INDIA'S IT EXPORT BOOM: CHALLENGES AHEAD

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ABSTRACT

Given the manifold ways, in which the information technology could contribute to human welfare**,** the developing countries have invested in Information Technology (IT) as a short cut to prosperity. India too has not been left much behind in this bandwagon and series of initiatives were made by the government to promote the IT sector in India. These efforts seem to have paid rich dividend in terms of IT sector emerging as one of the vibrant components in India's export basket. Moreover India has been able to establish credibility in the international IT markets. Given the boom in the world market for software the firms in software industry could afford to pay wage rate much higher than that offered by other sectors. Of late, the developed countries have come forward to relax the visa restrictions to Indian software personnel. This in turn is expected to facilitate the free movement of skilled manpower from India. In the light of these developments in India's IT sector the present paper seeks answers to three crucial questions. First, how to characterize India's recent performance in software exports? Secondly, what are the implications of boom in the IT export sector on other sectors competing for the skilled manpower? Thirdly, are there any threats to the sustained growth of India's software exports?

To answer the first question, we critically analyze the recent trends in India's software exports in terms of its structure and growth and highlights some of the disquieting aspects of India's IT export boom. To answer the second and third questions we develop a model drawing insights from the specific factors model. With the help of the model the paper highlights some of the emerging challenges which were generally overlooked in the existing literature. It was observed that the phenomenal increase in the export growth notwithstanding, the net export earning might be only in the range of 50 per cent. The study underlined the need for a structural transformation of the India's IT export sector through enhancing its value addition capability so as to achieve the target of $50 million exports by the year 2008. It is also argued that the boom in the software export sector is likely to adversely affect the growth prospects of other sectors, which compete for skilled manpower in the short run. This is primarily on account of the resource movement effect associated with IT export boom. This in turn could have adverse effect on the growth prospects of IT sector itself in the long run. Finally it is shown that the move towards relaxation in the visa restriction for Indian software manpower initiated by the developed economies is likely to pose a major threat for the sustained growth and competitiveness of India's IT exports.

JEL Classification: F2, L8

Key Words: India, Information technology, Software exports, specific factors model.

Introduction

The 1970s and 80s witnessed the microelectronics revolution, which sowed the seeds of Information Technology (IT) revolution. While innovations in the semiconductor industry were at the root of microelectronics revolution, the ongoing IT revolution, which essentially involves the interface between computing and communication technologies, has been accentuated by the innovations in fibre-optics and satellite communication on the one hand and computer hardware and software on the other. By enhancing the access to information and by augmenting the process of information exchange, IT offers enormous opportunity for productivity enhancement and growth in all spheres of human activity. In fact, it may not be an exaggeration to state that we are yet to fully comprehend the manifold ways in which IT could contribute towards human welfare. Unfortunately, however, the fruits of this ubiquitous technology are very unevenly distributed across different countries. On the one hand, we have a few countries like US with fairly higher level of IT diffusion (with about 400 computers per 1000 population) wherein IT contributes significantly to GDP[1]. On the other

1 For a quantitative analysis of the impacts of the investments in IT on economic growth in a cross section of 39 countries, see Pohjola (2000)

extreme is a number of developing countries, wherein extent of IT diffusion remains at very low level[2]. The observed "digital divide" is best summarized by the fact that "more than half of humanity has never made a phone call"[3]

The current unequal access to IT notwithstanding, it has been argued that, in an era of globalization, the ability to harness this technology improves the capability of developing country firms to withstand competition from multinational corporations or in developing partnership with them. At the same time, in a world wherein information is becoming a factor, like income and wealth, by which people and countries are classified into rich and poor (Pohjola 1998), there arises a potential threat for LDCs that if unable to harness this new source of wealth, they will fall even more behind the developed countries. No wonder, the developing countries have shown in great interest and high hopes are pegged on to information technology as a short cut to prosperity (UNDP 1997, World Bank 1999).

In this bandwagon India has not been left much behind. Series of policy initiatives and institutional interventions were made with a view to accelerate the diffusion of IT in different sectors of the economy[4] and promote IT as a major foreign exchange earner. These initiatives seem to have had fairly high returns; The Indian software industry has, established the credibility in the world market, which appears to be unique when compared with the experience of most other Indian exports. This

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2 In the African countries, for example, it is estimated that the number of computers per 1000 population is 0.3. Even in India, the number computers per 1000 people is only about 1.5 and only one in ten is hooked to Internet

3 This is a statement made by Mr Thabo Mbeki, Vice President of the Republic of South Africa as quoted in Pohjola (1998)

4 For a detailed account of the initiatives see Joseph and Harilal (2001)

is manifested in the emergence of software as a vibrant export sector, which is reported to have grown at an annual compound growth rate of over 50 per cent in the 1990s and contributes about eight per cent of the total export earning of the country (NASSCOM 2000). More importantly, in 1998-99 more than 203 out of the Fortune 1000 companies outsourced their software requirement from Indian companies. It is estimated that as on March 1999 the software industry in India employed more than 250,000 people[5] and continues to be amongst the fastest growing sectors in the Indian economy. Above all, the developed countries, in their pursuit to solve the IT related problems, which is of paramount importance in increasing their productivity and competitiveness, have come forward even to relax the visa restrictions to Indian software personnel.

Against this background the present paper seeks answers to the following issues; First what are the implications of boom in the IT export sector on other sectors in India, which compete for technical manpower. Second, in the light of relaxation in visa restrictions and consequent "free mobility of technical manpower" the paper inquires in to its implications on sustaining India's competitiveness in the world software market. These issues are addressed against the backdrop of an analysis of the structure and growth performance of India's software exports. This paper is organized in the following way. In the second section we critically examine the structure and export performance of IT against the backdrop of the government policy. In the third section we develop a model in line with the specific factors model to reflect on the issues raised above followed by some concluding observations in the last section.

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5 Out of this almost 80,000 people are employed in software exports, National Association of Software and Service Companies (2000).

II. Indian IT Sector: Policy[6], Structure and Export Performance

Though the genesis of software development in India could be traced back to the early 1970s it received the direct attention of the policy makers only in the mid-1980s. This was, probably, because in the early 1970s, the share of software in the total cost of a computer system has been negligible as compared to the hardware. Also it was generally held that the software and hardware are complementary and therefore, separate initiatives are not necessarily called for. Thus till the mid-1980s, while there were explicit policy announcements towards promoting the computer industry in general, there was hardly any specific policy towards software development. This also reflected the lack of demand on account of the limited diffusion of microelectronics technology and computers. The use of computers was confined mostly to a few government departments, private sector units and educational organizations, wherein software programmers were appointed to develop the required software. In general, software was not considered a product amenable for trade[7].

The computer policy of 1984, probably for the first time, explicitly acknowledged the importance of software development and underlined the need for institutional and policy support. The policy called for setting up of a separate Software Development Promotion Agency (SDPA) under the Department of Electronics (DoE). Imports of inputs needed for software development were made more liberal. The increase in the production and use of computers as a result of the liberal computer policy (Joseph 1997) enhanced the domestic demand for various software products and services. However, the nascent industry could not meet

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6 Our discussion of policy changes is rather brief. Interested readers may refer Heeks (1996)

7 A few firms, however, were engaged in the export of software but their mode of export was mostly on-shore development.

this increasing demand. As a result, a sizeable proportion of the domestic demand had to be met through imports. At the same time, the rapid growth in the world demand for software pointed to the increasing export potential. This in turn called for more concrete policies towards the promotion of software development and export. Accordingly in 1986 an explicit software policy was announced and software was identified as one of the key sectors in India's agenda for export promotion. The policy underlined the importance of an integrated development of software for the domestic and export markets (Government of India 1986). To facilitate the stated objectives, policy emphasized the need for simplifying the existing procedures and provided various incentives like tax holidays, tax exemption on the income from software exports, export subsidies, and duty free import of hardware and software.

In addition, the Government also made certain institutional interventions like the establishment of Software Technology Parks[8] (STP) to provide the necessary infrastructure for software export. Though the idea of establishing STPs was put forward in 1987, it was only in 1990 that the first technology park was established by the Government of India. The first ones to come into being were those at Pune, Bangalore and Bhubaneshwar in August, October and December 1990 respectively.

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8 A Software Technology Park (STP) in all respects is similar to a free trade zone exclusively for the software. The specific objectives of the STPs are :

- To establish and manage the infrastructural resources such as data communication facilities, core computer facilities, built up space, common amenities, etc.
- To provide services (import certification, software valuation, project approvals, etc.) to the users who undertake software development for export purposes.
- To promote development and export of software and software services through technology assessments, market analysis, marketing support, etc.
- To train professionals and to encourage design and development in the field of software technology and software engineering (Government of India 1995)

In 1991, four more STPs were set up by the DoE at Noida, Gandhinagar, Trivandrum and Hyderabad[9] . As of now there are 18 software technology parks set up in different parts of the country and they play a significant role in the export of software from the country. The infrastructure facilities available in these STPs included, among other things, modern computers and communication network which are beyond the reach of individual firms. The STPs also envisage a transparent policy environment and a package of concessions, which include among others;

- Approvals are given under the "single window clearance" mechanism and permission of 100 per cent foreign equity.
- The STP authorities issue approvals for projects costing Rs.30 millions or less with no foreign equity participation.
- Units are eligible for 5 years tax holiday with no value addition norms.
- All the imports are completely duty free while the domestic purchases are eligible for benefit of deemed exports.
- Sub contracting of software development activity by STP is permitted and sales in DTA is permissible up to 25 percent of the export (Oberoi 1991).

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9 In 1991 there was also a policy change as regards the management of the STPs. The earlier autonomous societies for managing each park were dissolved and a new society, called the Software Technology Park of India registered in June 1991, was given the charge of managing all the STPs in the country through individual executive in each of the parks. Under the new scheme the participating companies have the advantage of being fully involved in all decision-making, including fixing of rent, selection of hardware etc. The companies are represented in the executive board which manages the park under the overall supervision of the governing council

The formation of STPs and the series of incentives offered need to be seen as a concerted effort towards attracting more resources (both foreign and local) into the field of software development and to increase India's share in the fast growing world software market. Given the negligible share (less than one per cent) of India in the world export market in the late 1980s, the scope for increasing Indian software export could not have been over emphasized. It was also envisaged that these measures would lead to an increase in the on-shore content in the software export.

While the policy measures have led to a substantial increase in the capital endowment for software exports (Ventakesh 1995), the supply of technical manpower appeared to be a major constraint (Schware 1987, Sen 1995). Software development is a skill intensive activity *albeit* the intensity of skill requirement varies across different activities involved in software production. The development of software involves broadly the following stages; requirement specification, prototyping, designing, coding, testing and maintenance. While the first few stages call for highly skilled manpower, the skill requirement is relatively low in the later stages (Schware 1987).

Traditionally, in India the main sources of software professionals have been the public sector education institutes such as the IITs, (Indian Institute of Technology) ITIs, (Industrial Training Institutes) and the engineering colleges. To facilitate the entry of private sector in the training of software personnel the Department of Electronics started the accreditation scheme based on certain objective criterion[10] . As a result,

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10 The IT task force also made a series of recommendations to tackle the manpower bottleneck including greater participation by the private sector and transparent policy environment. See for details IT Task force, IT Human Resource Development, http:///www.IT-Taskforce.nic.in

large number of private organizations were set up for providing training ranging from three weeks to one year or even more. Available estimates show that in 1999 there were over 1832 formal educational institutions in India, which train more than 67785 computer software professionals every year (NASSCOM 2000). The structure of the current out-turn of technical manpower from these institutes indicates that the three categories, viz. BTechs, diploma holders and the ITI certificate holders accounts for nearly 70 per cent of the total (see Table 1) of which B Techs accounts for as high as 24 per cent. The share of Ph D holders is only 0.14 per cent. It may be noted that there are empirical evidence to suggest that during 1964-86 about 58.5 per cent of graduate computer science form IITs have migrated abroad (cited in IAMR 1999). The per cent of B Techs migrated from other institutes also would have been significant. Given the large scale migration of highly qualified to other countries, the software activity in the country is bound to be predominantly those operations undertaken by people with lower level of skills like diploma holders and ITIs. This point towards, though indirectly, on the type activity that the Indian firms are mainly engaged in.

With the initiation of economic reforms in the early 1990s there has been a number of other policy initiatives which have facilitated the growth of IT. The new policy initiatives included the provision to finance software activity through equity and venture financing, measures to make available easier and cheaper data communication facilities, removal of entry barriers for the MNCs and reduction and rationalization of taxes, duties and tariffs[11] (Narayana Murthy 2000).

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11 Mention need to be made of the substantial reduction in the duties and tariffs across the board for components and sub assemblies, zero duty of software import and zero income tax on profits from software exports.

Table 1. Structure of the Outturn of Software Manpower (1999)

Course	Number	Per cent
Ph D	95	0.14
M Tech	2130	3.14
B Tech	16160	23.84
M Sc	2800	4.13
B Sc	3200	4.72
BCA /MCA	7700	11.36
PG. Diploma	6000	7.38
Diploma	16700	24.64
ITI	14000	20.65
	67786	100

Source: NASSCOM (2000)

Structure and Growth of IT Exports

Against the backdrop of the policy reforms and institutional interventions, let us examine the structure and growth performance of software exports. Conceptually, the software export is amenable to analysis in the framework of trade in services. Unlike the trade in goods, trade in services could be carried out in different ways. In the literature (Sampson and Snape 1985) on trade in services, we find mainly four different modes of service export; viz.

a) trade taking place with the movement of provider to the receiver,

b) trade wherein the receiver is mobile not the provider,

c) movements of neither the provider nor the receiver is involved and

d) transactions wherein both the provider and the receiver move.

Trade in software, which is akin to service trade, is carried out mainly through; (a) on-site services (b) offshore services and (c) offshore products and packages. The underlying distinction being the movement of provider and the receiver involved. Let us now briefly deal with each of them in some detail for it is important in understanding India's software export performance.

On site services, popularly known in the industry circles as "body-shopping" occurs when the factors move to the site of the receiver. In its extreme form this occurs when software manpower is exported to help solving the users' software related problems. Here, the software firms actually export the manpower and need not necessarily have the complete understanding of the user requirements. It could also take the form of undertaking the task of software development to solve specific problems. The development and execution of the software will be done on-site. Under this mode of export, it has been argued that the net export earning will be substantially less than the total export earning because a part of the foreign exchange earned will have to be spent in the importing country itself (Heeks 1996).

The second mode of software export is offshore services. This mode of export involves limited movement of both the factor and the receivers. The software is developed offshore according to the specified requirements and exported to the users. This method could be cost effective for the software development process is organized in the domestic country. At the same time, this calls for more investments in the form of hardware and communication network. The third mode of

software export is offshore packages or software product development. Here, neither the factor nor the receiver of the service moves. This is also highly capital and labour intensive. Additionally, there is also the need for incurring substantial marketing cost. Nonetheless the net export earning will be higher in this mode of export as compared to others. On the whole, it appears that the extent of net export earning depends to a great extent on the structure of export. Hence, one of the major objectives of India's software policies has been to increase the offshore component.

Against this background let us examine the trend in exports. It may not be an exaggeration to state that, paramount importance attached to software export notwithstanding, reliable data on software export is difficult to obtain. There are three major data sources pertaining to the software export from the country. The first one is by the Department of Electronics, the second one is the NASSCOM (National Association of Software and Service Companies) and the third one is the Reserve Bank of India. For unknown reasons, the first two sources keep silent about the imports associated with the export of software. Hence one cannot reach any definite conclusion about the net export earning (which is of relevance to the economy) from the first two sources. In the case of RBI data on software export is included in the item on miscellaneous services. The import data is available only for the three years beginning with 1997-98. The import of software according to RBI is $223 million, $348 million and $ 468 million respectively for the financial years 1997, 1998 and 1999 (RBI Bulletin April 2001). Though the RBI provides import data, problem with this data is the following. First, import of software need not necessarily be by the software exporters. Secondly, there is substantial import of hardware associated with software export, which cannot be isolated from the RBI data. Thirdly, import data by RBI may not take into account software embodied in a number of capital goods. Viewed

thus import data provided by RBI may be a gross under estimate and not reflecting the reality. The only alternative for the present purpose, therefore, is to examine the balance sheet data of software firms and reflect on their import intensity, which is undertaken subsequently.

For the present paper, we shall begin with an analysis of export trends based on NASSCOM data. The issue of net export earning is then taken up using firm level data. Table 2 presents data on export earning

Table 2. Trend in Software Export from India

Year	Rs.Million	Growth Rate	$ Million	Growth Rate
1990-91	2500		128	
1991-92	4300	72.00	164	28.13
1992-93	6750	56.98	225	37.20
1993-94	10200	51.11	330	46.67
1994-95	15350	50.49	485	46.97
1995-96	25200	64.17	734	51.34
1996-97	39000	54.76	1085	47.82
1997-98	65300	67.44	1750	61.29
1998-99	109400	67.53	2650	51.43
1999-00	172000	57.22	3900	47.17
Annual Average Growth Rate		60.19		46.45
Annual Compound growth Rates				
1990-91 to 1995-96		78.18		54.74
1995-96 to 1999-00		61.63		51.82
1990-91 to 1999-00		60.02		46.10

Source: NASSCOM, Indian Software and services Directory, Different years.

as reported by NASSCOM[12], an often quoted data source on exports. We have presented export earning in both dollars and rupees for the data is in current prices[13]. By comparing the export in rupee and dollar terms will also enable us to reflect on the possible effect of devaluation. From the data presented in table 1 following observations may be made[14]. To begin with, the recorded rate of growth in exports, (over 50 per cent in the sub periods as well as for the whole period) both in rupees and dollars, is almost unprecedented in any other sectors of Indian economy. Secondly, There is a wide margin between the recorded rate of growth in terms of rupees and dollars (which is termed as exchange rate effect by Pronab Sen, 1995) which reflects the possible effect of devaluation of Indian rupee vis a vis US dollar.

Thirdly, the observed difference between rate of growth in terms of rupees and dollars (exchange rate effect) comes down as we move from the early part of the 1990s to closing years. This, probably, point towards the reduced role of devaluation in sustaining the export growth.

The phenomenal increase in the export growth has to be viewed, i*nteralia*, in terms of the growing world demand, comparative advantage that India has on account of the highly skilled, English speaking

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12 It may be noted that data provided by DoE and NASSCOM are highly comparable. NASSCOM data is compiled from the firm level data. As of 1999, 545 software and service companies were having membership of NASSCOM and these companies accounted for about 95 per cent of the revenue of software industry in India. It is claimed that there is hardly any software company in India, which employs more than 20 professionals and is not a member of NASSCOM.

13 It would have been ideal to convert the export earning in to constant prices. In absence of an appropriate deflator we are forced to carry out the analysis at current prices.

14 For a detailed analysis of the trend in software exports the interested readers may refer Heeks (1996) Pronab Sen (1995) Venkitesh (1995) and Schware (1992), It also need to be noted that while there is a fairly good data base on software export, reliable data on domestic production is practically non existent.

manpower at relatively low cost (see table 3) and the time difference between India and US, which still continues to be the major export market for India. While the cost of software manpower in India is much less as compared to the developed economies, it is much higher as compared the prevailing wage rate in other sectors in India. More importantly, the salaries of software personnel have been growing at a rate of 25-30 per cent per annum (Kumar 2001). This has to be viewed against the backdrop of growing world demand on the one hand and excess demand for software personnel on the other.

Now let us examine the trend in net export earning as revealed from the balance sheet data of firms in software industry. At the outset it needs to be noted that argument with respect to net export earning may not be stretched too far for our analysis is based on a sample firms .

Table 3. Comparison of Annual Wages in Software Industry (1994)

Country	Computer Programmer		Systems Analyst	
	US $	Index	US $	Index
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)

Secondly, from a macroeconomic perspective it is not necessary that each sector is an economy is a net export earner. We have obtained the firm level data from the computerized data base of Centre for Monitoring Indian Economy called "Prowess". Table 4 presents the details of number of firms as well as their mean export and import. To begin with it may be noted that the number of firms in our sample increased from 32 in 1993 to 79 in 1997. The share of these firms in the total export (as reported by NASSCOM) increased from 24.8 per cent in 1993 to 26.76 per cent. To the extent that our sample accounts for about 25 per cent of the total exports it may be considered as representative. From the table it is also evident that the mean export earning has increased from about Rs 8 crores in 1993 to over Rs 22 crores in 1997. At the same time the import also kept pace with exports: The mean imports increasing from Rs 4.5 crores in 1993 to over 11 crores in 1997. What is important to be noted is that the ratio of imports to exports remained at over 57 per cent in the initial year and increased to over 64 per cent in 1995 and later declined to 51 per cent in 1997. If the data presented in table 3 is any

Table 4. Trend in Export Import and Import Export Ratio for a Sample of Software Firms.

Year	No. of firms	Mean Export Rs Crores	Mean Import Rs Crores	M/X (%)
1993	32	7.915	4.570	57.73
1994	53	8.008	4.532	56.59
1995	57	11.651	7.568	64.95
1996	69	13.017	7.847	60.28
1997	79	22.125	11.389	51.47

Source: Estimates based on PROWESS, Centre for Monitoring Indian Economy

indication one could safely conclude that the net export earning from India's software export is not more than 50 per cent.

To reflect on the prospects of India's IT exports we shall examine the current structure of exports. The structure of exports in the early 1990s has been one wherein the software services (developed mostly on-site) accounted for about 80 per cent of total software exports with hardly any presence in the software products. As a result of the series of policy initiatives, the share of on site services has come down to about 58 per cent. However, the comparative advantage of Indian firms has been in the export of services such as customized software development with very few well known products of proprietary packages in the international market (Arora and Asundi, 1999). As has been argued by Heeks (1996) this has implication on the net export earning from software exports. This is because the gross figures do not take into account the fact that the foreign exchange must leave the country to pay for worker's travel and living allowances. It has been estimated that the net earning is only about 55 per cent of the gross. Another aspect of India's software development relates to the fact that India's presence in the fastest growing segment viz. the software packages (or software products) is negligible. As per the NASSCOM data the share of products has come down from about 9.5 per cent in 1995 to less than 8 per cent in 1999 (see table 5). This tend to indicate that the technological change in the Indian software is yet to reach a stage as where in the services splinter-off from the factor. It has been argued that Indian firms have generated little knowledge of proprietary nature that is replicable and has revenue productivity abroad. Services are considered low value adding as compared to products. It must also be noted that there are high entry barriers to high value-added software products market which is dominated by large multinational companies which spend up to 60 -65 per cent of price component of packages on marketing and distribution (Kumar 2001). The hesitation

of the firms to go in for software products also could be seen in the context of the widespread software piracy in the domestic market. It has been said that software piracy has forced some of the companies out of the domestic packaged software market. The magnitude of the problem is illustrated by an estimate from Lotus Development Corporation, that of 150,000 copies of Lotus 1-2-3 in India, 140,000 have been pirated. Companies that developed microcomputer based products for word processing, data base management and accounting found selling their products in India practically impossible because of the piracy (Schware 1992).

From the discussion so far made it evident that the software sector in India has been growing at a phenomenal rate in terms of exports. Higher growth rate in total exports notwithstanding, there is substantial imports associated with software exports. Hence the net export earning would be substantially less and not more than fifty per cent of gross exports. Moreover, the share of software products in India's export basket is even today is negligible and has shown a marginal decline in the recent years. Hence to achieve the targeted $50 million exports it is important that the Indian software industry goes up in the value chain and

Table 5. Structure of Software Export from India (Percentage)

Type of Software	Year	
	1995	1999
Onsite Services	61.00	58.18
Offshore Services	29.50	33.92
Products and Packages	9.50	7.90
Total	100.00	100.00

Source: NASSCOM (2000)

progressively increase offshore development. It I also important that the industry develops strategy towards import reduction. If the import intensity remains at the current level, the net export earning may not be more than $25 billion in 2008. Against the backdrop of the above discussion two issues arises: What are implications of the booming software export on other sectors in the economy especially those sectors, which need technical manpower? Secondly as we have stated earlier it is important that we inquire into the implications of relaxation in visa restrictions on Indian IT. It is to these questions that we turn now.

III. A Model of India's IT Export

Having examined the changing policy framework and the emerging trends in India's software development and exports let us now proceed to provide answers to the questions raised above. For this purpose we developed a model drawing insights from the specific factors model[15]. In developing the model we are concerned with only that sectors of the economy, which require technically skilled manpower.[16] The sectors that require the technical manpower are divided (for the present purpose) in to two broad sub-sectors a) those engaged in the production of services and b) those engaged in the production of goods. The service sector in turn is subdivided in to those engaged in teaching/trainning/research and those engaged in software export. The sector engaged in goods includes hardware, communication, control instrumentation etc, which require

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15 The specific factors model is due to Jones (1965), also known as Ricardo-Viner model. The model has the same structure as the Heckscher-Ohlin (HO) model except that one factor is mobile that is used in all the sectors and a set of sector specific factors. That is, unlike the HO model, each sector has a factor, which is not freely mobile across different sectors. In a dynamic framework, specific factors can be allowed to be mobile thereby leading to an equilibrium tantamount to HO equilibrium in the long run (See Neary 1978 and Mussa 1974).

16 For more formal treatment of the model in the context software production for export vis a vis domestic use, see Joseph 1996.

highly skilled technical manpower. The model is based on the following assumptions.

There are only two factors of production viz. technical manpower and capital. While the technical manpower (labor) is perfectly mobile across different sectors the capital is not assumed to be mobile and hence specific to the sector. This simply means that while the technical manpower engaged in service sector could be easily moved towards the production of goods producing sectors, the capital engaged in one sector cannot be moved in the short run towards the production in other sectors. Following Jones (1965) we also assume that output in each sector depends on the fixed input coefficients and the level of factor use. The model also assumes full employment. (In fact full employment is not an assumption but a reality at present in India as far as the technically skilled manpower is concerned) We shall also impose Inada conditions on the production functions. It states that labor is indispensable for the production of both software and that the marginal productivity of labor in each sector is infinite if the ratio of labor to sector's other specific factor is zero. The model also assumes constant returns to scale and diminishing returns to the variable factor. Need less to add all the other standard neoclassical assumptions also hold good.

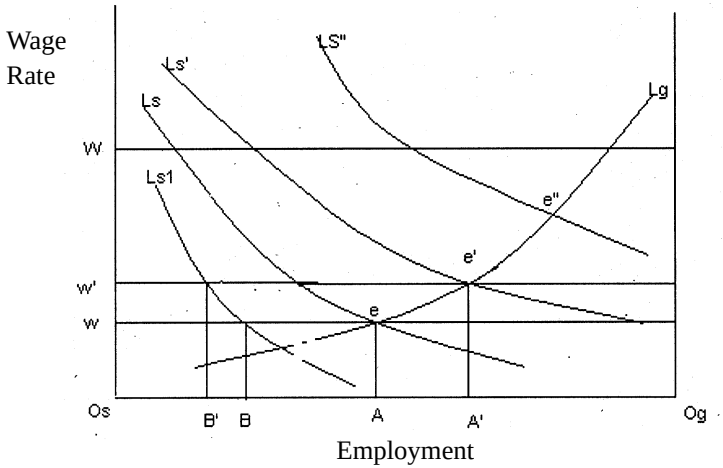
Given these assumptions let us look at the Value of Marginal Product of labour (which is also the demand for labor) in each of the sectors. Assume that the prices of the products in both sectors remain unchanged. Given the initial capital endowment, the distribution of technical manpower across sectors, the level of wage rate and the output of each of the sectors is determined with the help of fig 1. In fig 1 the horizontal axis measures the employment and the wage rate is shown in the Y axis. The length of the horizontal axis is equal to the total supply of skilled manpower available in the economy, which may be used by

the two sectors. The employment in the service sector is measured from Os and that of in the goods producing sector is measured from Og The vertical axis passing through the left-hand side measures the wage rate in the service sector. Since the wage is equal to the marginal product of labour and mobility of labour is assumed wage rate in the service sector will be equal to the wage rate in the goods producing sector.

The curves Ls1, Ls and Lg show the demand curves for technical manpower in the service sectors other than software, software export sector and the goods producing sectors. The curves Ls1 and Ls are drawn in such a way that Ls1 is the manpower demand in the service sector other than software and by laterally adding labor demand in the software sector we get Ls. The intersection of Ls and Lg gives the initial equilibrium wherein the allocation of skilled manpower across different sectors and the wage rate is determined. Corresponding to the initial equilibrium at e we have the wage rate is w. At this point of equilibrium, the total technical manpower is allocated across different sectors in the following manner; Os A is employed in the service sector, of which OsB is employed for teaching/ research etc and AB is employed in software export. OgA shows the employment in the goods producing sector. Given the assumption that the total output in each sector depends on the fixed input coefficient and the level of employment we can also infer the output level in each of the sector which is given by the area under the corresponding labour demand curves.

Now, let us examine the implications of a boom in the software export sector purely on account of exogenous increase in world demand. This results in an increase in the endowment of capital in the production of software and keeping the supply of labour constant the labour demand curve for the service sector (Ls) shifts upwards to Ls'. The new equilibrium is reached at point e' At the new point of equilibrium the

Fig. 1. Effect of Software Export Boom



wage rate rises to w'[17]. The higher wage rate naturally would attract labour, which is mobile, to the software export sector from the other sectors which is competing with the software sector for technically skilled manpower. Wage rate rises in both the sectors. Thus under the new equilibrium, the employment (and hence output) of the software sector increases from AB to AB'. Correspondingly the employment (and hence output) of the other service sectors like teaching/R&D declines from OsB to OsB' and that of goods producing sector also declines from OgA to OgA'. The observed rise in wage rate is unlikely to have any

17 It is important to reflect what does it really mean in the actual world. When there is an increase in demand for technical skilled manpower in the software sector, they are able to offer higher wage. Given the fact that software manpower are in short supply, manpower from other engineering branches will also get absorbed in the software sector. Here, it may be noted that during our interview with some of the firms engaged in the production of professional electronics equipment, it was reported that during their campus interviews they found it difficult to get bright candidates unless they offer salary levels comparable to that offered by the software firms. Since these firms are not having such a booming external market like software, very often they had to satisfy themselves with the second best.

adverse impact on the software-exporting firms because, the world wage rate (W) is still higher. The wage difference, there fore, continues to give competitive advantage to India's software exporting firms.

The prediction of the model that there could be a general rise is wage rate may not hold good if the labour market is segmented (which is assumed away in the model). The reality is likely to be the one wherein, the firms in the other service sectors and goods producing sectors would be left with following choices. Either they could pay the salaries on par with the software firms, or be satisfied with the second best by paying the lower wages. While it is an empirical question, one could safely infer that either of the strategies could have adverse effect on the firms operating in sectors other than software.

The implication of our finding that there could be a reduction in the employment and out put of service sectors other than software could be better appreciated if viewed in the context of the recent finding made by the Task Force on Human Resource Development in IT. It has found that there is the deficit of about 10,000 teachers in software training[18]. How to account for such a shortage? The model provides the probable answer. Given the fact that technical manpower for software development and training are substitutable, and that labour is mobile, there appears to be a preference for employment in software industry as compared to software training which is less rewarding at present. It could also be argued that in the current context of IT boom those who are available for software training and other teaching and research activities could be the second best as the top layer get absorbed in IT. The obvious question is can we expect high quality manpower from the hands of second best?. If

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18 See "IT panel sees manpower crisis" *Economic Times*, January, 16, 2001.

no, will India be able to sustain the present credibility in terms of having abundant supply of highly skilled technical manpower? How will it affect our future prospects in terms of software exports?

We have also observed that as a result of the software export boom there could be reduction in the employment and output of the goods producing sector which includes, hardware, communication etc. This finding goes well with the observation made by the task force on IT in its report on hardware. It was observed that " a steady decline of the IT hardware industry over the 7-8 years due to faulty and deficit policies, should be immediately reversed into a growth path through the introduction by a set of policies conducive to growth and international competitiveness" (http:/www.IT-task force nic.in). The fate of communication equipment has not been much different either. The task force, while attributing the negligible growth of the hardware entirely to faulty policies, seems to have failed to recognize the labour market linkage between the hardware and software sector. While we have no intention of underplaying the role of faulty policies, from our model it emerges that the poor growth in the hardware cannot be totally de-linked from the resource movement effect associated with the software boom.

Now, let us examine the implications of the recent relaxation in visa restriction on Indian software personnel made by the developed economies. Recently, the ceiling for visa issue for US has been raised to 1.95 lakhs wherein India has a quota of 43 per cent. (ie 84,000)[19] Assuming that 50 per cent (a very conservative estimate) of this would be software personnel, the demand for software manpower from US alone will be of the order of 42,000. Countries like UK Germany, Japan, France

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19 See among other news paper reports "No more interviews, just drop the passport" *Economic Times* January 17, 2001. " France to ease immigration of Indian IT pros" *Economic Times*, January, 20, 2001.

and others have made similar initiatives. What would be the implication of this move by the developed countries?

In terms of our model the labor demand curve for the service sector would shift upward again. This would result in a competition in the labor market between the Indian software exporting firms and their foreign counterparts for skilled manpower. If the Indian firms intend to retain the best brains, there would be hardly any option but to offer remuneration comparable to that offered by the foreign firms or be satisfied with the second best offering a wage rate lower than the world wage rate. Here again the ultimate choice made is an empirical issue. The moot question that raises is; can the Indian firms be competitive in the world market, if they offer a wage level comparable to the world wage? If the Indian software firms opt for the second choice of being contented with the second best, the issue to be resolved would be; can the Indian firms enter into the high value added areas like software products and be competitive. These are some of the issues and challenges that the Indian IT sector will have to face in the years to come.

IV. In Lieu of Conclusion

At this stage we shall highlight some of the limitations of the present analysis. Our model has not incorporated the implications of the existence of labour market segmentation which we intend to reserve for future work. Secondly we have also not reflected on the net welfare gains of the on going IT export boom which should be substantial. Hence we consider the conclusions as tentative and need to be subjected to empirical verification.

The paper highlighted some of the disquieting aspects of India's IT export boom and emerging challenges resulting interalia from the present international mobility of labour, which were generally over looked

in the existing literature. It was observed that the institutional and policy reforms initiated by the government seem to have paid rich dividend in terms of making India's presence felt in the International software market. The Phenomenal growth in gross exports notwithstanding, the net export earning may be only in the range of 50 per cent. The study underlined the need for a structural transformation of the India's IT export sector, specifically in terms of upward movement in software value chain, so as to achieve the target of $50 million exports by the year 2008. It is also important that the present dependence of US market which accounts for over 60 per cent of India's export earning is reduced. Thus there appears to be an urgent need for diversification not only in terms of product-structure but also in terms of destination. The ongoing depression in the US economy and the large scale cut in software employment should be a pointer to the ill effects of a high dependence on a few markets. It is also argued that the software export sector is bound have an adverse effect on the other sectors, which compete for skilled manpower in the short run and in the long run this will have adverse effect on the growth prospects of IT sector itself. Thus viewed, the observed stagnation the hardware and communication sectors or shortage of skilled manpower for software training cannot be totally de-linked from the on going software export boom. Finally we have argued that the move towards relaxation in the visa restriction for Indian Software manpower initiated by the developed economies is likely to pose a major threat for the sustained growth and competitiveness of India's IT exports.

Is there any way out ? While a precise answer calls for more detailed inquiry and hence beyond the scope of the present paper, some suggestions, though tentative may be in order. To begin, with there appears to be the need for exploring the possibilities of devising proper incentive structures. This, however, is easily said than done. Secondly, the severity of the problem could be mitigated by enhancing the supply of technically

skilled manpower. Here, it is encouraging to note that that the Task force on Human Resource Development in IT has come out with a recommendation in this line. The task force recommended that the intake of students in IT related programs needs to be doubled in 2001-02 and tripled in by 2003-04[20]. However, given the growing world demand for software and software personnel, the challenges that we have highlighted is likely to continue in the near future. The long lasting solution to the problem, probably, lies in accelerating the pace of IT diffusion in different sectors of the economy, including governance. Only such a strategy could help achieving the twin objectives of enhanced productivity, international competitiveness and growth on the one hand and sustained growth of IT export sector on the other. If the result of the study by Pojhola (2000) covering 39 countries including India is any indication, IT induced prosperity still remains a mirage for the developing countries including India. As of now, there is some merit in the argument that, India is in its endeavor to help solving the IT problems of developed economies without addressing itsown problems. Hence, what is called for is realization of the catalytic role of domestic market in promoting a sustained IT export. This calls for a concerted effort to adopt, to quote Schware (1992), a “strategy of walking on two legs”. These are issues to be debated by the leaders of Indian IT industry who, today have a much better say in the policy making of the country than during the yesteryears.

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20 See "Taskforce for doubling infotech students intake next year" *Times of India*, January 16, 2001, New Delhi.

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