixties witnessed further increase in the access to foreign technology as there has been on an average 356 agreements per annum. Thus there was an almost six fold between 1948 /1958 and 1954/1970. The FDI stock more than doubled to Rs 560 Million between 1948 and 1964. Technology related royalty payment jumped sixteen fold between 1956-57 and 1967-68 (Richardson 2002). Thus as noted by Desai (1980), the building of industrial capacity during the early years proceeded almost totally on the basis of import technology.

Yet when we consider the first policy phase as a whole, India was able to achieve considerable progress with respect to the declared objective of reducing technological dependence and building technological self-reliance viewed in terms of the achievement in respect of the capacity created for technology unpackaging in the system (Subrahmanian 1984). There also occurred drastic reduction in the cost of technology imported during the period of restrictive regime. It was also shown that domestic R & D effort increased at an unprecedented rate while the cost of technology import increased at a much lower phase as compared to national R & D The annual average growth rate in R & D expenditure (8.34%) was at a higher rate than the corresponding increase in the direct cost of technology import (7.7) during the seventies. On the whole it has been shown that regulatory policy of the seventies did stimulate in-house R & D especially industrial R & D.

Let us now examine how technology import and local R&D have behaved under the liberal regime. It is evident that the number of foreign collaborations recorded unprecedented increase during the post liberalization period. The number of collaborations during the five years beginning with 1980s was only 686 where as it increased more than threefold to reach level of 2175 during 1996-01 (see fig 2.2) and the available evidence tends to suggest that the trend continues. This

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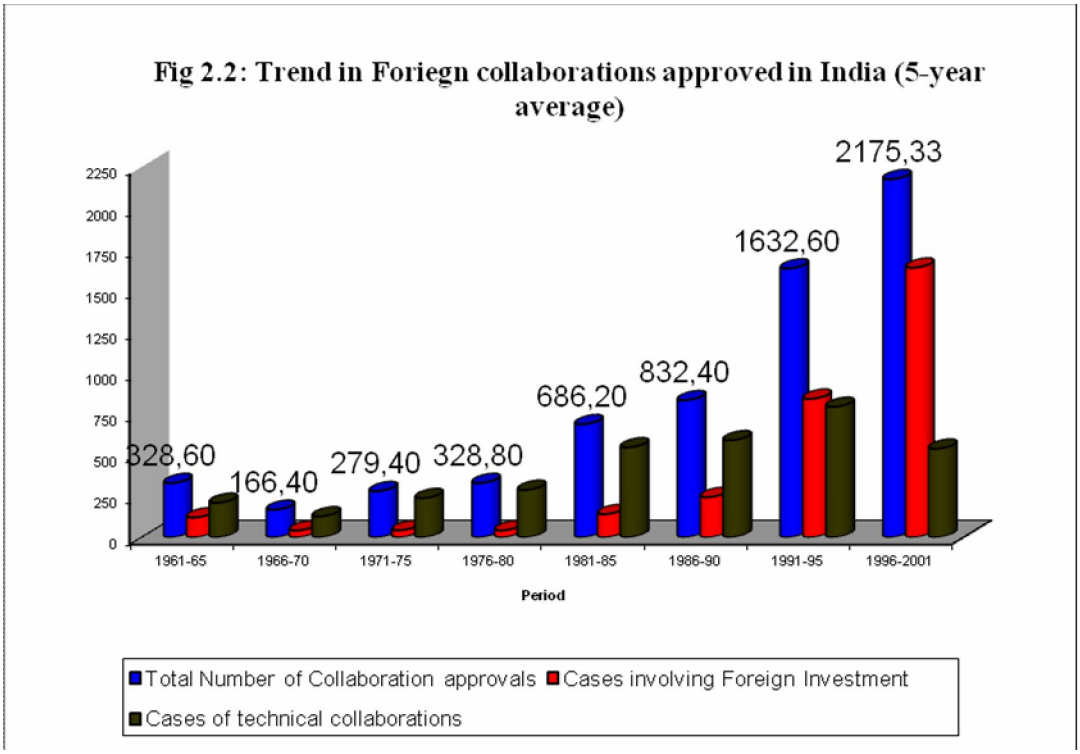
tend to suggest that the strategy of Indian firms, in the event of increasing international competition, is to increasingly depends on foreign firms to build their competitiveness and enhance their access to foreign market.



Source: Department of Scientific and Industrial Research, Foreign Collaborations Ministry of Science and Technology, Government of India.(different Years)

Along with an increase in the dependence on foreign technology, the nature of collaborations also changed. In the earlier period when there was a general disenchantment with foreign capital, the policy was to encourage technical collaborations. In 1960, for example, for every financial collaboration, there were 1.4 technical collaborations and by 1977 it increased to eight. But as the policy became more open towards foreign technology and capital there was steady increase in the number of financial collaborations vis-a vis the technical collaborations and that by 2001 there was only 0.1 technical collaboration for every financial collaboration. Here again there was increasing incidence of cases involving majority equity participation. Also mergers and acquisitions grew at an unprecedented rate during the 1990s, rising from US $ 3.5 million to US $ 1 billion by 2001 (Basant 2000, Beena, 2004, Kumar 2000).

1.8. R&D capacity building

1.8.1. Trends in S&T investments in India

The third issue of consideration is the nature of institutions and organisations that constitute the research and development infrastructure of the country, and their impact and relationship between higher education systems. Finally we shall also highlight trends and patterns in the R&D activities and also major achievements and their limits with a view to provide a realistic picture about the development of these activities and their influence on the productive and innovative

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capabilities, considering the specificities adopted in the sectoral and regional scopes, and in the performance and funding of those activities.

Table 2.9 - Plan wise S&T Expenditure in India

	In Rs. Million		
Five year plan period	Total S&T expenditure	Average per annum	Average Annual Growth rate (%)
1st plan	2000	400	
2nd Plan	6700	1340	235
3rd Plan	14400	2880	115
4th Plan	37300	7500	160
5th Plan	138100	27620	268
6th Plan	366800	74320	169
7th Plan	826400	150700	103
8th Plan	1752900	350580	133
9th Plan	2552900	510580	46
10th Plan			
11th Plan			

Source: R& D Statistics, DST, New Delhi (2002), Pg. 55

The prime indicator of S&T growth in a country is the investment in S&T. Though literature does not explicitly consider (Frascati manual for example) the quantum of investment, analysts do use the quantum of investment as an indicator in terms of national commitment and resources availability. Interestingly Indian investment though is impressive, the cumulative growth rate after reaching a peak during the 5th plan period (268%) has shown signs of petering of, and trend becomes all the more visible as one examines the expenditure as a per cent of GNP (Table 2.10).

Table 2.10 - S&T Expenditure as a % of GNP

Year	S&T Expenditure (In Rs. million)	S&T Expenditure as % of GNP	Annual Growth Rate in %
1958-59	229.3	0.16	
1965-66	683.9	0.27	69
1970-71	1396.4	0.33	22
1975-76	3567.1	0.47	42
1980-81	7605.2	0.58	23
1985-86	20687.8	0.83	43
1987-88	33472.6	0.91	10
1989-90	37257.4	0.86	-5
1994-95	66224.4	0.73	-15
1998-99	129015.4	0.81	11
2001-02	170381.50	0.82	10
2003-04	197269.90	0.79	-13

Sources: R&D Statistics 2004-05 (DST, New Delhi, 2006). Pg.64

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As a percentage of GNP even in absolute terms, India, is few notches below Russian Federation (0.88), Spain (0.90) and even the neighbor Pakistan (0.92), but is way below the developed nations (2.21) R&D Statistics, (2002). But what is of concern even here is that the Annual growth rate is progressively declining, though has shown a positive twist in 1998-99. But if one examines the R&d expenditure as a per cent of GNP during the last two decades it consistently hovers in the range of 0.70% to 0.90%, which is not very encouraging for a country with superpower ambitions.

Table 2.11 - Contribution of expenditure on R&D by Government and Industry

	Percentage Share by			
Year	Central	State	Private	Total
1948-49	100	0	0	100
1950-51	100	0	0	100
1955-56	100	0	0	100
1958-59	95	4	1	100
1965-66	91	5	4	100
1970-71	81	9	10	100
1975-76	81	7	12	100
1980-81	76	8	16	100
1985-86	80	8	12	100
1990-91	77	9	14	100
1994-95	71	9	20	100
1998-99*	82	10	26	100
2000-2001*	67	8	23	100

R*&D Statistics 2000-01 (DST, New Delhi, 2002).(based on pg.69)*

And as one examines the degree share of investment from table 2.11 that communicates an interesting story, wherein the contribution of the federal source, is substantial, though is progressively decreasing. The private sector share has consistently raising form a meager 1 per cent in 1960s to a respectable 23 per cent in 2000. This trend of increasing private sector participation is line with the international scenario; however the phase of growth of private sector participation is substantially low. This picture is contrary to the scenario in the developed world where in the private sector dominates the R&D spending, while the state focuses on education and human capital building. (See Nelson, 1993 for details).

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19. Innovation outputs - Direct and Indirect

1.10.1. Stock of knowledge – trends in publications and patents

Table 2.12 - S&T Periodicals published from India

Year	General Sciences		Agriculture		Chemicals		Engineering		Biologicals	
	No	% change	No	% change	No	% change	No	% change	No	% change
1964	53		138		60		138		45	
1968	76	43	159	15	83	38	192	39	46	2
1976	111	46	308	94	113	36	295	54	89	93
1992	132	19	327	6	137	21	339	15	208	134
1998	296	124	389	19	108	-21	377	11	193	-7
2000	170	-43	333	-14	87	-19	225	-40	412	113

Source: R&D Statistics, DST, New Delhi, 2002,Various years

Scientific publishing is a hallmark of a mature S&T producing and consuming economy. Though publishing by its very nature may not have a direct impact on economic production, the process of knowledge accumulation which publishing generates plays a major role, providing research velocity (Chidambaram, 1999) to a country. Since only aggregate data, on periodicals as a whole is available, an analysis of the nature, quality, and stature of the periodicals may be hard to achieve, but even an examination of the trends in publishing, communicates an across the board, deceleration even in the quantum of scientific periodicals, being published barring Biological sciences, which shows an increase. The reasons for such sudden deceleration are worth examining, but what is of more importance is the quantum of scientific publishing India does, which is examined in Table below.

Table 2.13- Research Papers published from India

Year	Agriculture		Chemicals		Mathematics		Engineering		Biologicals	
	No	% Change	No	% Change	No	% Change	No	% Change	No	% Change
1998	10942		11766		1441		3444		6896	
1991	11014	1	12449	6%	1463	2%	2921	-15%	8131	18%
1995	11515	5	12569	1%	1841	26%	3658	25%	9992	23%
1999	11702	2	13384	6%	1318	-28%	4550	24%	8948	-10%

Even though, research publishing, has shown a consistent raise, in the crucial mathematics sector it shows a substantial decline (28%). One way of explaining such a drastic decline is the increasing focus on patenting rather than publishing in the Indian scientific and technological community. But in terms of world output, it is showing mixed trends with, agriculture's contribution drastically decreasing, mathematics and engineering showing modest increases. But

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this quantum of output has very little meaning, since in terms of scientific citation index, India, has lost its position and is slipping down in the last two decades. Thus there is a definite danger of quality being compromised, in the mad rush for achieving quantity.

1.10. Trends and patters in FDI inflows

As expected increasing incidence of financial collaborations and increased foreign equity participation in a context of removal of the restrictions and joining bandwagon in with more ever new subsidies, there has been an unprecedented increase in the inflow of FDI into the country. During the pre-liberalization period India attracted FDI but the magnitude of FDI was less. But after the 1991 there has been a significant increase. The average annual inflow of FDI increased from $ 79 Million in the 1980 to $ 237 Million in 1990 and by 2007 the total inflow of FDI in India was to the tune of US $ 19156 Million making India the second most favoured destination after China for foreign investment (UNCTAD 2007).

Table 2.14 - FDI inflow to India (in million Dollars)

Year	$ Million	Year	$ Million	Year	$ Million
1980	79	1990	237	2000	2,873
1981	92	1991	144	2001	3,728
1982	72	1992	264	2002	3,791
1983	6	1993	607	2003	2,526
1984	19	1994	992	2004	3,753
1985	106	1995	2,065	2005	4,361
1986	118	1996	2,545	2006	11,119
1987	212	1997	3,621	2007	19,156
1988	91	1998	3,359	2008*	11,875
1989	252	1999	2,421		
Annual Growth rate					
1980-89	21.89	1990-99	92.15	2000-07	70.84

Note: For 2008, the measure is only till March 2008
Source: UNCTAD Data Base, Secretariat of Industrial Assistance , Government of India

The growth rate of FDI in the pre-liberalisation period was at 21.9 percent annually, while in the immediate post liberalisation period the inflow was growing at the rate of more than 92 percent per annum, and in the period 2000-07 it was growing at the rate of nearly 71 percent per annum. Thus with the adoption of liberalized policies there has been a marked change in the growth of FDI inflow into the country.

The remarkable increase in the volume of FDI however is not matching to the size of the Gross Fixed Capital Formation of the economy. During 1999-2000 the average FDI inflow accounted only for 1.9 percent of the GFCF in the country. But after year 2000 the share of FDI in GFCF has sharply increased and reached 8.7 percent by the year 2006 This represented a rise in FDI as a share of Gross Domestic Product from the average 0.5 percent in 1990 to reach 5.7 percent of the GDP.

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Table 2.15 - FDI as a percentage of GFCF and GDP

Indicator	1990-2000	2004	2005	2006
FDI inflow as percentage of Gross Fixed Capital Formation	1.9	3.2	3.6	8.7
	1990	2000	2005	2006
FDI stock as a percentage of GDP	0.5	3.8	5.5	5.7

Source: UNCTAD

The changes in the foreign investment policy in the Indian economy in the 1990s created substantial changes in the sectoral composition of FDI. The deregulation of many sectors, allowing 100 percent automatic approval and the change in equity cap in different sectors like telecommunication, electric generation, transmission and distribution in Power Sector have attracted FDI to these hitherto protected sectors. Thus some of the sectors that received prominence in the post liberalization period were electrical equipments, accounting for nearly 14 percent o the FDI; transportation industry (8.6 %) fuels (8 %) telecommunications (8%) Service Sector (7 %).

Table 2.16 - Sector wise distribution FDI inflow: 1991 to 2005

Sector	***1991-2005***	***Rank***
Chemicals (Other Than Fertilizers)	4.87	7
Consultancy Services	1.76	11
Drugs And Pharmaceuticals	2.64	9
Electricals Equipment (Incl S/W & Elec)	13.71	1
Food Processing Industries	3.05	8
Fuels (Power & Oil Refinery)	7.96	5
Glass	0.86	16
Metallurgical Industries	2.11	10
Miscellaneous Mechanical & Engineering	1.33	12
Paper And Pulp Including Paper Product	1.1	14
Service Sector	6.99	6
Telecommunications	8.01	4
Textiles (Include Dyed, Printed)	0.96	15
Trading	1.26	13
Transportation Industry	8.59	3
Miscellaneous Industries	11.46	2

Source: Secretariat for Industrial Assistance (SIA)

The incentive competition among states for attracting FDI along with, the relative strengths of the states in terms of resource availability, market size and factor costs the FDI investment got concentrated in a few states. For example, Delhi and Maharashtra together accounted for nearly 30 percent of all FDI during 1991 to 2002. The three southern states of Tamil Nadu, Karnataka and Andhra Pradesh together account for another 21 percent and the western state of Gujarat, account for 6.5 percent. The remaining 43 percent of the FDI is thinly spread across the rest of the 29 states

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and centrally administered union territories. On the whole, in a country like India that is more regionally more diverse than most continents, its contribution to the national economic development would depend on regional distribution of FDI. If available evidence is any indication, foreign investment has been getting concentrated into a few regions and thus contributing to the widening of interregional disparities.

Table 2.17 - State-wise distribution of FDI approval: 1991-2002

States	*Percentage Share*
Andhra Pradesh	4.64
Delhi	12.48
Gujarat	6.5
Karnataka	8.31
Madhya Pradesh	3.37
Maharashtra	17.42
Orissa	2.9
Haryana	1.27
Rajasthan	1.06
Tamil Nadu	7.81
Uttar Pradesh	1.72
West Bengal	3.15
Other States	29.34

Source: Secretariat for Industrial Assistance (SIA)

1.10.1 Research and Development

While there was an increased orientation for foreign technology and capital the domestic technology generating effort did not show any marked increase but has taken a back seat. This has been true not only in case of a number of technology intensive industries like electronics (Joseph 1997) but in many other industries and hence at the national level. The R&D effort at the national level has shown a marked increased especially in the first period. But as we move to the second period, there has been steady decline in the R&D effort in terms of R&D.

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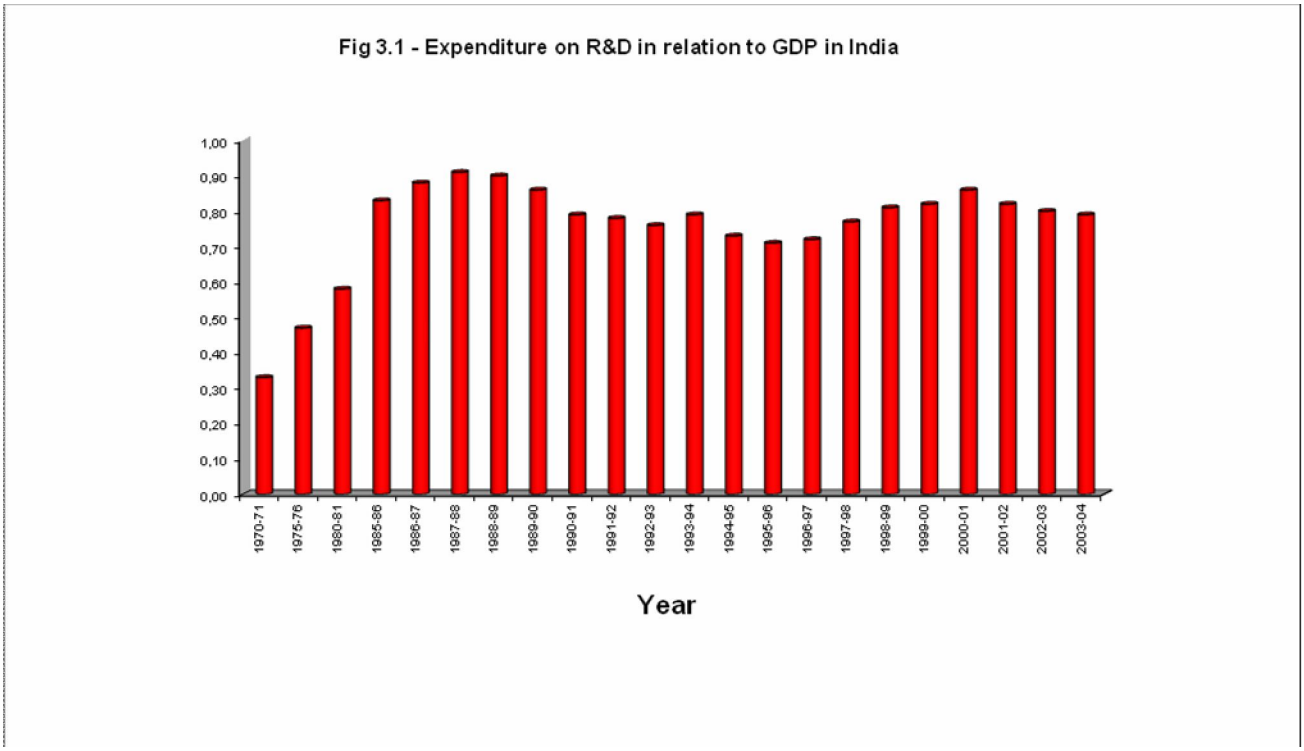

Source: Department of Science and Technology, Science & Technology Data Book 2002, NSTMIS

Expenditure at national level as proportion of GDP (see fig 3). The target for R&D investment set by the latest Science and Technology Policy (STP-2003) by the end of the Tenth Plan, which the current is supposed to implement, is 2 percent of the gross domestic product (GDP). After reaching the high point of 0.91 percent in 1987-88, there was a steady decline to reach 0.71 percent in in mid 1990s. According to the statistics provided by Department of Science and Technology, it slowly picked up in 1998-99 to 0.81 percent and stands today at around the figure of 0.90 percent – still lower than the record 20 years before.

It is evident that even today there is heavy concentration of central R&D expenditure in a few departments like atomic energy, defense and space (see table 3) Civilian R&D priorities continued to be neglected. The annual budget on R&D relating to health, communicable disease control, nutrition and family welfare put together is only around Rs. 3500 million. Compare this figure with the spending of Rs. 25000 million for defence R&D and Rs. 8000 million on atomic energy R&D. R&D in meteorology, an area that is critical to agriculture, irrigation, flood control, drinking water and disaster prediction is only about Rs. 1300 million. Put together even today the outlays for botanical and Zoological surveys (that are responsible for biodiversity assessment and protection in the country) are of order of merely Rs. 300 million. (Abrol 2005).

Along with increasing concentration in terms of certain departments, there has also been increasing regional concentration where in R&D activity is concentrated a select industrially advanced states (Chadha 2006). While a number of policy initiatives including fiscal concession starting with 1996-97 to 2006-07 to encourage the investments in R&D by industry, judging from their impact it can be easily seen that significant change in the growth of private sector R&D activities is yet to occur. While there are empirical evidence to indicate that the share of private sector in industrial R&D has increased from about 41 per cent in 1985 to 61 per cent in 2003-04 (Mani 2008) R&D intensity (R&D Expenditure as per cent of sales turn over) of private sector in India is only about less than 0.1% of their turnover and has shown a declining trend since 1992-92 (Kumar and Aggarwal2005). Thus, as noted by Krishnan (2005) promotional efforts undertaken by

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the government to lure the corporate sector to participate in the development of indigenous technology have been far from effective. What is more, there is heavy concentration of R&D in selected industries. Seven industries (pharmaceutical, transportation, chemicals, electrical and electronics, defence, information technology and telecommunications) account for about 70 per cent of the total industrial R&D and the remaining is shared across 34 other industries. Pharmaceutical industry is the single largest R&D spender accounting for over a quarter of the R&D expenditure followed by the automotive industry.

Table 2.18 - Distribution of Central Government R & D expenditure across different agencies

Year	DAE	DRDO	DoS	CSIR	ICAR	ICMR	Total
1958-59	41	8		27	20	3	100
1969-70	30	21		27	20	2	100
1976-77	24	21	16	17	15	1	100
1980-81	19	20	13	18	17	2	100
1984-85	19	20	16	13	12	2	100
1988-89	14	27	20	10	9	2	100
1994-95	11	32	19	9	11	1	100
1998-99	12	32	21	10	12	1	100

DAE: Department of Atomic Energy, DRDO: Defense Research and Development Organization,
DoS: Department of Space, CSIR: Council for Scientific and Industrial Research,
ICAR: Indian Council for Agricultural Research, ICMR: Indian Council for Medical Research.
Source: Department of Science and Technology, Government of India, R&D Statistics, different Years

Patenting

Patent Act of 1970 has been considered as the most innovative initiative by the state that helped indigenous development of technology. Comprehensive and extensive, the Act was aimed at protecting the nascent domestic industry and was a role model for many developing countries. The new Patent Act abolished product patents in food, chemicals and drugs. It also reduced the life of patent from 14 to five years from the date of sealing of the patent or seven years from date of filing which ever was earlier. The act had many other features to facilitate indigenous development of technology like adoption of process instead of product patenting in the area of chemicals, powerful compulsory licensing provisions, enabling state intervention in pricing of patented products and so on.

In tune with globalization and under the influence of WTO India moved towards a liberal copyright regime. While it is true that the post 1970 period witnessed a decline or stagnation in the number of patents applications and number of patents sealed in India, the mechanism of process patenting led to substantial increase in the adaptive research even by small and medium enterprises and proved especially effective for the development of industries like pharmaceuticals. More importantly, there has been an increasing incidence of patenting by Indians as is evident from the drastic decline in the ratio of patents registered by foreigners vis a vis Indians (see fig 4). It has also been shown that there has been a drastic increase in the number of US patents by Indians after 1990s and the observed increase has been at a higher rate than China (Mani 2008)

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Source: Department of Science and Technology, Government of India, R&D Statistics, different Years

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Section 3

1. Sub-System: Policies, Representation and Financing

1.1. Science, technology and innovation since independence (1947- 2008)

Independent India, benefited, substantially by the emergence of secular and progressive leadership that undertook a host of initiatives to promote S T&I in the country. Pundit Jawaharlal Nehru, the first Prime Minster of India, who remained in office for nearly a decade and a half, dominated the Indian policy scene[14]. Being a liberal and socialist, he believed in the paramount nature of the state, distrusted business[15], had an abiding concern for the poor, admired soviet style planning, which led to the establishment of Planning Commission, and to its subsequent primacy in the Indian economic development and finally he had full faith in the capability of Science and Technology as a key to development[16]. Under Nehru, India embarked upon a journey of freedom with the avowed objectives of, growth, prosperity, economic development and equitable distribution of wealth (Nehru, 1947), by harnessing amongst others the power of S&T. To quote from SPR" the key to national prosperity, apart from the sprit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw materials and capital, of which the first is perhaps the most important"(SPR, 1958).

1.2. Promotion of R&D and pursuit of technological self reliance

The Nehruvian era (1947-64) saw an impressive build up of institutions, with an affirming faith in the capability of S&T to catapult a primitive, predominantly agricultural based, illiterate, nation into an advanced country. The Science Policy Resolution of 1958, notwithstanding its emphasis on big science, underlined the need for pursuing self-reliance in technology when it stated "in industrializing a country heavy price has to be paid in importing science technology and early and large scale development of science and technology in the country could there for greatly reduced the drain on capital". Hence the SPR aimed to "foster, promote, and sustain, by all appropriate means, the cultivation of science and scientific research in all its aspects-pure applied and educational".

The strong belief in the capability of Science and Technology to improve productivity substantially and provide employment in sufficiently large numbers so as to overcome the disadvantage of lack of ownership of means of production, thus led to the industrial policy finally favoring a rapid heavy industry led industrialization strategy. The Industrial Policy Resolution (IPR, 1948) thus explicitly states that, "meager redistribution of existing wealth would make no difference, and a dynamic policy must therefore be directed to continuous increase in production". Thus rapid industrialization was ensconced in the policy, and since the Indian capitalist class, was

[14] For a detailed discussion see, Science in India first ten years by Ashok Parthasarathy & Baldev Singh, Discussion Paper. NMML, New Delhi'

[15] Correspondence between Pundit Nehru and T.T.Krishnamachari, Pvt. Papers, NMML, New Delhi.

[16] It also needs to be mentioned here, that but for Pundit Nehru, the majority of Indian political establishment was at best indifferent to science or at worst even anti science (Rehman, 1980). This led to the development of an axis between Pundit Nehru, and a selected group of scientists, and consequent development of Indian science in a particular direction. An examination of the rich and political relevant discourse regarding this period is done by a bevy of scholars, (for instance see Krishna, 1991, Kumar 1995, Babbar, 1996, Osborne and Kumar, 1999)

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primarily of trading vintage, the state assumed role of the prime mover of industrialization, with the IPR (1948) reserving major sectors of the industry exclusively for the state, and reserving the right "to intervene whenever the progress of the private sector is unsatisfactory" which the state seldom did. The import substitution industrialization strategy, which finally emerged, focused on building large industrial assets, and the strategists believed that, such a big push strategy would compress within a short period the kind of changes that had taken over two centuries to unfold in the developed world, and it was expected that it would bring in prosperity without violently affecting any of the existing power structures. As Swamy (1995) puts it 'the strategy is a sort of local syncretism of Keynes, Prehisch, Soviet Style planning, and the 'spirit of caste'".

The technological underpinning of an import substitution strategy adopted by a technology starved third world country was two –pronged. While dependence on imported technology and capital was accepted, the policy made it clear that, ownership and control as a rule would lie in the Indian hands, there by effectively gaining control, on the technology and its dynamics Statement of Prime Minister (1949). By restricting the entry of foreign capital, the foreign players were forced to sell technology outright or enter into collaborative arrangement with Indian players, there by leading to diffusion of technology. The outcome of such a technology strategy could be examined at the large industrial or capital goods sector, dominated by the public sector and the batch processing industries sector. Based on the sectoral studies by Dhar (1984) on fertilizer, D'Mello (1985) on steel, Khanna (1984) on petrochemicals Taybji (2000) concludes that though they achieved a certain degree of innovational capacity, they are severely constrained by state support and consequently subjected to political vagaries, while as Swamy (1995) would argue that though public sector achieved production capabilities comparable to the developed countries, they were dependent substantially on foreign technological assistance, a view partly shared by Mani (2003) with respect to telecom and Menon (1982) in case of the fertilizer industry.

In case of batch processing sector the phased manufacturing programme was the tool, which the state wielded to assimilate technology especially in the batch-processing sector. The phased manufacturing programme was the key component of the ISI strategy, This as the name suggests was a programme, where in the in a both the foreign firm, and the Indian collaborator, undertake to reduce the import content of products or systems progressively and over a period of time achieve a certain degree of technological competence. At the level of production capability, the programme was a success, and India, by mid 1960s achieved a large range of industrial and consumer goods. But as Bagchi (1975) emphasized the high cost of adaptations in the context of slow and growing potential markets and the prevailing xenophilia among bureaucrats, politicians and scientists, inhibited innovations and local adaptation of imported technology. Such stagnation led to high production cost of goods, and in a dynamic market, these firms and their technologies would have been outpaced be new and nimble competitors with improved technologies, and consequently, new products. Using their clout as Hazari (1967) and Dutt (1969) point out, the industrialists of the day, obtained pre- emptive licenses ,to prevent entry of future competitors. Thus, while the licensing system restricted the private capital onerously in abstract, it was in practice, the linchpin of a profitable, anti-Schumpetiran bargain. With their hoarded licenses, the capitalist of the day, could rest assured that capacity restrictions would prevent Schumpeter's gale of creation destruction from threatening the lucrative rental heaven that the custodial state has bestowed upon them. (Evans, 1992). While the Scientific policy resolution, dutifully acknowledges that' an early development of S&T in the country could greatly reduce the drain on capital during the early and critical stages of industrialization' by reducing the dependency of foreign capital" since no attempt is made in the industrial policy to incorporate achieving technological competence as a critical success factor, the import content of new investment continued to be more than 60% even during the 3rd plan period. (Hazari, 1967) a point reinforced by (Nayar , 1983).

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While the technology competence of the majority of Indian industry to use Tyabji's (2000) words, showed impressive post independence advances in sheer range of products indigenously produced, they have not been able to generate innovation in design, manufacture, ,quality and reliability and cost reduction. In other world, they learned to innovate but not to industrialize. The failure of Indian technology policy and the dichotomy between Indian Science and Indian technology policy becomes distinct in this era. To achieve economic growth, nations need to invest in both science and technology. But the proportion of investment and the outcomes of such an investment is subject to debate. Parthasarathy (1966) opines that, as for as the technical component of economic progress is concerned, it is obliviously not the expenditure on science that is crucial, but rather, the input of know-how in terms of new and relevant technologies. He goes on to criticize the science focus of S&T policy, and according to him technological policies, have to take into consideration, the balance between, high low and intermediate technology and arrive at an optimum ideal for a developing country like India, a tall order indeed.

Rahman A (1964) compared R&D expenditure in select sectors to the number of foreign collaboration agreements by way of import of technologies and concluded that both of them are anti correlated. ParathasarathI (1969) compared the same to Japan and found that in case of Japan they more are perfectly correlated. Thus here is a classic example of the technology strategy, and industrial strategy, operating in blissful isolation, there by providing validity to the criticism, that indigenous corporations are incapable of producing quality products, and domestic R&D is devoid of practical applications. Such a chorus, coupled with, the external influences, led to the replacement of import substituting industrialization with export oriented strategy with increased implication for the technology policy and consequently technology competitiveness.

In case of batch processing industry, the Indian Patent act (1970) played a major role in promoting indigenous technology by way of learning by doing. The patent act was one of the corner stones of India's indigenous technology development initiative. Comprehensive and extensive, the Act was aimed at protecting the nascent domestic industry, and was a role model for many developing countries. In the case of food c pharmaceuticals, pesticides and other agrochemical products, the term of patents was shortened to five years from the date of sealing the patent or seven years from date of filing which ever was earlier. The act had many interesting features, like adaptation of process instead of product patenting, reduction in the number of years of patent protection, powerful compulsory licensing provisions, enabling state intervention in pricing of patented products and so on. The mechanism of process patenting proved very effective for the development of pharmaceuticals, light engineering, industrial components and even chemical process equipment industry.

Though the 1970, Industrial policy attempted to revert back to the nationalistic mode of industrial development, albeit in a socialistic mode, reflected by way of the passing of Manipulative and Restrictive Trade Practices Act (1969) , compulsory industrial licensing, within a span of three years, the policy underwent a sizable shift, instead of evolving into a watch dog for enabling competition, reduce concentration of economic power, and by extension induce technology diffusion, the Act, became yet another toll- gate mechanism showering its implementers with powers to dispense favors (Pranjepae 1991). Having shifted from the ideological moorings, in terms of technological self- reliance, and domestic capacity building, Indian technology policy slowly veered towards foreign capital and technology. As a consequence of the shift in strategy, the nature, and direction of control of foreign capital and there by foreign technology progressively loosened. The Govt. Guidelines (July 1970) thus opened up the market space, for large firms, in sectors other than that reserved for them, if they committed to export more than 60% of their products.

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To achieve technological self-reliance through promoting indigenous development the government, apart from adopting a series of measures to restrict the acquisition of foreign technology, formulated a 'comprehensive science an technology plan' for the first time in India closely integrated with the fifth five year plan of the country. Also, there was a marked increase in the investment in the science and technology. By the end of fifth five year plan an amount of Rs. 13800 million was invested against the out lay of 18500 . This constituted an almost four fold increase in the investment in science and technology as compared to Rs. 3730 million spend in the fourth five year Plan (1969-75). What is more the outlay for R&D during the last year of the plan (1978-79) constituted 0.84 per cent of the GDP against the target of 0.95 percent (Parthasarathi 2007).

A number of specialized laboratories and institutions providing a variety of services relating to science based technologies were set up. Though the history of S&T institutions could be traced to the pre-independence period[17], after independence a separate Ministry of Scientific Research and Cultural Affairs under the Prime Minister was set up - a indication the high priority attached to the development of science and technology in the country. Since then an elaborate scientific and technical infrastructure has been set up over the years under CSIR, ICMR, ICAR and various government departments like Department of Atomic Energy, Department of space, Department of S&T, Defense Research and Development Organization and others. As Patel (1993) observed "the maze of institutions for science and technology is an outstanding testimony to the wide spread of the scientific and technology infrastructure. India has no rival in the whole third world for the vastness of infrastructure and even many among the highly development countries could not be able to rival India in the number and the spread of the institutions" (p 34) These institutions, apart from their wider contribution in the field of their specialization, became the largest source of experienced scientists/technologists for in-house R&D activities in the country (Desai 1980).

Governments in both industrially developed and developing countries have been employing tax incentives and subsidies to support private R & D investment as they are considered as an effective measure to address market failure in private firms' R & D investment decisions by eliminating the wedge between the private and social returns to R & D investments. Government subsidies have taken different forms in different countries. In South Korea for example, (Kim 1993) finds that more than 94 per cent of industrially funded R & D in 1987 was derived from low interest R & D loans from state controlled banks and other public funds. A number of European governments have used targeted R & D subsidies to provide support for R & D in selected areas notably in microelectronics. In Germany, R & D subsidy programmes included defraying a part of the salaries of new R & D employees (Stoneman 1991)

In India also the fiscal incentives offered by the state had an important role. As early as 1974, government started a scheme of recognizing the in-house R & D units of industrial firms. Such units were given easier access to imported equipments, row material and various tax concessions, For example, expenditure incurred on scientific research were 100 percent deductible from profit for the purpose of income tax calculations. The various fiscal incentives provided by the state continued in the 1980s and 1990s notwithstanding major changes in the approach of the government policy towards technology development. The number of such registered units increased from106 in 1973 to over 900 by early 1980s. With respect to Tax incentives a study (Mani 2002), however, finds that its effectiveness varied across different industries. Also the importance of tax incentives for starting R & D as well as for carrying it out varied positively with

[17] The Indian Council of (ICMR) was set up as early as in 1911 followed by the Indian Council of Agricultural Research (ICAR) in 1929 and the Council of Scientific and Industrial Research (CSIR) in 1942.

the R & D intensity of the firms. Firms with foreign collaboration were less motivated in starting R & D by tax incentives.

Apart from fiscal incentives, venture capital, provided mostly at the instance of public sector institutions such as Industrial Development Bank of India, State Industrial Development Bank of India, State Finance Corporations and the Industrial Credit and Investment Corporation of India in the initial years has also been made available. In 1988, the government of India introduced the Venture Capital Guidelines, along with a venture fund of $ 45 million provided by the World Bank[18]. The policy provided a differential tax advantage to venture capital vis-à-vis Capital gains tax of the corporate sector. The policy also stipulated that VC funds could be provided only to new technology areas and the promoters should be relatively new to the field with inadequate funds to meet their project demands.

During the period 1991-99, the Total Capital Under Management (TCUM) of Venture Capital in India had recorded a whopping annual growth rate of 232.9 percent, which was higher than most Asian economies (Mani and Bartzokas, 2002). However only 4 percent of the venture capital industry in Asia was located in India. Mani and Batrzokas (2002) also shows that in India, as in the rest of Asia, much of the VC originated from the western world. In India nearly 50 percent of all VC investment goes into high technology industry, that includes, computer related industries, electronics, information technology and telecommunications.

1.3. Approach to foreign technology

Though the hallmark of S&T policy in India during the first three decades has been considered as technological self-reliance and indigenous development, that in turn implied limited recourse to foreign capital and technology, there has been a significant variation in the intensity with which the above objective was pursued. The policy towards foreign technology and capital was relatively liberal up to mid 1960s as is evident from the industrial policy resolution of 1948 and the statement on foreign investment made by the Prime Minister in Parliament on April 1949. The overall approach until late sixties remained liberal as foreign investment was considered to be a channel of technology transfer but the effective control was expected to be with the local firms keeping in view of national interest.

However the policy towards foreign technology became most stringent from the mid 1960s in the context of difficult balance of payment situation. In 1966 following the recommendation of Mudhaliar Committee on foreign collaborations, the procedure for the approval of foreign investment proposal was streamlined. The Foreign Investment Board (FIB) was set up to deal with all the cases involving foreign investment of less than Rs. 20 Million and those within the 40 percent equity limit. Collaborations that exceed this limit were to be referred to the cabinet committee on foreign investment. Government also made a list of industries were foreign collaborations are considered necessary and those where in technical collaborations could be permitted. Government also set maximum ceiling for royalty payment (normally 5 per cent of sales) and duration (normally 5 years). In general foreign collaborations were severely restricted and FDI was allowed only in core industries where no alternative local technologies were available (Kumar 1987). As a result there has been a marked decline in the reliance on foreign technology as is evident from the fact that the number of foreign collaborations approved per annum during the early years of 1970s was less than half of those approved in the early 1960s. More importantly the number of cases involving foreign equity participation declined from 165 in 1961 to 27 in 1971.

[18] For a review of the evolution of venture capital in India see Bowonder, B and Sunil Mani (2002)

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1.4. Internal liberalisation (1980-1990)

During the first phase of internal liberalization, beginning from the early eighties to 1991, the thrust was on internal competition. The policy initiatives during this period aimed at encouraging the Indian corporate sector to acquire the means of industrial upgrading through technology imports and removal of internal controls[19]. With external liberalisation policies still on hold domestic firms were allowed to grow in size and increase their share in the Indian market. During this phase domestic firms also had relatively better protection against imports. Domestic firms also got the government to protect the Indian market from the entry of new foreign firms. The government was made to de-license sufficiently the industrial space, relax the regulations regarding foreign collaborations and foreign exchange and dilute the controls over the expansion of Indian big business to provide them with enhanced access to the home market. The government had eased the restrictions in respect of the scope and terms of duration and payments for technology collaborations. The corporate sector was provided with a wide range of fiscal and non-fiscal incentives to take an active part in the strengthening of in-house technological capabilities. It was actively encouraged to access the publicly funded R&D institutions for the purpose of consulting them for problem solving and sponsorship of R&D for taking their assistance in the task of absorption of imported technologies (Abrol, 2006).

The Technology Policy Statement of 1983 aimed to step up the pace of technological change through the development of new policy instruments. The basic objective, as stated in the policy statement was the development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources. The policy highlighted the importance of building up of human capital, providing the maximum gainful and satisfying employment to all strata of society, especially to women and weaker sections of society while harnessing their tradition skills and capabilities and making them commercially competitive. Given the context of increasing international competition and concern for environment the policy also underscored, among others, the need to develop technologies which are internationally competitive, particularly those with export potential and reduce demands on energy, particularly energy from non-renewable sources and ensure harmony with the environment.

Some of the initiatives under TPS (1983) included, the Program Aimed at Technological Self Reliance (PASTER)- now known as Technology development and demonstration program (TDDP). This program aims at technology adaptation by research design and development executed by the industry and overseen by the exports from Lab/university, Technology Absorption and Adaptation Scheme, National Register on Foreign Collaboration, S&T for Weaker sections, S&T for Rural Development, Science & Technology Entrepreneurship Park (1984) jointly with

[19] Starting with the mid-eighties the government undertook these reforms at a fairly good speed for a period of about six to seven years. The Indian corporate sector was freed from the controls of the government over capacity regulation, which was began in the late seventies, reservation of markets and access to foreign exchange. Capacity controls were removed more particularly in the sectors of importance to the big business. Selectively several industrial segments were de-reserved and de-licensed for the benefit of their entry. The Monopolies and Restrictive Trade Practices Act was diluted to facilitate the expansion and diversification of large firms or firms belonging to the big business groups. In case of foreign investment regulation the step taken was the grant of automatic approval, or exemption from case by case approval, for equity investment up to 51 percent and for foreign technology agreements in identified high-priority industries. Foreign Exchange Regulation Act was modified so that companies with foreign equity exceeding 40 percent of the total were to be treated on par with foreign companies. However, foreign controlled companies were restrained from having a direct access to the internal markets. Foreign controlled companies were allowed an entry if they fulfilled the obligations of furthering the exports from India or of bringing to the country highly monopolised technologies.

financial institutions, state Governments and academic institutions. In addition there were added incentives for in-house R&D and technology development to industry apart from the setting up Technology Development Fund (1987), through the levy of a cess on all technology import payments (Gupta and Dutta). Finally A full-fledged Ministry of Science and Technology was created in 1985, with the earlier Department of Science and Technology (DST) and a new Department of Scientific and Industrial Research (DSIR) as constituents (Richardson 2002). This period also witnessed DSIR initiating the scheme of granting recognition to scientific and industrial research organizations (SIROs) in the private sector.

A major innovation in explicit policies for STI pursued during this period pertains to the perusal of technology missions for the promotion of technological applications for civilian development and their diffusion in the society. Important positive outcomes obtained from these missions in terms of the technology development and diffusion in the fields of telecommunications, oilseeds and literacy. Successful creation of the rural telephone exchanges developed by CDOT, achievement of improvement in literacy targets to the extent of almost ten percent, are cited here as examples of what could be achieved through technology missions. Technology missions for societal development were however not pursued consistently by the implementing agencies involved by the government after 1991. India experienced a loss of momentum gained in respect of these missions at an early stage. The government failed in respect of the institutionalization of this very connection of S&T with development, particularly as there was a need to guard the mission orientation emerging for societal development in the S&T agencies on the one hand and in the government line departments on the other hand. Therefore, after 1991 the policymakers in these agencies were also free to shift to the projects that they believed to be far more consistent with the new goals of external liberalization.

1.5. External liberalization (since 1991)

In the second phase of reforms the thrust of policy changes was on external liberalization although it involved changes in many different aspects. Indian firms were permitted to enter into collaborations of their own choice with the foreign firms. The policy, thus became a vehicle for the foreign firms to demand financial participation from the collaborating firms in India. There has been an enhancement of both fiscal and non fiscal incentives to the corporate sector for undertaking in-house R&D with a view to encourage the enterprise sector to 'innovate' faster in respect of the development of new products and processes and the absorption of imported technological know-how. IPR also undergone changes to bestow an absolute monopoly to the generators of intellectual property with the aim to encourage the corporations to invest in the development of technology. Above all the corporate sector has been offered a strategic role by the government in the processes of policy-making, planning and regulation with the aim to achieve a better coordination between the S&T institutions and the Indian industry. In addition new policy initiatives were made to encourage Indian companies to invest abroad and facilitate access not only to their technology and human capital but also to their markets.

During this period also there were new initiatives which aimed at promoting science technology innovation through public-private partnerships in pre-competitive R&D. They included but not limited to the setting up of Innovation foundation to promote the harnessing of traditional knowledge, New Millennium India Technology Leadership Initiative (2000) and Technology Development Board (TDB) to provide financial assistance in the form of equity, soft loans or grants. This was followed by the setting up of Technology Business Incubators (TBIs) (2001)

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where in grants-in-aid is provided by the Department, both on capital and recurring for a stipulated period.

The observed shift in policy focus, however, was built on a vibrant innovation system evolved over the years as evident, among other, from a sound infrastructure base for science and technology - research laboratories, higher educational institutions and highly skilled human resource. This, as stated in science policy statement of 2003 was built up over the years on account of the commitment towards promoting the spread of science and recognition of the key role of technology as an important element of national development. In a context wherein returns of science, technology and development were yet to reach large segments of society, the new science policy statement laid emphasis on inclusive development as is evident from its focus on enhancing livelihood security, removal of hunger and malnutrition, reduction of regional imbalances, generation of employment, by using scientific and technological capabilities along with traditional knowledge pool. Another import aspect of the new policy in tune with earlier policies is its renewed focus on human capital and emphasis on environmental protection while continued with fiscal incentives and other measures to promote R&D and innovation.

1.6. Promotional initiatives- R&D schemes and mission projects

1.6.1. Technopreneur Promotion Programme (TePP)

As a golden jubilee initiative during 1998-99, Ministry of Science & Technology, Government of India launched a novel programme known as "Technopreneur Promotion Programme (TePP)" to tap the vast innovative potential of Indian citizens. The programme is jointly operated by the Department of Scientific and Industrial Research (DSIR) and Technology Information, Forecasting & Assessment Council (TIFAC) of Department of Science & Technology (DST). The programme aims to support individual innovators, from informal knowledge system as well as from formal knowledge system so as to enable them to become technology-based entrepreneurs (technopreneurs). TePP provides financial support to individual innovators to convert an original idea/invention/know-how into a working prototype/process. Under the programme, any Indian citizen, viz. artisan, technician, engineer, architect, doctor, scientist, housewife, student, farmer, etc. having innovative idea could aspire to become technology based entrepreneur technopreneur). The proposal can be made, either by an individual on his own or jointly with sponsoring/collaborating organization involved in technology development and promotion. The proposals from the owner of 'start-ups' are also considered for TePP support, if the annual turnover of the company doesn't exceed Rs 3.0 million. During last six years of its operation, the programme has been able to fulfill the dreams of many innovative Indian citizens in their pursuit of becoming technopreneurs. Since its inception, the Government of India under TePP programme has given financial support to over 115 projects. Out of these, around 50 projects have been completed and around 25 projects have been commercialized. The scheme has resulted in grant of domestic patents to more than 10 innovators and US patent to 3 innovators, besides commercialization of the processes/gadgets. Some of the successfully completed/commercialized projects under TePP are tiltable bullock cart, innovative cotton stripper machine (US patented), small 10 H.P. tractor, small sprayer (5 ltr. capacity), design cutting machine, solid bio-mass fired furnace, alkali lignin from dry pine needles, diagonal inverter for operation microscope, protein dialysis device (US patented), on-line time domain moisture measurement, neem oil for non-healing wounds, 2 novel process for manufacturing heterocyclic chemicals, bus heating system, DC MCBs, manufacturing of grape flakes, etc.

1.6.2. Technology Development and Demonstration Programme (erstwhile PATSER)

The Technology Development and Demonstration Programme (TDDP) of DSIR aims at catalyzing and supporting activities relating to technology absorption, adaptation and demonstration including capital goods development by involving industry and R&D organizations. Under the programme, innovative technologies are up-scaled from the 'proof of concept stage' to 'pilot plant/pre-commercial stage' by the industry. The projects involve research, design, development and engineering and are executed by industry, overseen by experts from university/laboratory.

DSIR has supported over 150 projects so far since inception of the scheme in 1992, when it was called PATSER. More than 65 projects have been completed and 31 companies have started paying lump sum premia /royalty. So far, more than Rs. 35 million royalty/premia have been received. About 15 patents have been filed based on projects supported under the scheme.

1.6.3. Home Grown Technology Programme (HGTP)

The Home Grown Technology Programme (HGTP), a mechanism of Technology Information Forecasting and Assessment Council (TIFAC) of the Department of Science & Technology, Government of India was started in 1993 following a suggestion from the Planning Commission. The HGTP was started primarily to support the Indian industry for achieving competitive strength through technological innovation. HGTP assists industries/companies for scaling up laboratory/bench scale technology to pilot or precommercial stage. The HGTP is intended for bringing about significant improvement in an existing product or process. HGTP is designed to support commercialization of technologies developed by indigenous research and development. HGTP provides soft loan (generally not exceeding 50% of the project cost) for technology development which is repayable in user friendly instalments after the completion of the project. More than 60 projects have been supported so far.

1.6.4. Science & Technology Entrepreneurship Parks (STEPs)

Science Parks help in creating an atmosphere for innovation and entrepreneurship, and promote active interaction between academic institutions and industries for sharing ideas, knowledge, experience and facilities for the development of new technologies and their rapid transfer to the end user. The major objectives of STEPs are to forge linkages among academic and R&D institutions and industry, to promote entrepreneurship among Science and Technology persons, to provide R&D support to the small-scale industry and to promote innovation based enterprises.

The Science & Technology Entrepreneurship Park (STEP) programme was initiated during 1984 by Department of Science & Technology, Government of India jointly with all India financial institutions (IDBI, IFCI & ICICI), State Governments and the academic institutions. Under this initiative, DST has catalyzed setting up of 15 such STEPs in different parts of the country.

1.6.5. Technology Development Board (TDB)

Technology Development Board (TDB) was set up by Government of India on 1st September 1996 and the operation of fund was assigned to Department of Science & Technology, Government of India. The Board provides financial assistance in the form of equity, soft loans or grants. TDB's participation in a project generally does not exceed 50 per cent of the project cost.

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The projects funded by the Board include sectors such as medicine and health, engineering, chemicals, agriculture and transport. Till 31st March 2005, the TDB had handled 141 projects valued at a total cost of Rs 20,438.9 million. Of the TDB's commitment of Rs 6,629.4 million towards these projects, it has already released Rs 5,264.1 million.

1.6.6. Drug Development Programme and Pharma-ceuticals Research and Development Support Fund (PRDSF)

The Department of Science and Technology (DST) launched a Drug Development Programme during 1994-95 for promoting collaborative R&D in drugs & pharmaceuticals sector involving industries and institutions. Fifty projects have been supported under the Programme involving 22 institutions and R&D establishments and 23 industries. These projects were about development of new chemical entities, new vaccines, assay systems, drug delivery systems and herbal drugs. These projects have resulted in filing of 4 product patents and 12 process patents. The Programme has also led to setting up of eight National Facilities for R&D.

The Government established a Pharmaceuticals Research and Development Support Fund (PRDSF) of Rs. 1,500 million (US$35 million) in January 2004. The fund will be used for supporting Pharma R&D projects by extending soft loan with 3 per cent p.a.interest rate.

1.6.7. New Millennium India Technology Leadership Initiative (NMITLI)

The Government of India has recognized the power of innovation and had launched a new initiative during 2000 to enable Indian industry to attain a global leadership position in a few selected niche areas by leveraging innovation-centric scientific and technological develop-ments in different disciplines. In a very short span, NMITLI has crafted more than 25 path setting technology projects involving over 50 industry partners and 150 R&D institutions with an estimated outlay of Rs 1,600 million. These projects are setting new global technological paradigms in the areas such as nano material catalysts, industrial chemicals, gene-based new targets for advanced drug delivery systems, bio-technology, bio-informatics, low cost office computers, improved liquid crystal devices and so on. The scheme is being implemented by Council of Scientific & Industrial Research (CSIR).

1.7. Policies towards FDI

An explicit policy aimed at attracting Foreign Direct Investment in India came about only after the liberalization of the economy in the early 1990s. However, this is not to put the point that the government was not aware of the importance of FDI as a catalyst of economic growth. Authors (Subrahmanian et al 1996) have identified four phases of the state attitude towards FDI. *The first phase,* beginning with 1948 to mid 1960s was marked by 'Cautious welcome" as evident from the Industrial policy resolution of 1948. FDI was considered important, and foreign investors treated on par with local enterprises. But the controlling interest and ownership were to be with Indian hands. However the adverse external Balance in the 1970s made FDI as a source of foreign exchange outflow through the transfer payments by Foreign investors. Thus in the *second phase (*mid 1960s to late 1970s) the government became more inward looking and FDI approval was selective and regulated. The Foreign Exchange Regulation Act (FERA) was enacted in 1973, and FDI inflow was regulated through the provisions of this act. Some of the large MNCs like IBM and Coca Cola had to withdraw from Indian market due to their inability to comply with the provisions of FERA.

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However, by late 1970s it was realized that the high entry barriers for the foreign firms have had large negative externalities, including widening technology gap, poor competitiveness of Indian firms and the ultimate lose for the Indian consumers. Thus in the late 1970s, the *third phase was* began, marked by partial liberalization. Accordingly the Industrial policy of 1977 allowed foreign firms to engage in financial and technological collaboration with Indian firms and fully owned foreign firms were permitted in highly exports oriented and sophisticated technology areas. Industrial policy of 1980, among others, focused on the need for promoting competition in the domestic market, technological up gradation and modernization. The policy laid the foundation for an increasingly competitive export based investment and for encouraging foreign investment in high-technology areas. A number of policy and procedural changes were introduced in 1985 and 1986 under the leadership of Shri Rajiv Gandhi aimed at increasing efficiency, productivity, and competitiveness. The emphasis was on opening up the domestic market to increased competition and preparing the Indian industry to be internationally competitive.

The New Industrial policy of July 1991, marks the beginning of the *fourth phase.* A landmark in the history of Indian economy, the New Industrial Policy announced on July 24, 1991 marked announced major policy shifts in terms of investment liberalization, along with privatization and opening up the economy for free trade. Among other olicies of liberalsiation the most relevant for foreign investment was the removal of the general ceiling of 40 percent foreign equity under Foreign Exchange Regulation Act (FERA) and abolition of the Monopolies and Restricitve Trade Practices Act. The policy also called for lifting the restriction on use of foreign brand names in the local market, withdrawal of the restriction on entry into low technology consumer goods; abandonment of the phased manufacturing programme (PMP), dilution of the dividend balancing condition and export obligation; liberalisation of terms for import of technology and royalty payments'; and allowed investment up to 24 per cent in small scale units.

Thus today India has a FDI policy more liberal than ever before and comparable to many other developing countries and even retail trade is being opened for FDI. The FDI policy as prevailing in the country provides for "automatic" approval in many sectors, by which foreign investors only need to notify the Reserve Bank of India (RBI) of their investments, and need not obtain government licenses or approvals. The Foreign Investment Promotion Board clears the proposals that do not confirm to the guidelines of automatic approvals. Government also encourages investment from Non Resident Indians . Investments and returns are freely repatriable, except where the approval is subject to specific conditions such as lock-in-period on original investment, dividend cap, foreign exchange neutrality, etc. as per the notified sectoral policy. The condition of dividend balancing that was applicable to FDI in 22 specified consumer goods industries stands withdrawn for dividends declared after 14th July, 2000.

While the FDI policy at the national level governs the inflow of FDI into the country, the decision of the TNCs with respect to the location of their investment is guided to a great extent by the policies and practices adopted by the state governments. Thus, while the regional governments do not have an FDI policy of their own, they do have various policies with respect to industry, labor, power and other related issues that in turn have a crucial bearing on the location decision of TNCs. This is because, India has a federal system of government with clear demarcation of powers. The states deal with subjects of law & order, agriculture, sales tax, minor minerals, electricity, health, education, irrigation, water supply, minor ports, roads, etc. From time to time the states are liberalising their policy to attract investment in both private and public sector. Since many of these areas act as determinants of location of FDI, states do compete among themselves to attract FDI using these policy instruments. Some states provide special packages to foreign investors and representatives of some states visit investors' country to give information regarding the state policy preference to foreign investors.

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1.8. Policies towards industry, trade, and finance

The initiative towards promoting industrial development with emphasis on self-reliance was evident in the industrial policy resolution of 1948 and got firmed up with the Industrial Policy Resolution (IPR) of 1956. The industrialization process, however, was to be achieved through a planning process involving greater role for the state (read as public sector) and small scale sector with limited role for the market. With regard to industrial restructuring, the Indian plans were influenced by the Mahalanobis strategy, which deviated from the `textile first' strategy of industrial development followed by the successful "late-comers" like Japan in industrialization [Chakravarthy (1987)]. Considering the labour surplus nature of the Indian economy and perceived advantage of small scale sector in generating industrial employment a large number of industries were reserved for the small scale sector and their number grew steadily over the years from 47 in 1967 to 836 in 1989 (Hussian Report).

Given the fact that the domestic private capital was in infancy and in tune with the declared objective of establishing a socialist pattern of society, the Industrial Policy Resolution (1956) reserved almost all the key industries (scheduled B) and infrastructure reserved for the public sector. Given the importance assigned to the development of capital goods industries as envisaged by Mahalanobis model to achieve self-reliant development, a number of public sector units were set up to manufacture a wide variety of basic and capital goods. Thus the underlying task implied in the Mahalanobis strategy was the development of a capital goods sector as rapidly as possible which would reduce imports and make production less dependent on foreign market.[20]. Indian planners, also laid emphasis on import substituting growth as opposed to export oriented strategy which in turn was guided by the export pessimism argument prevalent among the development economists ( ). The fact that the planners assigned key role to the state needs to be seen not only in the context of their limited faith in the market as the memories of great depression of 1930s remained fresh but the Soviet experience with planning has been generally viewed as a great success. Thus the policy makers were influenced not only by the state of the economy and the experience of development under colonial rule but also by the state of development thinking prevalent at that time.

Though the issue of land reform remained a subject only for discussion, a number of policies were evolved over the years with a view mitigate in equities at all levels especially personal and regional. Almost all the Five Year Plans a serious of programmes designed to address the welfare of weaker section. Industrial policies announced at points of times have had the number of provisions to ensure that industrial location decisions are not guided by market forces but intone with the declared objective of balanced regional development.

The concerted effort by the state towards achieving an equitable growth notwithstanding, prominent committees (Mahalanobis 1962, Hazari Committee 1966) came out with disturbing evidences with respect to achieving equitable growth. While Mahalanobis pointed towards growing inter personal inequalities, Hazari Committee revealed that the licensing system as existed in the country, inadvertently though, has been acting as instruments of promoting industrial concentration and monopoly power. Responding to the findings of the Industrial licensing Policy Inquiry Committee, government among others, appointed The Monopoly Enquiry Commission and its recommendations inter alia leading to the passing of Monopolies and Restricted Trade Policies (MRTP) Act .

[20] See Raj and Sen (1961) for Theoretical articulation for such a development strategy

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Apart from this the state also felt the need for protecting the industries from external competition. Following Frederic L infant industrial protection through high tariff and non-tariff barriers were the rule of the day. The policies in general, aiming at import substitution and focusing on self-reliance in remained intact until the late 70s. Success in building up a fairly diversified industrial structure under the import substitution strategy notwithstanding, there has been a marked deceleration in the rate of growth of Indian economy since the mid 1960s[21]. To be more specific, the rate of growth of industrial value added, during 1965-75 was only of the order of 4.7 percent per annum as compared to 8 percent during 1956-65. Being a democracy, different committees were appointed to search for the reasons and come up with solutions. The Committees in general were unanimous in concluding that India has been overplaying with her controlled regime and hence called for doing away with many of the restrictions that hindered the growth of the economy.

The IPR (1970) was issued with an objective to give teeth to the socio-economic and technological advancement objectives enunciated in the earlier polices. But by 1973, with the excitement over restriction of concentration of wealth waning, and a looming recession in the economy, and the seemingly intractable economic mess, compounded by the Oil shock, the state made the first attempts at loosening of the resolve to move firm on the industrial policy regime, with a focus on developing indigenous technological capability. The MRTP Act was loosened, the IPR (1973) Govt. decisions was the first explicit attempt at inviting foreign participation. The statement invited foreign players to participate in industries, where production is predominantly for exports, an uncontrolled openness criticized by Subharamanian (1978). This period also saw the first signs of vacillations on the efficacy of industrial licensing focusing on outputs, vis a vis productivity or technology competencies. Thus while a report on economic times (1974) suggested the Govt. setting up a working group to review the IPR in the light of new technological advances in the world, and incorporate the same into Indian economy, and stream line licenses, the same paper in (1975) quoted the Industries Minister wanting to abolish licensing altogether to improve availability of consumer goods. According to Tyabji (1997) what failed the country was the lack of conception of a phased technological improvement programme analogous to the Phased manufacturing programme. Not only that even when credible technological competences where built, the contradicting policies of the state ensured their untimely death. To use an example, in the case of thyristorised control devices, India built up a substantial degree of expertise and the Department of Electronics (hereafter DoE) thus restricted the award of industrial licenses to those applicants using domestic technology. But when BHEL was given a go ahead for a foreign collaboration with Siemens, the DoE too had to reverse its policy, there by opening the floodgates for foreign collaboration (EPW, 1978). Thus a formulation that technology improvement also requires a phased process, which Tyabji (1997) opines, was beyond the understanding of the state, and hence the Indian policy establishment doomed the Indian manufacturing sector willy-nilly to perpetual foreign dependence. This is a view advocated by Joseph (1997) while studying Indian electronics he opines that " in a perverse sense the Indian policy wily nilly made the domestic firms in the private sector the trading agents of foreign firms". This was reflected in the three major phases of import liberalizations, which India undertook, 1975 to 79, 1980- 84, and 1885- 89, and the fourth and the final phase it entered into in 1991. As the state, was buffeted by political, economic and external crisis's like oil shock on one hand, and political crisis's on the other hand culminating in emergency, the economic policy was subjected to violent mood swings from socialism to guarded capitalism to rural development within a span of one decade, and they definitely influenced the S& T policy too.

[21] See in this context Rangarajan (1982) and Raj (1986)

The Statement on Industrial Policy IPS (1977) was epochal in the sense that it understood the fact that ' a technique of production not only generates certain incomes' but also determines the pattern of production. So the IPS (1977) recognized the relationship between technological choices and over all development. This policy is breathtaking in its range of areas covered from small-scale sector to pricing policy to appropriate technologies. It acknowledges that in terms of generation of employment, bridging of rural – urban divide, growth of rate of investment and industrial output, the polices have performed well below expectations. The policy correctly diagnoses the problem that, there was very little interaction between the agricultural and industrial sectors, which is important since' only by a such a process of reinforcing interaction that employment can be found for large numbers of the rural population who cannot be absorbed in the agricultural sector ' Statement on Industrial Policy (SIP 1978) and the introduction concludes with the bombastic assertion that the new IP ' will here after place man at the center of the planning" (SIP 1978).The policy was also important in the sense that it gave for the first time, adequate attention to the small industries (almost 25% of the report was focusing on it), cottage, tiny, and mechanized industries.

The case of small scale industries development policy is unique in itself and the role of S&T in their development and growth is all the more quirky. IPR (1948) delineated the role of small scale industries as being particularly suited for achieving self sufficiency in consumer goods like food, clothing, and agricultural implements. With its delineation based on size and nature of work, and with the focus of Gandhians[22] to ensure supply of consumer goods with essentially using traditional technology and with no wage labor, the door to development utilizing technology was virtually closed for the sector[23]. This led Sachitanand (1978) to argue that the new found enthusiasm of the state in promoting Small scale sector is meaningless, since technologically backward, small scale can never satisfy the growing demand for goods, if the state improves efficiency and quality of the industrial sector in a systematic manner, both small and large scale industries would find their own place in an economy. While as Kurien (1978) argued that small scale sector could survive only if steady and increasing markets were to be found for the products of this sector. Growing markets for the sector would come only if purchasing patterns are deliberately geared towards the outputs of this sector. An effective form of assistance thus would be to initiate technological change within the sector to make it produce more attractive to the consumers. But the policy, though mentioned appropriate technology, shied away from recognizing the importance of management, organization, and entrepreneurship, and totally overlooked the lack of their infusion in the small scale sector, there by ensuring its continued dependence on reservations for survival. (EPW 1978).

In terms of capital goods sector, the policy grudgingly acknowledges that certain measure of growth of existing large units is inevitable, and in the rest of the cases, the growth in size would be curtailed by various measures like, denial of expansion, reduction in finance availability, regulatory mechanisms etc and the public sector is expected to play a commanding role in ensuring supply of essential goods. An acknowledgement for the need for continuous adaptation of foreign technologies was mentioned in this statement and this resulted in the establishment of the national registry for foreign collaboration to monitor these activities. Foreign investment was restricted to only those in India's national interest, collaborations are put under scanner, and Indian Joint Ventures abroad are frowned upon. Even in this case though the policy rightly favored the outright purchase of foreign technologies, and their subsequent modifications for Indian conditions, it made no mention of a monitoring mechanism to ensure the same. And even before any of the policy

[22] For the philosophical underpinnings of the support to small scale sector see Karve Committee report (1955)
[23] Fir a detailed discussion on small scale industry see Tayabji (1980, 1984) and others.

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measures could reach fructification the policy died collapsing under the weight of the inherent contradictions the initiating Government. itself.

With the introduction of, the IPS (1980), which was the first SIP, which explicitly focused on Research and Development and transfer of technology domestically, and the Technology policy statement TPS (1983) whose high light is that it for the first time focuses on the nitty- grities of acquisition of technologies, India moved towards explicitly focusing on reserach. The statement speaks of identification of priority areas, promotion of imports, and seeking commitment from importers, in terms of absorption, adaptation and subsequent development of imported technologies. With broad-spectrum policy initiatives one would have expected an analysis of the current status of technologies in the country, and a road map for developing domestic R&D capabilities. But contrary to such expectations the policy laid the foundation for an increasingly competitive, albeit skewed, export base, and for encouraging foreign investment in high technology areas. As Bagchi (1986) surmised, based on the RBI's fourth survey report on Foreign collaboration in Indian Industry, by and large foreign collaboration agreements are rather poor instruments in raising efficiency of utilization of resources, and the absorption, assimilation of foreign technology is minimal in case of Indian firms, which spend just of half of the amount spend on technology imports in domestic R&D.

The primary shift in policies during this period especially in electronics and telecommunications which announced that in order to promote high technology import and to take advantage of up gradation of high technology by foreign suppliers' equity participation of foreign suppliers would be preferred over outright purchase of technology from aboard. More explicitly with the sectoral polices brought out during the, 1984-1989 period, India was firmly perched on the path to industrial development based on technology imports, and the general perception was, foreign control was not any more a necessary evil, but a welcome phenomenon since it would bring along with itself, technology and management skills so, crucial for the growth of the industry. The mood was captured in statements like 'the technological somnolescence of the seventies was replaced by a spate of technological collaborations and ambitious schemes of modernization' (Kelkar, 1990). The Business Week (1987) proclaimed, "The nation of nearly 800 million has a new attitude about technology in general and computers in particular Such exuberant statements were countered by a set of careful observers who expressed doubts regarding the stated advantages of a free import regime technologically[24] " (Joseph 1989 , Mahalingam 1989 , Mody,1987).

BM (1987) after critically examining past performance of the Indian industrialization experience in terms of foreign capital and technology concluded, liberalization of economy and the strategy of import based industrialization would lead the industrial enterprise in the country, to function and develop as appendages to foreign suppliers of technology, a view echoed by Mohan (1989) when he states the promotion of modern technology has become a tool of neo-colonialism. The foreign exchange crisis in 1991 proved his predictions right. But to argue in the light of the above discussion that, the policy apparatus gave up building up domestic capability building in terms of technology would be far from truth. While liberalization of foreign technology took place during this place, the state also attempted to provide increased incentives to domestic technology building. The Department of Science and Technology (currently operated by DSIR) since 1973, has been providing a registration scheme for R&D Units which provided them incentives in terms of import of equipments, and the income tax provides effectively 125% tax exemption of investment made in developing indigenous technology. The Department of Scientific

[24] All of them quoted in Evans, world development paper on Indian Electronics

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and Industrial Research (DSIR) set from 1984 was explicitly seized with the responsibility of promoting industrial research, The R& D Cess Act (1986) was an attempt to promote indigenous technology and discourage imports, by way of a carrot and stick policy. The act paved the way for collection of a sum up to 5% of the total money paid for importing technology and to be utilized for the commercialization of indigenously developed technology. The money thus collected was to be deposited with IDBI for a venture capital fund to further the stated purpose. A critical assessment of the nature and direction of the money spend from a such a fund could help in assessing the outcome of Indian initiative. The setting up of Technology Information and Forecasting Assessment council (TIFAC) was also an attempt to enable and facilitate technological development. Parthasarthy (2001) argues in his article Give the state it's due, that the state had been attempting to Department of Electronics promote technological development.

Summing up the discussion, Patel (1989) in his interesting article on elements shaping future technology policies for India after paying the customary tribute to India's achievements in the epochal systems turns his focus on industrial technology. He concludes that neither the public sector, not the private sector, separately or together, did much to build up independent, self reliant technological capacity to cope with the requirements of accelerated development. He reasons out several factors, but the prime factor is the absence of any pressure of effective demand for domestic technologies. According to him, the very system of technology demand in India was skewed. the public sector, obtained its technology especially on a turn key basis from the foreign supplier, the private sector had plainly not paid any attention to R&D.

The result was the series of economic reforms in the 1980s, which were initiated over the fairly strong edifice built during the import substitution phase. While the reforms involved, devaluation and removal of import barriers, the focus has been on internal liberalization with a view to make the domestic industry more competitive in structure. The new reforms measures, therefore, involved the removal of entry barriers through industrial delicensing, removal of restrictions on capacity expansion along with regularization of the excess capacities created earlier, dismantling of price controls and expansionary fiscal policies to expand the domestic demand base.

While there has been acceleration in the rate of output growth, in the 1980s, the growth momentum could not be sustained as evident from the mounting fiscal and current account deficits leading to a liquidity crisis towards the end of 1990s. It was against this background that India embarked on the far-reaching economic reforms in 1991 that marked a profound change in India's economic policies with the twin objectives of stabilization and structural adjustment. While the former dealt mainly with short term demand management through correcting fiscal, external and monetary imbalances, the latter focused on addressing the rigidities associated with the supply side of the economy by liberating it from the fetters state control and promoting an open and market friendly economy. The structural adjustment measures, aiming at enhancing efficiency, productivity and competitiveness of the economy; *inter alia* included industrial deregulation, liberalization of foreign direct investment, trade liberalization and reforms in public sector, infrastructure and financial sector. Given the crisis that prevailed in the external sector, the initial focus has been on the external sector and later the reforms were extended to other sectors of the economy.

1.9. Reforms in the last decade

However, as 1990s approached, the macro economic crisis's led to the launch of the new economic and industrial policy. An exercise in managing contradiction, this path breaking policy statement, while reaffirming the contribution made by the founding father of Indian economic

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policy, Nehru, made a clean break from the planning led economic policy, though the breaches began much before, the complete demolition had to wait for the 1991 policy statement. The policy abolished the industrial licensing for industries but for select sectors, thereby signaling the end of planned development of the economy and placing its trust on the market to govern the phase and direction of industrialization. It was a landmark decision to effect a complete burial of industrial licensing which in any way was diluted throughout the late 1970s and 1980s and the closure of Directorate of industrial and technical development. But in terms of conception of technology the policy was far reaching. The premise of the NIP (1991) is that hang up on self reliance in the past has resulted in foreign capital and multinationals passing India in favor of other countries and they have consequently grown and modernized themselves and hence to achieve growth India too needs to integrate itself with the world economy, while the stated objectives of foreign collaboration even with equity participation is the continuous improvement of technology, the policy lays down that foreign equity proposals need not be accompanied by foreign technology agreements (Pranjepae, 1991). It then presumes that Indian industry has reached a certain level of general resilience, sophistication and size and therefore suggests a much more dynamic relationship between foreign and Indian firms[25]. The policy permitted automatic approval for foreign investment up to 51% in Appendix –I industries. In terms of foreign technology collaboration the policy makes an epochal statement "Indian companies will be free to negotiate the terms of technology transfer, with their foreign counterparts, according to their own commercial judgment." (IPS, 1991).

This was the first policy in 40 years of independence, which criticized the public sector and went overboard in criticism. It almost castigated the public sector as a liability rather than an asset. So the policy promises to review the public sector philosophy, recast them in the light of changing economic scenario and get out of consumer goods and service sector. With respect to the MRTP Act, the thrust shifted from governing the size, nature and direction of investments by business houses, to the taking appropriate action in respect of monopolistic, restrictive and unfair trade practices. Technologies in all areas of production are not such that o adjustment in factor combinations for producing the same broad product range is possible. One of the very purposes of control and regulation of Indian industrialization was that to ensure the use of such means of production which will be labour intensive and capital savings. But not only the mode of industrialization which India adopted with its capital intensive plants, but also the means of control which the state adopted in terms of quantitative controls rather than qualitative control led to the failure of the stated objectives and thus the IPS (1991) had no alternative other than to lament that the despite investment in S&T Indian industry has continued lag behind MNCs and the only way to induce technology is through foreign collaboration. This coupled with the shortsightedness of the Indian entrepreneur[26], who is protected by controlled market, led to continued dependence on foreign technology, which was officially recognized by the IPS (1991)[27]. In terms of technology, especially foreign technology unfortunately the IPR (1991) seems to have prescribed a medicine worse that the cure Pranjepe (1991)

[25] For interesting case studies on the effect of such premises see Industrialization and Innovation by Tyabli (2000)

[26] Through out this discussion no attempt is being made to examine the role of Indian entrepreneur, the role of policies in restricting or promoting competition at domestic level, and its impact on technology competencies, the class character of the Indian capitalist class and its impact, and the organizational, motivational, and educational dimensions of fostering innovation is not considered, though they are extremely important for want of time as well as resources.

[27] In fact Mani (1992) argues that the NIP (1991) is a logical culmination of series of policy measures undertaken by different regimes in the previous decades, and the NIP (1991) is not so radical after all.

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In terms of promotion of domestic technology development, this era saw three major policy initiatives, the aborted technology policy statement (1993), Technology Development Board Act (1995), and the new S&T policy statement 2003**.** It also the evolution inauguration of three schemes, PATSER, NMTLI, and SEETOT. The technology policy (1993) was, landmark opportunity to take stock of India's technology initiatives, coming exactly after a decade, it would have been an ideal platform to evaluate the measures of liberalization, which was undertaken throughout the 1980s in different sectors, and the a quick review of the impact of India's economic liberalization initiated two years before and consequently evolve a set of directions. Instead policy makes no mention of, different sectoral studies initiated by DSIR, on telecom, cement, switchgear, transformer and control equipments, to examine their degree of technological competences. The policy draws no conclusions or inferences on such documents, and makes no attempt to take stock of the existing scenario. As Sheshadri (1993) comments the worst draw back of the technology policy is that there is nothing new about the new technology policy. It is an add- on, incremental type of effort, essentially trying to smear the cosmetic of 'software' and biotechnology on the old tied face of 'rural development et al. But the other initiatives in technology development are relatively successful. The mismatch between the policy statements and the reality was captured by EPW (1993) in its comment paper plans, there seems to be a mismatch between stated and the real intentions of the policy makers. The 1993-94 union budget allows for no doubts on this count. The thrust areas are what they have always been, the strategic sectors, defense, atomic energy, space.

The partial convertibility of rupee on the trade account was announced in the 1992-3 budget that was subsequently broadened to full convertibility on current account by August 1994. India is cautiously moving towards the full capital account convertibility.

Reforms in the trade sector included the progressive reduction in the customs tariff rates from peak rates of 150% in 1991/92 to 45% by 1997/98 to 25% in 2003/04. In January 2004 these were further brought down to 20% for non-agricultural goods. The import licensing system has been dismantled and quantitative restrictions on imports have been phased out two years ahead of schedule. India has bound over 3298 of the 4701 (i.e. 70 per cent) of her tariff lines (at 6 digit level HS classification). Of these 99 per cent of the bound lines have been bound at rates 40 per cent or lower. The applied rates are much lower than the binding rates for most of the products.

The Capital Issues Control Act was repealed and the Securities and Exchange Board of India (SEBI) was set up as a watchdog for regulating the functioning of the capital market. SEBI has focused on regulatory reform of the capital market as well as on market modernization. Online trading and dematerialized trading have been introduced. Companies have been allowed to buy back their own shares subject to the regulations laid down by SEBI.

In September 1992, the government announced guidelines for investments by foreign institutional investors (FIIs) in the Indian capital market. FIIs were now allowed to invest in all types of securities traded on the primary and secondary market with full repatriation benefits and without restrictions on either volume of trading or lock-in-period. In January 1993 a package of financial sector reforms was announced that included permission to new private sector banks including foreign joint ventures. The government has also established a policy regime for functioning of private non-banking finance companies (NBFCs) and agencies for rating their credit worthiness.

With a progressive liberalization of FDI policy, foreign ownership of up to 100% is permitted in most of the manufacturing sectors (except for defense equipment and for items reserved for production by small scale industries). A system of automatic approval of FDI proposals fulfilling the conditions laid down has been put into effect. Dividend balancing requirements imposed on consumer goods industries have been withdrawn.

Along with policy measures to integrate the Indian economy with the world market, a conscious attempt was also made to intensify the economic integration with other countries in the South. This was manifested the Look East policy adopted in the early 1990s. As a result, the ASEAN-India Partnership has seen a virtual transformation from just a sectoral dialogue partnership of India with ASEAN to a Summit-level interaction within a decade viz. 1992-2002. It scaled new heights with the signing of the Framework Agreement on Comprehensive Economic Cooperation between ASEAN and India at the Bali Summit in October 2003 and FTA by 2008. Similarly, India entered into FTA with Sri Lanka and Thailand and played a key role in the formation of BIMST-EC **by** combining Myanmar, Thailand Bangladesh, Sri Lanka and India and SAFTA.

Working with Brazil and South Africa, IBSA Forum was formed in June 2003 to promote mutual cooperation and to voice jointly the demands and concerns of the South[28]. The leaders of the three countries formally launched IBSA at the UN General Assembly in September 2003. Since then there has been increased interaction between leaders of the three countries. Among others, there has been a meeting of the Defence Ministers in South Africa, Co-operation at WTO's fifth ministerial at Cancun, Mexico on agricultural issues and a state visit by Brazilian President Luiz Inacio Lula da Silva to India in January 2004 where in he highlighted the need for exploring "new trade geography" followed by the Ministerial meet in Delhi on 4-5 March 2004.

The Ministerial meeting of IBSA held in March, 2004 in New Delhi, in tune with Brasilia declaration, emphasized the importance of concrete trilateral cooperation in civil aviation, infrastructure, job creation and small medium and micro enterprises, science and technology, information technology, tourism, energy, defense and social sectors covering health, education etc. The Minister's agreed that the IBSA countries can reinforce the economic strength of each other by synergising their complementarities in area of industry, services, business and technology which in turn could create a market of 1.2 billion people 1.2 trillion dollars of GDP and foreign trade of 300 billion dollars. It was also decided that each countries could conduct studies to examine the potential for economic and commercial partnership and the ways and means for increasing trade and investment flows among the three countries.

Section 4

1. Sub System: The Demand Side

The current growth trends of the economy and rising purchasing power of Indians have evinced immense interest in the Indian market. World over, the Indian 'middle class' is being seen as a huge untapped market. There are even predictions that the future of the international market would depend upon the consumer behaviors in the two emerging economies of India and China. The survey conducted by National Council for Applied Economic Research (NCAER) in 2005 forecasted that the Indian middle-class will increase to 154 million (28 million households), accounting for 13 per cent of the country's population by 2010, with one-thirds of them living in villages. The study further claimed that the overall expected growth in the demand of various consumer goods would be around 9 per cent per annum. A billion strong population, with the demographic advantage of having a majority of younger working age population, and a per capita income that is growing at the rate of around 6.2 percent is indeed great potential and bound to influence the innovation system in general and growth in particular

[28] It was agreed that all the three countries should cooperate in opening up of their market each other and not depend entirely on developed countries for investment and export. Agriculture, defense, aeronautics, IT, Biotechnology, Civil aviation etc are identified as areas of cooperation.

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Table 3.2 - Per capita income and consumption (in 1999- 2000 prices)

	Income		Consumption	
	Rs.	**Growth(%)**	**Rs.**	**Growth(%)**
IX plan avg.(1997-2002)	19245	3.4	12392	3.0
Xplan avg.(2002-07)	24156	6.2	14677	4.3
2002-03	20996	2.2	13352	1.1
2003-04	22413	6.8	13918	4.2
2004-05	23890	6.6	14413	3.6
2005-06	25696	7.6	15422	7.0
2006-07	27784	8.1	16279	5.6
2007-08	29786	7.2	17145	5.3

Source: Economic Survey 2007-08
Income is taken as GDP at market prices.
Consumption is Per capita Final Consumption Expenditure.

1.1. Income Levels and Distribution: Wages and Consumption

One of the worrying aspects about the growth of wages in India had been the stagnation , or even deceleration of real wages in India. Whether it is casual or regular employment, between every round of NSS there has been a secular deceleration in growth of wage rates during the period 1983 to 2004-05. For the regular workers the growth rates declined from 4.1 percent per annum during the period 1983 to 1993, to 3.9 percent during 1993 to 1999, and by 2004 the rate turned out to be negative at –0.62 percent. For the casual workers the rates had declined from 3.3 % to 3.1% to 1.9% during the same periods. The urban regular male workers and rural male casual workers, the two representative groups of Indian workers, had experienced a marginal rise in growth of wage rates during the previous period, 1993-99, but both these groups experienced decline in the later period. For the urban male regular workers it declined from 7.43 percent in 1993-99 to –4.17percent in 1999-2005, and for the rural casual male workers the growth rates declined from 3.33 to 3.19 percent.

Table 3.3 - Real Wage Rate Levels and Growth Rates

Levels	Regular workers		Casual workers	
	Rural	Urban	Rural	Urban
1983	14.63	23.48	6.77	9.51
1993	26.94	32.46	9.56	12.01
1999	34.99	40.67	11.51	14.54
2004	38.73	37.27	13.23	14.05
Growth Rate				
1983-1993	6.3	3.29	3.51	2.36
1993-1999	4.45	3.83	3.14	3.24
1999-2004	2.05	-1.73	2.82	-0.68
1993-2004	3.36	1.26	3	1.44

Source: Calculated from NSS unit level data, 38th, 50th , 55th and 61st round on CDROM published by Central Statistical Organization, Government of India.
Source: Abraham,Vinoj (2007)

A comparison across the two decades of 1983-1993 and 1993 –2004, clearly shows that the growth of wage rates in the first period had been substantially higher than the second period in all

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sectors, gender and employment status, except for the rural casual male workers, which is marginally higher in the second period. However this margin petered out in the period 1999 to 2004 exhibiting a secular and pervasive decline in growth of wage rates.

The most striking aspect about the regional patterns in real wage growth is that the negative growth rate (or a decline in the wage rate levels) during 1999-2004, among regular employees is almost a pan-Indian phenomenon. Barring the states of Assam, Bihar, Punjab, and Uttar Pradesh, all major states in the country experienced this negative growth in the regular wage rates. In the case of casual wage rates though the growth rate is positive among most states, a few states such as Haryana, Punjab, Rajasthan and West Bengal had shown negative growth rates.

Table 3.4 - Real Wage Rate growth rates across states (at 1983 prices)

	Regular			Casual		
	1983-1993	1993-1999	1999-2004	1983-1993	1993-1999	1999-2004
Period	**1**	**2**	**3**	**1**	**2**	**3**
Andhra Pradesh	7.45	-0.92	-3.45	5.28	0.1	0.67
Assam	4.69	2.73	5.82	1.57	2.35	2.89
Bihar	5.11	6.06	0.42	1.71	6.3	3.05
Gujarat	2.87	4.61	-3.13	2.58	2	0.69
Haryana	2.54	8	-5.27	0.58	5.12	-1.45
Himachal Pradesh	1.34	7.81	-1.36	2.79	7.03	2.91
Karnataka	2.91	2.89	-0.38	3.89	3.44	1.3
Kerala	3.05	4.58	-0.19	2	5.66	2.5
Madhya Pradesh	5.09	4.35	-2.6	4.08	0.48	3.23
Maharashtra	3.02	3.45	-0.21	3.27	2.63	0.21
Orissa	5.99	7.7	-0.57	2.06	4.69	6.06
Punjab	4.44	3.55	1.82	2.71	0.91	-0.62
Rajasthan	4.17	4.61	-1.89	2.84	3.44	-0.9
Tamil Nadu	3.53	4.51	-0.61	4.94	5.52	1.1
Uttar Pradesh	4.46	2.66	2.11	2.8	2.42	1.79
West Bengal	3.67	5.89	-2.83	2.88	3.2	-0.06
Group Total	4.1	3.97	-0.63	3.32	3.16	1.98

Source: Abraham,Vinoj (2007)

Not only that the growth of wages had stagnated during this period the degree of wage inequality among wage earners alos widened during the period 1983 to 2004-05. Between 1983 and 1993 the range of the wage rates had reduced, but since 1993 the range had been widening, and by 2004 the range had reached to 1983 levels. A comparison of the values across time period brings out that at the lower spectrum (below the 5th decile) the wage inequality is declining, while at the upper spectrum (above 5th decile) the wage inequality is widening among the regular workers. The wage inequality among casual workers is considerably lower than the regular workers. There is no widening of wage inequality in the case of casual workers. Intertemporal comparison of the calculated ratios shows that between 1983 and 1993 there was some reduction in wage inequality across all deciles, and after that there has been remarkable stability in wage inequality till 2004.

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Table 3.5 - Inter-Decile Variations in Wage Rate-Regular Employees

	Regular				*Casual Workers*			
ecile ratio	1983	1993	1999	2004	1983	1993	1999	2004
$1^{st}/ 1^{st}$	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
$2^{nd}/1^{st}$	1.6	1.5	1.5	1.4	1.3	1.2	1.3	1.2
$3rd/1^{st}$	2.0	2.1	1.9	1.9	1.7	1.5	1.5	1.5
$4^{th} /1^{st}$	2.9	2.8	2.6	2.5	1.7	1.7	1.7	1.7
$5^{th}/1^{st}$	3.6	3.6	3.6	3.2	2.0	1.9	2.0	1.9
$6^{th}/1^{st}$	4.2	4.4	4.6	4.7	2.3	2.1	2.2	2.2
$7^{th}/1^{st}$	5.0	5.3	5.8	6.5	2.7	2.5	2.5	2.5
$8^{th}/1^{st}$	6.0	6.5	7.2	8.6	3.3	2.9	2.9	2.9
$9^{th}/1^{st}$	8.0	8.5	9.5	11.5	4.0	3.7	3.7	3.7
$10^{th}/1^{st}$	33.2	21.6	25.9	33.0	50.5	20.8	40.0	24.8
$9^{th} /5^{th}$	2.2	2.4	2.7	3.6	2.0	1.9	1.9	1.9

Source: Abraham, Vinoj (2007)

The Table 6, below provides the decile variation in wage rate between successive NSS rounds for both regular employees and casual workers. For decadal comparison, the last column in each panel provides the variations during the period 1993-94 to 2004-05. The distribution of wage rate increment is such that the rise in wage rate is much higher among the high wage earning groups rather than the low wage earners, which accounts for the widening inequality among the regular workers during the period. Such an increasing trend in wage inequality is visible during the period 1993-99 as well. During the period 1999-04 the wage increment is confined to the 8^{th} percentile and above, while all the deciles below experienced absolute decline in the wage rates. Thus if inequality of wage rates was widening in relative terms during the period 1993 to 1999, during the period 1999-2004 wage inequality was widening in absolute terms , with low wage earners earning less in 2004 than what they earned in 1999, while high wage earners earned higher than what they earned in 1999. For casual workers, however the incremental widening of wage inequality is very low compared to regular workers. Between the 1^{st} and the 9^{th} decile the increment in wage rate differs by Rs. 3.2 in the period 1983-93. This difference continues in the later decade 1993-04 as well. Comparison between the periods also shows that there are no incremental changes in wage inequality among the casual workers.

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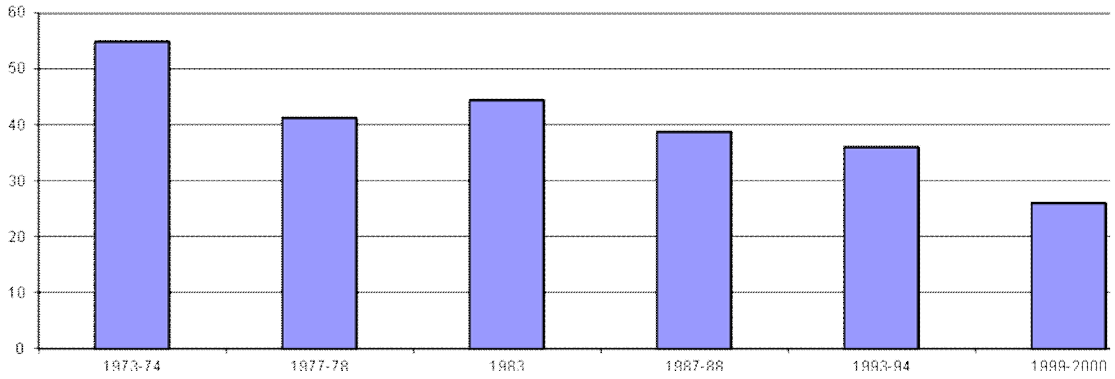
Table 3.6 - Inter-temporal variations in Wage Rates across Deciles

	Regular Employees				Casual Workers			
Decile	1983-93	1993-99	1999-04	1993-2004	1983-93	1993-99	1999-04	1993-04
1st	2.2	1.2	-1.1	0.2	1.6	0.8	0.6	1.4
2nd	3.1	1.5	-1.8	-0.3	1.7	1.1	0.7	1.7
3rd	5.4	1.2	-2.6	-1.4	1.9	1.2	1.0	2.2
4th	6.2	2.0	-4.3	-2.3	3.1	1.1	1.3	2.4
5th	8.1	4.3	-6.4	-2.1	2.9	1.8	1.2	3.0
6th	11.0	7.3	-4.1	3.2	2.9	2.1	1.0	3.2
7th	13.8	10.2	-0.7	9.5	3.6	1.9	1.5	3.4
8th	17.0	14.1	2.3	16.5	3.4	2.1	1.9	4.0
9th	21.2	19.2	4.9	24.1	4.8	3.3	2.2	5.5
10th	-9.3	62.9	25.0	87.8	-55.0	121.7	-67.4	54.4

Source: Abraham,V(2007)

Poverty alleviation has been one of the most important challenge faced by the Indian policy makers. Irrespective of measurement used, there appears to be a broad agreement regarding the direction of change. Going by the head count ratio, the population under poverty line declined from about 44 per cent in 1983 to 26 percent in 1999-00 a period covered by the 55th round of National Sample Survey (NSS) survey (figure 4)[29]. Notwithstanding such a reduction in the proportion of the people in poverty line, India still has about 250 million people considered as poor, a major challenge before the policy makers.

Figure 3.1 - Proportion of People under Poverty line



[29] Mahendra Dev (2000). At the same time, it has been argued that there has been a mythological problem associated with the estimation of poverty in the 55th round (1999-00) of National Sample Survey. A recent study (Sen, Abhijit & Himanshu, 2004) has shown that during 1993-94 to 1999-2000 the poverty ratio fell at most by 3% and it is likely that the number of poor increased over this period.

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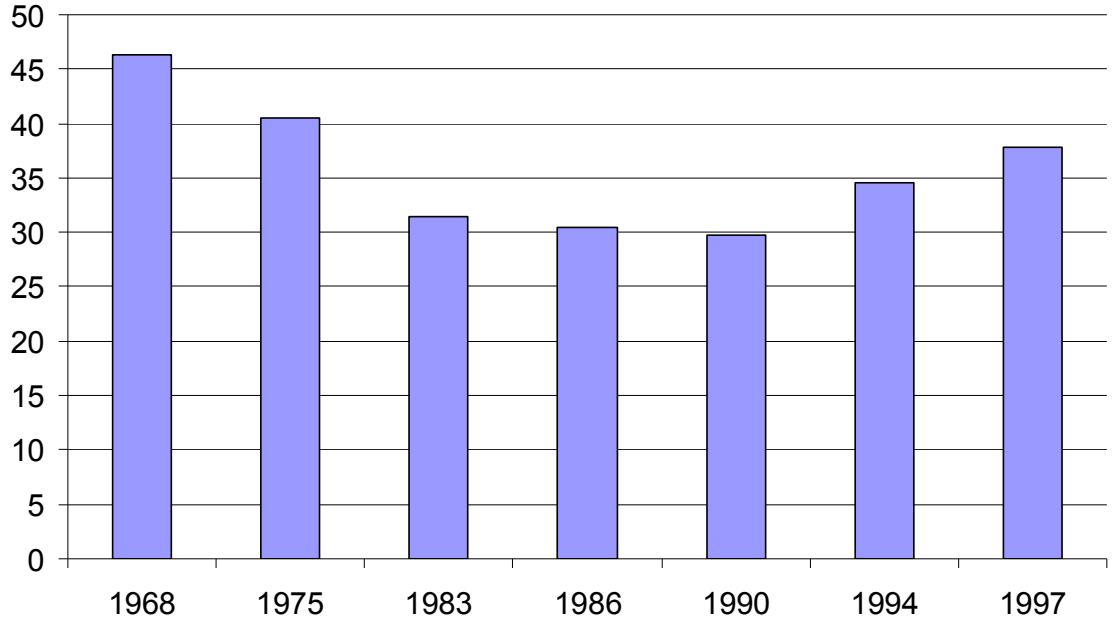
Remarkable achievements with respect to poverty reduction notwithstanding, interpersonal inequality has shown an undesirable trend. Fro Fig it is evident that the period prior to liberalization, despite lower growth rate, was marked by a signifivant reduction in the gini index. With the on set of liberalisation and out ward orientation there appears to have been a trend reversal which casts doubt on the sustainbility of the system and that inclusive developmet has become the buzz word in the policy discourse and the focus of the present plan

Figure 3.2 - Trend in Interpersonal inequality (Gini Index in Consumption)



The observed trend at the national level is found reinforced at the regional level (see table) from the table it rather disturbing to note that states that Kerala noted for its social sector development along with an equitable distribution has emerged of late as one most unequal states in the country.

Table 3.7- Trends in Consumption Inequality (Gini coefficient) in India

	1983	1987-88	1993-94	1999-2000	2004-05
India Urban area	0.341	0.332	0.343	0.374	0.375
India Rural area	0.308	0.300	0.286	0.311	0.305
India(U+R)combined	0.321	0.313	0.311	0.339	0.336

Source: Estimated from NSS (thick sample) of household consumer expenditure surveys

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Table 3.8 - Trends in inequality (Gini coefficients) in major states

	URBAN		RURAL		COMBINED	
	1993-94	2004-05	1993-94	2004-05	1993-94	2004-05
AndhraPradesh	0.323	0.374	0.289	0.294	0.303	0.331
Assam	0.288	0.321	0.179	0.199	0.231	0.257
Bihar	0.311	0.341	0.225	0.213	0.265	0.274
Gujarat	0.291	0.31	0.24	0.272	0.263	0.288
Haryana	0.283	0.364	0.313	0.339	0.295	0.348
JammuKashmir	0.288	0.252	0.243	0.248	0.263	0.247
Karnataka	0.318	0.368	0.27	0.265	0.291	0.314
Kerala	0.343	0.410	0.301	0.382	0.319	0.392
MadhyaPradesh	0.33	0.406	0.28	0.277	0.302	0.338
Maharashtra	0.357	0.378	0.306	0.311	0.328	0.341
Orissa	0.307	0.353	0.247	0.285	0.274	0.316
Punjab	0.28	0.402	0.283	0.296	0.279	0.345
Rajasthan	0.293	0.372	0.265	0.251	0.276	0.308
Tamilnadu	0.347	0.358	0.312	0.321	0.326	0.336
UttarPradesh	0.326	0.366	0.281	0.29	0.301	0.325
WestBengal	0.338	0.383	0.254	0.273	0.293	0.325

Source: Estimated from NSS (thick sample) of household consumer expenditure surveys.

1.2. Social discrimination in India

The Indian society is stratified on the basis of the caste system, a hierarchical segregation of the society based on hereditary occupation. The occupational segregation, however, is attached with dignity or the lack of it , and discriminatory practices based on it. The caste system, which has been practiced atleast for the past two millennia in India, is deeply entrenched into the very fabric of Indian society. *Dalits* who are considered to be outside the caste hierarchy are the victims of the worst forms of caste discrimination including untouchability. The *Adivasis, or* native tribal communities, are another social group who are subjected to extreme forms of isolation and discrimination.

Table 3.9 - Socio-religious Groups in India

Religion/Caste	SCs	STs	OBCs	Others	All
Hindu	22.2	9.1	42.8	26.0	100
Muslim	0.8	0.5	39.2	59.5	100
Christians	9.0	32.8	24.8	33.3	100
Sikhs	30.7	0.9	22.4	46.1	100
Jains	0.0	2.6	3.0	94.3	100
Buddhists	89.5	7.4	0.4	2.7	100
Zoroastrians	0.0	15.9	13.7	70.4	100
Others	2.6	82.5	6.2	8.7	100
Total	19.7	8.5	41.1	30.8	100

Sachhar Committee Report (2006)

The Dalits or the Scheduled Castes account for 19.7 per cent of the population. Adivasis or Scheduled tribes account for about 8.5 per cent of the population of the country. Both these groups together forming nearly a third of the Indian population remain as the most backward social

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groups in economic and social development. The scheduled castes are mostly landless agricultural workers. As can be seen from the table , nearly 62 percent of the SCs were either having no land holding or held marginal lands. Having no land assets to hold, and at the same time restricted by the caste identity their living conditions and access to basic amenities of life is extremely poor.

Table 3.10 - Land Owned and Operated by social groups

	0-0.1	0.1-2.5	> 2.5 ha	Total
ST	34.03	58.59	7.38	100
SC	62.02	36	1.98	100
Other	38.96	52.56	8.48	100
Total	43.36	49.67	6.97	100

Source: Gaiha et.al (2007)

The scheduled tribes have experienced similar conditions of livelihood not so much due to the lack of assets, but mainly due to their vulnerable geographical location. STs are much better endowed in terms of the quantum of land they hold when compared to the SCs. However, the more worrying fact for the STs is the type and quality of land they hold. The adivasis are often subjected to land alienation, and marginalization as a result of the mainstream developmental initiatives. This has resulted in a condition wherein these segments of the population suffer from relatively much higher levels of poverty, illiteracy, mal nutrition, and general standards of living in comparison to the rest of the population (Kurien, N,J. 2007). As can be seen from the table below the share of poor among the STs (44 %) and SCs (32 %) were substantially higher in comparison to that of the general population (25 %) as per the NSS survey conducted in 2004-05. Similarly the level of illiteracy was to the tune of 62 percent for STs and 58 percent for the STs, while for the general category the rate of illiteracy was only 43 percent. On the other hand these deprived groups also performed very poorly in higher levels of education.

Though initially it was claimed that the caste system was intrinsic to the Hindu community, later studies show that caste discrimination continued to occur in other religious groups as well. As can be seen a substantial share of Buddhist (89.5%) and Sikh population (30.7%) belong to the SC category.

Table 3.11 - Poverty among the social groups

	ST	SC	Other	Total
Poor	43.79	32.19	19.48	24.58
Nonpoor	56.21	67.81	80.52	75.15
Total	100	100	100	100

Note: Poverty cut is Rs.358 per month (approx $ 8.5 per month)
Source:Gaiha et.al (2007)

Table 3.12 - Level of Education among the social groups

	ST	SC	Other	Total
Illiterate	61.94	57.85	42.58	47.68
Literate	8.92	7.6	8.07	8.07
Primary	10.68	11.6	14.02	13.18
Middle	10.66	12.25	16.35	14.93
>Middle	7.79	10.7	18.97	16.14
Total	100	100	100	100

Source:Gaiha et.al (2007)

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The discriminatory practices such as denial of access to resources, employment, education and common facilities that others have, impoverishes the lives of individuals from excluded groups, which is concern not only for the sake of equity but even for the sake of efficiency. Fixed occupations essentially involve restrictions on mobility of labour and capital across caste groups, leading to an imperfect market situation and a fragmentation of economic activities (Thorat, 2007). Akerlof (1976) had argued that given the segmented and imperfect character of the labour market, the economic outcome of the caste economy is lower than posited in the model of perfectly competitive markets. Moreover, the caste stigma acts as a disincentive to respond to market signals due to the notions of pollution and purity attached to occupations.

Towards a Perspective

This study within the broad perspective of national system of innovation and development framework, examined the evolution of the India's innovation system, and highlighted a number features, emerging trends and located a number issues for issues for future research. Given the objective at hand we have adopted a broader perspective in analysing the national system of innovation and production. This necessitated an exploration of the production system, capacity building process, policies and institutions above all the demand side - very often neglected aspect in the common discourse in innovation and development. We have argued that a broader set of institutions such as macro-economic policies, trade and investment policies, the policies relating to financial system and labour market among others play a significant role in the making of India's innovation system. In this process we have been able to locate a number of unique characteristics of the national innovation system in a developing country like India. This is could contribute significantly to conceptualise innovation system from a southern perspective.

Innovation systems being a post-facto analytical approach informed by historical perspective, the paper attempted to situate the uniqueness of India's innovation system in its unique colonial origins as well as the subsequent rich and diverse debates about the nature and direction of development to be undertaken. It is evident that notwithstanding the varies attempts towards evolving institutions and promoting their interactions the innovation system in the country appears to be in the preliminary stage of development as compared to those in developed countries. We have highlighted the emergence of a vibrant economy driven by the service sector with increased presence of skill intensive sectors like IT and software; However, dichotomies of varied type like the lagging industrial sector, stagnant agriculture inter-alia on account of decreasing public investment and a near collapse of the research and extent system and other developments leading to a situation where in millions of small and marginal holders get excluded from the innovation system. What is more, the agricultural sector that accounts for only boy 15 per cent of the GDP accommodates nearly 60 per cent of the population a manifestation of the growing inequalities in an otherwise vibrant economy. While the state has been instrumental in evolving varied institutional arrangements for the emergence of an innovation system as well as the ways and means to harness the powers of science and technology for the transforming a backward, agrarian economy to one among the engines of southern growth, there do exist dichotomies and rigidities at different levels. This in turn calls for varied issues like the role of state in innovation system; and financing innovation and other issues to see how it is different from the experience of north on the one and between the BRICS countries so that lessons could be drawn.

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The industrial structure of the country, with dominant public sector and organised private sector co-existing with a substantially large and diverse small scale sector with its contribution national innovative capability, opens up yet another set of issues especially the process of innovation as it takes place in the SME sector. An over view of the structure and nature of demand, especially of the social kind, and the unequal distribution of resources and infrastructure that characterise the innovation system and the corresponding levels of inequality it generates is yet another issue we have highlighted. While there are indications of a growing economy with greater role for the service sector, over 92 per cent of the employment is in the unorganised sector which yet another uniqueness of the innovation system and our understanding its dynamics at best remain rudimentary. Driven by globalisation India has also been competing with other countries like China to attract more FDI with a greater degree of success. There are also growing evidences to indicate that India is increasingly moving up from participation in Global production network driven by FDI to global innovation network with actively participating in the R&D network of MNCs. More importantly the country takes pride today as one of the major sources of outward FDI from developing countries. This again raises a number of issue of immense policy relevannace not only for India but also for countries in the South in general and BRICS in particular.

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