TECHNOLOGY IMPORTS IN INDIA

An Analysis of Selected Industries Under Liberalisation

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I, hereby affirm that the research for this dissertation titled ***"Technology Imports in India: An Analysis of Selected Industries Under Liberalisation"*** being submitted to Jawaharlal Nehru University for the award of the Degree of Master of Philosophy in Applied Economics, was carried out entirely by me at the Centre for Development Studies, Thiruvananthapuram.

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Certified that this dissertation is the bona fide work of Mr.Emmanuel Thomas, and has not been considered for the award of any other degree by any other university.

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Chapter 1
INTRODUCTION

The role of international technology spillovers in accelerating the process of technological transformation of developing countries is increasingly being acknowledged. Such spillovers are facilitated predominantly by the transfer of technology from firms in the developed countries through different modes ranging from setting up of fully owned subsidiaries to outright purchase of technology in arms-length transactions. Of late, with the increasing appeal to the tenets of globalisation among the developing countries, studies have found that they compete among each other to attract more foreign direct investment and technology (UNCTAD, 1995). This trend is in sharp contrast to the general disenchantment with foreign capital and technology that prevailed among the developing countries during the 1960's and 70's.

In India, the planners in the early days of development planning acknowledged the role of foreign capital and technology and the policies guiding the inflow of capital and technology were liberal. However, these policies become more selective following the adoption of inward oriented development strategy in the Second Plan. A series of high power committee reports in the 1970s [for example, Alexander Committee Report (GOI, 1978), Dagli Committee Report (GOI, 1979), Tandon Committee Report (GOI, 1980), and Hussain Committee Report (GOI, 1984)] came to the conclusion that the regulatory regime had the effect of stifling efficiency, productivity, and growth. In line with recommendations of these Committees, the regulatory policy framework of the seventies was subjected to substantial dilution in the eighties. The liberal policies of the eighties gained further momentum in the early nineties with initiation of economy wide reform

measures. In the changed scenario, where firms have to be more competitive, market forces increasingly guide the import of technology and capital.

In this context, there arise a number of issues, which warrant careful empirical analysis. To cite a few; how have the Indian firms responded (in terms of the import of technology) to these policy reforms in general and more specifically to the globalisation policies of the eighties? What are the factors that influence the firms to resort to foreign collaboration? Has there been any change in the nature of foreign collaboration and the accompanying terms and conditions? Indeed, there are a number of studies that looked into different aspects of technology transfer in India[I]. Almost all of these studies, however, pertain to the period when Indian policy regime was characterised by state regulations. Hence, the present study intend to analyse the technology import behaviour of firms in Indian manufacturing industry in the 1990's. The specific objectives of the study may be stated as follows.

a. to examine the emerging trends and patterns, and the terms and conditions accompanying technology import against the backdrop of changing policy regime; and,

b. To study the determinants of firm level technology import behaviour in terms of the decision to and the intensity of technology import.

Data sources and methodology.

Though globalisation calls for detailed analysis of the different aspects of the economy, the availability, coverage and reliability of data from the official sources is scanty. This is particularly true of data on foreign technology import and R&D (refer Chapter 2 for more details). In this context the database developed by the Centre for Monitoring Indian Economy is highly useful. This database is generated from the balance sheet and the director's report of all the public limited companies. In addition to data on almost all the financial variables the data base also contain information on export, import, outflow on account of technology import, and so on.

Another data set made use of in the present study is the database on foreign collaboration compiled by the Department of Scientific and Industrial Research, which has been restricted for official use till 1993. This data base contain following information on each collaboration; name of the Indian firm, name of the foreign firm, product/process technology involved, royalty rate and its duration, lump sum, foreign equity share and amount and duration of collaboration. If the royalty rate on exports were different from that of domestic sales, such information is also furnished. However, since 1993, while this database is made public, the amount of information available is less. For the post 1993 period the publication does not specifically state the extent of royalty and lump sum, instead it states whether any payment in the form of royalty or lump sum is involved. The major problem with this data is that it refers to approvals.

Chapter Scheme

The study is presented in four chapters including the introduction. The second chapter traces the changes in government policy governing the import of technology and capital. Against this background, the changing nature of foreign collaborations, cost of technology import and the terms and conditions accompanying technology import are examined. The third chapter addresses three questions. It is found that, despite the liberal policy environment, all the firms are not resorting to foreign technology import. Hence, the first question is; what are the factors that determine firms' decision to import foreign technology? The next question, which is related to the first one, is what are the factors that determine the "quantum" of foreign technology imported. The third question that follows from the first two questions is whether the decision to import and the "quantum" of technology import are shaped by the same set of factors. The fourth chapter presents the summary of the study and the concluding observations.

End notes.

i Since there are a number of reviews available we do not intend to have another survey. For an excellent review carried out recently (see Singh, 1994). Nevertheless, the literature relevant to the specific issues addressed in the present study will be dealt with in the relevant context.

Chapter 2

IMPORT OF TECHNOLOGY: TRENDS AND PATTERNS

Introduction

The role of foreign technology in industrial development has been acknowledged in India from the early days of development planning. This is evident from the Industrial Policy Resolution of 1948 and the Prime Minister's Foreign Investment policy statement of 1949 in the Parliament. While underlining the role of foreign capital, Indian planners were also conscious of the possible adverse implications. Therefore, policy measures were initiated with a view to regulate the import of foreign capital and technology. Overtime, however, the approach towards foreign capital and technology has undergone significant changes. This is manifested in the changing policy framework governing the inflow of capital and technology. The policy changes in turn had its bearing on the number of collaborations, their nature (financial or equity), their distribution across industries, and above all in the accompanying terms and conditions. In this chapter we shall probe into some of these aspects of technology import in India against the backdrop of changing policy environment.

This chapter is organised into three sections. The first section deals with policy changes as regards foreign collaborations. In the second section we attempt an analysis of the trends and pattern of foreign collaboration in terms of number of collaborations, inter-industry pattern of collaboration, sources of origin and other related aspects. In the third section we examine the changing conditions of technology imports.

I

Technology Import Policy in India

In its quest for industrialisation and growth after independence, social equity and self-reliance also got adequate attention in India. This was sought to be achieved by a centrally planned economy where virtually everything was to be controlled by the state. The policies thus adopted emphasised on reducing external dependence through extensive import substitution in large number of products and technologies, regulation of large conglomerates, regulation of foreign equity participation and technological collaborations and a host of controls on foreign trade. As regards technology, specific policies were announced with a view to achieve technological self-reliance and building up the technological capability. In addition to technology policy statements the industrial policy statements made from time to time also sought to uphold the stated objectives. Many studies (for e.g. Subrahmanian, 1972 ; Singh, 1992; Kumar, 1990) have surveyed the policy regimes that prevailed. On the basis of government's approach towards foreign technology import, broadly four phases could be identified.

Phase I: Liberal Technology Import (till mid-sixties)

The Industrial Policy Resolution of 1948 recognised the importance of foreign capital and technology in the rapid industrialisation of the country. However, the conditions under which foreign capital could participate in Indian industry was carefully regulated in the national interest.[1]

As a rule, the major interest in ownership and effective control was expected to be in the Indian hands though provision was made for special cases in a manner calculated to serve the national interest. Foreign investment policy was further amplified in 1949. Foreign capital was recognised as an important supplement to domestic savings for the development of the country and for securing scientific, technical and industrial know-how. Foreign enterprise was assured of non-discriminatory treatment on par with domestic enterprise, facilities for the repatriation of profits and dividends as well as payment of fair compensation in the event of compulsory acquisition of industrial units by the State. Although the ownership and effective control of undertakings was to be in Indian hands, it was recognised that there could not be a hard and fast rule in this matter. Government would not object to foreign capital having control of a concern for a limited period if it was found to be in the national interest and each case was to be dealt individually, with its merits. The employment of foreign personnel to posts requiring technical expertise was permissible when nationals of requisite experience were not available, subject to the requirement that local personnel should be trained to facilitate indigenisation within a reasonable period.

The Industrial Policy Resolution, 1956 divided industries into three categories. Industries in Schedule A were those in which future development would be the exclusive responsibility of the State; industries in Schedule B were those in which the State would generally take the initiative in establishing new undertakings, but in which private enterprise would also be expected supplement the effort of the State. Third category, comprising all the remaining industries, were left to the initiative of the private sector. It was stressed at the same time

that the demarcation of the public and private sectors would be operated with flexibility to meet special situations.

Apart from the basic considerations relating to the sphere of foreign collaboration and the extent of foreign capital participation, the terms of technical collaboration have also to be approved by the government to ensure that these are not too onerous. Royalty rates were generally limited to a maximum of five per cent of net sales subject to tax, though higher royalty rates are agreed to when necessary, depending upon a number of factors like the essential nature of the item, the degree of sophistication of technology and export prospects. In cases of majority foreign capital participation lower royalty rates are generally prescribed. Distinction is made between royalty as such and payments for technical and other services rendered by the collaborators in respect of drawings, layout of plants, erection of machinery, purchase of goods, etc. The primary concern of the government in approving technical collaboration terms was the essentiality of such assistance and the reasonableness of the fees in relation to the foreign exchange expenditure involved. The government favoured capitalisation to technical collaboration payments in some cases as it helped avoiding immediate pressure on the balance of payments.

Phase II Controlled Imports (till the eighties)

In the late sixties and early seventies, to check industrial concentration, investment ceilings were set for big business houses through the Monopolies and Restrictive Trade Practices Act, 1969 (MRTP) and Industrial Policy Resolution, 1970. As the foreign exchange situation assumed crisis proportions in the late sixties and there were increased outflows on

account of foreign collaborations, the government began to take a restrictive stance on foreign collaboration. In particular, the enactment of Foreign Exchange Regulation Act (FERA), 1973 became the key to guiding and controlling investment inflows. Thus came into being the phase of tight regulation in the seventies. A highly restrictive and selective policy implemented by and administrative system based on discretionary power prevailed throughout the seventies. The FERA, (1973) which came into force on January 1, 1974 provided the regulatory framework regarding trading, commercial and industrial activities of the foreign companies in India. Also the Indian joint stock companies with non-resident participation of more than 40 per cent were subjected to regulation. Under section 29 of the Act, all companies incorporated outside India and Indian companies with more than 40 per cent non resident interest, had to obtain a fresh permission from the RBI to carry on business and were required to comply with the directions that might be given by the Reserve Bank on permissible level of foreign participation in the capital structure. Under the guidelines, companies engaged predominantly in the following activities were allowed to continue their operations in India, provided Indian share participation was raised to not less than 26 per cent within specified period:

1. in production of items specified in Appendix 1 of the Industrial Licensing policy, 1973 and where such turnover is not less than 75 per cent of the company's annual turnover, or
2. in export oriented items and where exports accounted for not less than 60 per cent of the total production, or
3. in production of items requiring sophisticated technology, or
4. in tea plantation activities.

Trading companies and companies engaged in other manufacturing activities were required to reduce non-resident participation to 40 per cent or less.

Phase III gradual liberalisation (1980's)

It has been argued that the restrictive regime has led to inefficiency (Lall 1985, and Lall 1987.) It has also been shown that the restrictiveness on payments imposed by the government policy have limited the size and scope of technology packages, effectively adjusting their price to one acceptable to suppliers of technology (Alam, 1985). Hence, in tune with the general trend towards policy reforms in the context of disenchantment with the regulatory regime, government began to liberalise the import of foreign capital and technology. These policy measures initiated in the eighties mostly followed from the Hussain Committee Report of 1984. The government adopted a multi-pronged strategy for promotion of exports including encouraging TNCs to undertake export oriented manufacturing. The eighties thus witnessed selective efforts to attract FDI and technology especially in high technology areas and export oriented activities. Many restrictions on large houses and FERA companies were removed signalling a less restrictive environment for private investment including, foreign investment. Following Alexander Committee report (1978) all items except those with explicit restrictions were allowed to import. Trade policies were lilberalised considerably in the case of capital goods imports. The reforms in the eighties were in a way the forerunner of the liberalisation policy of the nineties.

Phase IV. Period of Globalisation

As the economy slipped into serious external crisis at the beginning of the nineties, the government initiated comprehensive macro economic and structural adjustment policies with emphasis on further liberalisation and globalisation. This phase in India's foreign collaboration policy is characterised by transparency and 'openness' and is intended to seek increased foreign direct investment and inflow of advanced technologies. The degree of openness is seen in terms of the entry policy on (a) sectors open to FDI, (b) level of foreign equity participation and (c) transparency in approval procedures. The New Industrial Policy of 1991 explicitly stated that "foreign investment and technology collaboration will be welcomed to obtain higher technology, to increase exports and to expand the production base." (Government of India, 1991). In pursuit of this objective, the government decided to take initiatives of introducing changes in policies relating to foreign investment and foreign technology agreements. As a result, the industrial policy statement of 1991 has heralded an `open door' policy on foreign investment and technology transfer. Automatic approval for foreign investment up to 51 per cent equity in 34 industries were allowed subject to the condition that the dividend payments would be paid out of export earnings. This condition was dropped in 1992-93 except in the case of consumer goods industries. The existing companies with foreign equity were allowed to raise it to 51 per cent subject to certain prescribed guidelines. NRIs and Overseas Corporate Bodies (OCB) predominantly owned by them were permitted up to 100 per cent equity in high priority industries with repatriability of capital and income. Provisions of the Foreign Investment Regulation Act were liberalised and now companies with more than 40 per cent equity are also treated on par with fully Indian owned companies.

Foreign companies have been allowed to use their trade marks on domestic sales from 1992. The Foreign Investment Promotion Board (FIPB) was also set up to process applications in cases not covered by automatic approval. India signed the Multilateral Investment Guarantee Agency Protocol for the protection of foreign investment in 1992.

II

Trends in Foreign Collaborations

In a broad sense, technology could take either the embodied or disembodied form. While the former will get reflected in the import of capital goods, spares and raw materials, the latter will be manifested in technology licensing agreements. Another mode of technology import is through foreign direct investment, which may involve the import of both embodied and disembodied technology. Viewed thus, any study on technology import should give adequate attention to all the above mentioned forms of technology imports. To focus sharply on the issues in this study we shall deal mainly with disembodied technology imports (foreign collaborations) as reflected in the technology licensing agreements.

Table 2.1. *Annual average number of collaborations*

Phases	Period	All (A)	Financial(F)	(F as % of A)
1	1948-65	151	NA	NA
2	1966-79	239	40	16.73
3	1980-90	724	174	24.03
4	1991-96	1744	960	55.03

Source: estimated from Foreign Collaborations: a Compilation, *Department of Scientific and Industrial Research (DSIR)*, Various issues.

In tune with different phases of the policy regime, the annual approvals of foreign collaborations depict four distinct growth phases. The first phase until the mid- sixties is marked by sluggish growth. This was followed by the second phase of stagnation in growth until the end of the seventies. The third phase during the eighties (particularly since the mid eighties) witnessed gradual recovery in growth of number of collaborations. Finally, there is the ongoing fourth phase of rapid growth beginning from 1991. The annual approval of foreign collaboration averaged 151, 239, 724 and 1744 cases respectively during the four growth phases (see Table 2.1) What is remarkable is marked increase observed in the fourth phase when the restrictions are lifted almost entirely. Further, the proportion of cases involving financial collaboration in the total has increased from an annual average of 17 per cent in the second phase to 24 per cent in the third phase and further to 55 per cent in the fourth phase.

Inter-industry pattern

From Table 2.2, we can see that throughout the past two decades most of the collaborations were in three industries viz. chemical, electrical and electronics and industrial machinery. These three industries together accounted for about 50 per cent of the collaborations till 1991. This tends to indicate high concentration of foreign collaborations in the technology intensive industries. In the nineties, however, some changes in the patterns are discernible. While chemical industry maintained its share, the other two industries registered a decline in their shares. The decline was conspicuous in the case of industrial machinery, which registered a decline in absolute terms also. The remarkable feature of the sectoral pattern of foreign collaborations in the nineties is the

surge in the number of collaborations occurring in consultancy and other services. The average annual number of collaborations in this sector increased from 51 in the latter half of eighties forming 6 per cent, to 328 in the nineties forming 17 per cent of the total number of collaborations.

Table 2.2: *Sector wise distribution of foreign collaborations.*

Sectors	Annual average 1980-85	%	1986-91	%	1992-96	%
Alt/Ren. Energy Sources	5	0.76	3	0.33	12	0.62
Chemical	62	9.06	117	13.64	253	13.32
Electrical and Electronics	163	23.75	191	22.34	289	15.21
Industrial Machinery	145	21.13	143	16.74	111	5.84
Mechanical Engineering	86	12.56	92	10.76	164	8.65
Machine Tools	20	2.91	18	2.08	14	0.76
Metallurgical	31	4.52	44	5.16	81.8	4.31
Textile	7	1.02	13	1.56	47	2.48
Transport	31	4.49	41	4.81	83	4.39
Consultancy & other Ser.	10	1.40	51	5.93	328	17.26
Miscellaneous	108	15.74	153	17.91	516	27.17
Total	686	100	856	100	1898	100

Source: same as Table 2.1

Turning to collaborations involving foreign equity, it is found that four sectors, namely, chemical, electrical and electronics, industrial machinery and mechanical engineering accounted for the highest shares of financial collaborations till the nineties (see Table 2.3). In the nineties, consultancy and other services registered phenomenal growth in the number of collaborations. It rose from a mere 2 in 1987 to 352 in 1995 and 458 in 1996. For the corresponding periods their share in total number of financial collaborations was 0.77, 26 and 29 respectively.

Table 2.3: *Sector wise distribution of financial collaborations.*

Sectors	1987	1988	1990	1995	1996
Alternate/Renewable Energy Sources	1 (0.39)	3 (1.07)	1 (0.50)	9 (0.66)	10 (0.64)
Chemical	36 (13.9)	45 (16.07)	18 (8.96)	100 (7.38)	158 (10.16)
Electrical and Electronics	62 (23.94)	74 (26.43)	39 (19.40)	255 (18.82)	225 (14.47)
Industrial Machinery	30 (11.58)	26 (9.29)	22 (10.95)	42 (3.10)	74 (4.76)
Mechanical Engineering	16 (6.18)	17 (6.07)	21 (10.45)	93 (6.86)	97 (6.24)
Machine Tools	8 (3.09)	4 (1.43)	1 (0.50)	6 (0.44)	16 (1.03)
Metallurgical	7 (2.70)	14 (5)	4 (1.99)	35 (2.58)	56 (3.60)
Textile	7 (2.70)	10 (3.57)	3 (1.49)	23 (1.70)	52 (3.34)
Transport	6 (2.32)	10 (3.57)	8 (3.98)	22 (1.62)	67 (4.31)
Consultancy and other Services	2 (0.77)	8 (2.86)	40 (19.9)	352 (25.98)	458 (29.45)
Miscellaneous	84 (32.43)	78 (27.86)	44 (21.89)	418 (30.85)	342 (21.99)
Total	259 (100)	280 (100)	201 (100)	1355 (100)	1555 (100)

Source: same as Table 2.1
Notes: Figures in parentheses show percentage

Trends in Lump sum payments

High cost of technology import has been found by a number of studies (Kumar 1985, Subrahmannian 1986). Subrahmanian found that the costs are generally the highest for the foreign subsidiaries followed by firms with minority equity stake and the lowest for those firms relying on technology licensing. We shall examine the trend in one of the major items of cost viz. lump sum payments.

Table 2.4: *Sector wise lump sum payments approval (US $ million).*

Sectors	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	growth rate*
Alt./Ren Energy	-	7	6	69	383	84	21	146	34	525	62.50
Chemical	935	2285	5053	15237	11579	38193	23770	29740	38710	31537	30.02
Elect.& Electronics	630	4333	2656	3667	13119	16420	8841	11503	7711	8645	7.15
Ind. Machinery	854	2003	2611	3695	10224	1602	4538	16141	5273	16311	23.33
Mech. Engineering	409	1823	1100	1959	2008	4027	3103	3326	7069	4419	9.25
Machine Tools	90	31	245	940	591	492	882	1105	599	357	27.55
Metallurgical	273	1174	353	1046	4488	5403	6659	6015	35519	18586	31.81
Textile	1014	212	202	980	3923	311	161	1172	234	318	4.17
Transport	305	849	1330	819	1790	1651	1384	1621	1282	2898	13.07
Cons.& other Serv.	-	153	233	49	695	-	439	1058	5297	7913	48.39
Miscellaneous	400	813	1936	5682	6903	5965	4389	9417	11628	8967	27.14
Total	4912	13682	15725	34142	55704	74148	54186	81244	113354	100475	22.06

*compound growth rate cont'd.

Source: *DSIR.*

Table 2.4. Concld.

Sectors	1991	1992	1993	1994	1995	Growth rate*
Alt./Ren. Ene. Source.	-	630	987	577	2457	40.5
Chemical	97923	242832	861226	307232	1570263	74.2
Electrical and Electronics	26753	59247	35154	56913	148904	41.0
Industrial Machinery	20522	61805	8543	15113	45109	17.1
Mechanical Engineering	9947	20897	14329	13940	17630	12.1
Machine Tools	1275	1734	619	1371	9266	48.7
Metallurgical	21459	19977	102812	75659	279854	67.1
Textile	2428	40498	53646	46967	38836	74.1
Transport	14054	8385	23281	109123	95019	46.6
Consltsy. & other Services	8926	62920	30674	11565	35840	32.1
Miscellaneous	19025	72394	29013	83126	90448	36.6
Total	222311	591319	1160286	721585	2333626	60.0

Trends in the lump sum payments (recall that it is only approvals) across different industries is presented in Table 2.4. It is evident that there has been a phenomenal increase in the lump sum payments across all the industries. The total lump sum payments during 1980's recorded a growth rate of 31 per cent, which increased to 36 per

cent during 1991-96. The higher growth however, was not uniformly distributed across industries. While the rate of growth of most industries increased during the 90's as compared to 80's that of industrial machinery declined. In Chemicals, the observed rate of growth more than doubled to reach 74 per cent during the 1990's. In the case of electrical and electronics, the increase in growth rate during the 1990's was still higher.

Country wise variation

The country wise break-up of foreign collaborations (see Table 2.5) showed a remarkable concentration till 1991. The USA, UK and Germany accounted for almost two- thirds of the total number of collaborations till 1991. In the subsequent period their share has come down by almost ten percentage points. The share of other countries showed a striking increase in the post liberalisation period. This points towards the diversification of collaboration sources after liberalisation.

In terms of the distribution of financial collaboration across countries it is observed that USA continued to be the top collaborator in all these years although its share declined over the years. Other leading collaborators are Germany and United Kingdom. Nineties saw the emergence of new sources of financial collaboration especially from South East Asia and tax haven countries like Mauritius. Mauritius accounted for 7 per cent of financial collaborations with 109 collaborations in 1996. South Korea is the leading collaborator from South East Asia.

Table 2.5: *Country wise distribution foreign collaboration*

Country	Annual average					
	1980-85	%	1986-91	%	1992-96	%
USA	140.2	20.43	178.83	20.88	389.4	20.51
Germany	126.4	18.42	157.17	18.35	220.8	11.63
UK	115.2	16.78	121.83	14.22	192.4	10.13
Japan	65	9.47	80.5	9.40	127.4	6.712
Italy	36.2	5.27	53.33	6.22	86.4	4.552
Switzerland	37.4	5.45	37.5	4.37	70.4	3.709
France	38.4	5.59	38.83	4.53	66	3.477
Netherlands	13.4	1.95	23.66	2.76	93.8	4.94
Sweden	17.4	2.53	21.33	2.49	21.8	1.148
Others	96.6	14.07	143.33	16.73	629.6	33.17
Total	686.2	100	856.33	100	1898	100

Source: same as Table 2.1

From the above discussion it may be inferred that the foreign collaboration in India recorded an unprecedented increase as a result of liberalised policies. Also the proportion of foreign collaborations involving foreign equity has increased. Along with an unprecedented growth in the number of foreign collaborations, there has been a phenomenal increase in the lump sum payments. While the observed increase has been across the board, there are a few industries, which accounted for the bulk of the foreign collaborations and lump sum payments. These industries are electrical and electronics and chemicals. It is also found that the role of different countries as exporters of technology to India has undergone some change with decline in the share of Germany and UK. Nevertheless, USA, Germany and UK continue to be the major exporters of technology to India.

Table2.6: *Country wise distribution of financial collaborations*

Country	1987	1988	1990	1995	1996
USA	74	75	44	280	282
	(28.57)	(25.95)	(21.89)	(20.66)	(18.14)
Germany	42	50	41	133	146
	(16.22)	(17.30)	(20.40)	(9.82)	(9.39)
UK	26	42	23	107	127
	(10.04)	(14.53)	(11.44)	(7.90)	(8.17)
Japan	17	16	9	42	77
	(6.56)	(5.54)	(4.48)	(3.10)	4.95)
Italy	13	21	15	44	45
	(5.02	(7.27)	(7.46	(3.25	(2.89)
Switzerland	12	12	8	49	44
	(4.63)	(4.15	(3.98)	(3.62)	(2.83
France	10	13	13	32	60
	(3.86)	(4.50)	(6.47)	(2.36)	(3.86)
Netherlands	7	4	4	89	71
	(2.70)	(1.38)	(1.99)	(6.57)	(4.57)
Sweden	5	2	3	9	14
	(.93)	(0.69)	(1.49)	(0.66)	(0.90)
Mauritius	NA	NA	NA	66	109
				(4.87)	(7.01)
South	4	4	5	37	46
Korea	(1.54)	(1.38)	(2.49)	(2.73)	(2.96)
Singapore	3	8	1	55	58
	(1.16)	(2.77)	(0.50)	(4.06)	(3.73)
NRI	6	4	2	111	156
	(2.32)	(1.38)	(1.00)	(8.19)	(10.03)
Others	40	38	33	301	320
	(15.44)	(13.15)	(16.42)	(22.21)	(20.58)
Total	259	289	201	1355	1555
	(100)	(100)	(100)	(100)	(100)

Source: same as Table 2.1
Figures in parentheses show percentage

Having dealt with the broad trends and patterns it is important to examine whether there has been any major change in the terms and conditions governing technology imports to India. It is to this question that we turn now.

III

Changing terms and conditions of technology imports.

Our analysis in this section focuses on three major industries viz. Chemical, electrical and electronics, and industrial machinery. These industries are selected on the ground that they together account for about 50 per cent of the total number of collaborations.

Some hypotheses[ii]

The payment for technology import is usually made in the form of lump sum (this includes, transfer cost[iii], technical fee, documentation fee, cost of training if any) and or royalties. The lump sum payment is usually made at the time of collaboration. In this case the seller of technology is assured of the reward regardless of the resultant economic viability of production and level of sales. Accordingly, it may be argued that most of the risk is borne by the buyer. [iv] This argument, however, may not hold in cases where the lump sum is made in two or three instalment. In cases involving the transfer of only design and drawing, payment is mostly made in terms of lump sum.

Royalty is linked to the sales, usually a certain percentage of the sales. The royalty rates will vary from case to case and differential rate may be charged for export and domestic sales. Unlike the case wherein the payment is made in terms of lump sum, in cases with royalty, the risk is shared by both the foreign and local firms because royalty is based on sales realisation. Hence a case where the local firm has succeeded in making the foreign firm to share the risk at a lower rate of royalty may be taken to indicate the highest bargaining power of the technology buyer. Viewed in the same logic, incidence of cases

with both lump sum and royalty may tend to indicate lower bargaining power, which would raise the cost of technology imports.

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Apart from risk sharing, the cost of technology also figures in ... s of importing firms. By incorporating the cost of technology in to the cost function of the firm one could show that if the technology is bought by paying only technical fee it may not have any effect on the short run price and output decisions of the firms in monopoly and competitive market (Katrak, 1988). This is because technical fee (lump sum) affects the fixed cost and not the variable cost. But the impact of royalty could be different: In the case of a competitive firm it could lead to a decline in the output where as in monopoly, in addition to the reduction in output, it could also lead to an increase in the price depending on the elasticity of demand for the product. Under these conditions, one could show that the profit maximization by the technology importing firm requires that technology import involves only the technical fee and no royalty.

Now consider the technology seller's calculus: Assuming that the possession of an innovation and patent provides the seller with certain monopoly power, the seller would like to charge the highest possible price to maximize his profit. Given the fact that marginal cost curve of the seller could be constant[v] i.e. a straight line, s/he could equate marginal cost with marginal revenue and charge a price according to the demand curve. Here arises the possibility of price discrimination between early buyers and late buyers. Late buyers may get the technology under the following conditions, P=MC=MR. This is because of the increased threat of imitation and also that since the patent life is getting

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older the seller would be better off even if the technology is sold at the marginal cost (Bidault, 1989)

Having set the price, the seller has to decide on the mode of its extraction; in terms of royalty, lump sum, or a combination of both [vi]. In reality, there are limits set by different factors which in most circumstances would force the sellers to adopt different combinations of the two components of price to different buyers (some kind of price discrimination) in such a way as to maximize his return. What are the different possible combinations? We shall present them as follows:

Strategy 1	**Strategy 2**	**Strategy 3**
R only	TF only	Both R & TF
High R	High TF	High R & High TF
Med R	Med TF	High R & Low TF
Low R	Low TF	and so on

Note: R = Royalty, TF = Technical fee. Empirically high may mean the highest Rate allowed by the policy or more than the industry average. Medium may be the industry average rate and low may be less than the industry average

What are the financial implications of each of these choices? And what are the conditions under which the seller prefers the one to the other? An understanding of this would throw some light into the possible ultimate choice that the seller would adopt under different conditions. This may also help formulating some empirically viable hypotheses.

Cases with only royalty

This implies that the seller is ready to take the risk. What are the conditions under which the seller would take the risk?

a. If the buyer is a large firm with market power so that he could pass the high cost (on account of royalty) to the market. Also he may have a good past performance record so that the seller is assured of a good return in terms of royalty.

b. If the seller has a control over the buyer in terms of decision making, may be through equity participation. It will minimize the risk of shirking

Having decided to charge only royalty, the extent of royalty may depend on the nature of technology and patent life. Older the patent, lower the royalty, newer the patent, higher the royalty.

Only technical fees

This means that the seller is not ready to take any risk. The possible reasons could be;

a the buyer has the technological capability to take care of future problems without continued support.

c. Also when technology is either not patented or in the fag end of the patent life.

d. It is also possible that the buyer has substantial technological capability and what is imported is only the design and drawing for which only technical fee is to be paid.

Royalty and technical fee

The prime issue is how the decision on this combination is made. To answer this question one needs to consider how both the buyers and sellers perceive the risk involved in the deal. Tentatively one could argue that to maximize the profit the seller would demand the highest possible royalty and to minimize the risk he would demand the highest possible lump um (Contractor, 1985). Here it is important to note that conditions under which the buyers' profit is maximized is the polar opposite of the sellers' profit maximization. However, whether the seller would be ready for certain relaxation or otherwise depends on

a. The market power of the buyer. i.e. if the seller perceives that the buyer has a fairly large market and there would be substantially large sale proceeds then s/he may settle on a low technology fee and low royalty.

b. The brand name of the seller or the market power of the seller.

c. The nature of technology. Here one refers to two aspects like the availability of substitutes and the age of the patent possessed by the firm.

Now let us visualize the possible scenarios:

i Technology with new patents and no substitutes. Here the seller may charge both the highest permissible royalty and maximum permissible technical fee even if the buyer is a large firm. In fact the technology may be sold only to the large firms and small ones may not get it at all.

ii Technology with old patents and no substitutes. Here the seller may behave as in (a) above provided the buyer is a big firm and may even part with the technology to the small firms but conditions may be like in (i) above.

iii The price will more or less be the same if there are substitutes even if the technology is patented or not.

Neither Royalty nor Lump sum

Cases involving neither type of payment tend to suggest that payments are not made in the form of either royalty or lump sum. Such cases could arise in the context where the foreign firm has substantial control and that its returns could be ensured through other means like dividends, or through the imports. Such a trend has the possibility of the increasing incidence of transfer pricing observed in the earlier studies on the import of capital and technology (Subrahmanian, 1972).

While all the above hypotheses are worthy of empirical verification, it is beyond the scope of the present study. Nevertheless we shall try to examine some of them by looking at the broad trends as reflected in the different combinations of royalty and lump sum across different industries under study.

The Broad Trends

Table 2.7 shows four different types of technology payments agreed upon by the Indian firms. An important question that needs to be looked into is whether there is any

discernible change in the conditions of technology import during the different policy regimes.

Table-2.7: *Technology import conditions: Three industries.*

Year	Only Lump sum	Only Royalty	Both	None	Total
1982	134	25	102	20	281
	(47.69)	(8.90)	(36.30)	(7.12)	(100)
1983	151	51	136	24	362
	(41.71)	(14.09)	(37.57)	(6.63)	(100)
1985	239	68	243	30	580
	(41.21)	(11.72)	(41.90)	(5.17)	(100)
1987	211	60	226	33	530
	(39.81)	(11.32)	(42.64)	(6.23)	(100)
1988	224	68	216	41	549
	(40.80)	(12.39)	(39.34)	(7.47)	(100)
1990	171	41	142	27	381
	(44.88)	(10.76)	(37.27)	(7.09)	(100)
1991	191	84	191	37	503
	(37.97)	(16.70)	(37.97)	(7.36)	(100)
1995	243	74	198	298	813
	(29.89)	(9.10)	(24.35)	(36.65)	(100)
1996	171	90	143	351	755
	(22.65)	(11.92)	(18.94)	(46.49)	(100)

Source: *Department of Scientific and Industrial Research* (DSIR)
Figures in parentheses show percentage.

It appears that during the 1980's the dominant form of technology import was the outright purchase of technology with only lump sum payments followed by both royalty and lump sum. The cases with only royalty were limited. This is in tune with the policy followed during the controlled regime aiming at reduced outflow on account of technology imports. Studies have shown that government's restrictive policies have been successful in containing the outflow of resources on account of technology imports (Subrahmanian 1986 and Kumar 1990). It is interesting to note that there has not been any major change during the early liberalisation phase (1985-90) as regards the conditions of technology imports.

With the initiation of further liberalisation in the nineties and greater emphasis on globalisation, there appears to be a marked change in the terms of technology imports. To begin with, it is found that the proportion of cases involving neither royalty nor lump sum has increased from less than 10 per cent in the pre ninety period to more than 35 per cent in the years 1995 and 1996. This could probably be seen in the context of increasing incidents of foreign equity participation (both minority and majority) which enables the foreign partner to repatriate the return for technology in forms other than royalty and lump sum.

Secondly, there appears to be a decline in the cases involving both royalty and lump sum. Both royalty and lump sum imply that total cost of technology would be higher. This in turn could push up the cost and price with its adverse implications on the firm's competitiveness. However, if the firm is a price maker it could pass on the higher cost to the consumers in the form of higher prices. At the same time, if both royalty and lump sum are involved, the technology importer is assured of the continued support from the exporting firm. Such a support will be of importance to firms with low technological capability. Hence the incidence of the higher proportion of cases involving both royalty and lump sum in the 80's tend to suggest the behavior of firms with low technological capability and high market power on account of the protected market. And the decline in the proportion of cases with both royalty and lump sum in the 90's tend to suggest that with increasing competition firms are not in a position to pass the high cost of production to the consumers.

Thirdly, we also observe that the proportion of cases with only lump sum payments has significantly come down during the post 1991 period. Finally, the cases involving only royalty has not shown any increase, notwithstanding, the fact that the firms are free to set the terms in accordance with their commercial viability. This tend to suggest that firms are forced to minimise the incidence of royalty in the face of the direct bearing of royalty on cost and price and increasing competition.

Our discussion so far has been focused on all the three industries put together. Hence one is tempted to probe into the inter-industry pattern. The terms and conditions of the industries selected for the analysis is given in tables 2.8, 2.9 and 2.10. It is evident from these tables that the pattern observed in all the three industries is comparable.

Table-2.8: *Technology import condition: Chemical industry.*

Year	Only Lump sum	Only Royalty	Both	None	Total
1982	33	6	10	3	52
	(63.46)	(11.54)	(19.23)	(5.77)	(100)
1983	51	9	10	2	72
	(70.83)	(12.50)	(13.89)	(2.78)	(100)
1985	31	6	27	2	66
	(46.97)	(9.09)	(40.91)	(3.03)	(100)
1987	82	10	35	11	138
	(59.42)	(7.25)	(25.36)	(7.97)	(100)
1988	74	16	36	10	136
	(54.41)	(11.76)	(26.47)	(7.35)	(100)
1990	48	5	19	4	76
	(63.16)	(6.58)	(25.00)	(5.26)	(100)
1991	74	13	35	14	136
	(54.41)	(9.56)	(25.74)	(10.29)	(100)
1995	138	18	46	68	270
	(51.11)	(6.67)	(17.04)	(25.19)	(100)
1996	96	41	39	125	301
	(31.89)	(13.62)	(12.96)	(41.53)	(100)

Source: same as Table 2.7
Figures in parentheses show percentages.

Table-2.9 :*Technology import conditions: Electrical and Electronics industry*

Year	Only Lump sum	Only Royalty	Both	None	Total
1982	52	6	61	8	127
	(40.94)	(4.72)	(48.03)	(96.30)	(100)
1983	43	17	70	17	147
	(29.25)	(11.56)	(47.62)	(11.56)	(100)
1985	99	36	140	24	299
	(33.11)	(12.04)	(46.82)	(8.03)	(100)
1987	72	22	117	16	227
	(31.72)	(9.69)	(51.54)	(7.05)	(100)
1988	81	25	112	25	243
	(33.33)	(10.29)	(46.09)	(10.29)	(100)
1990	63	14	53	16	146
	(43.15)	(9.59)	(36.30)	(10.96)	(100)
1991	53	21	88	13	175
	(30.29)	(12.00)	(50.29)	(7.43)	(100)
1995	90	33	110	197	430
	(20.93)	(7.67)	(25.58)	(45.81)	(100)
1996	50	27	71	177	325
	(15.38)	(8.31)	(21.85)	(54.46)	(100)

Source: same as Table 2.7
Figures in parentheses show percentages

Table 2-10: *Technology import conditions: Industrial machinery.*

Year	Only Lump sum	Only Royalty	Both	None	Total
1982	49	13	31	9	102
	(48.04)	(12.75)	(30.39)	(8.82)	(100)
1983	57	25	56	5	143
	(39.86)	(17.48)	(39.16)	(3.50)	(100)
1985	109	6	76	4	195
	(55.90)	(3.08)	(38.97)	(2.05)	(100)
1987	57	28	74	6	165
	(34.55)	(16.97)	(44.85)	(3.64)	(100)
1988	69	27	68	6	170
	(40.59)	(15.88)	(40.00)	(3.53)	(100)
1990	60	22	70	7	159
	(37.74)	(13.84)	(44.03)	(4.40)	(100)
1991	64	50	68	10	192
	(33.33)	(26.04)	(35.42)	(5.21)	(100)
1995	15	23	42	33	113
	(13.27)	(20.35)	(37.17)	(29.20)	(100)
1996	25	22	33	49	129
	(19.38)	(17.05)	(25.58)	(37.98)	(100)

Source: same as Table 2.7
Figures in second rows show percentages

Terms across Countries.

The next relevant question to ask is if there exists any association between the terms and conditions and the country from which technology is being imported. To answer this question the terms and conditions of technology transfer is examined with respect to different countries. (see Tables 2.11- 2.13) As regards US, UK and German collaborations, it is found that the proportion of cases with only lump sum payments is found to be higher than the average implying that the proportion of cases with only royalty in lower. It is also found that most of the countries seem to have a preference for collaborations with neither royalty nor lump sum during 1995-96. More over, the proportion of cases with only lump sum and both royalty and lump sum showed a declining trend in all the countries. Technology import conditions of countries other than USA, UK and Germany are presented in Table 2.14. During 1995-96 these countries also showed a preference for collaborations with neither lump sum nor royalty. This points to the diversification of the sources of financial collaboration in the post nineties.

Table 2.11: *Technology import conditions : Collaboration with USA*

Year	Only Lump sum	Only Royalty	Both	None	Total
1982	22	8	19	6	55
	(40)	(14.55)	(34.55)	(10.91)	(100)
1983	26	14	30	13	83
	(31.33)	(16.87)	(36.14)	(15.66)	(100)
1985	58	12	59	15	144
	(40.28)	(8.33)	(40.97)	(10.42)	(100)
1987	43	16	67	10	136
	(31.62)	(11.76)	(49.26)	(7.35)	(100)
1988	52	23	42	13	130
	(40)	(17.69)	(32.31)	(10)	(100)
1990	30	9	34	5	78
	(38.46)	(11.54)	(43.59)	(6.41)	(100)
1991	43	15	39	5	102
	(42.16)	(14.71)	(38.24)	(4.90)	(100)
1995	61	11	43	79	194
	(31.44)	(5.67)	(22.16)	(40.72)	(100)
1996	39	26	26	74	165
	(23.64)	(15.76)	(15.76)	(44.85)	(100)

Source: same as Table 2.7
Figures in parentheses show percentages

Table 2.12: *Technology import condition: Collaboration UK*

Year	Only Lump sum	Only Royaly	Both	None	Total
1982	23	4	24	1	52
	(44.23)	(7.69)	(46.15)	(1.92)	(100)
1983	17	12	25	3	57
	(29.82)	(21.05)	(43.86)	(5.26)	(100)
1985	32	12	34	3	81
	(39.51)	(14.81)	(41.98)	(3.70)	(100)
1987	31	7	30	7	75
	(41.33)	(9.33)	(40.00)	(9.33)	(100)
1988	23	16	32	5	76
	(30.26)	(21.05)	(42.11)	(6.58)	(100)
1990	31	10	14	3	58
	(53.45)	(17.24)	(24.14)	(5.17)	(100)
1991	30	10	28	3	71
	(42.25)	(14.08)	(39.44)	(4.23)	(100)
1995	18	11	15	17	61
	(29.51)	(18.03)	(24.59)	(27.87)	(100)
1996	10	6	8	27	51
	19.61	11.76	15.69	52.94	100

Source: same as Table 2.7
Figures in parentheses show percentage

Table 2.13: *Technology import conditions: Germany*

Year	Only lump sum	Only royalty	Both	None	Total
1982	25	6	19	1	51
	(49.02)	(11.76)	(37.25)	(1.96)	(100)
1983	35	11	24	2	72
	(48.61)	(15.28)	(33.33)	(2.78)	(100)
1985	62	16	26	1	105
	(59.05)	(15.24)	(24.76)	(0.95)	(100)
1987	26	17	42	5	90
	(28.89)	(18.89)	(46.67)	(5.56)	(100)
1988	42	10	39	9	100
	(42)	(10)	(39)	(9)	(100)
1990	29	12	28	6	75
	(38.67)	(16)	(37.33)	(8)	(100)
1991	34	17	33	0	84
	(40.48)	(20.24)	(39.29)	(0)	(100)
1995	21	14	25	32	92
	(22.83)	(15.22)	(27.17)	(34.78)	(100)
1996	18	25	19	45	107
	(16.82)	(23.36)	(17.76)	(42.06)	(100)

Source: same as Table 2.7
Figures in parentheses show percentages

Table 2.14: *Technology import conditions: Other countries*

	Only lump sum	Only lump sum	Both	None	Total
1982	32	7	24	7	70
	(45.71)	(10)	(34.29)	(10)	(100)
1983	42	10	30	4	86
	(48.84)	(11.63)	(34.88)	(4.65)	(100)
1985	49	21	60	7	137
	(35.77)	(15.33)	(43.80)	(5.11)	(100)
1987	60	14	46	5	125
	(48)	(11.2)	(36.8)	(4)	(100)
1988	53	9	53	9	124
	(42.74)	(7.26)	(42.74)	(7.26)	(100)
1990	49	7	35	6	97
	(50.52)	(7.22)	(36.08)	(6.19)	(100)
1991	53	26	58	19	156
	33.97	16.67	37.18	12.18	100
1995	93	23	52	146	314
	29.62	7.32	16.56	46.50	100
1996	64	15	54	158	291
	21.99	5.15	18.56	54.30	100

Source: same as Table 2.7
Figures in parentheses show percentages

Trends in lump sum payments

As we have already seen the total lump sum payments recorded an annual growth rate of 36 per cent in the nineties. Now let us examine the size distribution of lump sum payments with a view to understand whether the increase that we have observed is on account of the increasing incidence of collaboration or on account of collaborations involving higher amount of lump sum. It may be noted that we do not have access to information regarding the amount of lump sum payments during the post 1991 period. Hence the analysis is confined up to 1991.

Table 2.15 :*Lump sum payments: Three industries. (US $ lakhs)*

Year	<2	2-5	5-10	>10	Total
1982	167	33	16	20	236
	(70.76)	(13.98)	(6.78)	(8.47)	(100)
1983	203	47	14	24	288
	(70.49)	(16.32)	(4.86)	(8.33)	(100)
1985	343	80	31	28	482
	(71.16)	(16.60)	(6.43)	(5.81)	(100)
1987	261	92	41	45	439
	(59.45)	(20.96)	(9.34)	(10.25)	(100)
1988	254	98	38	50	440
	(57.73)	(22.27)	(8.64)	(11.36)	(100)
1990	196	61	31	26	314
	(62.42)	(19.43)	(9.87)	(8.28)	(100)
1991	225	86	26	46	383
	(58.75)	(22.45)	(6.79)	(12.01)	(100)

Source: same as Table 2.7
Notes :Figures in parentheses show percentages

Table 2.16: *Lump sum payments : chemical industry. (US $ lakhs)*

Year	<2	2-5	5-10	>10	Total
1982	22	8	6	7	43
	(51.16)	(18.60)	(13.95)	(16.28)	(100)
1983	34	13	1	13	61
	(55.74)	(21.31)	(1.64)	(21.31)	(100)
1985	26	11	10	11	58
	(44.83)	(18.97)	(17.24)	(18.97)	(100)
1987	43	21	20	35	119
	(36.13)	(17.65)	(16.81)	(29.41)	(100)
1988	35	26	18	31	110
	(31.82)	(23.64)	(16.36)	(28.18)	(100)
1990	23	15	11	18	67
	(34.33)	(22.39)	(16.42)	(26.87)	(100)
1991	47	16	13	34	110
	(42.73)	(14.55)	(11.82)	(30.91)	(100)

Source: same as Table 2.7
Notes: Figures in parentheses show percentages

Table2.17: *Lump sum payments: Electrical and Electronics(US $ lakhs)*

Year	<2	2-5	5-10	>10	Total
1982	81	16	6	10	113
	(71.68)	(14.16)	(5.31)	(8.85)	(100)
1983	80	20	6	8	114
	(70.18)	(17.54)	(5.26)	(7.02)	(100)
1985	164	51	17	7	239
	(68.62)	(21.34)	(7.11)	(2.93)	(100)
1987	120	46	16	7	189
	(63.49)	(24.34)	(8.47)	(3.70)	(100)
1988	111	55	16	11	193
	(57.51)	(28.50)	(8.29)	(5.70)	(100)
1990	79	22	13	2	116
	68.10	(18.97)	(11.21)	(1.72)	(100)
1991	84	44	8	5	141
	(59.57)	(31.21)	(5.67)	(3.55)	(100)

Source: same as Table 2.7

Notes : Figures in parentheses show percentages

Table2.18: *Lump sum payments: Industrial Machinery. (US $ lakhs)*

Year	<2	2-5	5-10	>10	Total
1982	64	9	4	3	80
	(80)	(11.25)	(5)	(3.75)	(100)
1983	89	14	7	3	113
	(78.76)	(12.39)	(6.19)	(2.65)	(100)
1985	153	18	4	10	185
	(82.70)	(9.73)	(2.16)	(5.41)	(100)
1987	98	25	5	3	131
	(74.81)	(19.08)	(3.82)	(2.29)	(100)
1988	108	17	4	8	137
	(78.83)	(12.41)	(2.92)	(5.84)	(100)
1990	94	24	7	6	131
	(71.76)	(18.32)	(5.34)	(4.58)	(100)
1991	94	26	5	7	132
	(71.21)	(19.70)	(3.79)	(5.30)	(100)

Source: same as Table 2.7

Notes: Figures in parentheses show percentages

To begin with, it may be noted that the proportion of cases with lump sum less than $2 lakhs has shown a declining trend. Their share has declined from about 70 per cent in 1981 to about 62 per cent in 1991. (see Table 2.15) The 8 per cent point decline has been mostly compensated by the cases with higher lump sum payments. The increase appears to be more pronounced in the cases involving equity range of two to five lakhs dollars. An examination of this aspect across different industries showed that the above pattern. While the decline in the lowest size class is found in all the industries, the increase was mostly confined to second size category for the electrical & electronics and the increase in the more than $ 10 appeared to be more pronounced in the chemical industry. (see Tables 2.16- 2.18.)

An examination of lump sum payment per collaboration across three industries however, has shown that while the chemical industry recorded a four fold increase, electrical machinery and electronics marked a declining trend in the average lump sum payment. (see Table 2.19)

Table 2.19 *Average lump sum payments (US $ lakhs)*

Year	All Industries	Chemical	Electrical Machinery	Electronics
1982	5.99	5.64	5.47	6.9
1983	3.54	7.12	3.13	2.01
1985	4.17	11.47	2.99	3.4
1987	4.1	9.28	2.35	1.99
1988	7.49	13.67	2.9	8.89
1990	5.07	14.46	2.38	2.63
1991	8.6	21.84	3.69	2.93

Source: same as 2.7

Trends in royalty rate.

Has liberalisation induced the firms to fix royalty rate at a higher level? The available evidence tend to suggest that there has not been any change in the pattern of royalty rates (see Table 2.20). This has to be seen in the context of increasing cost price consideration among the Indian firms. This in turn has to be seen as a result of the increased competition and decline in the extent of protection enjoyed by the Indian firms. An examination of this aspect across the three different industries also does not indicate any change (see Tables 2.21- 2.25.)

Table 2.20:*Royalty rates : Three industries*

	<2	2-5	>5	Total
1982	5	63	59	127
	(3.94)	(49.61)	(46.46)	(100)
1983	7	75	93	175
	(4)	(42.86)	(53.14)	(100)
1985	6	117	188	311
	(1.93)	(37.62)	(60.45)	(100)
1987	14	115	157	286
	(4.90)	(40.21)	(54.90)	(100)
1988	11	121	152	284
	(3.87)	(42.61)	(53.52)	(100)
1990	7	75	101	183
	(3.83)	(40.98)	(55.19)	(100)
1991	8	102	165	275
	(2.91)	(37.09)	(60)	(100)

Source: same as 2.7
Figures in parentheses show percentages

Table 2.21: *Royalty rates: Chemical industry*

	<2	2-5	>5	Total
1982	1	10	5	16
	(6.25)	(62.5)	(31.25)	(100)
1983	2	11	5	18
	(11.11)	(61.11)	(27.78)	(100)
1985	0	18	15	33
	0	54.55	45.45	100
1987	8	23	14	45
	(17.78)	(51.11)	(31.11)	(100)
1988	3	32	17	52
	(5.77)	(61.54)	(32.69)	(100)
1990	0	17	7	24
	(0)	(70.83)	(29.17)	(100)
1991	5	34	9	48
	(10.42)	(70.83)	(18.75)	(100)

Source: same as 2.7

Notes: Figures in parentheses show percentage

Table 2.22: *Royalty rates: Electrical and Electronic industry*

	<2	2-5	>5	Total
1982	4	38	25	67
	(5.97)	(56.72)	(37.31)	(100)
1983	4	43	29	76
	(5.26)	(56.58)	(38.16)	(100)
1985	4	72	100	176
	(2.27)	(40.91)	(56.82)	(100)
1987	5	58	76	139
	(3.60)	(41.73)	(54.68)	(100)
1988	8	65	64	137
	(5.84)	(47.45)	(46.72)	(100)
1990	3	27	37	67
	(4.48)	(40.30)	(55.22)	(100)
1991	2	39	68	109
	(1.83)	(35.78)	(62.39)	(100)

Source: same as 2.7

Notes: Figures in parentheses shows percentages

Table 2.23: *Royalty rates: Industrial machinery*

	<2	2-5	>5	Total
1982	0	15	29	44
	(0)	(34.09)	(65.91)	(100)
1983	1	21	59	81
	(1.23)	(25.93)	(72.84)	(100)
1985	2	27	73	102
	(1.96)	(26.47)	(71.57)	(100)
1987	1	34	67	102
	(0.98)	(33.33)	(65.69)	(100)
1988	0	24	71	95
	(0)	(25.26)	(74.74)	(100)
1990	4	31	57	92
	(4.35)	(33.70)	(61.96)	(100)
1991	1	29	88	118
	(0.85)	(24.58)	(74.58)	(100)

Source: same as 2.7
Notes: Figures in parentheses shows percentages

Conclusion

Viewed in a historical perspective, one could identify four phases in the evolution of the policy towards foreign collaboration in India. The first phase covering the period up to mid 1960's was marked by a relatively liberal approach towards foreign collaboration. The second phase (up to early 1980s) was marked by restrictive policy environment with the objective of technological self-reliance. During the third phase (1980's) there has been a series of efforts towards relaxing the series of restrictions introduced in the second phase. The final phase (1990's) is marked by liberalisation with emphasis on greater integration with the rest of the world, implying that the foreign collaborations are guided more by market forces. The behaviour of trends and patterns in foreign collaborations as well as the terms of technology import were found to be governed by the policy changes.

It was found that the foreign collaborations recorded an unprecedented increase as a result of liberalised policies. Also the proportion of foreign collaborations involving foreign equity has also increased. Along with an unprecedented growth in the number of foreign collaborations, there has been a phenomenal increase in the lump sum payments. While the observed increase has been across the board, there are a few industries that accounted for bulk of the foreign collaborations and lump sum payments. These industries are electrical and electronics and chemicals. It is also found that the role of different countries as exporters of technology to India has undergone some change with decline in the share of Germany and UK. Nevertheless, USA, Germany and UK continue to be the major exporters of technology to India. Our analysis of the terms of technology import has shown that there has been a marked change in the terms at which foreign collaboration is being agreed up on. While there has been an increase in the incidence of cases involving neither royalty nor lump sum, there has been a decline in the cases involving both royalty and lump sum.

END NOTES

i. Studies have also noted that restrictions imposed by India was much higher than other LDCs (Lall and Mohamad, 1983 Lall 1987).

[ii] This section draws from Joseph (1997).

iii.. See for a conceptual formulation of transfer cost Teece (1977) It was Teece who made the first attempt to formalise the idea that technology is transferred across countries at some cost to the transferor and the transferee.

iv. There is a growing literature on technology licensing using the framework of agency theory. However, most of these studies remain in the realm of theoretical formulation with hardly any empirical base. See Arora (1995), Lafontaine (1992) Mundel and Lanfontiane (1995). For empirical analysis, though with limited scope, see Bidault (1989) and Caves et al (1983)

v. It need not be the case always. The cost of producing technology also depends on the nature of technology. If the technology is only a byproduct of the firm's research the cost will be different.

vi. Alam (1985) has shown that there are evidence to suggest that lower royalty rate is compensated by higher lump sum.

Chapter 3

DETERMINANTS OF TECHNOLOGY IMPORTS

Introduction

In the previous chapter our analysis of the emerging trends and patterns in foreign collaboration in India has shown *interalia,* that with policy liberalisation firms attach unprecedented importance to technology import. Notwithstanding the growing importance of technology import the studies on the technology behavior of firms in India have been pre occupied with the relation between technology import and local R&D (Katrak, 1985, 1989, Siddharthan 1988, Subrahmaninan 1991, Basant and Fikkert, 1996). While some of the studies found that the technology import and local R&D are compliments, there are also studies reporting that they are substitutes (Basant and Fikkert 1996). It could be argued that the importance of the large body of literature that exist in this area is undermined by the fact that most of these are not preceded by a careful analysis of either R&D behaviour or import of technology by firms. In such a context arises the need to undertake a detailed analysis of the bahavioural patterns of firms as regards technology import and R&D strategies. The present study proposes to examine one of these aspects (technology import) in some detail.

The chapter is organised as follows. In the second section we present the issues and hypotheses for empirical analysis. In the third section the database used in the analysis is introduced and the construction of variables described. In the fourth section estimation results are presented and the final section presents some concluding observations.

The Issues and Hypotheses

In a liberalising developing economy like India, wherein firms are free to resort to technology imports, achieving competitiveness and cost reduction would be one of the objectives of firms. It may be argued that access to modern technology enables the firm to modernise and thereby bring down cost of production and price. It is also possible that firms resort to technology import either with a view to get access to the world market or with a view to obtain the privilege of using brand names which could enhance their share in domestic market. Conceptually it is possible to consider different types of technology transfer namely, the intra-firm transfer through foreign direct investment or through arms length transfer through pure technical collaboration. It is also possible that firms import embodied technology in the form of capital goods, spares etc. It has been shown in the literature that the imports of disembodied and embodied technology are closely associated (Chandra, 1986). Some studies (Caves, 1982 and Kumar, 1990) show that intra- firm technology transfer would occur in cases where transaction costs are high. In the present study our focus is mainly on the transfer of disembodied technology through licensing.

The present study addresses three different but interrelated questions. It is found that, despite the liberal policy environment, all the firms are not resorting to foreign technology import. Hence, the first question is; what are the factors that determine the firms' decision to import foreign technology? The next question, which is related to the first one, is what are the factors that determine the quantum of foreign technology imported. The third question that follows from the first two questions is whether the decision to import and the quantum" of technology import are shaped by the same set of factors. Given these three questions let us now briefly examine the relevant studies to identify certain hypotheses

that could be empirically verified.

A notable study on the question of technology import is carried out by Braga and Willmore (1991) by taking the case of Brazilian firms. In explaining the behaviour of technology imports by Brazilian firms they considered firm size, profits, exports, and foreign control as determinants. Using a Tobit model Siddharthan and Krishna (1994) analysed the technology import behavior of Indian firms for three years following 1987-88. Their model employed 12 variables as determinants.[1] The study found significant inter-industry variation in the factors governing the technology import behaviour. However, it was found that export oriented firms go in for imported technology more than the domestic market oriented ones. The technology-importing firms are also found to be the ones, which enjoyed advantages of high market share and skill. Import of capital goods and components went hand in hand with the import of disembodied technology only in a few industries. Advertising intensity is found to have a negative impact.

Study by Evenson and Joseph (1997) addressed a number of questions regarding technology licensing. They included; a) the probability that a firm involves in foreign collaboration and the factors that influence the decision to collaborate, b) the probability of choosing their partners from a particular country and the factors and forces influencing the observed choice, c) the probability of obtaining technology on certain terms and conditions and the factors that govern the terms of licensing, d) the determinants of the levels of royalty rate and lump sum payment to be made for the technology transferred and e) the effect of foreign collaboration on the licensees' performance in terms of profit and net export earning. Given the fact that only a select sample was found to be engaged in

foreign collaboration, the study used the Heckman selection model to correct for sample selectivity. While a probit model was used to estimate the probability of collaboration, multinomial logit models were employed to determine choice of the collaborating country and the terms of collaboration. The effect of foreign collaboration on licensees' performance was analyzed using OLS.

The study showed that the growth in the stock of scientific and technical knowledge abroad has a positive influence on the firms' decision to license foreign technology indicating the existence of strong international technological spillovers. While the firm specific factors like the size, imports, exports, profit and foreign control have a positive influence, the market concentration was found to have a negative effect on the decision to collaborate. The choice of a partner was influenced positively by the stock of patents in the partner's country and negatively by its competitor's patents suggesting that the stock of knowledge in one country appeared as a substitute to those available in other countries. Estimates of the multinomial logit model on the terms of foreign collaborations as manifested in the different combinations of royalty rates and lump sum showed that the highest probability is to have a technology deal with only lump sum payments indicating the terms in which firms obtain technology. This could be a combined effect of the bargaining power of the Indian firms and the increasing competition in the international technology market. The selection-corrected estimates of royalty rates and lump sum payments showed that foreign control and exports have a positive effect on royalty rates. Profit is found to have a negative effect. Similarly while the market share, exports and imports have a positive effect on lump sum payments, foreign control and firm size is found to have a negative effect. Analysis of the effect of foreign technology licensing

using the estimates of the profit and export functions produced mixed results. While technology licensing was found to enhance firms' profitability, it is found to be associated with a dampening effect on net export earnings.

It may be noted that both of these studies were carried out prior to the implementation of the current policy reforms[2]. The present study essentially follows the previous studies in terms of the nature of questions and the method of analysis. Its importance rest on the fact that it refers to the year 1995 wherein the effect of liberalisation is expected to have been almost fully felt by the industry. Drawing from the existing studies, following hypotheses have been specified for the present analysis.

Firm size is hypothsised to have a positive influence on the decision as well as the magnitude of technology import for the following reasons. First, similar to the resource cost of technology transfer incurred by the technology exporting firms (Teece 1977), there is substantial search cost to be incurred by the technology importing firms which the larger ones would be more readily willing to undertake. Secondly, the technology-exporting firms are likely to prefer larger firms because of their higher risk taking capability and higher expected return by way of royalty and lump sum payments. Viewed in similar vein, we expect a positive relation ship between the firm's profit and the decision to collaborate[3].

Another factor influencing the decision to license technology is the external orientation of the firm. It has been hypothesised that the export oriented firms may be more aware of the technological change abroad and therefore such firms are more likely to import foreign

technology as compared to their domestic market oriented counterparts (Siddharthan and Krishna 1994, Evenson and Joseph 1997). It has been argued that technology imports, imports of capital goods and intermediates and that of foreign equity are inter-linked (Chandra, 1986). Therefore it will be of importance to examine whether technology import through technology licensing (disembodied technology) and through capital goods (embodied technology) are substitutes or complements.

Another hypothesis is related to the R&D behaviour of firms, which has already subjected to empirical verification by a number of scholars. In the light of the available evidence we hypothesise that the relation could be either positive (if they are compliments) or negative (if they are substitutes). It has also been suggested in the literature that the decision to import is influenced by the nature of competitive environment in which it operates. In general, it is postulated that the market power of the firm will have a negative influence on the decision to collaborate. Assuming that the primary objective of the firm is to maximize profit, a price setting firm (monopolist), operating in a relatively closed economy has hardly any incentive to go for foreign collaboration. On the other hand, if the firm is a price taker, it may resort to foreign collaboration either to bring down the cost of production or to find new export market. Viewed thus, it could be argued that there is an inverse relation between the market share and the decision to collaborate.

It has also been hypothesised that the skill intensity of the work force will influence the technology import. The impact of this variable may differ according to the techno-economic characteristics of the industry concerned. In the skill intensive industries like electronics and chemicals the skill factor is expected to have a positive influence. Another hypothesis relates to the ownership of firms (foreign or local). There is a strong

presumption that the multinational enterprises would transmit their technologies more readily and efficiently to their subsidiaries, not only to recoup a part of the investment in R&D but also to reduce the risk of leakage (Dunning 1992). Hence it is hypothesized that those firms with foreign majority equity participation are more likely to license technology than their local counterparts.

Having dealt with the hypotheses to be verified let us now briefly deal with the method of analysis. Siddarthan and Krishana (1994) analysed the problem using a tobit model. The selection of the Tobit model is justified on the following grounds. In the probit or the logit models the issue is reduced to either "Yes" or "No". By doing so, such models are not able to explain the inter firm variation in the extent of technology imports. More over, such models do not distinguish firms that spent very little from those spent heavily on technology imports. In the present context, a probit model need to be supplemented by an OLS estimate. The former analyses the question of decision to import and the latter will help analysing the magnitude of technology import. Accordingly we have estimated a probit model of the following type;

Prob (Import Technology) = a0 + a1rdtot + a2 wage + a3 netp + a4 capin + a5 expin + a6impin + a7 mktshare + a8 sales + a9selc+ a10 forshare + error term

Where,

Prob (import technology) = Probability that a firm goes for foreign collaboration, rdtot = total R&D expenditure, wage = wage share in value added, netp = net profit, capin =capital intensity, expin = export intensity, impin =import intensity, mktshare = market

share, sales = sales, selc=sellingcost, forshare = foreign share.

In this study it is assumed that the decision to import technology and the magnitude of technology import (given by the cost technology import) are influenced by the same set of factors. The inter-firm variations in the intensity of technology import has been analysed using an OLS model of the following type:

Cost of technology import = b0 + b1rdtot + b2 wage + b3 netp + b4 capin + b5 expin + b6impin + b7 mktshare + b8 sales + b9selc+ b10 forshare + error term

Data and the construction of variables

Since data on all the variables are not available from any of the published sources of the government[4] we have made use of the corporate database of the Centre for Monitoring Indian economy (CMIE). We have gathered all the variables that are needed for the present analysis from this database .The analysis is carried out by taking the case of three major technology importing industries viz. chemicals, electrical machinery and electronics. These three industries, as we have already seen in the previous chapter, account for about 50 per cent of the total number of collaborations. The analysis refers to the year 1995. The selection of this year is justified on the ground that the impact of the policy reforms on the behavior of firms will be felt only with a lag. By selecting 1995 we are able to allow for a lag of about four years.

In this study the collaboration dummy takes the value one if the firm has incurred any cost on technology import and zero otherwise. The extent of technology import is measured by

the total cost incurred on technology import, which is taken as the sum of royalty and technical fees and dividends. The size of the firm is measured in terms of the sales and profitability is measured in terms of the ratio of net profit to net sales. The foreign ownership is measured by the extent of equity held by the foreign firms. Export intensity is measured as a ratio of exports to sales. Capital import intensity is measured by the ratio of imported capital goods to total fixed assets. R&D intensity is measured as a ratio of R&D expenditure to sales. Selling cost intensity is defined as the ratio of selling cost to sales. Skill factor, in the absence of information on the educational qualification of the work force, is measured as the share of wages and salaries in value added. Mean and standard deviation of the variables used in the analysis are presented in table 3.1.

Table 3.1 sample mean and standard deviation of variables.

Variable	Mean	Std. Dvtn.
Rdtot	0.341	1.896
Wagein	0.309	1.459
Netp	0.016	0.373
Capin	0.189	0.382
Expin	0.091	0.192
Impin	0.173	0.819
Mktshare	3.477	7.604
Sales	83.385	241.764
Selcoin	0.039	0.045
forshare	7.057	14.330

Estimated correlation matrix for the variables used in the analysis showed very low correlation between the variables used in the analysis and rules out the chances of multicollinearity. As the variables are defined in terms of ratios, chances of occurrence of heteroscedasticity is also minimised.

Estimation Results

The estimation results of the probit model and OLS are given in Table 3.2 and Table 3.3 The two models are separately estimated for the whole sample and each industry. All the estimated models are found to be robust.

Table 3:2 Probit estimates on the factors influencing the decision to collaborate.

Variables	Whole	Chemical	Electrical	Electronics
rdtot	.103*	.085	-.006	.165
	(1.789)	(1.247)	(.039)	(1.143)
waqein	-0.055	-.022	-.057	-.049
	(1.332)	(.441)	(.494)	(.252)
netp	0.001	.0002	-.010	.026*
	(0.485)	(.076)	(.619)	(1.999)
capin	0.326*	.568*	.055	.083
	(2.699)	(2.475)	(.115)	(.395)
expin	0.064	.025	.945	-.320
	(0.305)	(0.087)	(1.001)	(.850)
impin	0.48*	.345*	1.856*	.757*
	(4.045)	(2.595)	(2.131)	(2.487)
mkt share	0.051*	.045*	.101*	.127*
	(5.834)	(4.725)	(2.796)	(2.712)
sales	0.002*	.002*	.001	.001
	(4.381)	(4.324)	(.482)	(.652)
selcoin	-0.242	1.365	-8.320*	-4.466
	(.256)	(1.208)	(2.076)	1.595)
forshare	0.021*	.023*	.021*	.018*
	(7.388)	(6.421)	(2.294)	(2.740)
cons	-1.323*	-1.503*	-1.071*	-1.098*
	(18.380)	(16.139)	(4.885)	(5.929)
chi 2	360.88	259.12	70.38	62.28
Loglikelihood	-574.277	-353.654	-84.405	-116.532
pseudo R2	0.239	.2681	.2943	.2109
No.of firms	1315	883	189	243

Figures in parentheses are t values
* significant at least at 10%

Let us begin with the results of the probit model. Among the variables used in the analysis, following variables are found to be statistically significant for the whole sample. They are R&D intensity, capital intensity, import intensity, market share, size and foreign share. The positive association between R&D intensity and the probability to import foreign technology tend to suggest that in-house R&D induces the firms to search for new technology from abroad in their effort towards building up technological capability. However, it must also be added that the above relation is not found to be statistically significant in any of the individual industries considered.

Import intensity is found to positively influence the firms decision to import technology. This relationship is found to be holding good in all industries. This is in tune with the findings of the earlier studies which argued that foreign collaborations very often involve such terms and conditions which force the technology importing firms to depend on foreign sources for the raw materials and spares.

Another significant finding of the present study is that the market share of the firms positively influences the firm's decision to import technology. This relation is also found to be holding good across all the industries studied. The tendency of firms with domestic market power to go for foreign technology probably points towards the emerging competitive environment (especially on account of opening up of the economy) in the Indian industry wherein, firms resort to import of foreign technology as a competitive strategy. The positive sign of size further strengthens the above argument. Finally as has been hypothesised, foreign share is found to have a positive sign across the industries studied.

Let us now turn to the results of the OLS estimates on the determinants of the magnitude of technology import. Among the variables considered in the model, R&D, profit, export intensity, market share and size are found to be statistically significant for the whole sample. However, there are inter-industry variations that could be attributed to the varying techno-economic characteristics of the industries studied.

Table 3.3 OLS Estimates: Determinants of technology imports.

Variables	Whole	Chemical	Electrical	Electronics
rdtot	-.222*	-.180*	.019	-.075
	(5.216)	(3.145)	(.380)	(.454)
waqein	-.018	-.006	-.013	-.085
	(.405)	(.083)	(.629)	(.348)
netp	.012*	.007*	.009	.021
	(4.134)	(2.057)	(1.057)	(1.445)
capin	.073	.067	.110	.049
	(.431)	(.281)	(.499)	(.166)
expin	.567*	-.140	.445	1.454*
	(1.670)	(.283)	(.954)	(2.635)
impin	.053	.037	.078	.511
	(.677)	(.422)	(.179)	(1.123)
mkt share	.030*	.037*	.032*	.110*
	(2.896)	(2.698)	(3.846)	(2.696)
sales	.005*	.006*	.001*	.0002*
	(10.963)	(10.510)	(2.075)	(.177)
selcoin	-.837	-.507	-1.573	-4.495
	(.577)	0.263)	(1.340)	(1.174)
forshare	.007	.007	.016*	-.009
	(1.425)	(1.022)	(4.443)	(.854)
cons	-.128	-.163	-.125	-.032
	1.269)	(1.197)	(1.276)	(.124)
Adj R2	.2341	.2542	.6415	.1153
No.of firms	1315	883	189	243

Figures in parentheses are t values
* significant at least at 10%

In contrast to the probit model, we find a negative relationship between R&D and technology import which tend to suggest that firms consider technology import as substitute for the in-house R&D. However, such a relationship is found significant only in one out of three industries studied (also for the whole sample). As hypothesised we obtained a positive relationship between the profit performance of the firms and their technology import intensity. A firm conclusion is not warranted in the absence of more rigorous analysis of this question in a simultaneous equation framework. Another important result relates to the positive influence of size and market share on the quantum of technology imports which, as we already noted may be viewed as an indicator of increasing competition in the Indian industry with the removal of entry (both internal and external) barriers. The foreign share is found to be significant only in one industry.

Summary

The above analysis showed that the decision regarding technology import and the extend of technology import are influenced by more or less the same set of factors.. At the same time an important inference that may be drawn from the above analysis is the following; while decision to import is positively influenced by R&D effort, the intensity of technology import has a negative bearing on the domestic R&D effort. Secondly, while the foreign share has a positive influence on the decision to import technology, the extend of technology import has no significant bearing on foreign share. This tends to suggest that the new policy regime provide avenues for the foreign firms to repatriate their returns in ways other than royalty and technical fees.

The analysis threw some light on the emerging competitive environment in the Indian industry. Firms were found to resort to technology import as a competitive strategy. Indicators of external orientation, namely foreign share and import intensity favourably influenced the decision regarding technology import and boosted the quantum of technology imports. To sum up, both firm specific and industry specific factors influenced the technology import behaviour of Indian firms.

End notes.

1. The determinants in their model are advertisement expenditure, age, foreign equity participation, capital-output ratio, import of components, import of capital goods, import of other raw materials, profit margin, R&D expenditure, firm size, skill intensity and export intensity.
2. It may be noted that the study by Evenson covers up to 1993. The study might not have been able to capture fully the effect of liberaliastion because the impact of the reforms might be felt with a lag.
3. Braga and Willmore (1991) in their analysis of technology imports in Brazil postulated a negative sign for profit on the ground that lower profits would prompt the firms to go in for technology imports, modernize and improve their profits. However, it is also possible to argue other way round and justify a positive sign.
4. Earlier study on this question by Siddharthan and Krishna (1994) made of the RBI data base and that by Evenson and Joseph (1997) is based on five databases including the CMIE data.

Chapter 4.

Summary and conclusion.

The economic liberalisation process in India has its beginning in the early eighties in the light of the increased understanding that the restrictive policy regime had a dampening effect on efficiency, productivity and growth in the Indian economy. The early nineties witnessed substantial policy changes with a view to integrate the economy with the world market. Under the new policy regime market forces are allowed to play a greater role in contrast to the previous periods. This study has been carreid out against the backdrop of the liberalisation initiatives undertaken in India in the nineties.

The role of technology in enhancing efficiency, productivity and growth, has been well acknowledged. In a period of liberalisation and globalisation, technology assumes added importance. In the changed economic climate the trends and pattern of technology import and technology import behaviour of firms are expected to change. In this context, it is important to understand the changes in trends and patterns of technology import, factors determining the decision regarding technology import, and the determinants of inter-industry pattern of the intensity of technology import The study is concerned with these issues. More specifically, it attempts to examine (1) the emerging trends, patterns and the terms and conditions accompanying technology import; and (2) the complex set of factors that determine the decision regarding the technology import and the quantum of technology import

The trends and patterns of technology import and the accompanying conditions have been analysed using the data published by the Department of Scientific and Industrial Research. The determinants of the decision to and the intensity of technology import,

have been analysed using corporate data base of Centre for Monitoring Indian Economy (CMIE). The industries selected for the analysis are chemical, electrical machinery and electronics which together accounted for almost fifty per cent of the total number of foreign collaborations.

Analysis reveals that the number of foreign collobration has increaed in the nineties as compared to the eighties. It suggest that import of technology proved to be an expeditious way of obtaining the required technology. Apparently, in an era of liberalisation and globalisation, Indian firms have felt the need for moderinising The striking feature of this trend is the increasing incidence of foreign equity participation in collaborations. This points towards the preference of multinationals for packaging of technology. Coming to sectoral pattern, chemical, electrical machinery and electronics industry accounted for majority of the foreign collaborations. In the pre-ninety period, sources of foreign collaborations have been mostly concentrated in a few countries like United States, United Kingdom and Germany. On the contrary, the nineties has witnessed diversification and expansion of these sources.

The study finds a marked change in the terms and conditions of technology in the nineties. In the nineties, there was a conspicuous decline in the share of collaborations with lump sum payments or royalty or both. This tends to suggest that firms are forced to minimise the incidence of collaborations involving lump sum or royalty payments, due to its deleterious effect on competitiveness. This is in sharp contrast to the eighties probably because of the protection enjoyed by Indian firms.

The issue of decision to import technology and the extent of technology import have been analysed using a probit model and OLS respectively. Among the variables usd in the analysis, following variables are found to be statistically significant for the whole sample. They are R&D intensity, capital intensity, import intensity, market shre, size and foreign share. The positive association between R&D intensity and the probability to import foreign technology tends to suggest that in-house R&D induces the firms to search for new technology from abroad in their effort towards building up technological capability. Import intensity is found to positively influence the firms decision to import technology. This is in tune with the findings of the earlier studies. Another significant finding of the present study is that the market share of the firms positively influence the firms decision to import technology. The tendency of firms with market power to go for foreign technology probably points towards the emerging competitive environment in the Indian industry. The positive sign of size further strengthens this argument.

The OLS estimates shows that, R&D, profit, export intensity, market share, and size are found to have significant influence on the magnitude of technology import. However there are inter industry variations that could be attributed to the varying techno-economic characteristics of the industries studied. A negative relationship is found between R&D and technology import, which tends to suggest that firms consider technology import as substitute for the in-house R&D. As hypothesised, we find a positive relationship between the profit performance and technology import intensity of firms. Another important result relates to the positive influence of size and market share

on the quantum of technology imports, which strengthens our findings on the increasing competition in the Indian industry.

To sum up, both firm specific and industry specific factors are found to influence the technology import behaviour of Indian firms. The study, thus, throws some light on the emerging competitive environment in the Indian industry. Findings of the study suggest that firms resort to import of technology with equity participation as a competitive strategy

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