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INSTITUTIONAL ENVIRONMENT AND THE DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY IN INDIA

Short title: Liberalization and IT in India

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Abstract

The paper examines the impact of institutional environment on the growth of the Indian information technology (IT) industry. The study reveals that before the first generation of reforms, that is, 1991, the government was pursuing a structuralist approach toward economic development. After liberalization in 1991, the government embarked on pro-active economic policies for the diffusion and production of IT. Consequently, the IT industry experienced an unprecedented growth rate in domestic as well as export markets. However, foreign direct investment (FDI) policies have not been successful in attracting the desired level of foreign investment, which is very important for a high-tech sector such as IT hardware manufacturing. The study suggests that immediate corrective measures need to be taken to augment the IT manufacturing industry, which can

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significantly contribute to national economic development and employment generation.

Keywords: Information technology, institutional environment, India, performance

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INTRODUCTION

Recent technological development led by information and communication technologies (ICTs) is regarded as revolutionary (Mansell and Wehn, 1998). Its potentials are recognized by both developing and developed nations. In the words of the Secretary General of the United Nations,

“Communication and information technologies have enormous potential, especially for developing countries, and in furthering sustainable development” (Annan, 1997).

The applications of ICTs cut across geographical boundaries and types of activities. ICTs are considered to be very pervasive as they can be applied in a wide variety of fields such as agriculture, health, education and training, manufacturing, services, transport, business, and environmental management. In recent years, the manufacturing of ICT products and related services has been a major industry in the US, Japan, and Europe (Dedrick and Kraemer, 1993). Several developing countries have also emerged as major producers of ICT products and services. India too has made significant progress in the development of an IT industry that is capable of producing hardware for the domestic market and software for exports.

It is argued in the literature (Coase, 1992; North, 1991) that the institutional environment created by governments in the form of policies and interventions has a bearing on economic development in developing as well as developed nations. In developed countries, interactions between firms and government may not be very strong, while in developing countries interactions are not only very strong, but many times firms require pro-active and promotional measures. The economic performance of a country is significantly influenced by the promotional and pro-active

policies of governments. The emergence of the strong economies of newly industrialized countries (Singapore, South Korea, Taiwan, and Hong Kong) is a case in point. The World Bank (1993) attributed the astonishing success of the East Asian “Tigers” mainly to liberalization, export orientation, high levels of investment, and education. Despite the pervasiveness of ICTs, the diffusion and development of ICTs in developing countries has been uneven (Mansell and Wehn, 1998). There have been several studies (UNCSTD, 1997; Howkins and Valantin, 1997; Lal, 1999) that analyze the causes and consequences of the adoption of ICTs in developing countries. These studies emphasize the importance of information infrastructure in the diffusion of ICTs. Besides information infrastructure, the UNCSTD (1997) study concluded that governments need to give priority to polices, regulations, education, and training, as also to technology assessment programs to enhance the capacity for creatively producing or using ICTs. While emphasizing the role of creating a conducive institutional environment, the UNCSTD study underlines the necessity of a national ICT strategy.

Lack of information infrastructure is considered to be one of the major impediments in the diffusion of ICT. Information infrastructure includes the development of technological capabilities for use and production of ICTs and can be divided into three categories: (1) global information infrastructure (GII); (2) national information infrastructure

(NII); and (3) local information infrastructure (LII). Governments can play a very important role in building a proper information infrastructure. However, models of development of information infrastructure are dependant on the stage of development of an economy and are expected to vary significantly in less developing and least developing countries (Mansell and Wehn, 1998).

There are strong reasons for skepticism about the positive impact of liberalization. It may lead to the destruction of domestic manufacturers, who cannot compete with low-cost imports. It could also lead to duality in economic development, because the benefits of liberalization could be grabbed by the elite. Despite these risks, every country that has become a significant player in the global IT industry has employed some form of promotional policies (Evans, 1992; Dedrick and Kraemer, 1993).

There have been several studies (Brunner, 1991 and 1995; Dedrick and Kraemer, 1993) that deal with the development of the ICT industry in India. The studies by Brunner (1991) and by Dedrick and Kraemer used the data of the pre-liberalization period of the Indian economy, whereas Brunner's 1995 study, though carried out after liberalization, concentrates on the technological changes in the Indian computer industry. While the earlier studies were undertaken in the era that was dominated by import substitution rather than by an export-oriented policy regime, this study examines the impact of liberalization on the growth of the IT industry in

India in an era of privatization and deregulation, the tenets of the neo-classical approach toward economic development.

The analytical framework that encompasses the interactions among the elements of the network—that is, among government policies, information infrastructure, the IT industry, and markets, is depicted in Figure 1.

******INSERT FIGURE 1 HERE******

Arrows in Figure 1 represent the direction of the influence of one element of the network onto another. As shown in the figure, governments can influence the growth of the IT industry by embarking on economic policies aimed at affecting supply-side as well as demand-side factors. Supply-side factors consist of telecommunications networks, power, transport, human resources development, and export-import policies, whereas the demand-side factors include encouragement of the use of IT in the domestic market. Demand elasticity of IT products in the domestic market can be greatly influenced by proper monetary and fiscal policies. For instance, banks and other financial institutions can provide loans for the purchase of IT products to individuals and corporations, at a competitive rate of interest. Another area where government intervention is needed to harness the potential benefits of the IT revolution is in human resource development. Liberalization of export-import policies are equally important for efficient allocation of resources.

The remainder of this paper is organized as follows. The highlights of export-import (EXIM) are presented in Section I, while Section II deals with technological policies. In Section III we outline human resource development policies, whereas Section IV delineates the structure of the Indian ICT industry. Performance of the ICT industry in domestic as well as in international markets is discussed in Section V. Finally, the findings of the study are summarized in Section VI.

I. EXPORT-ORIENTED POLICY REGIME

Past and present policies of the government of India have been responsible, by and large, for the success and failure of the growth of the ICT industry. Until the mid-eighties, India had been following the structuralist approach toward economic development by concentrating on import substitution policies. Inward-looking policies, however, could not achieve rapid economic growth, significant improvement in the living conditions of the people, or self-reliance, for which policies had been justified by successive governments since independence. In 1985, the government started a reform program aimed at changing import substitution to export-oriented policies. Due to an unstable political environment during 1988–90, the reform process could not maintain its momentum. With a relatively stable government in place in 1991, the liberalization process was accelerated. Major policy changes in the

electronics sector were introduced.[1] In the next sub-section, we present the salient features of the policies that might have contributed to the growth of the IT industry in India.

1.1 Export Processing Zones (EPZs)

The concept of EPZs was introduced in 1975 with the establishment of the Santa Cruz Electronics Export Processing Zone (SEEPZ) in Mumbai. Foreign and Indian investors were offered incentives to establish the export base in the SEEPZ. The incentives included inexpensive land, tax holidays, duty-free import of inputs, and a single-window clearance process. However, the procedures for acquiring a license to import inputs were very complicated. It was mandatory to get a not-manufactured-in-India (NMI) certificate for the import of inputs. This policy, under the general import-substitution policy regime, was aimed at encouraging the use of indigenous inputs as much as possible. Consequently, the success of the establishment of the SEEPZ was limited.

After liberalization of industrial policies in 1991, the mandatory requirement of the NMI certificate was relaxed on almost all electronic components.[2] The new liberalized import policy resulted in the

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[1]Industrial policies are promulgated by the government of India through legislation published in the *Gazette of India*. Industrial policies witnessed major changes in 1991 and 1998; these policy documents were published in the *Gazette of India* in the respective years.

[2]*Monthly Newsletter*, India Investment Center, April 1992.

establishment of several EPZs in other parts of the country. At present EPZs are located at Mumbai, Kandla, Falta (Calcutta), Chennai, Kochi, Noida, and Vishakhapatnam. Of these, the SEEPZ is primarily meant for the development and promotion of the electronics industry. The salient incentives available to a unit in an EPZ are as follows:[3]

1. Goods supplied to the units in EPZs from the Domestic Tariff Area (DTA) are treated as exports eligible for export incentives.
2. Permission to sell in the DTA up to 40% of the production in case the value addition exceeds 25%, and up to 30% of the production in case the value addition is between 15% and 25% (such sales attract 50% of normal customs duty).
3. Minimum value addition for computer software is 30%.[4]
4. Complete exemption from central taxes on production and sales.
5. Tax holiday for a period of five consecutive years during the first eight years of operation.

1.2 Free Trade Zones (FTZs)

Introduction of free trade zones is a very recent development in the liberalization process. FTZs were expected to be in operation beginning in

[3]*Investment Promotional Programmes for Electronic Hardware and Software*, Manufacturers Association for Information Technology (MAIT), 1999.

[4]Ministry of Information Technology (earlier DOE) annual report, 1999.

July 1999.[5] Units in the free trade zone shall be permitted to carry out any manufacturing or trading activities. They shall not be subjected to any predetermined value addition, export obligation, or input-output/wastage norms. They shall be treated as outside the customs territory of the country, and customs officials shall man only entry and exit points. This scheme is expected to further boost export performance, as the minimum value addition of 30% of software items has been relaxed.

1.3 Export Promotion Capital Goods (EPCG) Scheme

Capital goods are allowed to be imported at 10% customs duty, with an export undertaking worth four times the CIF value of imports over a period of five years. In the amended EXIM policy, the threshold limit for zero-duty import of capital goods for the software sector has been brought down from Rs. 200 million to 1 million. Software exporters can also import computer hardware under this scheme. Zero-duty import of capital goods in the electronic sector, other than software, has been brought down to Rs. 10 million from 200 million.

1.4 Duty Exemption and Duty Drawback Schemes

Exporters are eligible for reimbursement of all customs duty paid on imported inputs of an export product. In few cases, a fixed percentage of the export value is paid to facilitate quick reimbursement. Duty-free

[5]National Association of Software and Services Companies (NASSCOM) annual report, 1999.

import of raw material, components, consumables, parts, accessories, mandatory spares, and packing material are permitted against a duty-free license.

1.5 Foreign Direct Investment (FDI)

FDI policies provide automatic permission from the Reserve Bank of India for foreign equity up to 51% in almost all areas of electronics and software. Proposals from non-resident Indians (NRIs) and overseas corporate bodies whose predominant owners are NRIs receive automatic approval for up to 100% equity on a repatriable basis. Foreign investment up to 100% is welcome in electronics and software industries that are set up exclusively for exports. The units set up under these programs are eligible to import their entire requirement of capital goods, raw materials and components, spares, and consumables etc., free of duty. Deemed export benefits are available to suppliers of these goods from the DTA. These units are also entitled to the benefits that are available to EPZ units.

II. TECHNOLOGY POLICIES

The success of the IT industry is intertwined with communication technologies. Particularly in the era of networking and distributed computing, communication technologies have taken a pivotal place in the diffusion and production of IT. Thus while discussing the salient features of IT-related policies, we shall highlight the measures taken for the development of communication technologies.

2.1 Information Technology

Market equilibrium is determined by supply and demand factors. Laissez-faire market economy may not be the right policy choice for the development of a new industry such as IT. Realizing the need for proper policies for the promotion of IT use as well as the encouragement of IT production and related services, the government has initiated various schemes in different policy regimes. We discuss in this section the important policy measures that have been taken to promote the IT industry. The entire period of development of IT can be divided into three phases. The first period, before 1991, was dominated by a structuralist approach toward economic development. The second period, from 1991–1997, witnessed outward-looking liberal policies. The third period, after 1998, is expected to have a more liberal policy regime. We shall concentrate on the growth of the IT industry in the last two periods.

Although the government encouraged the production of IT in India during the 1980s, it failed to create the competitive environment which is crucial for growth of any industry. High tariff barriers were erected to prevent multinationals from entering the domestic market. During the 1980s the emphasis was on production of micro- and mini- systems. The computer software sector could not flourish, due to the non-accessibility of mainframe, mini-, and micro-systems. In that period, systems were not based on an open architectural design. Consequently, software packages

(system as well as application) used to be system-specific. By the late 1980s, PCs came into the Indian market. These systems were easily accessible to software companies, which began developing software on PCs in an MS-DOS environment. By the early 1990s the IT industry, particularly the software sector, emerged as a sun-rising industry. The government responded positively and came out with several policy measures to boost the development of the IT industry. A brief summary of the reform programs started during 1991 and 1998, and of the performance of the IT industry, is presented in the next two sub-sections.

2.1.1 First Generation of Reforms: 1991–97

Although programs to encourage the use of computers started in the mid-eighties, by and large these remained restricted to government-funded institutions. The main hindrance to the penetration of computer use into the private sector was the high price of the systems. This was because of high tariff barriers (180–200% duty on inputs and finished goods). Government institutions, however, were provided separate funds for the computerization of their activities. The diffusion process gained real momentum in 1992 when the tariffs were brought down substantially and the importation of computers and accessories was made much simpler.[6]

Several factors such as the high price of systems, lack of an information infrastructure, non-availability of customized products, the

[6]*Monthly Newsletter*, India Investment Center, April 1992.

complexity of the technology, uncertainty about returns on IT investment, the competitive environment, and limited access to financial institutions, could be cited as main reasons for the slow diffusion and production of IT. Government policies, such as substantial changes in import duty on inputs and on finished IT products, drastically reduced the prices of IT products in the domestic market. Consequently, PCs came within the reach of small companies and individuals. Reduction in prices due to low tariffs and high competition from multinationals might have resulted in the fast diffusion of IT. Availability of industry- and function-specific IT tools might also have contributed to the rapid adoption of IT. In the last few years IT firms have launched a larger number of application packages such as inventory management, accounts software, and office automation packages. These function-specific IT tools are expected to play a crucial role in the diffusion of IT.

2.1.1.1 Diffusion of IT

Massive computerization programs were launched to harness the potential benefits of IT in the manufacturing and service sectors. Private sector firms are provided free technical services by the government. For instance, free consultancy services are being provided to the manufacturing sector by Foundations of Innovative Technology Transfer (FITT), an organization funded and supported by the Indian Institute of Technology, Delhi. Efforts were also made to influence the supply-side factors. Several IT

manufacturing firms collaborated with financial institutions for fast diffusion of IT in the domestic market. Under the agreement between IT firms and financial institutions, buyers of IT products manufactured by such firms could get loans on easy terms and conditions from those financial institutions. The unprecedented growth of IT diffusion during 1991–97 in India may be due to the promotional measures taken by the government. Figure 2 shows the growth of IT industry in the domestic market, in value terms.

******INSERT FIGURE 2 HERE******

It can be seen from Figure 2 that the use of software is steadily rising. Its CAGR has been growing at 37.8%. Figure 2 also shows that growth of hardware sales is negative from 1997–98 to 1998–99. The negative growth rate of hardware in value terms is a result of stiff price competition. Although this is true in value terms, in quantity terms the industry has experienced a positive growth. According to an estimate of NASSCOM during 1998–99, more than 820,000 PCs were sold in India. This took the PC penetration in India to 3.2 PCs per thousand persons by the end of 1998–99. The manufacturing sector has experienced an average growth rate of 28–30% over the last decade. The hardware sector witnessed an accelerating paradox of increasing unit sales and constrained revenues.

2.1.1.2 Production of IT

In 1991, the government changed its economic policies and moved along the neo-classical approach to economic development. It opened the Indian market to foreign firms on the one hand, and embarked upon export promotion policies on the other. Major steps taken to augment export intensity included the establishment of Software Technology Parks (STPs) and Electronic Hardware Technology Parks (EHTPs).

The Ministry of Information Technology (then Department of Electronics) created STPs as autonomous institutions to cater to the needs of the IT industry in the fields of export of IT software and services. An STP acts as a single-window solution provider for organizations engaged in the export of IT software and services. It provides infrastructural facilities including high-speed data communication services, and solicits all the approval required by this industry with a minimum gestation period. STPs also own gateways for data communication. At present fifteen STPs are in operation in the country.

The EHTP scheme is not meant only for IT hardware. It has been designed to meet the specific requirements of the electronics sector. The EHTP scheme was launched to enhance the ease of doing business in international markets while making preferential access to the vast domestic market. The salient features of the scheme are: (1) duty-free imports of raw materials, components and other capital materials; and (2) sales into the domestic market from EHTP units are permissible up to 50%

of FOB exports and subject to only 50% of customs duties. The growth of IT production is shown in Figure 3.

******INSERT FIGURE 3 HERE******

It can be seen from Figure 3 that the performance of the software, services, and peripherals sectors has been steadily increasing since 1994–95. However, despite the EHTP and other promotional measures, IT hardware has not been able to keep pace with IT software. The main hindrance in the growth of the IT hardware sector has been lack of financial resources and procedural delays in importing inputs such as microchips and other accessories that are not manufactured in India. Another reason for decay in the IT hardware sector has been the delays in fulfilling the commitments made to foreign buyers. A high rate of obsolescence and an incapability of Indian IT firms to respond to the changes in product specifications and designs have also contributed to the dismal performance of the Indian IT hardware sector in global markets. The government has taken a few steps to augment IT production in the second phase of reforms.

2.1.2 Front-runner in the Age of Information Revolution: 1998–2002

An ambitious second generation of the economic reforms program was initiated in a very fluid political environment in 1998. The return of the same political party in 1999 provides reasonable political stability, so the reform process is likely to be accelerated soon. Having noticed the impressive performance of the Indian IT industry in the world market, the

government constituted a National Task Force on information technology in 1998 to recommend steps to be taken for removing the bottlenecks and to revise the existing policies in order to make India a superpower in the global IT industry. The salient features of the 108 recommendations of the Task Force aimed at increasing the production and diffusion of IT are discussed in this section.[7] These recommendations became effective in July 1998, and are as follows:

1. For any investment made in IT products and IT software, 100% depreciation shall be allowed in two years for which the Ministry of Finance shall take suitable action.
2. A major promotional program that includes the development of software in regional languages shall be launched.
3. 1–3% of the budget of every Ministry/Department shall be earmarked for applying IT in that Department.
4. Government shall soon launch three schemes for students, teachers, and schools desirous of buying computers under attractive financial packages. These schemes will be supported by initiatives for the donations of computers by IT companies and other business houses, as well as bulk donations by NRI organizations.

[7]For more on these recommendations see the *Gazette of India*, No. 60, New Delhi, July 25, 1998.

5. Computers and the Internet shall be made accessible to schools, polytechnics, colleges, and public hospitals in the country by the year 2003.
6. Out of the 217 items listed in ITA-I, 94 items which were proposed earlier for zero duty by January 1, 2000 shall now be advanced to January 1, 1999. These items include the components that are used to manufacture IT products.
7. The remaining items earlier proposed for zero duty by January 1, 2003/2004/2005 shall now be advanced to January 1, 2002.
8. Duty on capital goods for the manufacture of items covered under zero import duty by 2002, becomes zero by January 1, 2000.

With the implementation of the above recommendations, it is expected that the Indian IT industry might achieve an even higher growth rate compared to what it has been experiencing. If second-generation reform programs succeed, India might achieve its target of a tenfold increase in the penetration rate of PCs by 2008.

2.2 Communication Technology

An effective telecommunication network is a crucial element of the IT infrastructure. The government, after realizing the importance of this sector, started reforms in 1991. Consequently, telephone density per 1000 persons increased from 5 in 1989 to 12 in 1996 (Mansell and Wehn, 1998). However, the reforms initiated during 1991–1997 were considered

insufficient to keep pace with the technological development in IT. Thus the National Task Force has made several recommendations to remove the bottlenecks to create a powerful telecommunication network. The important recommendations are:

1. Voice and data communication on dedicated or leased circuits is permitted for IT software development and services, but no telephone traffic is permitted.
2. Requests made by STPs or IT promotional organizations approved by the government for release of bandwidth shall be acted upon by Videsh Sanchar Nigam Limited (VSNL) within two weeks of receipt.
3. Providing access to the Internet through authorized cable TV providers shall be permitted to any service provider without additional licensing, subject to applicable cable laws.

The recommendations of the Task Force are expected to show their impact on further growth of the Indian IT industry after some lag.

III. HUMAN RESOURCE DEVELOPMENT

Human capital is a key to success in a high-technology sector such as IT. Skilled workers are needed not only for the production of IT, but also for its successful use. The technological change caused by the adoption of IT is regarded as a skill-biased technological change (Doms et al., 1997; Lal, 1996).

The private sector in India took the first initiative to impart training in computer applications. NIIT and Aptech (earlier Apple Computers) were among the few private firms to start training programs in the early eighties. Subsequently, in the late eighties, public-sector institutions and a few universities also began offering computer courses. Among the public-sector institutions that offer degree and diploma courses in computers are the Electronic Trade & Technology Corporation (ET&TC), the Ministry of Information Technology (MIT), the Computer Maintenance Corporation (CMC), and the UP State Electronic Corporation (UPTRON).

We can group the computer training institutions into four categories: (1) universities; (2) technology institutions; (3) state-owned public-sector institutions; and (4) private institutions. Universities offer courses in computer applications such as Bachelor of Computer Applications (BCA) and Master of Computer Applications (MCA), whereas courses offered by technological institutions concentrate on system software, and system design and architecture. Most of the engineering colleges, the Indian Institute of Technologies (IITs), and the Indian Institute of Science (IISc), are the technology institutions that offer B.Tech. and M.Tech. degrees in Computer Science. State-owned public-sector organizations provide part-time training for in-service persons in applications areas, while private-sector institutions offer all types of courses including networking, Internet, and other applications areas. The training infrastructure of

private institutions in some cases is better than that of other organizations. The duration of the courses offered by all institutions varies from six months to five years.

In 1996, the Indra Gandhi National Open University (IGNOU) took the responsibility of providing computer education to people in remote areas. IGNOU started distance education computer courses leading to BCA and MCA degrees. The success of IGNOU's program can be judged by the increasing number of students in these courses. In 1998–99 the total enrollment was more than 10,000 all over the country. Despite these efforts in human resource development, the National Task Force on information technology has made the following recommendations to meet the growing demand for highly qualified engineers and technologists:

1. All universities, engineering colleges, medical colleges, research and development organizations, and other institutions of higher learning in the country shall be networked for a supplementary program of distance education for improving the quality of education before the year 2000.
2. The seven national institutions (six IITs, IISc) shall be encouraged to triple their output of students in IT by suitably restructuring the program.

IV. INDUSTRY STRUCTURE

Although there are around 135 companies involved in the production of IT, training, and software development, the Indian IT industry may be considered as a fairly concentrated industry in which the top five companies accounted for 64% of the market share in 1989–99. The performance of these five firms is presented in Table 1.

******INSERT TABLE 1 HERE******

Almost all of the above firms had collaborations with MNCs. For instance, Wipro's collaboration with Acer lasted for several years. Acer and Wipro are now doing business in India independently. Similarly, HCL's partnership with Hewlett-Packard was broken in 1997. By and large, the above five companies have been maintaining their market share for several years. For a better understanding of the impact of liberalization on the growth of the IT industry, case studies of the above firms are presented in the next sub-section.[8]

The companies selected for these case studies represent the major activities of the IT industry: software development, hardware manufacturing, human resource development, and Internet services

[8]The data and the descriptive information presented in the case studies have been taken from the Capital Line database. This database is collected, maintained, and distributed by Capital Line. The database contains comprehensive information about more than 8,000 Indian companies.

provider.

4.1 Wipro Corporation

The company is a large conglomerate with operations in agro-based industry, medical equipment, consumer products, financial services, and information technology. In 1994–95, Wipro and Acer (Taiwan) began a joint venture to manufacture and market the entire range of Acer products including desktops, laptops, servers, and monitors. The joint venture Wipro Infotech consolidated its position and emerged as one of the leading IT companies in India. Its sales turnover has been highest for the last two consecutive financial years.

After liberalization, the company concentrated on software engineering and IC designs for international customers. According to the Chairman of Wipro, Azim Premji, this initiative has changed the mindset of the company from that of a provider of hardware products to a company that is a provider of software services and customized, integrated, high-value, information-technology-based productivity solutions. The new strategy is earning dividends for Wipro. Table 1 shows that the profit and sales turnover of Wipro was highest in 1998–99. The company enjoys 30% of the market share of the Indian IT industry.

4.2 HCL Infosys

The company was set up by a group of technocrats in April 1986. It was established during the time when a reform process had begun to take form

under the dynamic leadership of India's youngest prime minister, Rajiv Gandhi. The major thrust of the reform process was a shift from import-substituting inward-looking policies to export-oriented outward-looking policies. The reform programs included steps to simplify the tax system and shift import control from licensing to tariffs. However, tariff rates were kept high to prop up sick state-owned enterprises. India could not attract foreign investment due to barriers created by the Foreign Exchange Regulation Act. Although the reforms introduced in the mid-eighties were welcome, they were neither sufficient for the IT industry to grow in the domestic market nor were they enough to permit venturing into the international market.

In 1991, the government implemented a broader reform program. Foreign equity participation was raised from 40 to 51% and restrictions on foreign investment were also eased. HCL Infosys took advantage of these policies and entered into a joint venture with Hewlett-Packard, US, for computer hardware manufacturing, marketing, and servicing. Its range of products included multi-user super-minis and engineering workstations. The technology of these products was being provided by the foreign partner.

Initially, the company was not in the software business. After establishment of STPs by the Government of India, HCL Infosys opened its software subsidiary. In 1998, the collaboration with HP was broken and

the company was renamed HCL Infosys. As can be seen from Table 1, the growth of its sales turnover has been much less than that of other firms. This may be because the main business of the company is hardware manufacturing. Although India has been successful in building an IT industry that is capable of producing hardware for the domestic market, the export performance of the hardware manufacturing segment has been negligible. In that sense, the market for hardware firms is limited to the domestic market. Moreover, MNCs have also made a dent in the domestic hardware market. Despite the presence of MNCs in the domestic market, HCL Infosys enjoys a very high share (67%) in the domestic corporate market.

4.3 Infosys Technologies

This is a 100% software company. Although the company was incorporated in 1981, it came into the limelight in 1992. It can take credit for being the only Indian software company to have a joint venture in the US, with Kurt Salmon Associates (KSA). The company has several overseas software centers and is engaged in software development in the areas of distribution, financial services, manufacturing, and communications. The company has been growing at more than 70% since 1992. Infosys is one of the few Indian firms that are listed on the NASDAQ stock exchange. Such an impressive growth rate might be attributed to the export promotion policies of the government.

4.4 National Institute of Information Technology (NIIT)

NIIT was incorporated by an Indian Institute of Technology-trained engineer in 1981. The company came into being with the objective of training professionals for the Indian IT industry. It diversified into corporate training and software development in 1984. While focusing on training IT professionals in India and abroad (Jakarta and Bangkok), NIIT started catering to system integration and IT consultancy. It is the largest private training institution in India, having a network of more than 600 centers. At present NIIT has offices in 17 countries including the US, UK, and Japan. The company's performance has been indirectly influenced by liberalization as its success was linked with the growth of the IT industry. The company has been growing at the same rate (more than 50% of the Indian IT industry) since 1992.

4.5 Satyam Computer Services Limited

Satyam Computer Services Limited (SCSL) has been in the software development business for quite a long time. However, the company made its presence felt in the Indian IT industry only in 1991. SCSL became a private limited company in the same year; it is one of the IT firms that took advantage of the liberal economic policies of 1991 to set up four software development centers in four major Indian cities: Chennai, Secunderabad, Bangalore, and Hyderabad. Initially it was engaged in the development of software for IBM systems, Windows, and Unix platforms.

Of late SCSL has emerged as the largest internet-service-providing company, while maintaining its dominance in software exports to France, Sweden, and the US. In 1989–99, the firm was listed in NASDAQ. The company's average annual growth rate has been more than 60% since 1991.

V. PERFORMANCE

The performance of the IT industry may be partly attributed to the liberalization and deregulation programs that were started in 1991. The IT industry has grown at 31.3% during 1994–95 and 1998–99. While the CAGR of software exports has been 53.8%, the software sector in the domestic market has achieved CAGR 37.8% for the same period. However, the performance of IT hardware has neither been impressive in the domestic market (13.4% growth rate during 1994–99) nor in the export market. In fact, India's hardware exports declined substantially in 1998–99 from the previous year. It may be mentioned here that India has a comparative advantage of a large pool of skilled workers. A comparative advantage of this kind is necessary but not sufficient for the development of IT hardware manufacturing, which is skill- as well as capital-intensive. FDI flows, therefore, are expected to have bearings on the growth of the IT hardware sector. The software sector, on the other hand, is neither capital-intensive nor does it face the problems of procedural delays in fulfilling the commitments of foreign buyers. The software developed for foreign buyers can be transferred instantaneously through the Internet. The

software sector, being more skill-intensive and less capital-intensive compared to its twin, is unlikely to be affected by FDI flows. The impressive performance of the software sector may be partly attributed to the characteristics of the sector and the comparative advantages of the country. The Stanford University Computer Industry Project (1997) conducted a survey to examine the comparative advantages of several developing and developed nations; the findings of the survey are presented in Table 2.

******INSERT TABLE 2 HERE******

It can be seen from Table 2 that an institutional environment created by the government, in the form of investment policies, specific training programs, and better communication infrastructure, has been found very conducive for the growth of the IT industry. These comparative advantages are not natural, but rather are acquired. India might have been able to acquire them as a result of the first generation of liberalization. The second generation of reforms may further strengthen them. We now proceed to evaluate the performance of the IT industry in the domestic and international markets.

5.1 Domestic Market

We have already discussed the performance of IT hardware and software sectors in Section II. However, the other features of IT such as internet, intranet, and extranet that started becoming popular in the Indian market in the late eighties need to be discussed. Initially, access to the Internet

was controlled by government institutions, and services were available to select educational and research institutions and government departments. In 1995 access to the Internet was made available to the general public. Since then the number of Internet users has grown exponentially. In the following sub-section, we discuss the growth of the Internet in India.

5.1.1 The Internet

The National Informatics Center (NIC) and the Ministry of Information Technology (MIT) have been providing e-mail and Internet services for a fairly long time. NIC's network (NICNET) became functional in the late eighties, whereas MIT's Education and Research Network (ERNET) was started in 1992. NIC has been providing Internet facilities to government departments, while MIT has focused on educational and research institutions. It is worth mentioning that NICNET is India's largest satellite-based network, providing connectivity to all districts of the country, the ministries, and the government departments. Although NIC and MIT were actively involved in encouraging the use of the Internet and in remote access of data by government institutions, Internet access was commercially launched for the general public by VSNL only on August 15, 1995. Despite initial bottlenecks in the communications infrastructure, the number of Internet users has been growing exponentially. The growth in numbers of Internet users is shown in Figure 4.

******INSERT FIGURE 4 HERE******

Figure 4 is based on data on Internet users who have access to the Internet through VSNL. The data provided by VSNL may be treated as representative of the total number of Internet users in India, because until recently VSNL was the only Internet Service Provider (ISP) in the country. The domain of VSNL has not been limited to the general public, however; it has successfully penetrated into government-owned and autonomous institutions. This may be attributed to the state-of-the-art technology provided by VSNL and its virtual monopoly on data communication gateways. Although the government of India, in its 1998–99 telecommunication policy, allowed private companies to set up their own gateways,[9] not a single private company has come forward so far to enter into gateway services.

5.1.2 Internet Service Providers (ISPs)

The government of India, in its 1998–99 telecommunication policy, also opened the Internet service sector to private- and public-sector companies. This policy became operative in December 1998. State-owned and private companies have responded very positively to the new policy. During the eight months since the launch of the scheme, 175 companies have obtained

[9]*Guidelines and General Information for Internet Service Providers, No. 845-51/97 VAS,* Ministry of Communications, Department of Telecommunications, Government of India.

licenses to provide Internet services.[10] Mahanagar Telephone Nigam Limited is one of the major state-owned public enterprises to enter into this business, while Satyam Computers Pvt. Ltd. is a very large private company that has begun competing aggressively with other ISPs.

5.2 International Market

In the export market, the performance of the IT industry has been better than in the domestic market. The trends in software, hardware, and peripherals exports are shown in Figure 5.

******INSERT FIGURE 5 HERE******

Figure 5 shows that the export of software has been steadily rising at an annual growth rate of 53.8%. On the other hand, the export intensity of hardware and peripherals has been fluctuating. The exports of peripherals have increased from US $6 million in 1994–95 to US $19 million in 1997–98 and then declined in 1998–99 to US $18 million. There could be three main reasons for such a phenomenal growth rate in the software sector. First, software is a knowledge-intensive industry which requires lesser fixed capital as compared to the hardware sector. Second, there is availability of qualified programmers and system analysts at a reasonable remuneration. Third, archaic procedural delays are not applicable to these sectors. Firms can honor, without any delay, their

[10]*Department of Telecommunications Report 1999,* Ministry of Communications, Department of Telecommunications, Government of India.

commitments to foreign buyers. The most important element for the success of software industry is a very reliable and high-speed communication network. Besides offering liberal policies, the major contribution of the government has been in providing communication infrastructure.

VI. CONCLUSIONS

This paper examined the effect of institutional environment on the performance of the Indian information technology (IT) industry. Information on reform programs that have been in effect during various policy regimes was collected from the Planning Commission, Ministry of Information Technology, and the Department of Telecommunications. Performance data were collected from the National Association of Software and Services (NASSCOM), the Manufacturers' Association for Information Technology (MAIT), and Videsh Sanchar Nigam Limited (VSNL). The entire development period of IT has been divided into three parts, that is, the pre-liberalization period (before 1991), the first generation of reforms period (1991–1997), and the second generation of reforms period (after 1997).

The study reveals that the government pursued a structuralist approach toward economic development before the first-generation reforms period, that is, pre-1991. The thrust during this period was to achieve

economic development through import-substitution activities rather than export-led development. Although MNCs were permitted to play in the Indian market, domestic firms were protected by fiscal instruments. Consequently, the Indian IT hardware sector could not become internationally competitive. IT software firms could not flourish, as they did not have easy access to the MNCs' computer hardware. Access to their hardware was essential to develop software for systems that were based on proprietary system architecture and designs.

The first generation of reforms was aimed at augmenting the growth of the IT industry in India. Therefore, policy measures were taken for a rapid diffusion of IT in the domestic market, and for boosting the export performance of the IT industry. Customs duty on finished IT hardware products and components was reduced from 200% in the mid-eighties to 25% in 1990 (Dedrick and Kraemer, 1993). The performance of the Indian IT industry in the post-reform period, that is, after 1991, may be partly attributed to the export-oriented policies launched in 1991. The Indian IT industry has achieved a 31% CAGR during 1994–95 and 1998–99, while the CAGR of IT software exports has been 53.8% during the same period. The government succeeded to a great extent in integrating the Indian IT industry with the global IT industry. However, despite several policies for IT manufacturing, the hardware sector has not performed according to expectations. The second generation of reforms launched in 1998 is

expected to boost the performance of the hardware sector. However, there are reasons to be skeptical about the success of the hardware sector even after the second generation of reforms.

The IT software sector has increased its share of total exports of the country from 2.4% in 1994–95 to 4.5% in 1998–99. The software sector has followed the Schware (1992) model of export growth—producing for the domestic market gives companies the skills and a strong financial basis for entering export markets. Having recognized the unprecedented success of the IT software industry, the government constituted a National Task Force on information technology in 1998 to recommend policy measures that can be initiated to make India a global IT superpower and a front-runner in the new millennium. The recommendations of the National Task Force emphasize e-commerce and e-governance. The major impediment in e-commerce and e-governance is the legality of electronically transferred documents. The present government has drafted the IT Bill 1999 that not only deals with the legalization of electronically transferred documents, but has also proposed cyber laws to facilitate electronic communication. The Bill was passed by the Parliament on May 16, 2000, and is likely to greatly stimulate the further diffusion and growth of the IT industry in India.

The impact of liberalization has perhaps been more noticeable in IT software and services. In fact, the hardware sector is thoroughly

demoralized in India. As pointed out by Evans (1992), India needs to have a positive agenda rather than merely adopting a laissez-faire policy, at least in IT manufacturing. The government needs to take immediate corrective steps to augment IT hardware manufacturing. One of the steps could be the creation of a stable investment climate. This can be achieved by further liberalizing the FDI policies to attract foreign investors. For instance, the facilities available to NRIs in the new FDI policies may be extended to other foreign investors. Another measure could be the removal of bureaucratic delays in hardware exports. The main reason for China being considered a desirable destination for investment is the pro-investment policies of the country. As argued by Dedrick and Kraemer (1993), given India's endowment, the government should provide incentives for MNCs to produce in India or to work with Indian companies in order to promote IT manufacturing.

Despite having so-called liberal FDI policies in place, foreign investors have been India-shy. In 1997, of the 10 most significant investments in China, 5 were in IT totaling up to over $6 billion, whereas in India, since liberalization until 1998–99, only $3 million were invested in IT manufacturing (MAIT, 1999). India must embark on pro-active policies to boost IT manufacturing. Failing that, India may witness the exit of the IT hardware manufacturing industry and could become an IT hardware trading country, once WTO recommendations are in place.

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FIGURES AND TABLES (IN THE ORDER THEY APPEAR)

Figure 1: Analytical framework

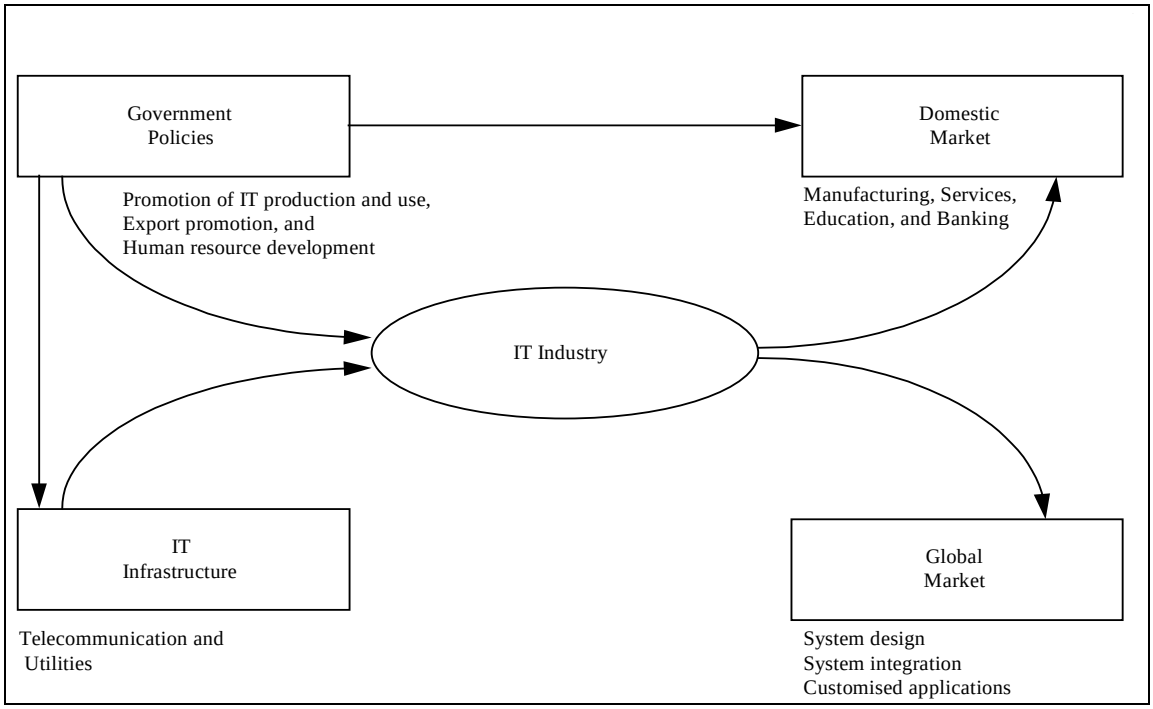
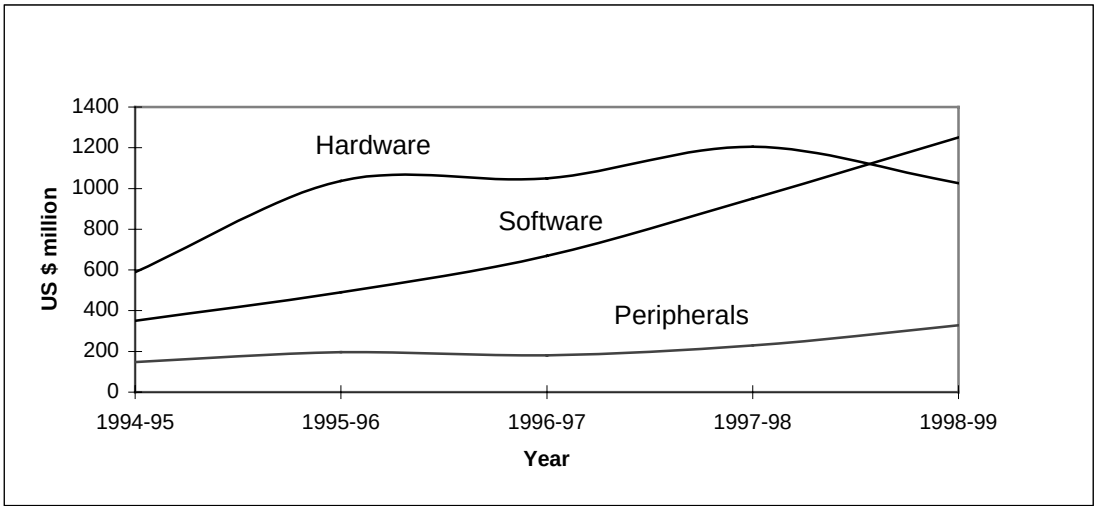
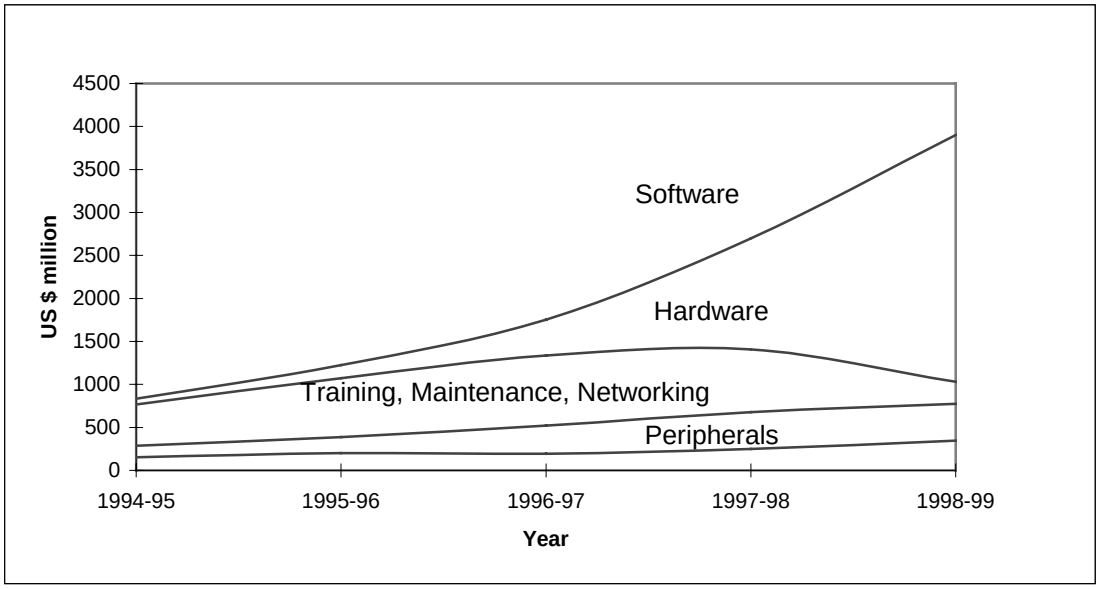


Figure 2: Diffusion of IT in India



Source: NASSCOM, 1999.

Figure 3: Production of IT in India



Source: NASSCOM, 1999.

Table 1: Structure of the IT industry in India

Company	Turnover[a]	Annual Growth (Turnover)	Profit[a]	Year
Wipro Corporation	18308.4	28.31	1702.0	1998–99
HCL Infosys	6940.1	8.80	261.3	1998–99
Infosys Technologies	5088.9	97.50	1352.6	1998–99
NIIT	4576.2	41.10	1083.5	Oct. 97–Sep. 98
Satyam	3781.3	111.85	728.0	1998–99

[a]Amount is in Rs. million.

Source: Dataquest India, *Top 20 IT Companies of the Year*, August 1999.

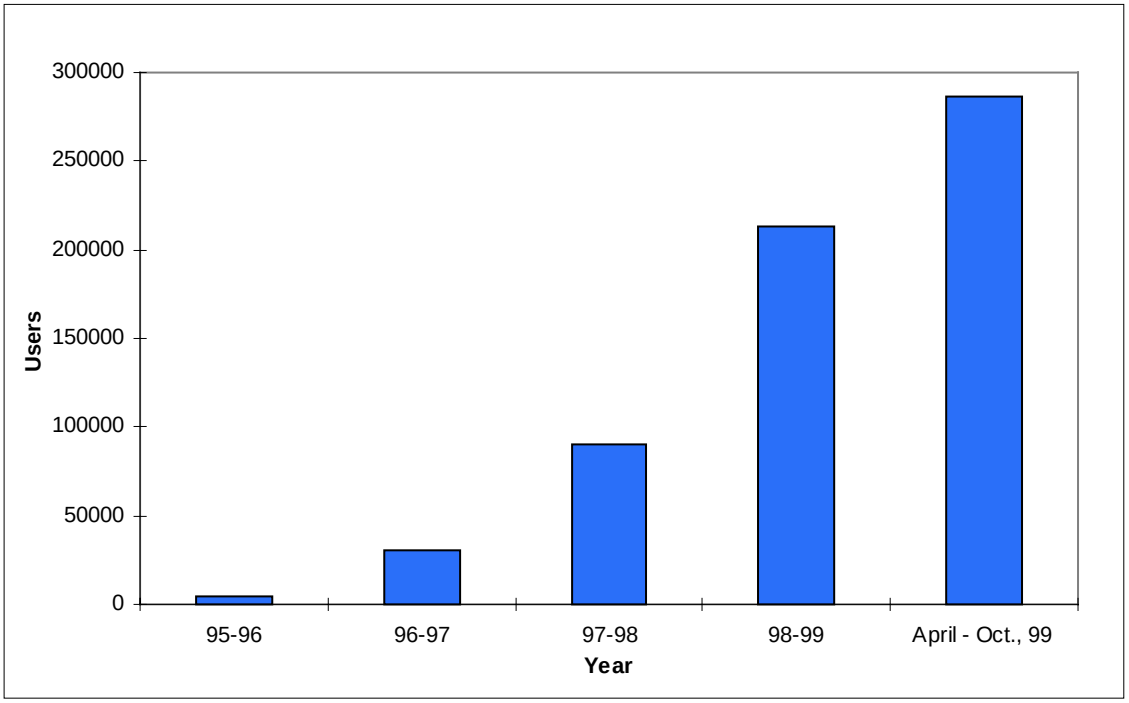
Table 2: Comparative advantages of selected developing and developed nations

	India	Russia	E. Europe	Malaysia	Singapore	China	Japan	Israel	Ireland
1. Good general engineering education system	+	+	+	-			+	+	
2. Specific software and system training	+			-			+	+	
3. Large pool of capable programmers	+	+	+	-	-	+	+	-	
4. English language competence	+	-	-			-	-	+	+
5. Government policies on investment	+	-		+	+	-	+	+	+
6. Communication Infrastructure	+	-		+	+		+	+	+
7. Entrepreneurial know-how	+	-			+		+	+	+
8. Foreign corporate investment	+	+			+	+	-		+

Note: + strong positive; - strong negative.

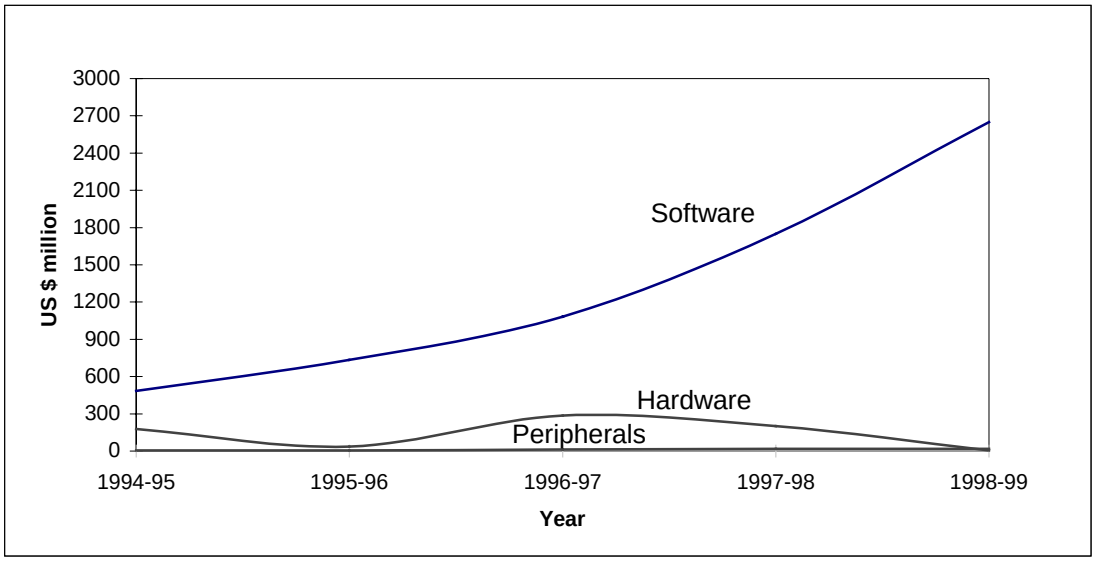
Source: Adopted from the Stanford University Computer Industry Project, 1997.

Figure 4: Growth of the Internet in India



Source: Videsh Sanchar Nigam Limited (VSNL) annual report, 1999. The data for April–October 1999 were collected through an interview of VSNL officials.

Figure 5: Export performance of the IT industry in India



Source: NASSCOM, 1999.