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# RIS Discussion Papers

**Strategic Approach to Strengthening the  
International Competitiveness in  
Knowledge Based Industries:  
Electronics Industry**

**K. J. Joseph**

RIS-DP # 88/2005



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## Strategic Approach to Strengthening the International Competitiveness in Knowledge Based Industries: Electronics Industry

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Prof. K.J. Joseph\*

*Abstract:* It is generally understood that while the IT software and service sector in India recorded unprecedented growth rate in a sustained manner for more than a decade and established credibility in the international market, the hardware sector, both computer hardware and other electronics equipment and components, has shown a decelerating trend. At the same time, being a signatory to Information Technology Agreement of WTO, India is committed to reduce the tariff rates on a wide range of IT goods to zero level by 2005 leading to unprecedented import competition. Hence it is important that the industry equip itself to meet the import competition and enhance its export competitiveness. Against this background the present paper analyzed performance (both export and production) of electronics industry and comes out with the broad contours of a strategic approach towards promoting the international competitiveness of India's electronics industry.

### 1. Introduction

While the Information Communication Technology (ICT) is generally considered as technology of the new millennium capable of bringing about fundamental changes in economy and society, the growth dynamics of ICT sector in turn is fueled by electronics industry in general and microelectronics in particular. India is one among the pioneering developing countries to make conscious attempt towards developing a broad based and technologically dynamic electronics industry as early as in the mid 1960s. In the early years of its development the Indian electronics strategy, in line with the then general industrial strategy, aimed at an import substituting, self-reliant and public sector-led growth under the umbrella of government protection and regulations.

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Towards the close of the 1970s, and in particular during the early 1980s, the industry witnessed an initial wave of shift in strategy as manifested in the series of policy reforms oriented towards making the industry more competitive yet with focus on domestic market. This was followed by the globalization policies of the 1990s with greater focus on export market and international competitiveness.

If the available evidence is any indication, recent deceleration in export growth notwithstanding, the export of IT software and service sector recorded unprecedented growth rate of over 45 per cent during the last decade. At the same time, the IT hardware sector (we mean electronics, both equipment and components) seems to have lagged behind. Despite the series of policy initiatives and institutional interventions towards enhancing the export competitiveness, output growth decelerated during the last decade as compared to 1980s and the recorded export growth was lower than the output growth. Given the inexorable link between IT hardware and software, a stagnant IT hardware sector might act as a drag on the sustained growth of the IT software and service sector and set limits to the process of diffusion of ICT to other sectors of the economy. This in turn is likely to have the effect of forgoing the opportunities for generating income and employment opportunities on the one hand inhibit the IT induced enhancement in efficiency, competitiveness and growth of other sectors of the economy on the other. More importantly, being a signatory to Information Technology Agreement of WTO, India is committed to reduce the tariff rates on a wide range of IT goods to zero level by 2005 leading to high import competition.

Against this background, this paper makes an attempt at undertaking a fairly disaggregated analysis of the observed production and export performance of electronics industry. Such an analysis enabled us to locate five groups of electronics products/firms. They are products/ firms with; a) high production growth and high export growth, b) low production growth and high export growth, c) high production growth and low export growth, d) low production growth and low export growth and finally e) no exports. From the policy perspective, the first group of firms is the one that performed well both in terms of production and export. Study notes that while there has been a general decline in output growth and export growth, some firms and some products have been recording higher growth in production and exports. Given the fact that all the firms have been operating under the same policy environment, one is inclined to infer that firm specific factors might have been instrumental in

explaining the observed inter-firm variation in performance. The crucial issue, therefore, is what are the distinguishing characteristics of the firms in the first category as compared to others, which enabled them to perform better as compared to others both in terms of export and production? An answer to this issue has been sought using a multinomial logit model by making use of firm level data.

While the inter-firm variation in export performance could be attributed to firm-specific factors, the firm behaviour in turn is conditioned to a great extent by the policy environment and thus influencing the overall production and exports. Hence in the second section of the paper we present a brief evolutionary picture of Indian electronics policy and highlight certain areas for further policy intervention. Given the link between production and export, the third section presents a disaggregated (product level) analysis, using descriptive statistics, of production and export performance. The analysis in this section, in addition to providing interesting insights, also sets the background for the fourth section. In the fourth section, we begin with an examination of the firm level data followed by an analysis of the inter-firm variation in export performance. The last section sums up the discussion and highlights the policy implications.

## **2. The Journey of India's Electronics Policy Framework<sup>1</sup>**

In the post-Independence period the process of restructuring in India was sought to be achieved through centralized planning. With regard to industrial restructuring, the Indian plans were influenced by the Mahalanobis strategy, which deviated from the 'textile first' strategy of industrial development followed by some of the successful "late-comers" like Japan in industrialization [Chakravarty (1987)]. The underlying task implied in the Mahalanobis strategy was the development of a capital goods sector as rapidly as possible, which would reduce imports and make production less dependent on foreign market, especially in a context of foreign exchange constraint.<sup>2</sup> In this restructuring process, the Indian plans envisaged a greater role for the public sector as the capabilities in the private sector were limited. While the private sector was assigned its due role, investment decisions were not carried out by the market test of profitability but in accordance with the overall plan requirements. Above all, restructuring was sought along with technological self-reliance, and hence, the strategy envisaged a limited role for foreign investment. To bring out the desired changes, the government used a variety of control instruments under the aegis of the Industries (Development and regulation) Act, Monopolies and Restrictive Trade Practice Act, (MRTPA) Foreign Exchange Regulation Act

(FERA), etc. The period since the late 1970s, and more specifically in the 1980s, however, witnessed a marked deviation from the earlier regime of planning and controls to one of liberalization and greater role to market forces. The process of internal liberalization initiated in the late 1970s was followed by the process of globalization as part of the structural adjustment programme initiated in the early 1990s. Thus, three phases could be discerned in the evolution of the policies governing Indian electronics: the import substitution period which lasted till the late 1970s, liberalization phase beginning with the early 1980s and Globalization period which began in the early 1990s.

### **Import substitution Period (Pre 1980s)**

During the early years of the development, the thrust was on self-reliant growth in tune with the then general industrial/technology policy framework. This may be seen against the fact that the foreign firms controlled important product segments of electronics industry. The computer industry during the late 1960s, for example, was marked by a concentrated market structure with a couple of foreign firms dominating the entire national market. In fact, a single foreign firm, IBM, alone accounted for nearly 75 per cent of the number of systems installed in the country during 1960-66 (Grieco 1984). No wonder, the resolution, which set up the Electronics Commission in 1971 asserted, “the government attached the highest importance to the development of an integrated and self reliant electronics industry in the country. ....an intensive promotional effort relating to both production and research & development was, therefore essential to ensure a rapid growth of self reliance” (Government of India, Department of Electronics 1982 p.14). “The strategy was to build up on a deliberately derivative basis an integrated structure so as to meet the requirements on the basis of local manufacturing” (Government of India, Department of Electronics 1979).

In pursuit of the above strategy, priorities were chalked out, production capacities and investments were licensed and imports progressively controlled by a wide array of policy measures, which were predominantly regulatory and protectionist in character. The industry was planned to be developed mainly within the confines of the public sector and the small-scale sector. The “small scale led growth” strategy was based on the following economic rationale. First, the manufacture of electronic equipments, essentially involved assembly and testing operations. It could be done at widely different levels of automation depending on the scale of operation. While at larger scale of operation, it is feasible to achieve higher levels of automation involving wave soldering,

automated wire insertion and wrapping, etc. at lower scale of production, the scope of automation is limited. Given the smaller domestic market it was believed that under Indian conditions there was no economic advantage for large-scale production.<sup>3</sup> Secondly, the above strategy appeared to be in tune with the objectives of regional dispersal of economic activities, utilization of local skills, materials and capital, broadening of entrepreneurial base etc. Thus, in 1976, out of the 81 units licensed for the manufacture of TV receivers, 71 units with a total capacity of 20 lakhs were in the small-scale sector. The remaining were in organized sector units, which included the units under State Electronics Development Corporations of Kerala, Rajasthan, Haryana, Punjab and UP.<sup>4</sup> In an environment of disenchantment with Transnational Corporations, the entry and operation of foreign capital and technology was regulated in accordance with the overall priorities of industrialization and objectives of self-reliance. These policies have had the effect of building up a balanced (both sectorally and regionally) and broad based electronics industry with the capabilities to design and manufacture a wide range of electronic components and equipment especially professional electronics equipment (Parthasarathi 1978). At the same time in terms of output growth, Indian electronics lagged behind other (then) newly industrializing countries like South Korea – during 1971-81 while electronics production in India increased four-fold, that in South Korea increased almost by twenty times! (Joseph 1992a )

### **Controlled Liberalization (1980s)**

The strategy remained more or less the same in essence for a decade or so. In a general environment wherein the economy has been faced with diminishing returns to increased restrictions, the Government acted on the recommendations of the Sondhi Committee and Menon Committee (Govt of India Department of Electronics 1981). The result was a gradual, but steady, move towards a market oriented policy regime in the 1980s through a series of policy changes as is evident from table 1. These policy changes sought a liberal climate, both internally and externally, through dilution of the industrial licensing, relaxations of MRTPA and FERA provisions, liberalization of imports and greater access to foreign capital and technology. Moreover, considerable relaxations were effected in the fiscal regime including reduction in direct taxes and reduction in excise duties to provide a more propitious economic climate for private sector in the Indian industrial economy.

While the main anchor of the first policy covering the 1970s was around the development of the industry under protection with minimal recourse to

foreign capital and foreign technology on the one hand and large companies and business houses (MRTP companies) on the other, the 1980s marked the second phase when the government took a number of initiatives in the direction of a more liberal and open electronics policy. Broadly speaking, the shift was from the earlier controls towards a more liberal policy with the emphasis laid on minimum viable capacity, scale economies, easier access to foreign technology and capital and free entry to private sector capital, including companies covered under Monopolies and Restrictive Trade Practice Act (MRTPA) and Foreign Exchange Regulation Act (FERA) with a view to making the industry technologically modern, cost effective and price-competitive. In a sense, the focus has been more on internal liberalization with the removal of restrictions on industrial licensing and capacity creation with a view to achieve economies of scale.

An immediate impact of the liberal policies has been an unprecedented shift in the product structure. In the case of electronics such a shift was evident in terms of a marked increase in the share of electronic consumer products at the cost of electronic intermediates and electronic capital goods. The growth has been concentrated in sectors with higher linkages in terms of imports, whereas sectors with higher linkage in terms of value added and employment lagged behind in output growth. In other words, the linkage pattern emerging from the changes in the product structure of the electronics industry has been such that the growth in output was not necessarily accompanied by a corresponding growth in income or employment. The component sector, notwithstanding the higher linkage in terms of maximizing value added growth and minimizing the import, has been characterized by the lack of investment coupled with low scale of operation and under utilization of capacity. More importantly, while the semiconductor industry accounted for major part (30 to 35 per cent) of electronics investment in the developed countries, its share in total electronics investment in India has been only around 10 per cent (Joseph1997).

The policy liberalization was helpful in removing institutional barriers to the entry of firms. This has had its impact upon the number and size distribution of firms and thus on the market structure and competitiveness. In case of computers for example, a number of foreign firms entered the market, all of them preferred to set up joint ventures rather than setting up subsidiaries. Even those firms, which preferred exit to sharing equity with the local firms in the 1970s, have started joint ventures - a clear indication of the industrial capability that the Indian Industry has built up over the years. The competitiveness of the market structure was based mainly on the existence of a large number of firms.

**Table 1: Milestones in Electronics Policy**

<b>Mile stones</b>	<b>Remarks</b>
1. Bhabha Committee (1966) Report	Recommended development of an integrated electronics sector to achieve self-reliance with minimal recourse to foreign capital and dominant role to public and small-scale sector.
2. Formation Department of Electronics (1970)	The Department was endowed with the responsibility for developing Electronics industry in the Country
3. Formation of Electronics Commission (1971)	This was mainly the policy formulating body relating to electronics industry in the country.
4. Sondhi Committee (1979)	Recommended dismantling of controls in general and MRTP and FERA in particular.
5. Menon Committee (1979)	Recommended liberalization of import of foreign capital and technology and duty free import of capital equipment.
6. Components Policy (1981)	De-licensing of component manufacture except for MRTP and FERA companies. Provision of 74 per cent foreign equity to FERA companies in high tech. areas. No clearance required under section 21 and 22 of MRTP Act except for LSI and VLSI circuits. General reduction in duty on components and liberal import of capital goods for component manufacture.
7. Telecommunication Policy (1984)	Telecommunication equipment manufacture was opened to private sector.
8. Computer Policy (1984)	All Indian companies, including FERA, were allowed to enter all segments of companies the computer industry with no restriction on capacity. Most of the components needed were put under OGL to facilitate import.
9. Integrated Policy (1985)	De-reserved certain components of small-scale sector. Introduced broad-banding and liberal approach towards foreign companies even with more than 40 per cent equity in high technology areas.
10. Computer Software Policy (1986)	Reduction in the import duty on all imports meant for software exports and no duty for hundred per cent export. Provision of special

*Table 1 continued*

Table 1 continued

Mile stones	Remarks
	financing schemes and permission for foreign companies (with more than 40 per cent equity) in hundred percent export projects.
11. National Taskforce on ICT (1998)	Made 104 recommendations on Software and 87 on Hardware development in the Country.
12. Telecommunication Policy (1994, 1999)	Opening up the Telecommunication Services for the private sector
13 Formation of MIT (1999)	Brought Together different actors involved in IT to form a separate Ministry of Information Technology.

Notwithstanding the entry of “new” firms, the top few firms together shared more than one half of the national market in some major branches of the industry.

In case of the major consumer electronics product – television receivers, the protective policy of the government towards the small-scale sector and a discriminate policy against the large-scale firms led to a concentrated market structure in the 1970s. With the introduction of the liberalized policies in the 1980s the industry appeared to be highly competitive at the national level in terms of four-firm concentration ratios. But the national market was found to be regionally segmented where, in each of the regional market, much of the sales were accounted for by a few brands; a few firms thus enjoyed some degree of “monopoly power” in the regional market, though their share in the national market was small and diffused. The leaders in the segmented market operated on a few lakhs sets whereas the leading Japanese and South Korean firms with their export orientation operated on a scale of a few million sets per annum. This in turn resulted in higher cost of production and prices leading to lack of international competitiveness. The lower scale of operation also has its implications on the firms’ capability to invest in research and development and bring about cost reducing innovations (Joseph 1992b).

The technology behaviour of the firms during the 1980s was oriented more towards technology import. The outcome was a phenomenal increase in the total number of collaborations in the electronics industry. Also, foreign collaborations were more restrictive in terms and conditions, which in turn led to a marked increase in the cost of technology. As for the trends in technology-

adaptation and internal technology generation, the emerging picture was found discouraging with a marginal fall and not a marked increase in the expenditure on in-plant R&D. The empirical analysis (Joseph 1997) thus depicted a picture of increasing technological dependence of Indian electronics industry in the short/medium run.

#### **Era of Globalization (since 1991)<sup>5</sup>**

The new industrial policy of July 1991 set the beginning of the third phase marked by further liberalization in industrial licensing and greater outward orientation. Recognizing the potential of Electronics/IT industry, the Prime Minister’s Office set up a National Task Force on Information Technology and Software Development in May, 1998. The first report of the Task Force on Software sector contained 108 recommendations and were accepted by the Government. The National Task Force also set up a Hardware Panel to explore the issues related to the development, manufacture and export of IT hardware. The Task Force was of the view that hardware industry and the software industry are two sides of the same coin, the success of one, whether it is export of software of \$50 billion by 2008 or IT penetration drive for realizing “IT for all” by 2008, depends on the concomitant success of the other.

The Task Force suggested measures to make the IT hardware industry competitive and achieve high growth by encouraging FDI, bringing tariffs on inputs and capital goods to zero per cent and simplification in EXIM Policy and Customs procedures. It recommended an integrated policy package in the form of 84 recommendations dealing with various issues. While, the recommendations of the Task Force were not implemented in full, the general approach of the Report is being pursued in phases. As discussed below, over the last 4 years, EXIM Policy for Electronics & IT products has been liberalized, Customs & Excise procedures simplified, EDI implemented, tariff on specified capital goods have been brought down significantly.

Thus, 1990s witnessed the removal of industrial licensing for most of the products except a few products of strategic significance, and further liberalization with respect to Foreign Direct Investment (FDI) and technology import along with series of fiscal and trade policy reforms to facilitate production and outward orientation. The policy reforms were based on the basic premise that the trade and investment provides an enabling environment for the overall development of an economy in general and developing an industrial base, especially that of high tech industries in particular and that there is an inter-se link between the two.

*Prima facie* it appears that the link between trade and investment is conditioned by the product characteristics and organization of production. For example, the link is likely to be stronger in assembly-oriented industries as compared to process industries. In an assembly oriented industry like IT goods, production essentially involves assembling hundreds of individual components based on a design. Let us take the case of a typical IT good like computer; we will find that the mother board is made in Malaysia or in Thailand, power supply in Indonesia, Floppy drive in Singapore and so on and final assembly in say in China. The production of needed components and materials may be highly skill, capital and scale intensive such that no country can afford to have the capacity to produce all the needed materials, components and other accessories. Hence there lies the need for rationalizing their production across different locations. This is what, perhaps, led to the global production networks<sup>6</sup> and the international division of labour in electronics production. Thus in the global production network, which today characterizes electronics, production of each of the component or sub assembly is made across different countries according to their comparative advantage such that the over all cost of production is minimized. This essentially means that the production in any country will call for significant imports and the output made will have to be exported to other countries rather than sold in the domestic market. Hence, if the production, and therefore investment, in ICT to take place in any country, the trade regime needs to be the one wherein the free flow of inputs into and outputs out of the economy is ensured. Thus viewed, there is an inexorable link between trade and investment, which is apparently much stronger in electronics as compared to most other industries. The series of policy reforms initiated in the last decade as well as the call for further reforms made here need to be seen in this context.

### **Industrial Policy**

The new Industrial policy of 1991 envisaged abolition of industrial licensing in almost all the electronic components and equipment except the manufacturing electronic aerospace and defence equipment (strategic electronics) and consumer electronics. By late 1990s the consumer electronics sector was also de-licensed and as a result, at present, industrial licensing is needed only for strategic electronics.<sup>7</sup> Moreover, the practice of reserving certain products in the electronics industry for public sector enterprises has been abolished with the result that private sector investment is welcome in every area of electronics. As of today, electronics industry could be set up anywhere in the country, subject to clearance from the authorities responsible for control of environmental pollution and local zoning and land use regulations.

### **Foreign Investment Policy**

The new industrial policy divided the foreign investment proposals into two categories; those cleared by the RBI (automatic approval) and those cleared by the Foreign Investment Promotion Board. The FDI policy provided for automatic approval by the RBI if the foreign equity is less than 50 per cent, lumpsum payment for the price of technology do not exceed \$ 2 million, royalty payments do not exceed 5 per cent of domestic sales and 8 per cent for exports (net of taxes)

The proposals that do not confirm to the guidelines of automatic approvals are cleared by the Foreign Investment Promotion Board. Government also encourages investment from Non-Resident Indians (NRIs) including Overseas Corporate Bodies (OCBs) to the domestic investment. Investments and returns are freely repatriable, except where the approval is subject to specific conditions such as lock-in-period on original investment, dividend cap, foreign exchange neutrality, etc. as per the notified sectoral policy. The condition of dividend balancing that was applicable to FDI in 22 specified consumer goods industry stands withdrawn for dividends declared after 14<sup>th</sup> July, 2000.

In a major drive to simplify procedures for Foreign Direct Investment under the “automatic route”, RBI has permitted the Indian companies to accept investment under this route without obtaining prior approval from RBI. Investors are required to notify the regional office concerned of the RBI of receipt of inward remittances within 30 days of such receipt and file required documentation within 30 days of issue of shares to foreign investors. This facility is available to NRI/OCB investment also.

The salient features of the investment policy applicable to Electronics/ Information Technology and Telecom Sector are as under:

1. Automatic route for foreign equity up to 100 per cent in software development and Electronics/IT/Telecom hardware manufacturing, except aerospace and defence and small scale reserved items.
2. 100 per cent foreign investment permitted in units set up exclusively for export. Such units can be set up under any of the following schemes, namely, Electronics Hardware Technology Park (EHTP), Software Technology Park (STP), Export Oriented Units (EOUs), Special Economic Zones (SEZs).
3. In basic, cellular, value added services and global mobile personal

communications by satellite, FDI is limited to 49 per cent (which has been raised to 74 per cent in 2004-05 budget) subject to licensing and security requirements and adherence by the companies to the licence conditions for foreign equity cap and lock-in period for transfer and addition of equity and other licence provisions.

4. In Internet Service providers (ISPs) with gateways, radio-paging and end-to-end bandwidth, FDI permitted up to 74 per cent, with FDI beyond 49 per cent requiring Government Approval.
5. FDI up to 100 per cent has been allowed for the following activities in the telecom sector<sup>8</sup>:
  - a. ISPs not providing gateways (both for satellite and submarine cables);
  - b. Infrastructure providers providing dark fibre (IP Category 1);
  - c. Electronic Mail; and
  - d. Voice Mail

FDI upto 100 per cent has been is permitted for e-commerce activities, under the Government route, subject to the conditions that such companies would divest 26 per cent of their equity in favour of the Indian public in five years, if these companies are listed in other parts of the world. Such companies would engage only in business to business (B2B) e-commerce and not in retail trading.

### **Trade and Fiscal policies**

To promote exports special schemes have been made available under export oriented unit scheme, electronics hardware technology park scheme, software technology park scheme and the provision for special economic zones. The units operating under these schemes are entitled to various tax incentives, which *inter alia* include access to duty free imports, exemption from corporate income tax for five years, 100 per cent foreign equity and others. (See for details; India, Ministry of Information Technology, 2004).

To facilitate the free inflow of inputs into and output out of the country, the trade polices were subjected to substantial liberalization. The first round of tariff reduction has been affected with the New Industrial policy of 1991 and further reductions were effected in the Exim policies that followed. India, being a signatory to the Information Technology Agreement of WTO is committed to reduce the tariff on information technology product to zero by April 2005. Physical controls on import of most of the electronic equipment and components have been by now done away with. In the Budget 2003-04, the peak rate of

customs duty has been reduced from 30 per cent to 25 per cent. Further reduction in the duty structure has been brought about in the budget 2004-2005. By now, the tariff on specified capital goods have been brought down to 10 per cent and 5 per cent for a number of raw materials. These initiatives to some extent have addressed the problem related to inverted tariff structure.

### **Foreign Technology Agreements**

The RBI through its regional offices accords automatic approval for foreign technology collaboration agreements in all areas of electronics and information technology, except electronic aerospace and defence equipment and small scale reserved items, subject to: (i) the lump sum payments not exceeding US \$ 2 million; (ii) royalty payable being limited to 5 per cent for domestic sales and 8 per cent for exports, subject to a total payment of 8 per cent on sales over a 10 year period; and (iii) the period for payment of royalty not exceeding 7 years from the date of commencement of commercial production, or 10 years from the date of agreement, whichever is earlier.<sup>9</sup>

From January 1991 to December 2002, Government approved 23462 foreign collaborations (Technical and Financial) proposals with a corresponding foreign direct investment (FDI) of US\$ 76.61 billion and the total FDI inflows add up to US \$ 32.41 billion. Out of these, the number of approvals for electrical equipment sector, including electronics, have been of the order of 5033 (21.45% of the total approvals) with an equity participation of US\$ 7053.0 million, accounting for about 9.82 per cent of the total investment. The Electrical and electronics equipment Sector rank 3<sup>rd</sup> in the list of sectors in terms of cumulative FDI approved from August 1991 to December 2002. Of these nearly 65 per cent of the investment has been in the field of software (see table 2).

### **Policy Towards Research and Development**

Experience of countries that followed highly liberal trade and investment policies in electronics have shown that, while they have been fairly successful in attracting investment from foreign firms, they also had to run the risk of getting locked up in low end of the production chain with very limited value added. A typical example is the case of Thai electronics industry which has the presence of the almost all the leading electronics producers in the world yet the value addition is at very low level. To address this risk there is need for complementing the liberal trade and investment policies with targeted efforts to build up technological capability and skill up-gradation. India is known for its efforts at building up wide range of institutional arrangements for promoting industry

**Table 2. Number of Foreign collaboration approvals and FDI in the Electrical and Electronics Sector during 1991-02**

Name of the Industry	No. of Approvals		Fin	Amount of FDI Approved		Share in Sectoral total (%)
	Total	Tech		In RupeesMillion	In US \$	
Electrical Equipments	1712	909	803	60799.1	1659.1	21.73
Computer Software	2707	89	2618	181143.5	4382.1	64.75
Electronics	523	160	363	32810.4	900.9	11.73
Computer Hardware	22	2	20	3785.2	79.1	1.35
Others Misc. (Software)	69	20	49	1238.4	31.8	0.44
Total of above	5033	1180	3853	279776.6	7053.0	100

Source: SIA Newsletter 2002: Annual Issue.

R&D in the country. India's commitments towards technology development in electronics have been in existence from the early stage of its development. Accordingly a fairly strong base in R&D has been established through the various laboratories under the Department of Space, Department of Information Technology, Department of Atomic Energy, Department of Scientific and Industrial Research and others.

The recent institutional interventions by the Government towards strengthening the innovation system in the country and promoting technology development include setting up of the Technology Development Board and TIFAC. These agencies, along with DSIR have initiated various programmes like the Programme Aimed at Technological Self Reliance (PASTER), Home Grown Technology Programme, Technopreneurs Promotion Programme, New Millennium Indian Technology Leadership Initiative and so on<sup>10</sup>. The Government also provides various incentives towards promoting research and development activities by the firms. These included, but not limited to, various tax incentives, duty free import of capital goods and materials needed for R&D, etc. In the field of electronics and information technology, the Department of Information Technology supports and funds technology development through its councils set up in various fields. R&D sponsored by the departments has led to the development of several products and technologies; some of the technology areas where success has been achieved include Internet, e-commerce and e-governance, automation, instrumentation and process control (India, Ministry of Information Technology, 2004). Here the success of the Center for Development of Advance Computing in developing the parallel super Computer (PARAM) needs special attention.<sup>11</sup> At present there are more than two hundred in-house R&D units in the private sector undertaking R&D on electronics and have been recognized by the Department of Scientific and Industrial Research.

In the world over, interface between academia and industry is shown to be instrumental in promoting innovative capability of firms. While industry academia interface is generally seen as a mutually beneficial game, in India it is yet to reap its full potential<sup>12</sup> and the Government policy has a crucial role to play in promoting such interaction.

#### **Promotion of Outward Investment**

While the policy reforms in the last decade aimed at attracting investment from abroad, Indian private sector has generated substantial capabilities over time to and has been investing abroad both by overseas acquisitions and green field

investment. Given the export augmenting role of such outward investment, government has also initiated measures to promote investment abroad by the Indian private sector. As per the budget 2003-04, Indian companies with proven track record are permitted overseas investments under automatic route even where investment is not in the same core activity. The earlier restriction, limiting such investments to 50 per cent of the net worth has been raised to 100 per cent. Provision for investment up to \$ 100 million on an annual basis through automatic route without being subject to the three-year profitability condition has been altered. While, investment by the software and service companies like Infosys, NIIT, TCS and other is well known there are a number of hardware companies, like Samtel Colour, Moser Baer and others now expanding their investment abroad. Such policy reforms are expected to act as a catalyst in the process of creating India based multinationals.

To sum up, the series of policy reforms has had the effect of making the trade and investment regime more liberal with almost free access to foreign technology. In addition, the government also announced a number of policies to encourage R&D activities by the firms along with institutional interventions like Hardware Technology Park Scheme to promote the export competitiveness of electronics industry. Nonetheless it needs to be noted that given India's commitment under ITA, the electronics industry is faced with a more competitive environment as compared to many other industries. Laudable reforms notwithstanding, high tariffs and taxes (especially indirect taxes that some times goes up to 40 per cent as compared to 5 to 17 per cent in other countries) leads to high prices which in turn leads to lower market and lower scale undermining export competitiveness. In case of electronics for example, at present, CENVAT (excise) is 16 per cent. In addition, Sales Tax ranging between 4-15 per cent is levied in various States. CST, octroi, entry tax, etc. are additional. In such a context there is an urgent need for reduction in taxes resulting in larger domestic demand, which in turn could act as a springboard for exports. There is also a need to review the present policy towards small-scale reservation in a context wherein the India's domestic market is being opened to world market under the ITA<sup>13</sup>.

While policy measures to liberalize trade and investment needs to be appreciated, some more industry specific initiatives may be called for on account of the specific character of electronics. As already noted, electronics manufacturing today is dominated by the contract manufacturers. It goes without saying that the presence of manufacturers having global scale operations would help in development of a vendor base. Large companies, in pursuit to

reduce costs and being close to their customer base are always on the lookout to leverage factor advantages of various countries. In such context, it may be advisable to offer special incentive on one time basis to attract a few such large manufacturers. Once a few such firms are established it would induce others to follow. Such units in addition to help developing local vendor base also would create substantial inputs demand from local sources and promote exports.

### **3. Trends and Patterns in Production and Export**

It has been estimated that, at present there are over 3500 firms in India's electronics industry that comprises of 11 central public sector units with 31 manufacturing establishments, 46 units in the state public sector, about 500 units in the organized private sector and more than 2900 units in the small scale sector. Over the years, with policy reforms, the share of organized private sector and the small-scale sector increased at the cost of public sector units. Today, the public sector accounts for only about 16 per cent of the total output, which was as high as nearly 35 per cent in 1981. The organized private sector, that also include foreign firms with considerable share in computers and television, today accounts for about 46 per cent of the total output recording an increase of over 16 per cent since 1981. The increase in their share took place mostly during the last decade. Similarly, the small-scale sector also increased their share in output by about 10 per cent during the last decade to reach a level of 38 per cent in 2002 (India, Department of Information Technology 2004). Against this background let us examine the trend in production and export over the years.

The analysis in this section is based mainly on the data on production and export provided by the Department of Electronics (DoE), Ministry of Information and Communication Technology.<sup>14</sup> Unlike many other industries, for electronics industry the DoE has made a highly detailed data on production and export of individual products available for more than two decades. This data has been compiled from the data obtained by the DoE from different producing/exporting units. Such a data set makes it possible to examine trend in export, production, export intensity and other important aspects like number of firms operating in each products, the number of products produced and exported in each product group, etc. While the data provided upto 1997 is highly disaggregated, for unknown reasons since 1997 the data is available only at less disaggregated level.

#### **Trends in Production**

Though the focus of the study is on export, given the inexorable link between production and exports, we shall begin with an analysis of trend in production

of different product groups as well as that of total output. In tune with the policy changes one could divide the whole period of analysis into two periods - with 1991 as the cut off. The post 1990s may be divided into two sub-periods with 1997 as the cut off because there has been a number of institutional interventions and new policy initiatives since 1997 like the formation of a separate ministry for IT & electronics, reorganization and merger of DOE/DIT autonomous bodies, attempts at hardware promotion, fiscal incentives, etc

Table 5 presents data on the trends in output across three broad categories - electronic consumer goods, electronic capital goods and electronic intermediates. It may be noted that the production figures are reported in current prices. We have not resorted to deflating the values because for most electronic items, unlike other industries, prices recorded a declining trend while there has been substantial increase in their capacity. From Table 3 it is evident that during the first phase the recorded output growth of total electronics output was substantially higher (28.6 per cent) as compared to the second period (13.8 per cent). As we move to the third period, series of institutional interventions and policy reforms notwithstanding, there has not been any marked increase in the recorded rate of output growth but a marginal decline (11.2 per cent). When it comes to different product groups the observed trend remained broadly the same where in the recorded output growth rate declines as we move from the first phase to the third phase.

It might also be of some interest to explore the changing product composition during the period under consideration. Studies have shown that during the liberalization period of 1980s there has been a shift in the product structure with increasing share of electronic consumer goods and there has been a corresponding decline in the share of electronics capital goods and electronic intermediates. To be more specific during 1981-88 the share of electronic consumer goods increased by more than 10 per cent (see Table 4). However by the end of the initial wave of domestic market oriented liberalization (by 1992), the share of consumer electronics had shown almost a 10 per cent decline with corresponding increase in electronic capital goods and a marginal increase in that of electronic intermediates. But by the end of the third phase (2002) there appears a trend where in the share of consumer electronics shows an increasing trend and that of others declined. Table 4 also shows that during the last decade, the share of communication equipment has shown a marked decline and also the production of data processing equipment has not been able to keep pace with on going IT revolution and that their share in total

**Table 3: Sectoral Trend in Electronics Output**

(Rs. Million)

Year	Electronic			Total
	Consumer Goods	Capital Goods	Intermediates	
1985	10600	11368	4100	26068
1986	13120	15320	5100	33540
1987	18348	20700	7000	46048
1988	23320	28090	10440	61850
1989	28250	39980	14620	82850
1990	29710	46270	15660	91640
1991	30240	48360	18020	96620
1992	33840	57450	22270	113560
1993	39290	65700	25180	130170
1994	45070	79030	30280	154380
1995	55590	83820	34490	173900
1996	64960	94910	35660	195530
1997	73530	101260	41800	216590
1998	90000	111490	46490	247980
1999	110010	116530	51000	277540
2000	119000	135100	55080	309180
2001	122990	142050	56650	321690
2002	135890	167330	65100	368320
<b>Annual Compound Growth Rates</b>				
1985-90	22.9	32.4	30.7	28.5
1990-97	13.8	11.8	15.1	13.1
1997-02	13.1	10.5	9.3	11.2

Source: Government of India, Department of Information Technology, Guide to Electronics Industry in India, (different years), Ministry of Information and Communication Technology.

output has remained stagnant or declined. In case of electronic intermediates, their share has been declining over the years. Within this product group, while the share of products like electron tubes recorded significant increase, that of components incorporating higher level of technology like the semiconductor devices recorded a sharp decline

#### **Trends in Exports**

Similar to the trend in production, there has been a deceleration in exports, while the recorded growth during 1985-90 (32.8 per cent) was higher than the output growth, the subsequent period recorded not only a decline in export growth but the recorded export growth rate turned out to be lower than that of growth in production (see Table 5). From Table 5 it is evident that the total electronics exports from the country increased almost four fold during 1985-90

**Table 4: Sectoral Distribution of Output across Different Sectors (%)**

Product Groups	Relative Share in Respective			Total 2002
	1981	1988	1992	
<b>Consumer Electronics</b>	<b>28.7</b>	<b>39.1</b>	<b>30.1</b>	<b>36.9</b>
Radio Receivers	39.0	5.0	0.2	0.7
Tape-cum-Radio	2.1*	2.4	19.2	10.7
Television receivers	36.3	71.5	49.5	53.3
Others	22.6	21.1	31.1	35.3
<b>Electronic Capital Goods</b>	<b>51.2</b>	<b>44.2</b>	<b>50.1</b>	<b>45.4</b>
Test & measuring instruments	5.1*	4.8	3.0	3.2
Medical Electronics	2.1*	1.3	1.4	2.5
Analytical instruments	0.9*	0.3	0.4	0.4
Special application instruments	1.4*	0.9	0.8	0.7
Automation equipment	2.1*	3.0	4.1	6.5
Process control equipment	10.1*	8.5	7.2	6.0
Power electronics	11.6*	10.1	7.3	10.13
Office equipment	0.6*	4.7	4.0	1.5
Miscellaneous equipment	0.8*	0.9	0.8	2.3
Computer systems	9.9*	14.6	13.2	14.8
Computer peripherals	0.9*	3.3	4.5	6.4
Switching systems	28.8*	23.4	37.9	30.4
Terminal Equipments	5.8*	5.2	4.3	
Other communication equipment	0.9*	0.3	0.3	
Broadcast equipment	1.7*	3.5	1.8	
Strategic electronic	17.4*	14.4	7.3	15.0
<b>Electronic Intermediates</b>	<b>20.1</b>	<b>16.7</b>	<b>19.8</b>	<b>17.7</b>
Electron tubes	9.8	26.3	26.8	25.7
Semiconductor devices	16.3	9.3	12.5	4.3
Passive components	44.5	30.2	22.9	14.8
Electromechanical components	9.2	6.1	9.8	7.4
Other components and materials	20.2	28.1	27.8	47.8

Note: Figures with \*refer to the year 1983.

Source: Calculations based on data obtained from Government of India, Department of Information Technology, Guide to Electronics Industry in India (different years)

to reach a level of 660 million dollars and thereafter it remained at more or less the same level till 1999 and in 2000 the exports more than doubled to reach a level of \$1500 million.<sup>15</sup> We have already seen that the output growth pattern of the three different product groups was in tune with that of total output. How did different product groups behave with respect to exports?

**Table 5: Trend in Electronics Export by Major Product Groups**

(in Million US Dollars)

Year	Electronic	Electronic	Electronic	Total
	Consumer goods	Capital Goods	Intermediates	
1985	11.45	47.83	39.17	151.13
1986	14.10	85.59	34.14	227.23
1987	23.37	88.77	73.96	283.52
1988	33.14	136.72	53.86	372.18
1989	34.24	204.82	79.88	538.11
1990	46.82	239.13	119.29	660.31
1991	49.45	110.75	72.74	350.23
1992	57.75	125.94	67.21	382.83
1993	63.76	162.58	60.57	456.69
1994	100.35	212.17	77.41	612.06
1995	134.53	323.77	146.49	942.25
1996	140.85	412.39	143.10	1124.32
1997	150.39	405.43	224.11	1200.32
1998	97.46	161.87	195.39	622.76
1999	78.70	177.01	196.86	635.49
2000	136.60	480.52	399.52	1510.66
2001	126.86	660.94	428.39	1893.64
2002	154.02	577.94	459.38	1784.37
<b>Annual Compound Growth Rates</b>				
1985-90	32.6	38.4	24.9	34.3
1990-97	18.4	7.8	9.4	8.9
1997-02	0.5	7.3	15.4	8.3

Source: Government of India, Department of Information Technology, Guide to Electronics Industry in India, (different years), Ministry of Information and Communication Technology.

In case of consumer electronics, the observed rate of export growth declined from over 32 per cent during 1985-90 to 18 percent during 1990-97 and further declined to almost zero growth rate during the third phase (1997-02). In case of electronic capital goods the observed trend was broadly in tune with total exports wherein the recorded growth rate declined sharply as we move from the first phase to the second and the same rate of growth was maintained during the third phase. When it comes to electronics components the deceleration in growth rate observed during the second phase was followed by a marked revival during the third phase. On the whole, it is evident that while different sub-sectors behaved more or less the same manner with respect to output growth, they presented entirely different pattern in terms of their export performance wherein

the electronic components showing a better export performance during 1997-02 despite lower rate of output growth. In case of electronic consumer goods, the rate of deceleration in export growth was higher than output growth. Incidentally, as we have already noted, in case of the major product in the consumer electronics, viz. television receivers, by 1991 the structure of the market was characterized by regional market segmentation wherein each of the regional leader operating as very small scale yet having some market power. As the economy was opened up large MNCs in the TV production like Samsung, Lucky Goldstar entered the Indian market and these two brands together account for nearly 30 per cent of the domestic market.

Similar trend has also been noted when we examined the number of products exported vis a vis produced. Table 6 presents the relevant information. It may be noted, that for the industry as a whole, as we move from 1985 to 1990 the percentage share of the number of products exported increased from a little over 20 per cent to 32 per cent and further to over 40 per cent in 1997. Thus, the proportion of products exported almost doubled during the period under consideration. The key question, however, is the variation across different product groups. It is evident from Table 6 that in case of most of the equipment (both consumer electronics and electronic capital goods) the ratio has shown a decline as we move from 1990 to 1997, CIIE being an exception. Here it may be noted that it is in tune with their observed trend in exports. Whereas in case of components the number of products exported showed an increasing trend throughout the period under consideration from 34 per cent in 1985 to 53 per cent 1997.

**Table 6: A Comparison of the Number of Products Produced and Exported**

Product Groups	Percent of products that Reports Exports		
	1985	1990	1997
Consumer Electronics	33.3	54.3	46.0
Control, Instrumentation and Industrial Electronics	13.0	21.6	37.9
Data Processing and Office Equipment	11.8	47.6	34.8
Communication and Broadcast Equipment	21.9	26.2	20
Strategic Electronics	0	0	28.6
Electronic Components	34.0	43.6	53.2
Parts of Electronic Components	29.4	46.2	40.0
Electronic Material	16.7	36.8	29.4
Miscellaneous items used by the Electronics Industry	25	57.7	48.5
Total	20.9	32.2	40.5

### Export Intensity

In a sense, export intensity measured as the ratio of export to production provide an indication of the extent of outward orientation as well as export competitiveness of the industry. Going by the aggregate data for the industry as a whole that include both production and export in the domestic tariff area and different export processing zones, the export intensity of Indian electronics has increased almost fourfold during 1985-2002 from about 7 per cent in 1985 to about 28 per cent in 2002 (see Fig. 1). However the picture turns out to be different when we examine the export intensity excluding export-processing zones. Table 9 presents data on export intensity of different product groups. From the table it may be noted that there are a few products in each year having export intensity substantially higher than 100 per cent. In some cases the reported export was found to be even higher than the cumulative production for the three preceding year. Hence in estimating the export intensity presented in the Table 7 we have not included those products for which export intensity was found to be more than 100. From our estimates it appears that as we move from 1985-1990 there has been an increase in export intensity by about 2 per cent, whereas during the second phase (1990-1997) the recorded export intensity marginally declined. The difference in the export intensity as shown in the figure and those reported above therefore may be on account of the presence of outliers in aggregate estimates and also on account of the inclusion of units in the export processing zones.

The table also points towards the wide variation in the extent of export intensity. In 1985, for example, about 62 per cent of the exporting products

**Fig 1 Trend in Export Intensity of Electronics**

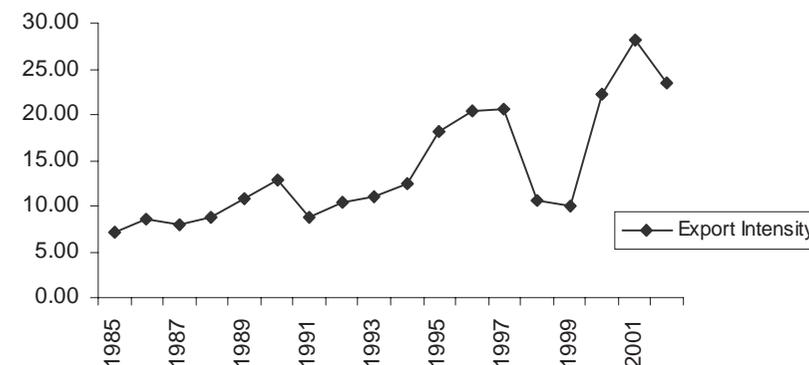


Table 7: Distribution of Export Intensity over the Years

Export Intensity Class (%)	1985			1990			1997		
	Number of Products	Export Intensity							
Less than 1	36	0.36	46	0.39	80	0.34			
1 to 3	15	1.61	20	1.75	30	1.95			
3 to 5	3	3.82	23	3.84	16	3.77			
5 to 8	10	6.09	11	5.87	12	6.00			
8 to 15	9	11.01	17	10.78	13	11.73			
15 to 25	4	20.09	11	19.64	16	19.88			
25 to 50	4	31.82	13	36.05	9	33.43			
50 to 100	3	63.67	6	61.27	10	76.21			
100+	3	274.00	4	385.14	6	13575			
No Exp (%)	80.6		68.6		70.2				
Total exported	84	7.22	147	9.80	186	9.42			
Total produced	449		481		486				

Note: Total number of products exported excludes those with export intensity higher than 100%.

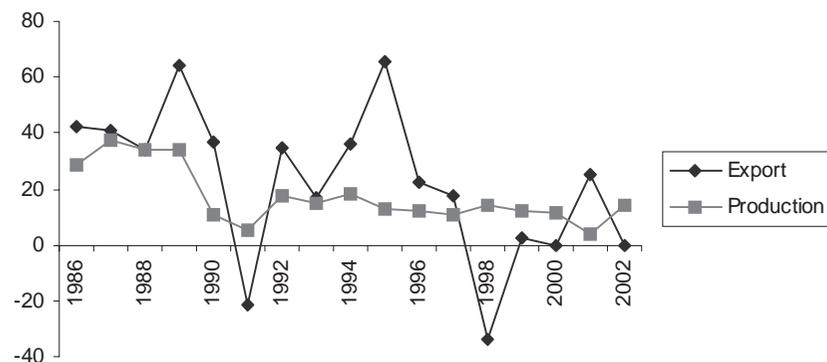
reported export intensity less than 5 per cent. As we move towards 1990, their share declined to 58 per cent and further increased to 67 per cent in 1997. If we consider those products with export intensity higher than the industry average as highly export intensive products, their share increased from 23.8 per cent in 1985 to 31.9 per cent in 1990 and recorded a decline thereafter to reach a level of 26.1 per cent in 1997. The evidence presented above tends to suggest that there are certain debilitating factors for units operating from the DTA.

#### Association between Production growth and Export Intensity

We have already seen that a decline in the rate of growth of output was associated with a corresponding decline in the overall rate of export growth of the industry (see Fig 2). However, we also observed that there are variations across different product groups. For example, in case of electronic intermediates, despite lower output growth there has been a sustained increase in export growth. In the literature on export performance the crucial policy variable considered is export intensity, which implicitly assumes that higher the export intensity, the higher the total export earning. However, if higher export intensity is associated with lower output growth, high export intensity may not result in a corresponding increase in export earning. The estimated correlation coefficients of export growth and production growth are found to be 0.06 and 0.17 respectively for the period 1985-90 and 1990-97. Also the correlation coefficients of production growth and export intensity also turned out to be -0.09 and -0.28 respectively. Thus, it appears that in case of electronics, there may be certain limits in reflecting of export competitiveness simply by focusing on export intensity. A better approach may be one that takes into account both the production and export performance.

The declared objective of liberalized policies has been to achieve higher output growth along with higher export competitiveness. Hence in any attempt to locate products, which have been fairly successful in achieving the policy objective, one needs to identify those products for which both export growth as well as production growth have been higher than the industry average. Analytically, based on the production growth and export growth the different products in electronics industry could be divided into five different categories. The first category may consist of those products for which both production growth and export intensity were higher than the industry average. These products may be considered as been successful in reaping the benefits of new policy regime. The second category may include those products for which export growth turned out to be higher than the industry average whereas their recorded

**Fig 2: Annual Growth rates in Exports and Production**



growth in production was lower than the industry average. These products may also be considered as successful in entering the world market and sustaining competitiveness but at the same time were faced with certain impediments in raising their output growth. The third category consists of those products for which production growth turned out to be higher than industry average whereas their export growth was lower than the industry average. These are products, despite general outward orientation at the industry level, continued with their domestic market orientation. In case of such products, the strategy should be to find ways and means of making them more out world oriented. The fourth group consists of those products for which both export growth and production growth are lower than the industry average. Finally we have the non-exporting products.

We have identified the number of such products across different product categories and they are presented in Table 8. From the table it may be noted that the total number of products in the first group remained at the same level as we move from 1990 to 1997 whereas the number of products in the second category increased. At the same time, there has been an increase in the number of products in the third and fourth category and that of the fifth category declined. If we consider the first two groups together as more competitive we are inclined to infer that an increasing number of products are getting tuned to the new competitive international market environment. The relevant question here is what type of electronic products are showing greater export competitiveness along with higher output growth. From the table it is evident that majority of such products are electronic components followed by electronic capital goods.

**Table 8: Distribution of Electronics Products based on their Production Growth and Export Intensity**

Products Groups	Number of Products		Average Export Intensity (%)	
	1990	1997	1990	1997
<b>Pg&gt;PG &amp; Eg&gt;EG</b>				
Electronic Consumer goods	3	2	34.5	28.9
Electronic Capital goods	8	9	26.9	28.9
Electronic Components	15	15	24.3	41.4
<b>Pg&lt;PG &amp; Eg&gt;EG</b>				
Electronic Consumer goods	5	3	29.9	56.7
Electronic Capital goods	3	7	41.5	18.4
Electronic Components	9	10	27.3	27.8
<b>Pg&gt;PG &amp; Eg&lt;EG</b>				
Electronic Consumer goods	8	9	0.02	1.5
Electronic Capital goods	33	40	2.4	2.4
Electronic Components	13	25	2.8	1.58
<b>Pg&lt;PG &amp; Eg&lt;EG</b>				
Electronic Consumer goods	9	7	2.9	0.9
Electronic Capital goods	24	44	2.2	1.1
Electronic Components	17	15	1.93	2.6
<b>Industry Total</b>				
<b>Pg&gt;PG&amp;Eg&gt;EG</b>	26	26	26.3	31.1
<b>Pg&lt;PG&amp;Eg&gt;EG</b>	17	20	30	28.8
<b>Pg&gt;PG&amp;Eg&lt;EG</b>	54	74	2.3	1.92
<b>Pg&lt;PG&amp;Eg&lt;EG</b>	50	66	2.3	1.41

Note: Pg - growth in production of the product concerned  
 PG - growth in production for the industry as a whole  
 Eg - export growth of the product concerned  
 EG - export growth for the industry as a whole

As already noted, components are generally manufacturing oriented and being intermediate products they are used by other firms wherein quality and timely delivery are important considerations. Electronic capital goods call for higher level of design capabilities and given the large pool of skilled manpower the Indian firms are found competitive in such products as well. Thus if the data presented in table is any indication, any strategic approach towards increasing the export of Indian electronics may focus on those products mainly in the components sub sector and electronic capital goods. Interestingly enough in case of electronic consumer goods which are more advertisement and marketing intensive, there has been a decline in the number of products showing high export intensity and production growth.

It is also surprising to note that even after the initiation of liberalized economic policies, there has been an increase in the number of products which recorded high production growth but low export intensity. Such products, it could be argued, are continuing with domestic market orientation despite the series of policy reforms and incentives to increase the export competitiveness. It could be plausible that the market structure in such products, despite delicensing, continues to be monopolistic and confer on them certain advantages, which in turn make them domestic market oriented. There appears to be the need for further research to find out the ways and means of inducing such products to explore the world market.

It is found that in case of electronic consumer goods and components, there has been a decline in the number of products in the last category wherein the recorded output growth and export intensity was lower than the industry average. But when it comes to electronic capital goods the number of such products almost doubled. This might be viewed as an offshoot of the earlier policy regime, which emphasized self-reliance and encouraged the production of wide range of electronic capital goods regardless of their economic viability. Given the policy reforms such products have become economically unviable leading to both low production growth and export intensity. In the context of the changed environment, it is important to devise appropriate policies that facilitate the restructuring in such a way that the resources invested in the production of these products are diverted towards the production of goods which are economically more viable and internationally competitive.

#### **4. Firm- level Analysis**

So far our analysis has been focused on the performance at the individual product level. Let us now proceed to analyse the behaviour of firms following the broad approach adopted in the previous section. Our analysis is based on firm level data obtained from the Center for Monitoring Indian Economy 1998-2003. All the firms reported were not having information for all the six years and in all we have 1577 observations. The firms in the sample were grouped into five different categories based on their export intensity and production growth. To repeat, the first group comprises of those firms which recorded output growth and export growth higher than the sample mean. On the other hand the fifth category consists of firms reporting no export. The second category firms recorded export growth higher than the average whereas their rate of growth in production was lower than the average. The third category firms are those with more than average production growth and less than average

export growth. The fourth category of firms recorded less than average export intensity and production growth.

#### **Hypotheses and Method**

In current era of globalization wherein the developing countries in general have embraced the export oriented growth strategy by dismantling the series restrictions on trade that existed hitherto and assigned greater role to the market in the allocation of resources, there is hardly any easy option to survive other than being internationally competitive. The conventional wisdom would suggest that the free trade regime with greater role for market forces facilitate the optimal allocation of resources according to the country's comparative advantage naturally leading to growth and welfare. However, starting from Leontief Paradox and the neo technology trade theories and later developments like the strategic trade theories (Krugman 1990) have questioned the efficacy of free trade regimes. As Brander and Spencer (1985) have argued, free trade might in some cases of market structure no longer yield world maximum welfare gain, but that a strategic trade policy might be justified and actually needed. In general, numerous studies notwithstanding, we are yet to fully grapple with the factors that contribute towards export competitiveness of less developed countries. The focus of the present study is to explore the bearing of firms technology behaviour, FDI participation and outward investment on the export competitiveness of the industry.

#### ***Technology and competitiveness***

The role of technology in trade performance has been well acknowledged in the literature. Most of these studies have their theoretical base in the neo-factor endowment and new-technology theories of international trade (Posner 1961; Vernon 1966; Hufbauer 1966; Krugman 1979). Given the fact that these theories generally predict the behavioural difference across different industries, earlier empirical testing mostly in the developed countries has been based on inter-industry difference in trade performance. At the same time, it has been observed that there exists wide inter-firm variations in export performance, which in turn tend to suggest that firm characteristics also play a considerable role on shaping the export performance.

A review of existing studies on the role of technology factor in trade performance reveals that the importance of technology in explaining the trade performance is confined mostly to the developed economies. Caves *et al* (1980) for Canada, Sveikauskus (1983) for US, Soete (1987), Wakelin (1997) for OECD,

Basile (2001) for Italy and Roper and Love (2002) for UK and Germany are some of the notable empirical studies confirming the role technology in explaining the trade performance. Empirical verification of technology-trade hypothesis is not confined to the developed countries. There are a few studies, which explored this question in the developing country context. The studies in the Indian context include Dasgupta and Siddharthan (1985), Lall (1986) Kumar (1990) Kumar and Siddharthan (1994). In the case of Brazil Willmore (1992) carried out an analysis using a large data set and found that the R&D is not significant in explaining neither the probability of export nor the export performance of exporters.

Studies in India found that Indian export is confined mostly to standardized goods with low skill and technological content. Moreover technology is found to have no significant influence on explaining the trade performance especially in high technology industries. However, Lall (1986) found R&D expenditure as significant in explaining trade in the case of chemical industries. The limited role of neo-technology models in explaining the trade performance in the developing country context is attributed in the following way. In most of the developing countries R&D activity is mainly adaptive rather than creative in nature. In high technology industries, competitive advantage is determined by product innovations, which are not the focus of technological activity developing country enterprises (Kumar and Siddharthan 1994). The imitative capability that technology gap models assume, therefore, is expected to provide competitive edge to developing country products only in low or medium technology industries. The above line of argument is also consistent with the theoretical predictions of the product cycle theory (Vernon, 1966; Krugman 1979) wherein exports from the developing countries take place only during the maturing phase of the product life cycle when competitiveness is determined more by factor costs.

However, it is important to bear in mind certain aspects of the studies carried out in the Indian context. First, all of them relate to the earlier period of import substitution characterized by protection on the one hand and series of restrictions on the technology import (both embodied and dis-embodied) on the other. Given the fact that liberalization has led to more liberal import of technology, it is possible to expect change in the technology strategies adopted by the firms and concomitant change in the export behaviour of firms. Secondly, the dismantling of the tariff and non-tariff barriers coupled with the removal of entry barriers would have made the industry more competitive in structure and resulted in the export behaviour of firms. Thirdly, while the theoretical prediction regarding technology and trade relates to the individual products, empirical

verification has been made with respect to broad industry groups. It may be noted that there is empirical evidence to suggest that with economic liberalization there has been increasing incidence of intra-industry trade even in the high technology industries (Veeramani 1999). Therefore it is possible that even in high technology industries Indian firms engage in exports. To what extent such trade in high technology industries are influenced by the firms' technology behaviour is an issue that calls for empirical verification.

Technological change in the developing countries is often understood in terms of the combined effect of in-house R&D and technology import (Blumenthal 1979, Katak 1985). The technology strategy of firms in India, as manifested in the relative role of in-house R&D and technology import, is found to be varying across different firms and influenced by the policy environment (Basant 1997). Technology import could be either disembodied, as manifested in technology licensing, or embodied in capital goods and spares. Notwithstanding the growing importance of embodied technology import in the Indian context, studies have taken into account only the disembodied technology import in capturing the technology behaviour of firms. Technology import *per se* need not confer the competitive advantage to the developing country firms. Firms own effort towards developing in-house technological capability is equally important in enhancing international competitiveness (Lall 1992, Bell and Pavitt 1997). Hence, in the present study we adopt two definitions of technology behaviour; a narrow definition of technology behaviour, following the existing studies, includes only in-house R&D and technology licensing whereas the broader definition includes the import of embodied technology as well. R&D intensity (RDIN) is measured as a ratio of total R&D expenditure to sales. Technology import is represented by a dummy variable (COLDUM) taking value 1 for technology importers (those firms reporting payments for royalty and technical fee) and zero for firms not importing technology. Embodied technology import (CAPIMP) is measured in terms of the ratio of import of capital goods total sales. We hypothesize that all the above variables will have a positive effect on the export decision as well as export intensity of firms. Given the fact that the shift in policy environment implied a move away from protection to open competition, the domestic firms might have been forced to choose their technology strategy in such a way as to build up competitiveness in the short run. Since returns to R&D and disembodied technology imports takes time and involves greater risk, the preferred technology strategy of the firms might to be resort to embodied technology import to enhance their international competitiveness in the short run.

### ***Foreign Ownership***

There is hardly any consensus in the literature on the influence of foreign ownership on the export performance (see Jenkins 1990 for a survey). On the one hand, there are a number of reasons put forward for the better export performance of foreign firms. To cite a few, the foreign firms, being part of the parent firm's global network possess better brand image and have access to international market accompanied by greater technological and organizational capabilities, would tend to be more export intensive as compared to the domestic firms. Another line of argument in support of the better export performance of MNEs has been put forward by Helleiner (1988). To Helleiner, MNEs may be better able to resist protectionist pressures in their home countries in such a way as to favour imports from their affiliates leading to higher export performance. On the other hand, it has been argued that the parent firms would discourage export by the subsidiaries if such exports were viewed as competitive to existing operations in other locations. This is because the MNCs in general plan their operations in a global scale and therefore the markets are allocated among different subsidiaries in such way as to maximize the global profits (Lall and Streeten 1977). According to the eclectic theory of foreign investment (Dunning 1988), there are a number of factors that influence the foreign investment decisions of TNCs. While some of these factors tend to induce export, others in most circumstances may not do so. In the Indian context most of the studies carried out in the earlier regime found that foreign control has either negative or no significant influence on export. (Subrahmanian & Joseph 1994, Pant 1983, Subrahmanian *et al* 1995, Kumar 1990, Joseph 2000). Aggarwal (2002) also tend to suggest that MNEs are yet to become more export oriented than their local counterparts. But more recent evidence (Kumar and Pradhan 2003) points towards increasing export orientation by the foreign firms during the globalisation era. We include the variable MNCDUM capture the influence of foreign control. MNCDUM takes value 1 if foreign share is more than 25 per cent and zero otherwise.

From the literature it is evident that apart from technology behaviour and FDI participation, there are a number of factors that influence the export performance of firms. What follows is brief discussion on these hypotheses.

### ***Firm size***

In most of the studies, firm size is considered as a factor positively influencing export behaviour, particularly where scale economies are important (see Bonaccorsi 1992 for a survey and Lall 1986). It has also been argued that the

large firms have greater resources to gather information on export markets and to cover uncertainties associated with export markets (Wakelin 1997) However, there is also enough empirical evidence to suggest that the relationship may be nonlinear (Willmore, 1992, Kumar & Siddharthan, 1994). If the firms operate in a concentrated market and enjoy market power at home, they may prefer the relatively easier life of selling domestically to the more troublesome one of exporting (Glejser and Petit 1980). Hence, if the domestic market is concentrated and larger firms have dominant share in the market, the relation between firm size and export intensity could be negative. That is, beyond a certain level, the relationship between size and export may be negative. Hence it is possible to have non-linear relationship between export and size. The non-linear relationship is tested by including the square of firm size (SIZE2), its quadratic term. Size is measured in terms of total sales of the firm.

### ***Profit***

Given the fact that export market is more risky than the domestic market, a positive relation between profitability and export intensity has been postulated. This is because the more profitable firms may be well positioned to take the risk as compared to the loss making (or low profit) firms (Kumar, 1990, Pant, 1993). Profitability (PROFIT) is measured as the ratio of net profit to net sales.

### ***Age***

We have incorporated age of the firm as a variable to test if the accumulated experience of the firms influences their export behaviour. Age is estimated as the difference between the year of incorporation and 2000. It is hypothesized that in low technology industries the accumulated knowledge may positively influence the export behaviour. Whereas in high technology industries, which are characterized by shorter product cycles, the new firms may be having more competitive advantage.

### ***Trade Orientation***

To the extent that increased investment provides an enabling environment for overall development of an economy in general and developing an industrial base, especially that of high tech industries in particular and increased export performance, it may be of some relevance to explore the link between trade and investment in industries like electronics. *Prima facie* it appears that the link between trade and investment is conditioned by the product characteristics and organization of production. Therefore to ensure competitiveness of firms operating under global production networks, the trade policy regime should be

the one that facilitates free inflow of inputs into and output out of the country (Joseph 2004). Hence, firms with high import intensity are likely to have better export performance.

#### ***Advertisement and sales promotion***

It has been argued that enterprises with more advertisement and sales promotion are likely to do better in the international markets than others. This is because in the process of building brands and trade names Indian enterprises are likely to become conscious of the need to maintain quality, which in turn is important for sustained export (Kumar and Siddharthan 1994). However, it needs to be noted that in high technology industries where basic consideration is technology and product characteristics, advertisement may not be important in influencing export. Advertisement intensity (ADS) is measured as a ratio of advertisement expenditure to sales.

#### ***Capital Intensity***

On the lines of Heckscher-Ohlin theory a firm, irrespective of its ownership, would be exploiting the comparative advantage in the manufacture and exporting of labour-intensive products from a labor-surplus country like India. Hence a higher capital intensity of operation is unlikely to give the firm a comparative advantage in export. Hence an inverse relationship is posited between capital intensity (CAPI) and export behaviour. CAPI is measured as ratio output to gross fixed assets.

Methodologically, the most common approach has been to measure the export competitive-ness of firms by export intensity measured as a ratio of export to total sales. The most common method of analysis has been the Tobit model. While export intensity is an appropriate indicator of the firms' ability to penetrate the world market, under certain circumstances, analysis based on export intensity might not reveal the export earning capacity of the firms. The point may be further elaborated, if increased export intensity of a firm is associated with low production growth, high export intensity need not be associated with high export earning. Under such conditions, it appears more appropriate to take into account both conditions of production and export. Hence in this analysis we consider a firm as competitive if it records high (more than industry average) production growth and export growth. Once we adopt such an approach it is possible to categorize the firms/products into five clusters based on their production and export performance and Multinomial logit model turns out to be the appropriate method to analyze such cases.

The central issue in the analyses is to identify the factors that influence the observed variations in the behaviour of firms that fall into different categories. Based on the above discussion we have identified three variables to capture the technology behaviour of firms and one variable to represent the foreign participation. Among the variables that represent the technology behaviour, we have R&D intensity to capture own technology generation efforts by the firms. In addition we have a dummy variable (COLDUM), collaboration dummy to represent the disembodied technology import behaviour of firms. The collaboration dummy takes value one if the firm reports any payment on account of royalty and 0 otherwise. Given the fact that embodied technology import (import of capital goods) plays crucial role in enhancing firms international competitiveness and domestic production capability, we have incorporated the variable capital import intensity (CAPIMP) to capture the effect of embodied technology import on firms behaviour. The foreign participation, following the usual practice in the literature, has been represented by a dummy variables (MNC DUM), which takes value 1 if the foreign equity is greater than 25 per cent and 0 otherwise. Given the fact that firms' behaviour with respect to production and export are influenced by other firm specific factors and firms strategy we have incorporated other variables like sales (estimated as log of sales) to represent firm size. We have also incorporated square log of sales to explore if there is any non-linear relationship. Other variables include age of the firm to represent the bearing of accumulated experience, advertisement intensity and profitability.

Given the issue at hand, we approach the problem using a multi nominal logit model. In the multinomial logit model<sup>16</sup> we estimate a set of coefficients say  $\beta^{(1)}$ ,  $\beta^{(2)}$ , and  $\beta^{(3)}$  corresponding to each category such that

$$P(y = 1) = \frac{e^{x\beta(1)}}{e^{x\beta(1)} + e^{x\beta(2)} + e^{x\beta(3)}}$$

$$P(y = 2) = \frac{e^{x\beta(2)}}{e^{x\beta(1)} + e^{x\beta(2)} + e^{x\beta(3)}}$$

$$P(y = 3) = \frac{e^{x\beta(3)}}{e^{x\beta(1)} + e^{x\beta(2)} + e^{x\beta(3)}}$$

The model, however, is unidentified in the sense that there is more than one solution to  $\beta^{(1)}$ ,  $\beta^{(2)}$ , and  $\beta^{(3)}$  that leads to the same probabilities for  $y=1$ ,  $y=2$  and  $y=3$ . To identify the model, one of  $\beta^{(1)}$ ,  $\beta^{(2)}$ , or  $\beta^{(3)}$  is arbitrarily set to zero. If we set  $\beta^{(1)}=0$  then the remaining coefficients  $\beta^{(2)}$  and  $\beta^{(3)}$  would measure the change relative to  $y=1$  group. Setting  $\beta^{(1)}=0$ , the equations for estimating the probabilities become

$$P(y = 1) = \frac{1}{1 + e^{x\beta(2)} + e^{x\beta(3)}}$$

$$P(y = 2) = \frac{e^{x\beta(2)}}{1 + e^{x\beta(2)} + e^{x\beta(3)}}$$

$$P(y = 3) = \frac{e^{x\beta(3)}}{1 + e^{x\beta(2)} + e^{x\beta(3)}}$$

In the model that we estimate there are five outcome categories as specified already and the selected comparison group is the first category.

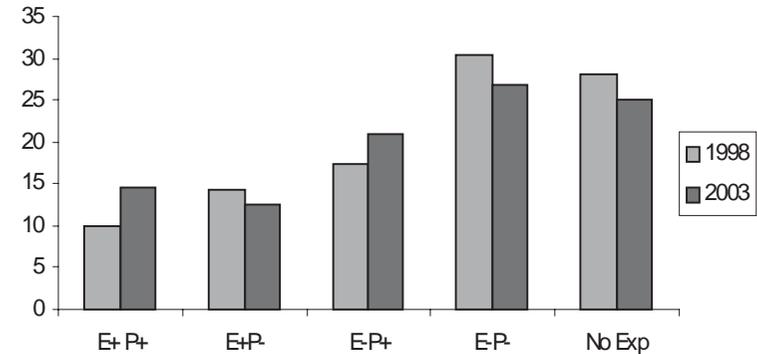
Before presenting the estimates of the model it may be instructive to examine distribution of firms across different categories and their behaviour with respect to technology and foreign participation. It may be noted that in 1998 about 11 per cent of the firms belonged to the first category and about 28 per cent belonged to the last category of non-exporters. By 2003, the share of first category increased by almost 50 per cent to reach a level of 14.6 per cent and that of the last category declined to reach a level of 25 per cent. Similarly, the share of the fourth category of firms (recording low production growth and

**Table 9: Distribution of Firms According Their Performance in Terms of Production Growth and Export Performance (%)**

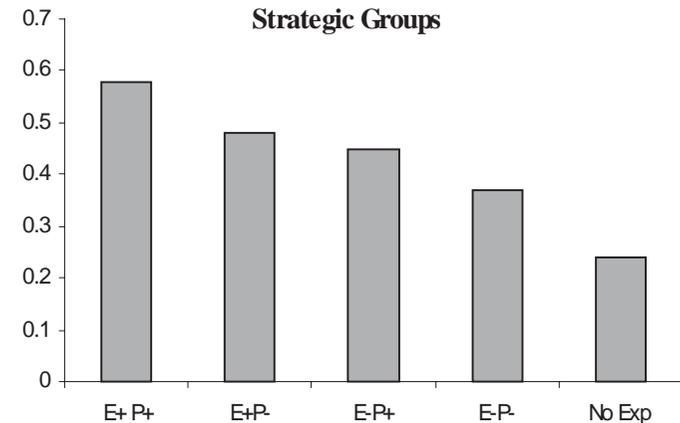
Year	P+ E+	P- E+	P+ E-	P-E-	No Export
1998	10.0	14.2	17.3	30.4	28.1
1999	9.4	14.1	21.6	30.0	24.9
2000	10.1	10.8	19.7	31.5	27.8
2001	10.6	10.9	19.2	28.8	30.5
2002	13.3	12.9	19.4	26.6	27.7
2003	14.6	12.6	20.9	26.8	25.1

export growth) also declined from about 30 per cent to 27 per cent. In general there appears to a significant change in the behaviour of firms (see Table 9 and Fig 3). However, it may also be noted that the share of domestic market oriented firms has not declined in commensurate with the general changes, instead their share increased Figure 4 shows the mean R&D intensity across different categories of firms. It may be noted that the firms in the third category recorded highest R&D intensity followed by the first category and the recorded R&D intensity of the last category was the least. The third category recorded highest R&D intensity for the period a cross examination of the data revealed that their R&D intensity steadily declined from 0.82 per cent in 1998 to 0.11 per cent in 2003. Such a decline notwithstanding the higher average for the period is

**Fig 3: Change in the Distribution of Firms according to Production & Export**



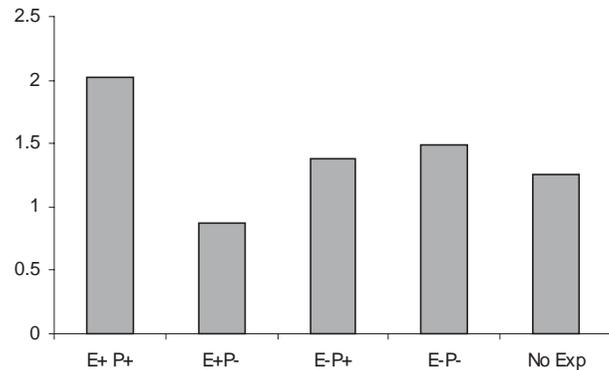
**Fig 4: R&D Intensity Across Different Strategic Groups**



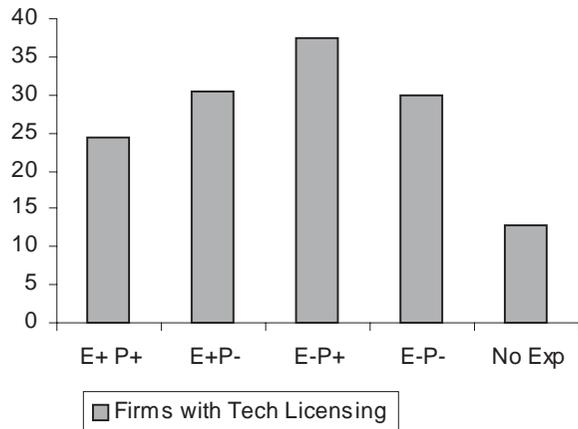
bound to influence their behaviour. In the case of the first category of firms on the other hand, R&D intensity showed an increasing trend from 0.36 per cent in 1998 to 0.78 per cent in 2003.

With respect to embodied technology import, the behaviour of the first group of firms is found to be distinctly different from all the other groups (see Fig 5). Coming to disembodied technology import, the firms in the third category showed highest incidence of foreign collaboration and firms in the last category

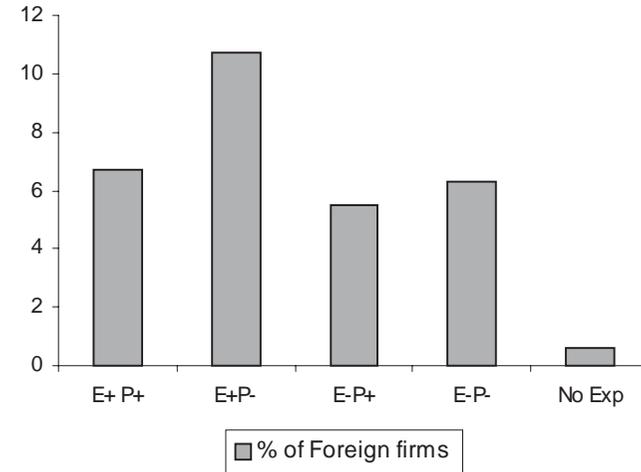
**Fig 5: Embodied Capital goods Across Different Strategic Groups**



**Fig 6: Disembodied Technology Import behavior Different Strategic Groups**



**Fig 7: Foreign Participation Across different Strategic Groups**



showed the lowest incidence (fig 6). In case of foreign participation the second category of firms recorded highest incidence of foreign participation and the last category of firms showed the lowest (fig 7) In general, from the discussion it is evident that the firms in different category behaved differently with respect to their technology behaviour and the extend of foreign participation.

**Estimates of the Multinomial logit Model**

The maximum likelihood estimates of the multinomial logit model are presented in Table 10. As we have already stated, the first category of firms is the base category and hence the estimated coefficients for the other category represents the extent of difference in their behaviour with respect to the base category.

To begin with we shall present the behaviour of firms in the first category in comparison with the last category so that the interpretation of the estimated coefficients become easier. As compared to the fifth category the first category of firms record positive and statistically significant R&D intensity, embodied technology import and have high incidence of foreign participation. The estimated coefficients of raw material import intensity, age and size are also positive and significant indicating that they depend more on imported raw materials and spares, they are larger in size and newly established. Advertisement intensity is negative and statistically significant indicating that advertisement

**Table 10: Result of the Maximum Likelihood Multinomial logit Model on Different Strategic Groups of firms**

Variables	E+ P-	E- P+	E- P-	No Export
Rdin	-12.422 (1.698)	-10.916 (1.006)	-6.819 (0.998)	-33.28 (2.850)
Coldum	0.174 (0.673)	0.654 (2.786)	0.058 (0.259)	-0.241 (0.962)
Capim	-7.658 (2.134)	-5.193 (2.326)	-5.920 (2.629)	-6.937 (3.082)
Mncdum	0.259 (1.653)	-0.3823 (0.932)	-0.335 (0.888)	-1.900 (2.859)
Rawimp	-0.031 (0.042)	-0.644 (0.961)	-1.421 (2.163)	-2.427 (3.703)
Isales	0.024 (0.151)	0.487 (2.444)	0.672 (3.954)	-0.216 (1.658)
Isales2	-0.018 (1.011)	0.059 (2.764)	-0.084 (4.467)	-0.024 (1.429)
Capi	1.746 (1.614)	-9.719 (5.950)	0.111 (0.109)	-1.189 (1.154)
Age	0.038 (5.064)	0.031 (4.123)	0.040 (5.657)	-0.008 (1.088)
Advin	21.693 (1.738)	28.809 (2.548)	34.353 (3.090)	33.278 (2.935)
Profit	0.105 (0.591)	0.576 (1.397)	-0.164 (1.166)	-0.118 (0.852)
Cons	-0.853 (2.103)	-0.215 (0.433)	-1.042 (2.482)	2.283 (6.937)
Log Likelihood	-2094.846			
Chi- squared	643.83			
Number of Observations	1570			

Note: Figures in bold are statistically significant at least at 10 per cent level.

and other marketing expenses are relatively less important. As we have already seen firms with better production and export performance are found engaged mostly in the electronic components and equipment other than consumer electronics wherein advertisement cannot very effective. The case of a firm (see box 1) operating from the DTA but performed fairly well in terms of both production and exports tend to suggest that firm's behaviour with respect to research and development, outward investment along with import of capital goods and greater interaction with academia and Government research laboratories enabled the firm to perform better in terms of production and export.

**Box 1: Samtel Colour Limited:  
Competing in Domestic and Export Market**

The field of display devices - Cathode Ray Tubes (CRTs) Computer Display Tubes (CDTs) and Colour Picture Tubes (CPTs)- is highly competitive internationally where in the world leaders like LG Phillips, Samsung, Thomson, Matsushita and Chinese firms like Changhong, TCL, Konka, Heur and Panda dominate. In such a competitive market Samtel Colour, largest component manufacturer in India and the market leader with 40 per cent market share, has been able to make inroads by exporting 1.1 million television picture tubes to countries in Asia and Europe. During 1998-03 sales and exports of Samtel recorded an annual compound growth rate of 19.5 per cent and 18.4 per cent respectively.

Today, the company's clients in India include all the leading names in TV industry like BPL, Videocon LG, Onida, Samsung, Panasonic Thomson and others. Beginning with its exports to the erstwhile USSR, the company now has safety approvals from USA, Canada, Germany and Britain for its products and act as OEM to a number of firms in Europe and Asia. With the phasing out of 14" CPTs by most of the manufacturers Samtel, with a production capacity of 2.3 million tubes, hopes to significantly increase its share in the near future.

Samtel Colour Limited was incorporated in 1986. Initially the company started with a technical collaboration with Mitsubishi Electric, Japan to manufacture 14' and 21" colour picture tubes. The collaboration had a duration of 8 years, which was later extended for another two more years. Almost 90 per cent of the capital equipment was imported from Japan for its first production line for the manufacture of picture tubes with a capacity of 0.5 million per annum which was later upgraded to 1.4million.

While the first product line was fully designed and installed by the foreign collaborator, the second product line for the manufacture of 14" CPTs with a capacity of 1.5 million tubes per annum was fully designed and installed by the Samtel team wherein the number of workers was almost halved to 400 as compared to the first line. The third production line, which is comparable to any modern production line in the world, was also designed and set up by its own team. The engineering service team after designing the state of the art capital equipment for the company has also undertaken equipment design task for other firms. They have designed sophisticated, automatic equipment for a large automobile manufacturer.

In addition to these achievements in the project front, there are major achievements to its credit in the sphere of product development. By 1998 the R&D team at Samtel developed the capability to design and manufacture 20" CPTs and by 2002, they moved up the value chain by designing and 21" pure flat tubes. By 2004, the company further moved ahead with the capability to design and manufacture 29" Semi Flat picture tubes. Recently, the R&D team developed the 42" Plasma Display Panel which is considered to be the frontier technology in the field of display devices and they are also working on OLEDs.

*Box 1 continued*

With a view make foray into the world market, the company acquired Thales Avionics a German Company in specialty tubes. Acquisition of one more company in Germany and another in the US is in the pipeline.

Better performance in production and export needs to be seen in the context of its firm commitment towards developing technological capability. Unlike the unusual practice in Indian industry wherein the local firms in the event of upgrading the technology resorting to repetitive collaborations, the Samtel Colour did not resort to a second foreign collaboration. Samtel has an R&D budget of Rs 170.2 Million accounting for about 1.77 per cent of its sales turnover. The in-house R&D is oriented towards both product development and project design and engineering. In addition to in-house R&D, the company has been able to develop interface with government labs like NPL and the laboratories of DRDO. More importantly the company had a long-term relationship with IIT Kanpur and this relationship got culminated in the setting up of the Center for Display Technology in the IIT campus with financial support from Samtel.

On the whole, Samtel's success could be attributed to a great extent to its commitment towards in-house R&D, interface with academia and Government along with an aggressive export marketing strategy, including overseas investment.

In comparison with the first category, the second category of firms behaved differently only with respect to R&D intensity, embodied technology import, raw material imports, age and advertisement intensity. Of these, R&D intensity, embodied technology import, age and advertisement intensity turned out to be statistically significant. We know that these two groups of firms have been able to record high export intensity whereas the second category recorded lower output growth. Hence the poor production performance of the second category of firms needs to be viewed *inter alia* in terms of their differential behaviour as compared to the first category with respect to the variables specified above. Based on this result we may infer that, the second category of firms needs to become more R&D oriented and give greater importance to import of embodied technology and use imported components and spare to make them equally efficient in production and export. Since many of the leading producers of electronics in the world over are phasing out production, there is an opportunity for Indian firms to buy up the production plants. This in turn reduces the cost of fixed investment to one third. While second hand import of capital goods is permitted, it was discerned from discussion with firms that there is the need for further trade facilitation in this regard. Another important finding refers to the importance of size in export competitiveness calling for policy measures to encourage consolidation.

When it comes to third category of firms which recorded better production performance but lagged in terms of exports, their behaviour is found to be different from that of the first category with respect to R&D intensity (not statistically significant) embodied technology import, foreign participation, capital intensity, age and advertisement intensity. It may also be noted that their behaviour with respect to technology licensing (with positive sign) is found to be not different but significant which in turn imply that, technology licensing and the accompanying conditions makes them more domestic market oriented. Given the fact that the third category of firms was able to record higher output growth, yet less than average export intensity, the crucial issue is how to make them more outward oriented. If the estimates of the model are any indication, these firms need to resort to higher extent of embodied technology to facilitate the modernization process and also to align themselves with foreign firms to get access to the export markets. Needless to say, aligning with foreign firms will be possible if and only if it fits well within the global operations of the foreign firm.

Based on the behaviour of the second and third categories of firms it appears that while foreign participation alone might enable a firm to enter the world market (provided it fits well within the global operation the foreign firms), to achieve higher output growth along with export competitiveness, the foreign participation needs to be complemented with domestic technology generation efforts on the one hand and modernize the plants and equipments using imported capital goods which also facilitates the access to embodied technology.

In case of fourth category of firms, which recorded both less than average export growth and production growth, the behaviour is found to be similar with the first category of firms with respect to foreign collaboration or disembodied technology import and size. No wonder as they behave differently with respect to almost all the technology parameters and foreign participation, their performance turned out to be poor as compared to the first category of firms both in terms of exports and production. Finally when it comes to the fifth category of firms there is hardly any similarity with the first category of firms with respect to any of the variables considered in the model.

In general the estimates of the model bring out the primacy of technology behaviour and foreign participation in achieving competitiveness in the international market and achieve better record in production. It also appears that the firms needs to adopt the "technology-FDI package" in its totality to have the best outcome of high export coupled with high production performance.

## 5. Concluding Observations and Broad Contours of a Strategic Approach

It is generally understood, both in the academic circles and policy parlance, that while the IT software and service sector in India recorded unprecedented growth rate in a sustained manner for more than a decade and established credibility in the international market, the hardware sector, both computer hardware and other electronics equipment and components, has shown a decelerating trend. The deceleration trend, which began in the early 1990s, continues even today with hardly any signs of turnaround. Given the fact the growth of IT software and service exports is fueled, at least, partly by the hardware sector, a stagnant hardware sector might act as a drag on the software sector. More importantly, India's current competitiveness in the international IT market may be undermined by the emergence of new players like China which has solid hardware base and strengthening software base. Hence, not only for sustaining the competitiveness of the software sector, but also for creating additional sources of employment and income generating opportunities in the country, India can ill afford to bear with a stagnant IT hardware (electronics) sector. At the same time, being a signatory to Information Technology Agreement of WTO, India is committed to reduce the tariff rates on a wide range of IT goods to zero level by 2005 leading to high import competition. Hence it is important that the industry equip itself to meet the import competition and enhance its export competitiveness. It is against this background that the present paper analyzed performance (both export and production) of electronics industry and comes out with the broad contours of a strategic approach towards promoting the international competitiveness of India's electronics industry.

Our exploration of the policy reform initiatives in the last decade has shown that there have been a number of policy initiatives and institutional interventions to make the industry dynamic in output growth and internationally competitive. Despite these policy initiatives, we have observed that the rate of growth of output and export recorded a declining trend in the 1990s as compared to 1980s. The deceleration in the rate of growth of production and export at the industry level needs to be seen in the context of certain debilitating factors that remain, wide ranging reforms notwithstanding.

High tariffs and taxes (especially indirect taxes that some times goes up to 40 per cent as compared to 5 to 17% in other countries) seem to have the effect of leading to high prices and lower market and lower scale undermining export competitiveness. In case of electronics for example, at present, CENVAT (excise)

is 16%. In addition, Sales Tax ranging between 4-15% is levied in various States. CST, octroi, entry tax, etc. are additional. In such a context there is an urgent need for reduction in taxes resulting in larger domestic demand, which in turn could act as a springboard for exports.

The need for such reforms becomes especially important in the context of ITA wherein India is committed to reduce tariff on a number of electronics goods to zero level, which in turn is likely to result in unprecedented import competition. To face such external competition, Indian firms may be provided access to needed components, raw materials and capital goods (both electronic and non electronic) at zero duty such that taxes and tariffs do not stand in their way of being competitive. While such policy initiatives might result in loss of revenue for the government, it may be justified in the context of a potential threat of income and employment loss if Indian firms are not able to compete with foreign firms. Once we extend such liberal tax tariff regimes to the firms in Domestic Tariff area the present distinction being made between DTA and Export oriented firms might get blurred. Therefore, the strategy in the ITA regime needs to be one of enabling India's firms to meet the import competition, which in turn along with adequate export incentives will act as a catalyst in export.

ITA will also lead to a situation wherein certain segment of Indian market which are not open to the large scale units (on account of reservation for the small scale sector) will be getting opened to the foreign firms. Hence there appears to be the need for a reexamination of our policy of small-scale reservation. Also it is important to undertake further studies to analyse the export competitiveness of small scale sector that today accounts for nearly 40 per cent of the total output and the implications of ITA on such units. The study might also analyze the effectiveness of the steps taken by different stakeholders to equip the Industry face the ITA and highlight new initiatives for the future.

While policy measures to liberalize trade and investment needs to be appreciated, some more industry specific initiatives may be called for on account of the specific character of electronics. Given the domination of contract manufacturers in global electronics industry, it may be advisable to offer special incentive on one time basis to attract a few such large manufacturers. Once a few such firms are established it would induce others to follow. Such units in addition to help developing local vendor base also would create substantial inputs demand from local sources and promote exports. Given the declining capability in the field of microelectronics, any such initiative to attract investment into this field is expected to have rich dividends.

We have observed that low output growth notwithstanding, some of the products recorded higher export growth. The study also noted the very weak correlation between export intensity and production growth and also between production growth and export growth. In such a context, we have argued that there are certain limits in using export intensity, as an indicator of export performance as we might have situations wherein high export intensity is associated with low export earning. Hence we have divided the products into five different groups based on their export and production performance. The first category consists of those products for which both production growth and export growth were higher than the industry average. The second group includes those products for which export growth turned out to be higher than the industry average whereas their recorded growth in production is lower than the industry average. The third category consists of those products for which production growth is higher than the industry average but export growth is lower. Fourth group consists of those products for which both export growth and production growth are lower than the industry average. Finally, there are the products, which are not exported at all.

We found that the number of products in the first two categories either remained the same or increased as we move from 1985-90 to 1990-97, indicating the increasing number of products exhibiting export competitiveness. We have also seen that products in these categories comprised mostly electronic components and followed by electronic capital goods, which are more design intensive. Naturally, the marketing and brand oriented products like the consumer electronics lagged behind. Thus it appears that, any strategic approach towards increasing the export of Indian electronics may focus on those products mainly in the components sub sector and electronic capital goods. Here again, it may be noted that there are significant intra-sectoral variation. For example, while the number of products in components belonging to the fourth category (low export and production) declined over time, there has been an almost doubling of such products in the electronic capital goods. We have also noted that there has been a decline in the number of products in the fourth and fifth categories whereas there has been an increase in the number of products in the third category which are more domestic market oriented.

Against the background these findings, based on product level analysis, we have proceeded with an analysis at the firm level. Here the focus of the analysis has been to highlight the role of technology factors and foreign participation in influencing the export competitiveness of firms. Technology

behaviour has been explored in terms of in-house R&D effort, dis-embodied technology import and embodied technology imports. We have also explored the bearing of firm-specific characteristics and firm strategies of the observed performance.

Following the criterion presented above, we have divided the firms into five categories and explored the issue at hand using a Multinomial logit model. The central finding of the analysis is the prominent role that technology behaviour of firms in the form of in-house R&D and embodied technology import (import of capital goods) along with foreign participation play in influencing the inter-group variation in the observed performance. It was also found that access to imported components and spares also has crucial bearing on the performance. However, if the firms resort to a strategy wherein it doesn't adopt the "technology-FDI package" in its totality, the outcome is likely to be less than optimum (defined as both high export and production). Thus the second group of firms behaved in similar manner to the first group of firms with respect to dis-embodied technology import and foreign participation and they could achieve higher export growth but not high production growth. Hence the strategic approach towards increasing the performance of these group of firms might entail inducing them to invest more in R&D, enable them to import needed capital goods, components and spares. This in turn calls for policy measures that facilitate import of capital goods. Given the fact that many of the world leaders are phasing out their electronics production there is an opportunity for Indian firms to buy up such production plants leading to substantial reduction in fixed cost. The policy needs to facilitate such imports as they can enhance the cost competitiveness.

When it comes to the third category of firms, while they behaved the same way as the first group with respect to disembodied technology import, they behaved differently in terms of foreign participation and embodied technology imports. The result has been that while they fared well in the production front they lagged in exports making them domestic market oriented. If the estimates of the model is any indication, the strategic approach towards enhancing the performance of such firms *inter alia* include inducing them to invest more in embodied technology imports, to help modernization, and joining hands with the foreign firms to get access to the export market. Also there appears to be the need for intensifying the in-house R&D efforts. The estimates of the model show that the firms in the fourth and fifth categories behave differently from that of the first category with respect to almost all the behavioural variables

specified in the model. This implies that major behavioural changes are called for to make the firms in these categories better performers. While these two groups account for majority of firms, it is encouraging to note that their number has been declining over the years. The fact that firms in the second to fifth category, behave significantly different from the first category with respect to embodied technology import which in turn adversely affect their modernization process, and import of components and spares, our enquiry leads to the door steps of trade facilitation in the country. The crucial issue is despite the liberal trade policy regime, how facilitating the trading environment is?

## Endnotes

- <sup>1</sup> Policy changes in electronics are well documented. See in this context BICP (1987, 1989), Joseph (1997)
- <sup>2</sup> See Raj and Sen (1961) for an analytical treatment of this issue.
- <sup>3</sup> See in this context, Department of Electronics (1974), "Guidelines for Industrial Licensing in Electronics" Electronics Information and Planning, Vol. 1, No.6 March.
- <sup>4</sup> Lok Sabha Question 4955, 27 - 7- 1977.
- <sup>5</sup> Information presented in this section draws heavily from the different issues of the Guide to Indian Electronics Industry published by the Department of Information Technology.
- <sup>6</sup> See in this context, Dieter Ernst and Linsu Kim (2001) Global Production Networks Knowledge Diffusion, and Local capability Formation: A Conceptual framework, East-West Center Working papers Economics series No. 19.
- <sup>7</sup> Industries exempted from licensing are only required to file information in the prescribed Industrial Entrepreneur Memoranda (IEM) with the Secretariat for Industrial Assistance (SIA), Department of Industrial Policy and Promotion, Government of India and obtain an acknowledgment implying that no prior approval is required. Immediately after the commencement of commercial production, Part B of the IEM has to be filled in the prescribed format.
- <sup>8</sup> However FDI up to 100 per cent has been allowed subject to the condition that such companies would divest 26 per cent of their equity in favour of the Indian public in five years, if these companies are listed in other parts of the world.
- <sup>9</sup> The aforesaid royalty limits are net of taxes and are calculated according to standard conditions.
- <sup>10</sup> See Sunil Mani (2004) for details.
- <sup>11</sup> See in this context Parthasarathi (2004)
- <sup>12</sup> See in this context Parthasarathi and Joseph (2002) Krishna (2003).
- <sup>13</sup> Some of these issues have been well articulated in a policy note by the Ministry of information technology but what is now needed is an implementation of the recommendations made. See for details <http://www.mit.gov.in/hwpolicy.asp>
- <sup>14</sup> Detailed examination of the industry structure at the product level, though important is not undertaken in the present paper.
- <sup>15</sup> The reason for nearly 130 per cent increase in one remains unknown to this author.
- <sup>16</sup> See Greene (1993). For an intuitive introduction to the topic see Kennedy (1992)

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