The Diffusion of Information Technology and the Implications for Global Development: A Perspective Based on the Indian Experience

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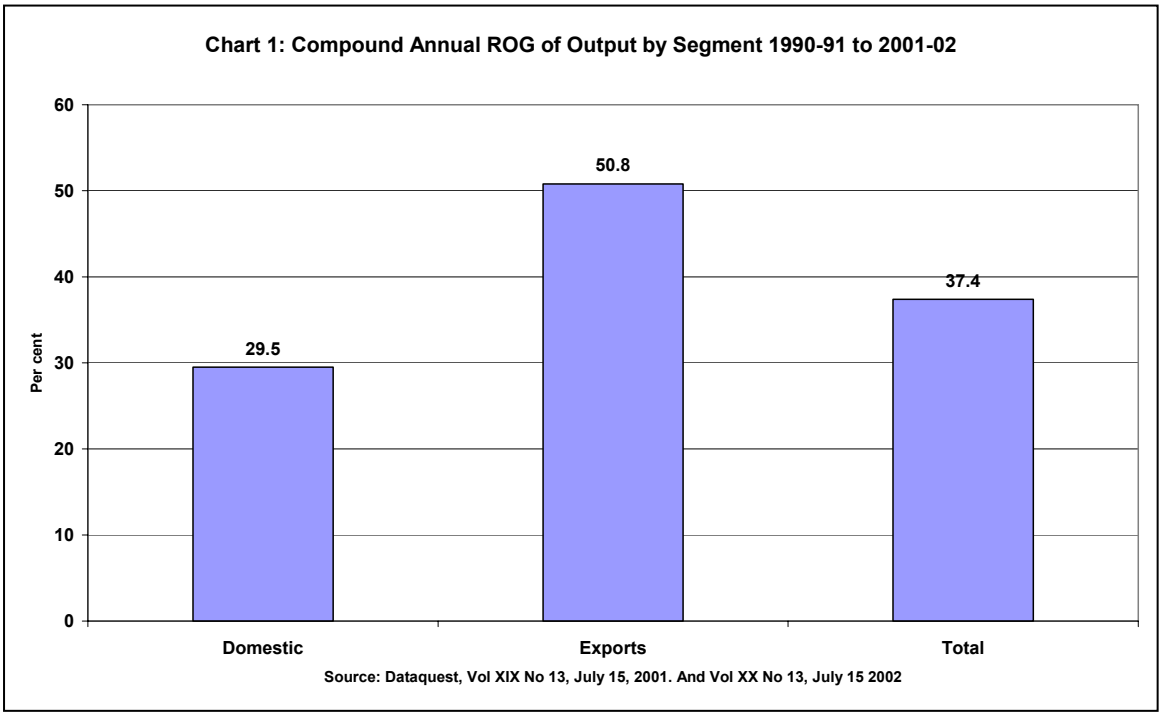
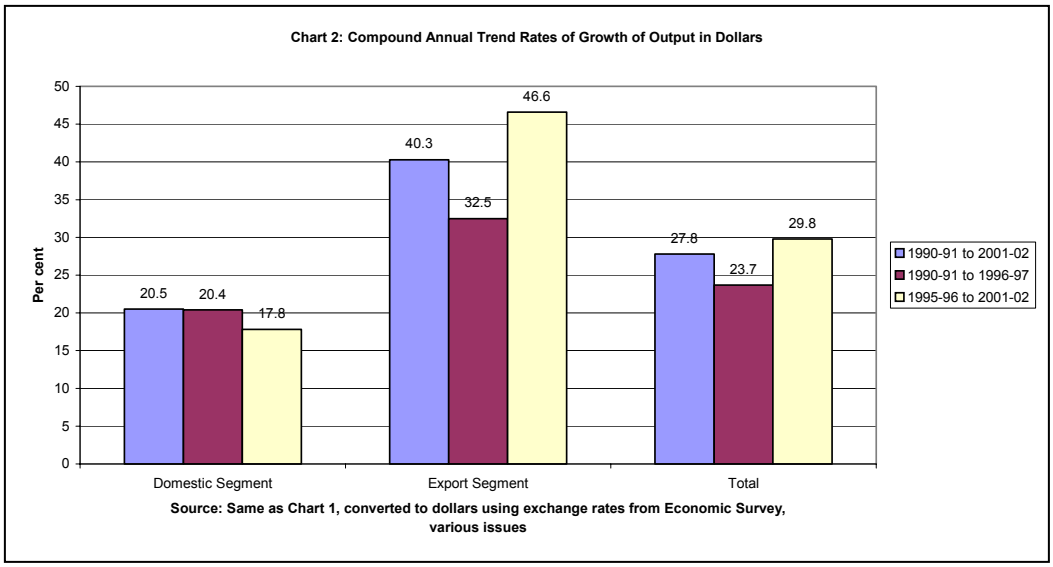
India's experience with growth of the Information and Communication Technology (ICT) sectors, especially the IT component, has attracted attention for a number of reasons. To start with, the pace of growth has been rapid, albeit from a low base, tallying with the dynamism seen as typical of the industry and captured by the oft-quoted Moore's Law.[1] Thus, according to data provided by Dataquest (Table 1), over the 12 year period 1990-91 to 2001-02, the annual compound rate of growth of output was 37.4 per cent (Chart 1).[2] That is, output was doubling every 2.2 years.



[1] This refers to the observation made by Gordon Moore as early as 1965 that newer chips that entered commercial production every 18-24 months incorporated twice the number of transistors as their predecessor.

[2] In this paper we use three different sources of information: Dataquest, NASSCOM and IDC. For comments on the nature of these data sources and issues of comparability, refer Appendix 1.

Secondly, this rapid growth has essentially been the result of a rapid expansion of exports. During the period 1990-91 to 2001-02, exports have been growing at 54 per cent per annum or doubling every 18-24 months. As Chart 2 shows, there has been a trend



shift in the rate of expansion of IT sector output in 1996-97, driven by exports. The trend rate of growth of output valued in dollars rose from 23.7 per cent during 1990-91 to 1996-97 to 29.8 per cent during 1995-96 to 2001-02, whereas the rate of growth of exports rose from 32.5 per cent to 46.6 per cent during these two periods. As a result, the share of exports in IT industry output, which rose from 20 to 28 per cent between 1990-91 and 1995-96, touched a remarkable 61 per cent in 2001-02[3] (Table 2 and Chart 3). The net result has been that the ratio of gross IT sector output to GDP rose from 0.38 per cent in 1991-92 to 1.88 per cent in 1999-00 and 3 per cent in 2001-02 (Chart 4).

Table 1: Dataquest's Estimates of India's IT Industry Output (Rs. Crore)

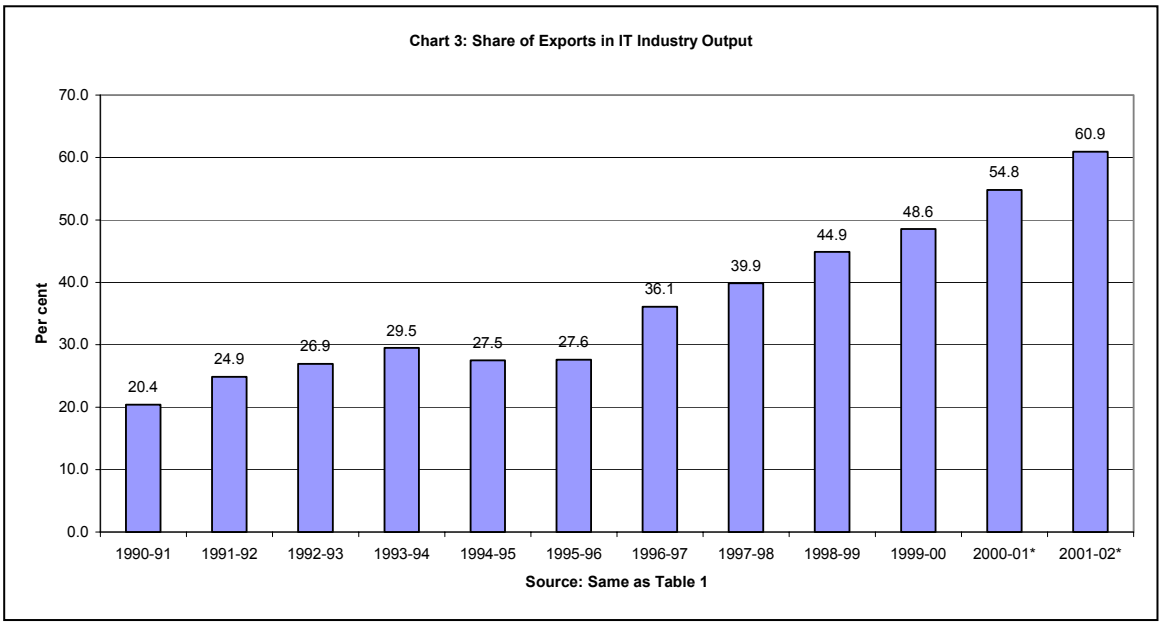
	Domestic Segment	Export Segment	Total
1990-91	1762	452	2214
1991-92	2041	676	2717
1992-93	2524	931	3455
1993-94	3356	1405	4761
1994-95	4959	1882	6841
1995-96	7032	2681	9713
1996-97	8587	4847	13434
1997-98	10835	7180	18015
1998-99	13204	10752	23956

[3] This includes exports of IT enabled services (ITeS) in the values for 2000-01 and 2001-02.

1999-00	17002	16050	33052
2000-01*	24670	29896	54566
2001-02*	24288	37846	62134
Source: Dataquest, Vol XIX No 13, July 15, 2001. And Vol XX No 13, July 15 2002			
Note : * ITeS included in software exports			

The third feature of the IT sector's growth is that it has been driven largely by the private sector on both the supply and demand sides, though government support in terms of IT infrastructure investments, duty free access to hardware for software exporters and zero taxation of export profits played a role. Almost all IT firms producing for the domestic and international markets are private firms, and as Chart 5 shows the private sector has accounted for a dominant and rising share of domestic IT spending since 1995-96 and contributed as much as 73 per cent of the total in 2001-02, as compared with 15 and 12 per cent by the government and public sectors respectively.

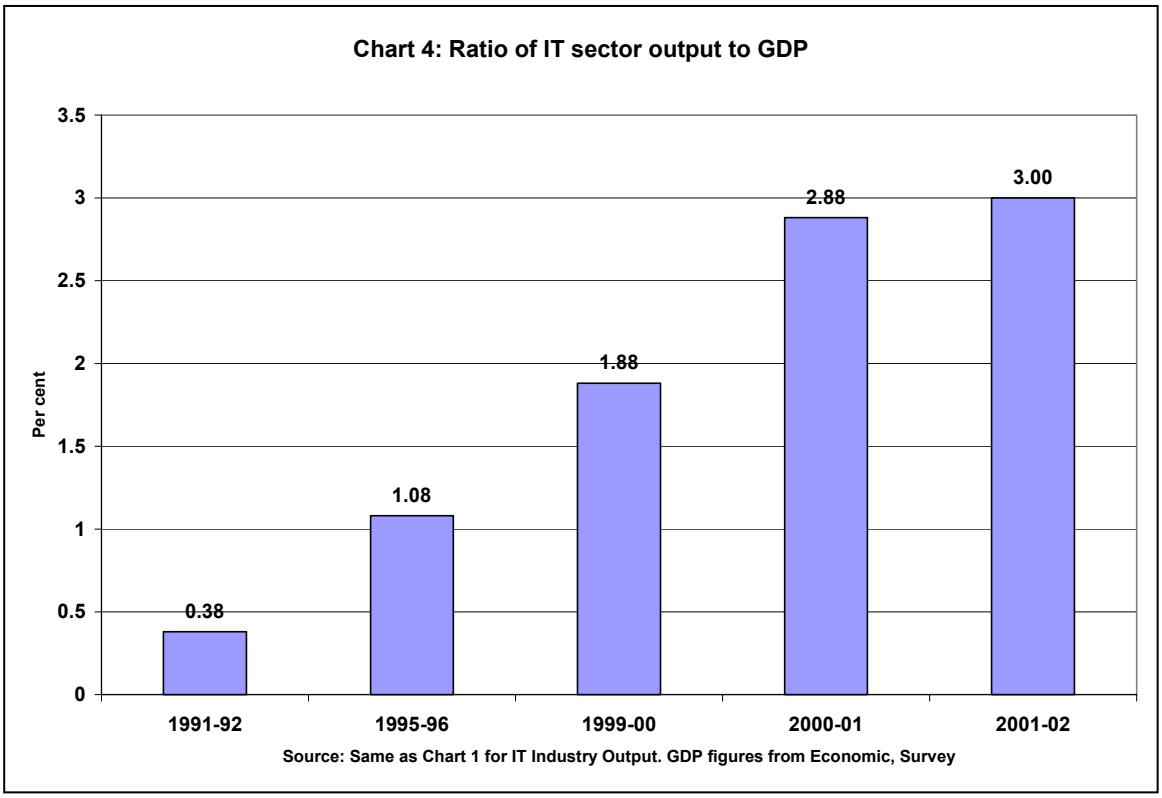
Table 2: India's IT Exports ($ billion)	
1990-91	0.25
1991-92	0.28
1992-93	0.30
1993-94	0.45
1994-95	0.60
1995-96	0.80
1996-97	1.37
1997-98	1.93
1998-99	2.56
1999-00	3.70
2000-01*	6.54
2001-02*	8.04
Source: Same as Table 1. Rupee figures converted using average annual exchange rates reported by Economic Survey and RBI.	



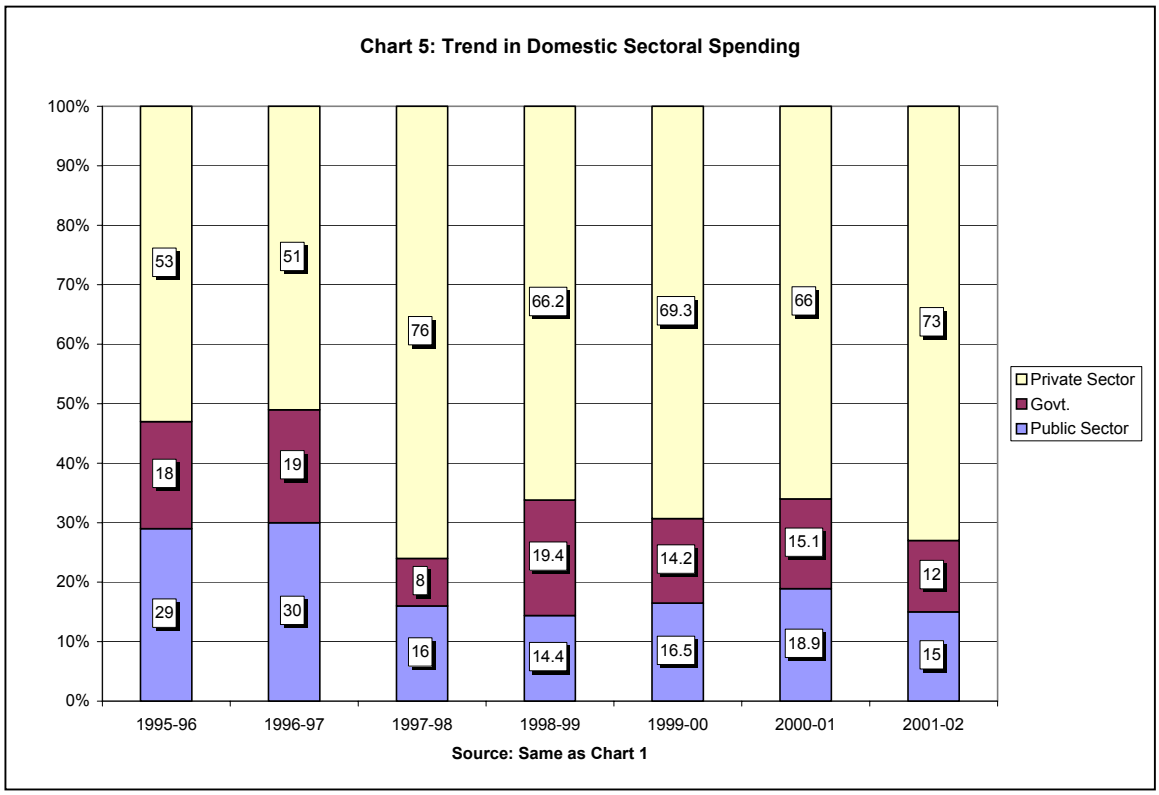
These features are remarkable for two reasons: (i) they have occurred in a policy environment very different from those which characterised the import substitution years, and have therefore been taken as indicators of the positive effects that policies emphasising private initiative and a minimalist state can have on growth; and (ii) since they are resulting in a noticeable increase in India's share of world software and IT services production and export, they lend credence to the view that the IT sector, besides being among the most dynamic areas in the global economy, is one where the new opportunities afforded are available to small firms including small firms from developing countries.

This notion of new opportunities that are not limited by the current level of inter-firm and inter-country inequality is grounded in the perception that unlike the 'routinised' technologies that dominated industry during the post-World War II years, the new 'entrepreneurial' technologies typical of the IT sector are characterised by entry conditions that favour the rapid international and domestic diffusion of the industry. The easy entry conditions are seen to result from two features of the technology. First, levels of investment required for entry are low and often easily afforded by private investors in developing countries. Second, the knowledge required for entry is in the public domain and is transmitted through open sources such as journals, seminars and universities.

Routinised technologies, such as those characteristic of the 'older' steel and chemical industries, were embodied in large continuous process plants requiring 'lumpy' investments in innovation, commercialisation, capacity creation and market acquisition. This made access to a critical size of capital crucial for entry, queering the pitch for the big players from the developed industrial countries. Moreover, dramatic innovations in these sectors were few and far between, with much technological development consisting of marginal changes that were cumulatively, rather than instantaneously, significant. These marginal changes were, in turn, very often stimulated by knowledge gained in the act of production, which led up to expensive R&D exercises that created new commercially-usable knowledge. Thus, not only were these industries dominated by big firms created with lumpy investments, but much of the technological change that occurred in the industry originated within or as a result of the activity of these big firms themselves. Entry into the industry by new, especially small new, players was rare. Competition was restricted to that between the dominant oligopolistic firms straddling domestic and world markets. To the extent that technological change could trigger a competitive challenge from outside the industry, this was largely the result of the emergence of substitute products or wholly new industries that rendered the older industries less significant or even irrelevant.



As compared with this the IT sector is seen as characterised by low costs of entry and an easily accessed and almost universally available knowledge-base for innovation. What is of special significance is that the sources of this knowledge in a significant segment of the hardware and software industries are conventional routes such as journals, conferences, seminars and publicly or privately financed training programmes. This makes it easy for wholly new entrants to acquire the knowledge base required for cutting edge technological contributions to the industry, as was and is true of at least some of the myriad start-ups in Silicon Valley.



The growth opportunity

In the hardware segment, the production of a range of products varying from components like printed circuit boards to peripherals like modems, on the one hand, and the assembly of personal computers, on the other, do not require large investments for entry. Many of these are heterogeneous products that can be put together on the basis of a combination of internally produced and externally sourced intermediates and components. There are no doubt some components entering into ICT hardware, such as the microprocessor, the production of which is capital intensive in nature, and dominated by a few global players like Intel, Motorola and AMD. But this does not preclude the presence of smaller players in important 'downstream' industries, since such components can be sourced from outside producers, even if located abroad, as is the norm in the computer industry worldwide. The real 'technology' in these downstream areas is a system architecture that maximises the benefit derived from an appropriate combination of sub-systems, components and peripherals. That is, the heterogeneous nature of the product allows a producer to restrict his own production activity to a sub-set of the total elements that

enter the product and/or just the design and assembly of the final product.[4] This requires that the technology in the sense of the knowledge for system design is freely available and is easily appropriated. But once such technology is available, the investment required for entry can be kept to the minimum, with labour intensive assembly often involving negligible investment in capital equipment and outlays on inventories kept to a minimum by employing innovative versions of the just-in-time method. This allows for easy entry even on the part of small developing-country producers and partly allows for the emergence of international brands from the developing world, as is true of Acer from Taiwan. What is crucial here is access to outsourced components ensured, *inter alia*, by a liberal import regime. Thus, the rapid growth of the PC hardware segment is seen as facilitated by the removal of quantitative restrictions and the reduction of tariffs imposed on imported components, even while restricting and keeping expensive end-product imports. As the domestic markets for PCs expands, domestic production of components becomes viable, resulting in the emergence of an IT production "complex" and a reduction in import intensity. However, while convincing as an idea, this process can be subverted by developments in the software sector, as happened in countries like India.

The logic of easy entry is even truer of the software sector, where knowledge is easily acquired and innovations easily replicated, and which is skilled-labour intensive and requires little by way of capital investment. Not surprisingly, over the years the software segment of the IT sector has come to dominate the industry in India. Entry into this sector requires access at competitive prices to very basic equipment such as networked PCs, to suitable high-speed connectivity infrastructure and to the appropriate personnel. An easy way to ensure the first is to remove restrictions on hardware imports and reduce import duties on the same. The difficult way would be to build an internationally competitive hardware sector catering to domestic buyers. With the sudden and dramatic success on the software export front in countries like India, the pressure to liberalise hardware imports, including complete, branded systems, increases substantially, and government

[4] In India, for example, the Centre for Development of Telecommunications (C-DOT) designed, developed and patented a switching system more suited to environments characterised by low telephone densities and low call densities than is the case with switching systems imported from abroad. Much of the hardware needed for these rural automatic exchanges was sourced from other domestic producers or imported from abroad.

finds this route an easy option. Access to imported equipment is combined with public investments in the infrastructure required for connectivity and in training to generate the required personnel, as well as relaxed regulations with regard to private entry into these sectors.

The third area where the ICT revolution has opened up whole new opportunities for developing countries is in the services sector. Prior to the digital revolution's transformation of service activity, the provision of most services required the presence of a service provider at the point of delivery of the service. As a result, services export took the form of migration of personnel to the location where the service was provided, as epitomised by the migration of skilled technicians, doctors and nurses to the US and of semi-skilled and unskilled workers, including carpenters, masons, chauffeurs and housemaids to the Gulf countries from India. Benefits to the home country came in the form of *remittances* of hard currency earnings by these migrants to their families, which augmented the scarce pool of foreign exchange available to these countries. But the magnitude of such income was limited by the restrictions on the movement of skilled and semi-skilled and unskilled personnel set by the immigration laws and practices of countries where the relevant service demand originated.

The digital revolution has changed all that. Now there is a range of services being provided by workers located in a country different from the one in which the service is actually delivered. These services are delivered via telecommunication or data networks, and are either *outsourced* or organised by agents in the country of origin of the service to whom the provision of these services are contracted out or *outlocated* by subsidiaries of corporations from the country of delivery of certain services. When categorised by origin and focus, it is possible to identify four types of (iT-enabled services (ITeS): in-house or captive centres, units that originally spin-offs, business process outsourcing (BPO) units and broad-based service providers, who offer consulting or IT services in addition to BPO. Examples of services outsourced/outlocated include customer interaction services; the processing of credit card accounts, insurance claims and business payrolls; the creation and maintenance of information bases in the form of networked data centres and their use in the provision of information services such as help desks; and the generation

of digitised records as in the case of medical transcription.[5] Other examples of outlocation include investment in design subsidiaries and back-office facilities.[6]

The possible range of IT-enabled services in an environment where the service sector's role is growing worldwide is immense. The reasons why such relocation occurs are obvious. It substantially reduces the cost at which such services are obtained or provided, and so long as an appropriate location in terms of the availability of manpower with the requisite skills (say, basic computer literacy) and the necessary characteristics (e.g., knowledge of English) is chosen the quality and efficiency of the service is also ensured.

Chart 6: Contribution of IT Enabled Services to Total Exports

Years	IT Enabled Services	IT Services
1999 -2000	14 %	86 %
2000-2001	14.5 %	85.5 %
2001-2002	19%	81%

Source: www.nasscom.org

NASSCOM estimates (which Dataquest uses) suggest that revenues from IT-enabled services increased from Rs. 2,400 crore in 1999-2000 to Rs. 4,100 crore in 2000-01 and Rs. 7,100 crore in 2001-02, increasing the share of IT-enabled services in the total revenues from IT services and the whole IT sector respectively at 10.2 and 6.8 per cent in 1998-99, 11.3 and 7.5 per cent in 2000-01 and 16.2 and 11.4 per cent in 2001-02.[7] As a share of exports, NASSCOM estimates suggest that the contribution of ITeS rose from 14 per cent in 1999-2000 to 14.5 per cent in 2000-01 and 19 per cent in 2001-02. Expectations are that ITeS would account fo a much larger share in 2002-03 (Table 3). As Table 4 shows, the IT-enabled services sector is highly diversified. However, excepting for medical transcription, which records an abysmally low revenue per worker,

[5] Medical transcription meets at low cost the need set by the medicare system in the US for detail patient treatment records. Doctors dictate the relevant entries and the spoken word is digitsed and transmitted to locations in India where they are immediately transcribed into wordprocessed files that, given the time difference between the two countries, is available to the doctor concerned the very next morning for correction and finalisation.

[6] The McKinsey-Nasscom report lists ten processes as attractive opportunities—telesales/telemarketing, Web sales and marketing, database marketing/customer analysis, benefits administration, payroll services, engineering and design, inbound call center, claims processing, billing services, and credit/debit card services.

[7] According to Dataquest. at present, the ITeS market in India is restricted to call centres. Even if some activity has taken place in other areas such as medical transcription, engineering and design or other Web services, this is seen as been too little to make a significant impact on the overall market or growth. "IT-Enabled Services: India IT's lone crusader," **Dataquest**, July 2002,

there is not too much difference in the revenue per worker which averages Rs. 6 lakh (or around $12,200) per year. This points to the fact that low wages do drive the industry.

Table 4: Employment and Revenues from IT-Enabled Services

	1999-2000		2000-01		2001-02	
	Employed	**Revenue (Rs. Crores)**	**Employed**	**Revenue (Rs. Crores)**	**Employed**	**Revenue (Rs. Crores)**
Customer Interaction Services include Call Centres	8,600	400	16,000	850	33,800	1,790
Back Office Operations/Revenue accounting/Data Entry/Data Conversion including Finance & Accountancy/ HR services	15,000	950	19,000	1,350	35,000	2,850
Transcription/Translation services	5,000	120	6,000	160	6,200	150
Content Development/Animation / Engineering & Design / GIS	15,000	820	27,000	1,600	30,000	2,100
Other services include Remote Education, Data Search Market Research, Network, Consultancy & Management	1,400	110	2,000	140	3,000	210
Total	**45,000**	**2,400**	**70,000**	**4,100**	**107,200**	**7,100**

Source: Nasscom website

Related advantages

The advantage that India has in the IT-enabled services sector is obvious. But India's competitive advantages in the software export area are also many. To start with, outsourcing of IT services is a dominant international business practice. According to IDC, out of a global market of $220 billion for computer services in 1995, as much as $68 billion was outsourced. Outsourcing totalled $16 billion in the case of customised software development, $32 billion in systems integration, $11 billion in IT consulting and $9 billion in business services. Compared with this, India's current (2001-02) exports of $8 billion of software services and IT-enabled services appears small. The opportunities are therefore substantial.

Second, till the recent slowdown in the IT sector, the shortage of software professionals in the developed countries was expected to result in an increase in the share of computer services outsourced. According to the OECD's *Information Technology Outlook 2000*: "A recent study based on responses to a telephone survey of 532 IT and non-IT companies with more than 100 employees found that there were some 346,000 IT positions currently vacant in the United States in three core IT occupational clusters (programmers, systems analysts, computer scientists and engineers). In addition, there were 240,000 vacancies in areas such as technical writing, training and sales. An earlier study estimated a shortfall of nearly 1 million software professionals in Japan. Even if these figures are high, most observers agree that, in developed countries, demand for skilled software professionals has grown rapidly and may exceed supply."[8] Even though this would no longer be true, many argue that the need to cut costs during the downturn would accelerate outsourcing to countries like India.

[8] Organisation for Economic Cooperation and Development, **OECD Information Technology Outlook 2000: ICTs, E-Commerce and the Information Economy**, Paric: OECD, 2000, p.131.

Third, the much lower cost at which software professionals can be accessed in India. Even before the downturn, wage costs in India had been estimated at one-third to one-fifth of US levels for comparable work (Tables 5 and 6). Taking all costs into consideration, some estimates suggest that the cost of software development in India is half of that in the US. Relative to outsourcing competitors like Ireland wages in India are estimated at a half to a third.

Finally, the rapid growth of software services exports from India noted earlier, which suggests that India has the managerial ability to exploit its competitive edge. The number of Fortune 500 companies that are outsourcing their software requirements to India has steadily grown to 185. The number of software exporting companies has also grown to 1250.

Table 5: Salaries[1] of software professionals in the United States and India, 1997

	United States	India[2]
	(USD per annum)	(USD per annum)
Help-desk support technician	25 000 - 35 500	5 400-7 000
Programmer	32 500 - 39 000	2 200-2 900
Network administrator	36 000 - 55 000	15 700-19 200
Programmer analyst	39 000 - 50 000	5 400-7 000
Systems analyst	46 000 - 57 500	8 200-10 700
Software developer	49 000 - 67 500	15 700-19 200
Database administrator	54 000 - 67 500	15 700-19 200

1. Figures are starting salaries for large establishments employing more than 50 software professionals. They may be marginally lower for smaller firms. Salaries for a particular designation vary owing to factors such as educational and experience profile of the professional; platform of operation; nature of the assignment (contract/full-time); location of the employer; and additional technical/professional certification.

2. Converted at exchange rate of INR 41.50/USD.

Source: INFAC, Bombay quoted in OECD Information Technology Outlook, 2000.

Table 6: Comparison of Annual Wages in Software Industry				
Country	Computer Programmer		Systems Analyst	
India	4002	100	5444	100
USA	46600	1164	61200	1124
Japan	51731	1293	64519	1185
Germany	54075	1351	65107	1196
France	45431	1135	71163	1307
Britain	31247	781	51488	1287
Hong Kong	34615	865	63462	1166
Mexico	26078	652	35851	658
Source: Gupta (2000) quoted in K.J. Joseph (2002), "Growth ICT and Harnessing IT for Development", background paper prepared for the **OECD-IPS Workshop on Promoting Knowledge-based Economies in Asia**, Singapore 21-22 November 2002, mimeo.				

The rapid expansion of revenues from IT hardware, IT software and ITeS resulting from these factors holds out the promise of substantial change in the nature of economic activity and the pace and pattern of growth in developing countries like India. By triggering the diffusion of information technology across nations and within individual nations this is expected to substantially alter the position of individual developing countries within the international economic order. There are four ways in which this could occur:

I. Through the growth of the IT sector itself.

II. Through the diffusion of information technology into the manufacturing sector, which transforms production processes and increases productivity.

III. Through the utilisation of the IT network by producers and consumer to undertake online transactions, which would reduce transaction costs and alter market structures.

IV. Through the utilisation of the IT network by governments, communities and individuals to share/provide information and offer various services either for a fee or free of cost.

It hardly bears stating that development along each of these directions depends on specific forms of investment and specific forms and degrees of development of the ICT infrastructure.

ICT Growth and Economy-wide Productivity

Experience from the developed industrial countries suggests that the growth of the ICT sector in terms of output and employment need not necessarily be accompanied by any equivalent diffusion of information technology into other sectors, especially manufacturing. As a result the existence of a large information technology sector need not imply that production processes elsewhere have been transformed resulting in substantial productivity gains. This "productivity paradox" was put on the agenda by the 1987 remark of Nobel laureate Robert Solow that: "You can see the computer age everywhere but in the productivity statistics." (Solow 1987). While there are numerous problems associated with total factor productivity (TFP) measures they have provided the evidence for the debate on the productivity paradox. To quote a summary of the evidence provided by Paul David (2000):

> "The long-run perspective on US productivity performance by Abramovitz and David (1999) shows a refined measure of the TFP growth rate (adjusting for composition-related quality changes in labour and capital inputs) having been maintained in the near neighbourhood of 1.4 per cent per annum throughout the era from 1890 to 1966From its 1.45 per cent level over the 1929-1966 trend interval, the annual growth rate plummeted to 0.04 per cent during 1966-1989. … More worrisome still, the post-1966 retardation was extended and intensified until the very end of the 1990s. Estimates of real gross output and inputs from the Bureau of Labour Statistics (USDL News Release 98-187, May 6, 1998) enable us to follow the path of measured productivity gains in the US economy well into the 1990s. The figures relating to the private *nonfarm business* economy are

> generally regarded as providing a more accurate picture of recent movements, because the deflation of the current value of output has been carried out by using price indexes that reweight the prices of component goods and services in accord with the changing composition of the aggregate. These "chain-weighted" output measures lead to productivity growth estimates that reveal two notable things about the "slowdown. The first point is that the productivity growth rate's deviation below that the trend that had prevailed during the 1950-72 "golden age" of post-World War II growth became even more pronounced during the late 1980s and early 1990s, instead of becoming less marked as the oil shock and inflationary disturbances of the 1970s and the recession of the early 1980s passed into history. Measured labour productivity rose during 1989-1996 at only 0.83 per cent per annum, half a percentage point *less* rapidly than the average pace maintained during 1972-1988, and thus fully 2.25 percentage points below the average pace during 1950-72. Second, concerning the magnitude of the slowdown, the TFP growth rate estimate of the Bureau of Labour Statistics for 1988-1996 sank to 0.11 per cent per annum, which represented a further drop of 0.24 percentage points below the pace of TFP advance that had been achieved during the post-World War II golden age."

Thus while the much more recent revival in TFP growth has reduced scepticism regarding the ability of ICT innovation to raise economy-wide productivity, the least which can be said is that the lack of correspondence between high rates of innovation and slow growth of TFP suggests that the process of diffusion is time-consuming, gradual and can even be painful from an output and employment growth perspective. There are, in fact, even more sceptical views on the matter. According to Robert Gordon (1999), a new economy skeptic:

> "When the period since 1995:4 is compared to 1950-72 and 1972-95, growth in output per hour in the most recent (third) period has recovered more than two-thirds of the productivity growth slowdown registered between the first and second periods. *All* of this productivity rebound can

be explained by three factors, (1) improved methods for measuring price deflators, (2) the normal procyclical response of productivity in periods like 1997-99 when output grows faster than trend, and (3) the explosion of output and productivity growth in durable goods, entirely due to the production of computers.

There has been *no* productivity growth acceleration in the 99 percent of the economy located outside the sector which manufactures computer hardware, beyond that which can be explained by price remeasurement and by a normal (and modest) procyclical response. Indeed, far from exhibiting a productivity acceleration, the productivity slowdown in manufacturing has gotten worse; when computers are stripped out of the durable manufacturing sector, there has been a further productivity slowdown in durable manufacturing in 1995-99 as compared to 1972-95, and no acceleration at all in nondurable manufacturing."

This dissociation between ICT-sector growth and overall productivity performance can be all the greater in developing countries like India, where IT growth is predominantly targeted at export markets. That is the advance of ICT growth along the direction I delineated above, i.e., through the growth of the IT sector itself, need not imply diffusion that implies advance along direction II, or through the diffusion of information technology into the manufacturing sector, which transform production processes and increases productivity. It needs to be noted that recent studies have pointed to a substantial slowing of the rate of growth of total factor productivity in Indian manufacturing during the years in which ICT sector expansion has been substantial.

Further, if expansion along directions I and II is not accompanied by the widespread diffusion of ICT across firms and households, the process need not be accompanied by the transformation of economic activity and markets that the growth of business-to-business and business-to-consumer e-commerce is expected to deliver. That is, there need not be any diffusion and development along the lines suggested by direction III, which is through the utilisation of the IT network by producers and consumer to undertake online transactions, which would reduce transaction costs and alter market structures.

Finally, even if there is substantial expansion along directions I, II and III, the appropriate infrastructure for the widespread diffusion of the information and communication technologies required to encourage the utilisation of the IT network by governments, communities and individuals to share/provide information and offer various services (direction IV), i.e., for meaningful e-governance and for improved service delivery that could make a dent on human development need not occur.

If all-round diffusion of this nature occurs the consequences would indeed be revolutionary. *It would create and massively expand industries catering to the market for a range of computing devices*, especially personal computers, that would now be accessories in the home and not just at the work place. *Second, it would transform the nature of a whole range of products varying from televisions and microwave ovens to automobiles and aircraft, as well as stimulate many new product innovations, such as cellular telephones and palm-sized personal organisers*. The stimulus to innovation in sectors completely outside the computing business itself, resulting in the emergence, creation and servicing of a host of new needs, makes the employment consequences of the new technologies virtually impossible to calculate.

Third, it would substantially transform industrial processes, since firms can now use the capacity to store information and execute instructions to automate and change the manner in which they conduct and manage their operations. Information technology is in part revolutionary because it ensures and necessitates the transformation of productive capacity in almost all sectors. *Finally, the resulting computing revolution would lead to a dramatic expansion of the size and scope of the services sector (across a wide spectrum including finance, banking, trade, entertainment and education).* This results partly from associated technological developments that find new uses for the massive computing power that is cheaply available, partly from the huge market that developments in communications and networking technology create, and partly from the fact that the increasingly ubiquitous PC becomes the vehicle to deliver a range of services, besides being a device in its own right.

II: The Constraints

In understanding the constraints to the realisation of this promise by advancing along the four routes to diffusion, there are three features of the structure of the ICT industry which are of relevance. These are: (i) private sector dominance in IT investment and spending; (ii) export dominance over IT revenues; and (iii) software sector dominance over IT revenues. Private sector dominance in IT investment and spending suggests that the nature of the capital stock and infrastructure generated and the pricing of most services that are offered would be largely governed by profit considerations. This would mean that infrastructure generation for provision of e-governance and IT-enabled social services delivery is not likely to result from the current dynamic of the IT sector, but would need substantial state intervention. Evidence from other countries such as south Korea, which leads to world in terms of the spread of broadband connectivity, point in two directions: (i) the need for substantial state investment or state support for private initiative; and (ii) the existence of a "killer application", (in this case gaming), if private initiative is likely to deliver such connectivity, even with state support. Since the level of per capita income and the experience with cable penetration suggests that such a killer application is unlikely to emerge in India in the near future, state investment becomes crucial if development along direction IV is to occur at all.

The setback to domestic diffusion is all the greater because of the fact that India's IT sector growth has been characterised by the dominance of export revenues over revenue growth. This does make the development of the sector take on an enclave-like character, with limited even if not negligible domestic linkage effects. It is not just that exports account for more than 60 per sent of IT sector revenues today, but the fact that exports from software technology parks account for 70 per cent of software exports from the country. This would suggest that ICT expenditure would be concentrated in a few locations, rendering the diffusion effects of ICT growth limited. In fact, an examination of the adoption of IT by Indian industry based on ASI data indicates that only 35 per cent of factories covered in 1997-98 claim to use computers in offices, only 1.1 per cent have networked computer systems, just 3.7 per cent were connected to the internet and a meagre 1.8 per cent used robotics or computerised processes in production.

Finally, diffusion is also limited by the fact that IT sector growth in India is increasingly dominated by software revenues. It is not just that software revenues have tended to grow

faster than hardware revenues, but the rapid growth of the software sector has generated a perverted form of the Dutch disease, adversely affecting hardware sector growth.

Initially the Indian hardware sector, which was more or less limited to domestic firms, consisted of three segments. Premium producers like Wipro, which controlled the market consisting of quality-conscious customers, who demanded a large and reliable after-sales service network and were willing to pay a higher price for these features. Large volume retailers like Sterling Computers and HCL, which kept prices down by pushing volume sales while limiting overhead costs and accepting lower per-unit margins. And a large number of assemblers with low overheads, a small employee-base and virtually no after-sales service, who catered to price-conscious customers willing to take quality risks. According to Indernational Data Corporation (India), vary small assemblers selling less than 200 units annually accounted for close to 50 per cent of the market for assembled PCs in 1998-99 (Table 7).

Table 7: Assembler Type (Units sold per year, 1998-99)

Size	Share of the market in unit terms
A (more than 1000)	21.60%
B (401-1000)	14.30%
C (201-400)	15.60%
D (up to 200)	48.50%
Total	100.00%
Source: IDC (India) website.	

These small producers most often used inputs obtained from suppliers who had managed to evade customs duties. This reduced their costs substantially. Besides, these firms were satisfied with extremely low margins. As a result their prices were much lower than that of the large domestic suppliers. Not surprisingly, the market catered to by the assemblers as a group was by no means small. For example, during the first six months of 1998-99, PC assemblers accounted for a 53 per cent share of units sold in the Indian market and a 45 per cent of that market in terms of value.

The large premium producers defended their prices on the grounds of being technologically superior, of offering better quality and of providing far more reliable after-sales service facilities. In practice, having invested much in marketing to build their brand images, these large suppliers used the protection afforded by the government to garner large margins on their sales, but did little to build brand loyalty in the domestic and international market. Neither did the government intervene to ensure that the period of protection was used to build technological capability and viable sales volumes.

When the domestic market for PCs and peripherals is relatively protected and component imports are highly taxed, the few large players coexist with the large number of smaller suppliers. It should be obvious that all segments of the domestic industry benefited substantially from the quantitative restrictions on PC imports, with premium producers garnering high margins and the lower-end assemblers surviving despite high costs and poor service support. Needless to say, the small assemblers with low margins were in no position to use the opportunity afforded by protection to build capabilities of a kind that would allow them to compete with large international suppliers as and when protection was withdrawn. On the other hand, with the government not enforcing R&D based competitive production in the premium segment, and premium producers choosing to encash the large margins rather than plough them back into production, even they did not concentrate on developing indigenous sources of supply of components and accessories and on reducing costs and developing significant product innovation capabilities.

The effects of this history were seen when the government, eager to exploit India's capabilities as a software and IT-enabled outsourcer decided to ease access to and lower duties on information and communication technology products. The first casualty were some producers in the premium segment who when faced with the abolition of quantitative restrictions and the reduction of duties on a range of PC products, decided they could not face up to the competition. Some chose to become domestic sales agents for international brands. But almost all leading producers have substantially diversified out of PC production into software-generation.

As a result, in the wake of liberalisation the industry has seen significant changes in structure. Liberalisation has resulted in the gradual conversion of some premium

producers into domestic sales agents for international firms. Wipro for example had virtually discontinued its own range of products and has become a supplier of Apple and Acer products. It has also resulted in the closure of at least some large volume retailers such as Sterling, though some other large producers like HCL have remained in the PC business. Finally, as the volumes sold by multinational brands increase and duties on imported components fall, there has been a growing threat of erosion of the market share of assemblers by these international suppliers.

As Table 6 shows, in 1999-00, about a half of the top 15 PC brands in India were known international brands, there were only two major domestic players who were involved in retailing volumes larger than 50,000 PCs a year, and these producers were falling behind in the competition with transnational producers. To quote Dataquest: "Gone are the days of PCL, DCM and ECI – the erstwhile heroes of the domestic IT market have long vanished or have been relegated to history books. Today's domestic market is run by MNCs. Look around at any of the IT segments in India and the frontrunners are likely to be MNCs. Think servers and you think Sun, IBM, Compaq and HP. Think printers, you have little option but to think HP, Epson and Samsung. Think networking products and who can you think of but Cisco and 3Com? Sure, there are some lone Indian rangers, for instance HCL Infosystems in desktops and TVSE in impact printers, but even their numbers are fast dwindling. This is a domestic scene that is nearly monopolised by MNCs."[9] The tendency for these transnational suppliers to source virtually knocked-down kits from production facilities abroad is known, resulting in a high and growing import intensity in the industry. This implies that the output and employment implications of the rapid growth of domestic hardware spending would be far less than suggested by the gross revenue figures.

Table 6: Major PC Vendors in the Domestic Market 1999-00 and 2000-01

Vendor	**Units 1999-00**	**Units 2000-01**
Compaq	79484 (2)	151568

[9] "Multinationals in India: Domestic Champions", **Dataquest**, July 31, 20001, p. 194.

HCL	101500 (1)	149500
Hewlett-Packard	63000 (3)	91200
IBM	40534 (6)	67644
Wipro	49000 (5)	66699
Zenith	59685 (4)	60646
DELL	15500 (12)	38000
PCS	17500 (10)	36350
Vintron	20598 (8)	30575
Minicomp	27260 (7)	29271
Visualan	16570 (12)	23746
Acer	18000 (9)	22100
Apple	9000 (14)	12000
SNI	10000 (13)	10000
CMS	5000 (17)	8000
Computech	5893 (16)	8000
Accel	6480 (15)	7000
Others+assembled	580321	892736
Total	1125235	1705335
Source: Same as Chart 1.		

This reflects the unusual situation in the PC market in developing countries like India, where despite a long record of PC production even by international standards, there are increasingly a few international brand names like IBM, Compaq, Dell, and HP, coming to dominate the market.

The core of the computing business is dominated by a capital-intensive and oligpolised product like the microprocessor, the market for which is dominated by a few producers like Intel, Motorola and AMD. And the technologies driving a range of peripherals like printers and networking products, for example, are proprietary and are not replicated without a licence. This implies that hardware production in developing countries like

India amounts largely to assembly of components, much of which is imported. Indigenous content is restricted to certain of these components and indigenous technological input is confined to system architecture and design. As a result, value added domestically tends to be small.

Further, while capital investment requirements for production may be small, production for geographically and quantitatively large national and world markets require high sunk costs. This takes the form of initial expenditures on marketing, retailing and the creation of an after-sales service network. Deep pockets and/or access to large sums of capital are therefore a prerequisite for entry into this segment of the hardware sector.

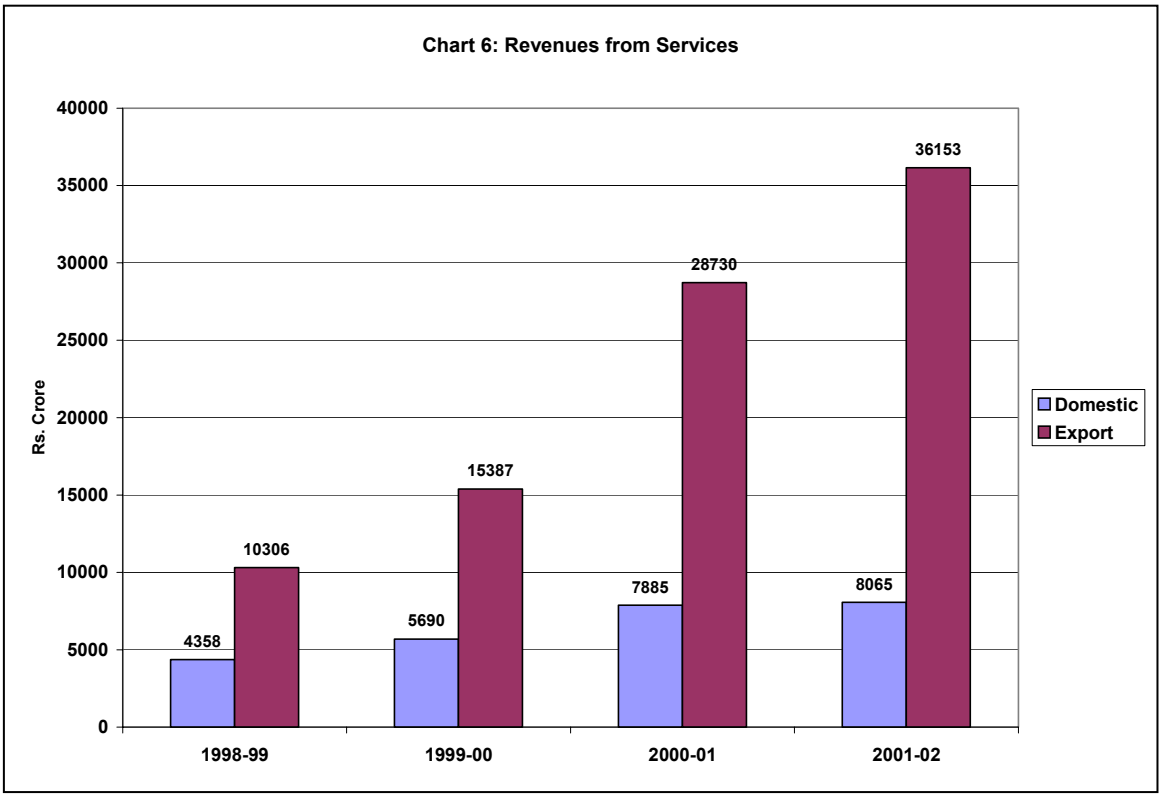
This also has implications for the linkage effects of the growth of the PC industry and for net foreign exchange earned by the information technology sector. Needless to say, with imported components accounting for a substantial share of the value of PCs assembled by both the international players and domestic assemblers, the domestic linkage effects of the growth of PC sales could only be limited. Much more employment is likely to be created by the growing demand for maintaining and servicing the installed PC base (estimated at 7.5 million). In the PC segment itself whatever value is added domestically would accrue in the hands of large international firms. Given the sourcing practices of these firms it is likely that the import intensity of PC production in India would remain high, resulting in the leakage of some at least of the revenues earned from exports of software and IT-enabled services.

These features of the PC market, which would be even truer of the peripherals market, indicate that, in the wake of liberalisation, the emergence of a strong indigenous industry that engages world markets is not likely in the hardware segment. This substantially dilutes the argument that there is likely to be a substantial restructuring of the international industry in favour of developing countries such as India, at leas so far as hardware production is concerned.

The Software Story

Thus, if the case that India is likely to emerge an IT powerhouse which invades developed country markets and challenges developed-country players is valid at all, it can only be true of the software segment. In IT-related services it is the export market that

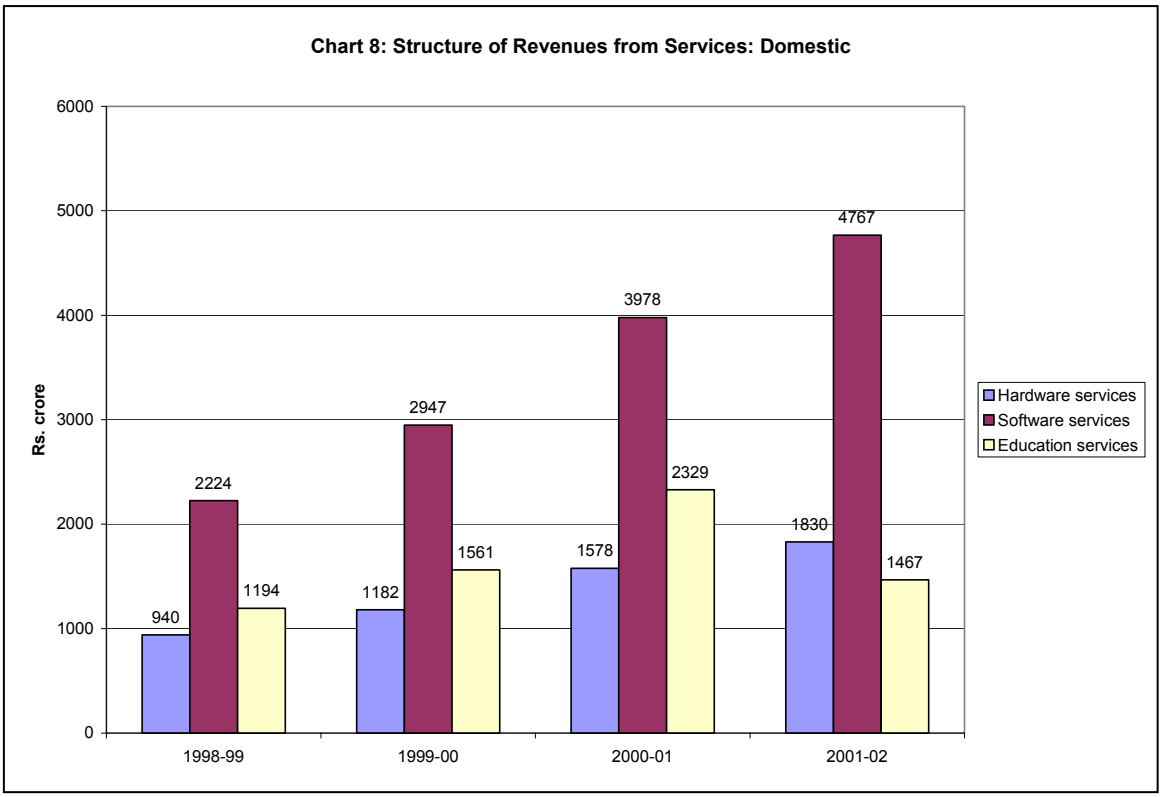
provides the real opportunity. As Chart 6 shows, revenues from services in the domestic market are currently close to a fifth of that from the export market, and the ratio of domestic revenues to export revenues fell from 42 per cent to 22 per cent between 1998-



99 and 2001-02.

There are three broad categories into which such services fall. Hardware services, including maintenance of the growing installed-base of computers; educational services, which generate the skilled and semi-skilled personnel needed to sustain IT-sector growth; and software services, including the production of software packages, generation of customised software and the provision of a range of IT-enabled services. In the domestic market, revenues from software services, at Rs. 4767 crore in 2001-02, was only about one-and-a-half times the combined revenue from hardware and educational services totalling Rs. 2743 (Chart 7). That is, not only were domestic service revenues small, but revenues from areas such as maintenance and the creation of basic IT skills generated as

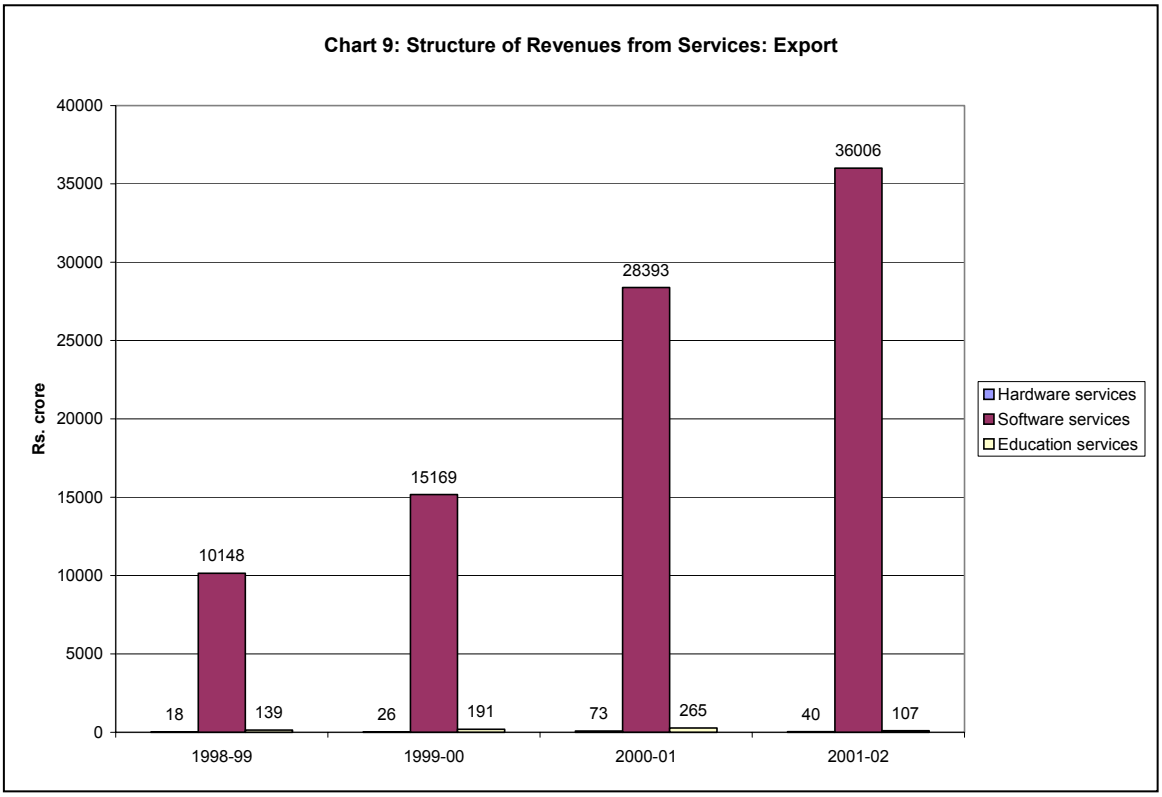
much 70 per cent of the revenue garnered from the production of IT-enabling software. This is of significance because a large domestic software services market provides the workplaces for training for software personnel and the base for generating the skills necessary to meet the higher demands of the export market and to graduate to the higher end of the software value chain. That base is crucial since a substantial part of revenues from IT-related educational services is known to accrue to teaching shops that do not develop adequate skills among its students. A growing disproportionality between the market for domestic and export software services, therefore, constrains the ability of the system to generate the wherewithal in terms of the personnel needed to service the export market. This is the first factor to take account of when making judgements of India's



potential in the export of software services.

To return to the point made earlier, the ability of the IT sector to "unleash growth that will change India's economic fortunes" depends largely on revenues from exports of services. As is to be expected, software services and IteS dominate the export of IT services, accounting, at Rs. 36006 crore, for more than 99 per cent of such exports (Chart

9). This is where the income and employment gains are going to be registered, as

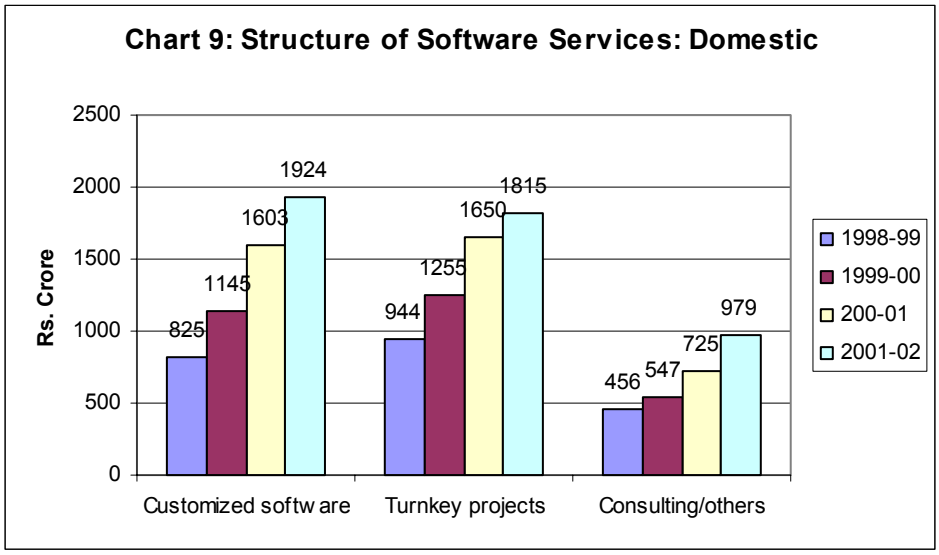


suggested by the fact that such exports grew by close to 50 per cent in 1999-00.

There are three prerequisites for the potential suggested by the above factors to realise itself. First, India software exports needs to diversify in term of sources and destinations. Of the 1250 companies exporting software services in 1999-00, those exporting more than Rs. 100 crore (about $22.5 million) stood at just 37. The top 25 exporters accounted for 61 per cent of export revenues. And the US market dominated in terms of destination accounting for 62 per cent of exports as compared with Europe's 23.5 per cent.[10] Second, Indian software service providers should be able to sustain the quality of services offered by inducting appropriately qualified and skilled personnel to not merely write code but design systems. Third, Indian firms should be able to migrate up the value chain, so as to ensure a growing share of the market as well as enter into segments that offer higher value per employee.

[10] "Software sales on hard drive", **The Economic Times**, Tuesday July 04, 2000.

In all these areas the availability of personnel is bound to prove a constraint. The inadequacy of training services resulting from the proliferation of poorly-staffed, profit-hungry teaching shops, and the limited base for training and skilled-development in the domestic software services segment has already been noted. As a result even as an outsourcer India still remains a lower-end software supplier and a supplier of IT-enabled services. As Chart 9 and 10 show, unlike in the domestic market, generation of customised software or generating code for systems specified by clients dominates both the export software services market. As has been repeatedly emphasised, this often involves some body-shopping in the form of temporary export of software professionals to

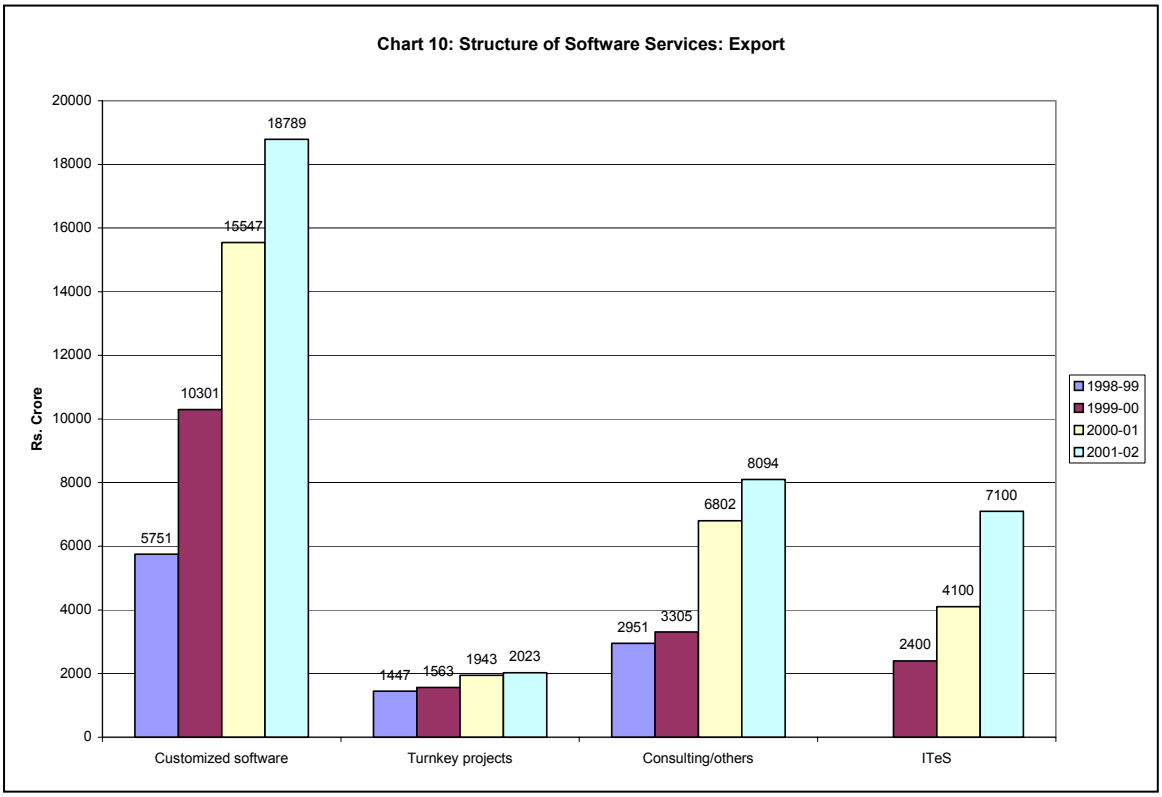


undertake specific jobs in large projects designed and executed in the West and enclave-type offshore supply.

What is noteworthy is that even the big exporters obtained little by way of revenues from frontline software products or higher end consultancy and software generation services. To quote a senior executive from the Indian software sector: "India, somewhere down the line, has to make up its mind whether it would be a quality software developer or concentrate on quantity…If you look at the typical structure of the IT services provided to any of the global companies – on the bottom layer is outsourcing, above it software development, on top of that is technology development and higher up is networking services and, finally, IT consulting. As you move up, you get higher billing rates, higher

revenues, higher gross margins and, thereby, high profitability because the complexity of the transaction is higher." According to industry insiders like Narayana Murthy of Infosys, this move up the value chain has hardly occurred and is not India's priority. In an interview Murthy said Indian software expertise in customised services had a long way to go in quantity and quality before focusing entirely on other fields. ``Yes, moving up the value chain is a good idea. We are at it ourselves - about Rs. 20 crores, which is just 8 per cent of our total business and not the main," he said.[11] He said India's share of the service industry - he calls it ``customised software provision" - was only $2 billions. The market is a staggering $25 billions. India needs that kind of money, while there is no stopping it from reaching out to higher levels of technology. There are others, like Vinay Deshpande of NCore who feel that while software services should not be sneered at, the contract should be properly designed. ``If the job is just another cover for body shopping, then there is little technology that accrues to the contractor… Except a few, such contracts mainly mean deputing engineers from here. The parent company does not get any fresh infusion of technology in this case. I strongly believe that even in service industries, contracts should be such that there is technological upgradation." He feels technology thus acquired could then be leveraged to develop indigenous products for, in the long run, the money is in developing products.

[11] R. Mohan, "Products vs Services: The argument continues", **Business Line**, Thursday, December 17, 1998, p.7.



Further, it is clear that a growing share of this export revenue is little more than the sale of cheap skilled and not-so-skilled IT-enabled labour services whose output is transmitted via modern communication technologies to sites where those services are required. The possibility of such service delivery has helped India circumvent the obstacle to service exports created by immigration laws in the developed countries. That is, a large part of software exports is not very different from the exports of nursing, carpentry, masonry and other such services, except for the fact that unlike those exports, the presence of the service provider at the point of sale is not required in the case of IT-enabled services.

Thus, conceptually, India's software thrust of the last decade is not as spectacular as it appears. It is substantially export of lower end software and IT-enabled services facilitated by the availability of cheap skilled labour. And it is in large part a technology-aided extension of the earlier waves of migration by service-providers of different descriptions: doctors, nurses, and blue-collared workers of various kinds. An expansion

of that kind cannot be self-sustaining. Even in quantitative terms the latter development is not spectacular. The 'net foreign exchange revenue' to the country from migration of the old kind, captured by the volume of remittances into India, is in the range of $10-12 billion. The gross foreign exchange revenue from software exports is even after the boom placed at $8 billion.

The difficulty is that the move up the value chain may not be a matter of pure choice, but structurally limited. While there have been instances of Indian companies delivering high-end products, like the banking and e-commerce software product, BankAway, from Infosys, the industry generally accepts that much of the exports from India consists of low end outsourcing and IT enabled services. This limited success in terms of the composition of exports may be because there indeed are barriers to entry into higher end software, resulting from the fact of increasing returns in the form of sharply reducing costs as volumes increase, helping create and strengthen oligopolistic positions.

Barriers to entry in software

What could be the source of barriers to entry in the software sector. Consider, for example, the packaged software segment, mass-producing branded products for large national and international markets. Knowledge products like software packages have the public good chracteristic of non-rivalry in consumption, since making the product available to one user does not preclude its availability without much additional cost to another. This essentially implies that so long as the producer and seller of that knowledge can ensure excludability, or that sale of the product to one does not lead to the replication of that package for free use by another, there are substantial increasing returns in the software sector. Producing the first unit of a software product requires large investments in its generation, whereas producing an additional unit is almost costless. The larger the sales, therefore, the lower is average cost and the higher the return.

But that is not all. When large sales imply a large share of the market as well, scale becomes a means of ensuring consumer loyalty and strengthening oligopolistic positions. This is the result of "network externalities" stemming from three sources. First, consumers get accustomed to the user interface of the product concerned and are loath to shift to an alternative product which involves some "learning" before the features of the

product can be exploited in full. Second, the larger the number of users of a particular product, the greater is the compatibility of each user's files with the software available to others, and greater the degree to which files can be shared. The importance of this in an increasingly networked environment is obvious. Finally, all successful products have a large number of third-party software generators developing supporting software tools or "plug-ins", since the applications program interface of the original software in question also becomes a kind of industry standard, increasing the versatility of the product in question without much additional cost to the supplier. These "network externalities" help suppliers of a successful software package to "lock-in" consumers as well as third party developers and vendors, leading to substantial barriers to entry.

Appropriating the benefits of new technology

Take the case of software products for mass use for example. Creating such a product starts with identifying a felt need (say, for a browser once the internet was opened up to the less computer savvy or for a web-publishing programme once the internet went commercial). The persons/firms identifying such a need must work out a strategy of generating the product, by hiring software engineers, at the lowest cost in the shortest possible time. Once out, the effort must be to make the product a proprietary, industry standard. This involves winning a large share of the target consumers, so that the product becomes the industry standard in its area. Once done, the product becomes a revenue generating profit centre. The investment required is the sums involved in setting up the company, in investing in software generation during the gestation period, and in marketing the product once it is out so as to quickly win it a large share of the market. Needless to say, while entry by individuals or small players are not restricted by technology, they could be limited by the lack of seed capital. This is where the venture capitalists enter, betting sums on start-ups which if successful could give them revenues and capital gains that imply enormous returns.

There are, however, three problems here. The first is one of maintaining a monopoly on the idea during the stage when the idea is being translated into a product. The second is that of ensuring that once the product is in the public domain competitors who can win a share of the market before the originator of the idea consolidates her position do not

replicate it. It is here that a feature of 'entrepreneurial technologies' – the easy acquisition and widespread prevalence of the knowledge base needed to generate new products - considered an advantage for small new entrants actually proves a disadvantage. Thirdly, no software product is complete, but has to evolve continuously over time to offer more features, to exploit the benefits of increasing computing power and to keep pace with developments in operating systems and related products. Thus large and financially strong competitors, even if they lag in terms of introducing a product 'replica', can in time lead in terms of product development, and erode the pioneer's competitive advantage.

There are two aspects of technology that are crucial in this regard. First, their source. Second, the appropriability of the benefits of a technology. As mentioned earlier, in industries with routinised technologies the source of technology was in significant part the activity of incumbent firms themselves. On the other hand, in the case of entreprenurial technologies the sources were in the public domain. This was where the advantage lay for the small operator. But once a technology is generated based on some expenditure in the form of sunk costs, there must be some way in which the innovator can recoup these costs and earn a profit as incentive to undertake the innovation. In the Schumpeterian world this occurred because of the 'pioneer profits' that the innovator obtained. The lead-time required to replicate a technology itself provides the original innovator with a monopoly for a period of time that generates the surplus which warrants innovation.

Most often this alone is not enough to warrant innovation and in the software sector lead times can be extremely low, especially if the competitor invests huge sums in software generation, reducing the lead-time substantially. It is for this reason that researchers have defended and invoked the benefits of patents, copyright and barriers to entry in production, which allow innovators to stave off competition during the period when sunk costs are being recouped. Unfortunately, neither is the status of patents and copyrights in the software area clear (as illustrated by the failure of Apple to win proprietary rights over icons in user interfaces), nor are there barriers to entry into software production.

This has had two implications. First, the importance of secrecy in the software business. The 'idea' behind the product must be kept secret right through the development stage, if not competitors can begin rival product developments even before the original product is in the market. A feeble attempt to institutionally guarantee such secrecy is the now infamous 'non-disclosure agreements' which prospective employees, financiers and suppliers are called upon to sign by the innovator who is forced to partially or fully reveal his idea. Secondly, even after the product is out, since the threat of replication remains, it is necessary to strive to sustain the monopoly that being a pioneer generates. This is where the possibility of locking in users with the help of an appropriate user interface which they become accustomed to and are reticent to migrate away from, and locking in producers of supportive software with an appropriate 'applications programming interface' becomes relevant. It should be obvious that sustaining monopoly to recoup sunk costs can indeed be difficult.

Such strategies did help the early start-ups, resulting in the jeans-to-riches stories (Microsoft, Netscape, etc.) with which Silicon Valley abounds. But more recently it has become clear that start-ups undertake innovative activities only to create winning products that the big fish acquire. This is because of the possibility of easy replication and development of an original product, which can be done by dominant firms with deep pockets that allow them to stay in place and spend massively to win dominant market shares. In the event, the likelihood that a small start-up would be able to recoup sunk costs, clear debts and make a reasonable profit is indeed low. Selling out ensures that such sums can indeed be garnered. And selling out is often a better option than investing further sums in developing the product, now faced with a competitive threat, in keeping with industry and market needs.

Given this feature of the software products market, it is not surprising that small players (such as Netscape with its Navigator and Vermeer Technologies that delivered Frontpage) are mere transient presences in key areas even in the developed countries. To expect developing country producers to fare better is to expect far too much. The latter can merely be software suppliers or outsourcers for the dominant players. This implies that, given the current trends in the industry, even on the software front the promise of ICT contributing to a redressal of even national, let alone international, inequalities in

technology and income is unlikely to be realised. The digital world seems to adding to and even worsening the existing divide.

Impact on growth and international inequality

It is in this background that we should assess the implications of the new opportunities promised by the diffusion of information and communication technologies in the hardware, software and IT-enabled services sectors are obvious. It would be useful to recall the nature of those opportunities. To start with, they offer a whole new range of income-generating sources of employment for labour surplus economies where there are definite signs of a decline in the employment elasticities of output in the conventional commodity producing sectors such as agriculture and manufacturing. In fact, in these sectors, the available evidence seems to suggest that trade liberalisation in the form of removal of quota restrictions and reductions in tariffs, necessitated in part by WTO norms, are resulting in the displacement of more workers in traditional activities than are being created in newer ones. Further, the promised expansion in exports as a result of the restructuring of commodity production by liberalisation has not been realised despite ten years of reform in a country like India. In the circumstances, the fact that the new sectors offer a combination of employment opportunities and export revenues from hardware, software and IT-enabled services, renders them the leaders in the effort to make globalisation the appropriate means to enhance growth in output and employment as well as to reduce balance of payments vulnerability.

As mentioned earlier, in the past, the special characteristics of the IT sector, which substantially reduce technological and financial barriers to entry by small players, were seen as underlying the success of small Silicon Valley start-ups. Those start-ups not only challenged traditional giants like IBM, but also have since grown to become major players in their own right and have changed the structure of the industry. The growth of the IT industry in India and elsewhere in the developing world and India's success as a software exporter, seem to suggest that these characteristics hold for firms in developing countries as well. Not surprisingly, it is now being argued that what was true for the Silicon Valley start-ups in terms of their ability to break through barriers to entry should be true for the developing countries. It is this perception that underlies the optimism that information technology heralds a new era of reduced international inequality.

However, our argument would lead us to suggest that the rapid rates of growth of turnover in the industry should be treated with caution. Gross revenues are obviously misleading in the domestic industry segment characterised by substantial dependence on imported capital goods, components and software, especially in the hardware and packaged software sectors. With hardware and packaged software accounting for a significant share of domestic IT, their high import intensity would substantially reduce the domestic multiplier effects of such spending.

There are a number of reasons to expect import intensity to be high. The domestic industry does not generate much packaged software, so that a substantial part of spending on this account would amount to leakage from the domestic economy. According to Dataquest, Indian companies launched 92 software products and updates in the domestic market in 2000-2001. However, MNC's launched 152, and dominated the market in most segments. Microsoft's Office suite for example, occupied over 80 per cent of the market. Even in the case of hardware, import intensity tends to be high, especially in the case of servers, workstations, networking hardware and peripherals. Finally, in the case of single-user systems two developments are likely to have increased import intensity over time. First, liberalisation of component imports and reductions in import tariffs would have encouraged all producers to increase the share of components outsourced from abroad. Second, import liberalisation and the relaxation of regulations on foreign firms, has increased the share of major international players in the domestic PC market.

However, it is not only in the domestic segment that there is a case for caution, if not scepticism, when assessing the lager international and national consequences of IT growth. Our discussion of the dominant export segment also suggests that there are not only difficulties in ensuring the appropriate "diffusion" through growth of this kind, but also that the sustainability of such growth is not altogether certain.

IT Growth and the State

These features of IT growth not only suggest that the high expectations from the IT sector were in part misplaced but that private responses to market incentives don't ensure the requisite changes in terms of technological development and brand-building in the hardware sector, the spread and appropriate diversification of software export activity,

the adequate generation of software skills and the much-needed migration up the software export value chain. This points to the need for some intervention by the State not merely to facilitate such changes but enforce compliance along these lines on the part of the private sector. Unfortunately, the prevailing perception is that ICT-based industries are best left to private initiate and private responses to market signals. Any attempt at regulation has been interpreted as an effort to throttle the dynamism of private sector-led growth. Accepting that perspective, the Indian government has increasingly withdrawn from regulation of this sector and has even offered substantial fiscal incentives and tax concessions, especially to the exporters of software and IT-enabled services. Besides implementing and proposing to implement a zero duty regime on a range of IT products, the government has exempted profits from software service and IT-enable service exports from payment of income tax.

On the other had in its role as facilitator, the government has taken on a range of responsibilities including that of ensuring the expansion of educational services so as increase the supply of IT professionals and investing in and creating conditions for the rapid expansion of the IT infrastructure, especially the availability of high speed links and international gateways with sufficient bandwidth.

This policy slant has had three consequences. First, it has meant that the government has not been able to ensure adequate technology absorption and development in the hardware sector. Second, the government has not been able to intervene to ensure the migration up the value chain of India's software industry. And, finally, the government has not been able to mobilise adequate revenues from what is a rapidly growing sector, even though it is required to undertake expenditures and investment to facilitate the growth of the sector, especially its export segment, as well as to seek to widen access to ICT. This is crucial given the fact that ICT is not all benign. As one analyst puts it there is: "a clear risk that, without policy intervention, ICT will intensify social divisions rather than close them. The unregulated market is likely to develop ICT to address the needs of the better educated, wealthier, and more technology literate individuals, communities and countries,

since these are the people who want and will be prepared to pay for the development of new and more sophisticated products and services."[12]

Case for Caution

With the government failing to direct the sector in appropriate direction, the persistence of the current growth trends in the industry depends on India continuing to exploit the possibilities of arbitrage generated by differences in custom software and IT-enable serviced costs between onsite sources and offshore centres. There is, however, some uncertainty as to whether India can do so. That possibility is threatened not merely by the emergence of alternative offshore centres in countries like the Philippines and Israel, but also by a reduction in the onsite-offshore cost differential. There are two tendencies driving that reduction in differential. First, an inadequate pace of generation of additional, appropriately skilled software professional, for the reasons delineated earlier.

Second, the "suction-effect" exerted by software centres in the developed metropolitan countries. Learning from the success of Indian software engineers in Silicon Valley and elsewhere in the US, the United States government itself and governments in other developed countries like Germany, France and Japan are selectively relaxing their immigration laws and rules and quotas regarding the provision of work permits, to facilitate the flow of the best Indian software engineers to their countries. The attraction of the better salaries, lifestyles and work conditions in these environments ensures the rest. This has had some adverse consequences in India. To start with, it has raised the salaries paid out to top-end software professionals to close to international levels, reducing the cost advantage India had in this area. Second, it has created an acute shortage of highly-qualified, top-end experienced and skilled professionals in the Indian market for software engineers. The prognosis with regard to India's migration to the higher-end of the software supply chain based on its knowledge-advantage is, therefore, not altogether positive. That movement is possibly as structurally constrained as the effort at increasing sophisticated manufactured exports from the developing to the developed world was. It for such reasons that optimistic projections of the kind

[12] Stephen McNair, "The Emerging Policy Agenda" in Organisation for Economic Cooperation and Development, **Schooling for Tomorrow: Learning to Bridge the Digital Divide**, Paris: OECD, 2000, p. 10.

emanating from the McKinsey/NASSCOM stable should be taken with more than a pinch of salt.

Implications for Policy

In brief, the fall-out of the above analysis of the constraints to the realisation of the potential of ICT is the following:

- Despite its rapid growth the information technology sector in India is small and marginal and the fall-out of its growth on the rest of the economy is limited.
- There are signs that barriers to entry outside the realm of production in both the hardware and software segments are substantial. This has adverse implications for sustaining the growth of both output and employment in this sector, unless the disproportionality in growth between the domestic and export segments is addressed and firms strive to strengthen domestic hardware production and move up the value chain in software. This requires the State to play a more proactive role in influencing the pattern of growth of this sector, rather than leave matters to the market which drives firms in the direction of the lower-end of the value chain, where entry is easier and profits quick to come by.
- Despite the rapid growth and high profitability of leading firms in the software and IT-enabled services sector, the notion that this is a sector whose growth is best left to the market, has resulted in fiscal concessions of a kind that substantially reduce the revenues garnered by the State. This substantially erodes the ability of the State to sustain even its role as facilitator (which involves large investments in the communications infrastructure), let alone providing funds to expand its role in the area. The industry must contribute out of its large profits a part of the revenues to meet the much needed expenditures by the State in this area.
- The State's role is all the more crucial when we examine the prospect of a sharply widening digital divide within the economy. Even beginning to provide access to the new technology to the overwhelming majority who cannot access it for technological reasons would impose a large financial burden. But the more

difficult task is to prepare the disconnected to develop the competence to participate, however marginally, in the emerging digital economy. This alters priorities completely. With literacy and schooling achievements still at indefensibly low levels, the first task of the government would be to rapidly advance the pathetic reach of literacy and school education in the country. In terms of priority this should be placed above the target of providing a minimum degree of access to ICT those who are completely disconnected. However, the nature of the challenge of overcoming backwardness is such that a degree of syncopation is inevitable, necessitating large resources which in part must come from the surpluses being garnered by the rapidly growing and highly profitable IT services sector. Thus the growing dilution of the State's role in the growth in the IT sector could aggravate the tendency to widen the 'digital divide' between India and the developed industrial countries, especially the US, and within India itself to persist and even widen. This strengthens the argument that the buoyant and highly profitable private sector has to be treated on par with the "brick-and-mortar" economy and taxed to generate the resources for such expenditures.

- This need to push for greater expenditure by the State is in the interests of the industry as well for two reasons. To start with, a widening digital divide can only widen social divisions and tensions. To quote one analyst: "a clear risk (is) that, without policy intervention, ICT will intensify social divisions rather than close them. Easy access to ICT enables people to become richer and therefore more able to afford still newer technology; it is moreover the already educated who – disproportionately – take up lifelong learning activities and who, in general, get better services. In short, the educated *information rich* become richer and the less educated *information poor* become poorer."[13] No democratic society can tolerate growing divisions of this kind, making effective State intervention an effective policy option for the industry as well. Second, as the infrastructure and the capacity to participate in the transformation being wrought by ICT expands, it not only expands the market for the domestic industry but also allows it use the large domestic market as the base to generate the skills and develop the capability to

[13] Stephen McNair, *op. cit.*, p. 10.

move up the value chain in both hardware and software production. Thus partnership between the State and private capital rather than free play for private initiative, with State as mere facilitator, is what is required to even begin to meet the challenge that the IT revolution sets for a developing country like India.

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