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Technology transfer & restrictive trade practices: A microeconomic study of the Indian electronic industry

Kashyap, Arun, Ph.D.
University of Hawaii, 1990

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TECHNOLOGY TRANSFER & RESTRICTIVE TRADE PRACTICES:
A MICROECONOMIC STUDY OF THE INDIAN ELECTRONIC INDUSTRY

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN ECONOMICS

DECEMBER 1990

By

Arun Kashyap

Dissertation Committee:

Seiji Naya, Chairman
Sumner LaCroix
James Moncur
William James
William Remus
When the world is destroyed, it will be destroyed not by its madmen but by the sanity of its experts and the superior ignorance of its bureaucrats.

John Le Carrè
ACKNOWLEDGEMENTS

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ABSTRACT

This dissertation analyzes the technology licensing contracts from an economic perspective. The literature on technology transfer, in general, and arms-length transactions, in particular, is reviewed with the conclusion that the intrinsic imperfection in the market for technology places the buyer in a weaker position. The licensor is a monopolist and will seek to sell the knowledge for the highest possible price. The licensee of technology is also assumed to have market power. The contractual arrangement between the supplier and recipient of technology is then analyzed in the framework of a bargaining model.

Data on technology transfer contracts in the India electronics industry were analyzed. Technology licensing contracts are perceived to vary along several dimensions. These may include, the degree of exclusivity, forms and size of compensations to the licensor, the package of technology in transaction, restrictive business practices of the supplier, regulations of contracts by the licensee firm's government and sharing of rents between the licensee and the licensor.

Logit analysis is used to predict the firm's choice of an exclusive technology licensing contract. The variables
affecting this choice of the licensee firm are the price of the technology licence mode, those pertaining to the information and transaction costs associated with each option, and the socio-economic-political variables providing additional "utility" to the unit exercising the choice. Specifically, it is observed that this choice is dependent on the compensation paid to the licensor, the quantity of technology in the package, the ownership of the licensee firm and the restrictive business practices of the licensor firm. None of the restrictions imposed by the licensee's government, except that of export obligation was seen to have an impact on this choice. From the various complementary services which could be provided by the licensor to the licensee only buying back of the contract product was significant for the choice of an exclusive technology licensing contract. Finally, the existence of a trade-off between the royalty payments and the lump-sum payments, based on the same data, was analyzed.
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CHAPTER ONE

INTRODUCTION

One of the major paradoxes in the discussion of "technology" is that in spite of the existence of an enormous literature on the subject some amorphousness continues to exist. Although technology and technical change have been considered as crucial to the process of economic development, the phenomenon itself is inadequately understood.[1]

The concept of technical change attains greater complexity for economists because of the issues of appropriation and measurement of technical change. The creation and acquisition of technology is also costly in terms of human effort and time. The issues become even more complex if the dynamic elements of technological innovations are introduced into the scenario.

In the static theories of David Ricardo, Eli Heckscher and Bertil Ohlin, technology was treated as given and inflexible in its supply. Technology or "knowledge" was consequently not progress per se, but it manifested itself
in a given set of capacities to be exploited through the division of labor. Schumpeter was the first economist to consider knowledge as a dynamic factor of production potentially available in abundance. However, it was only after Arrow's learning-by-doing process that technology was introduced as a productive factor endogenous to the production process.[2]

Knowledge, either of asset creation and usage or of organizing economic activity cannot be, generally speaking, considered as a given: It has to be created.[3] Besides, technology has the attribute of a public good in that the sale of knowledge does not reduce the magnitude of it available to the seller. An information asymmetry between the seller and purchaser of technology forces the latter to make a bid for the knowledge before being able to assess its value completely. The uncertainty of the market to guarantee either the supplier or the recipient of technology the terms of the agreement with respect to quality, price, protection of property rights, and the costs of compensating the failures of the market is also a source of imperfection.

Technology is, consequently, [frequently] expensive to transfer and disseminate.[Teece, 1977] It can, however, be readily transferred at a price either through the market or internally within the organization of which it is the specific property. The extent of the technology transferred will be defined by the process of technology
transferred or the conditions under which the technology is transferred, the organizational form of its transaction, and the absorptive capacity, and the economic characteristics of the supplier and the recipient countries. The technology transfer, particularly through licensing arrangements, has characteristics which advocate its analysis by means of a bargaining model.

Most of the developing countries have depended on technology imports as a means of acquiring new technologies. The need for technology transfer has increased over time and it is not limited to the developing nations only. This demand has brought in its wake a greater degree of scrutiny on the magnitude and the constituents of a technology package and the legitimacy of the compensation paid for it. A continuing concern of the recipient countries has been with the "unpackaging" of the imported technology. The unpackaging essentially involves the substitution of "local" constituents for "foreign" constituents. It manifests itself in the nature of the rights in a technology transfer agreement. The rights may be exclusive or non-exclusive.[4]

Earlier studies have analyzed the resources required to transmit and successfully absorb technical information [Teece, 1977] and the compensation derived by the licensors from technology transfer [Contractor, 1981, 1985]. It has been observed that "nonexclusive licences are usually used where a very valuable invention exists and several
manufacturers want licences to get into the business."[5] A study has also analyzed exclusive and non-exclusive contracts based on the scheme of compensation involved.[6] There are, however, no empirical studies pertaining to the constituents of the type of licences.

This dissertation will explain the determinants of the choice of a technology licensing contract. The determinants will be analyzed, keeping both the supply and demand factors of the knowledge in consideration. The theory will be developed for this "choice" from the viewpoint of a licensee. The licensee may be a firm, an individual or an institution. This theory will also be applicable to other contractual situations. Logit analysis will be used to test the model. The data used will be from the Indian electronics industry.

The electronics industry has been chosen because, since the World War II, its development has been regarded as an imperative by all the countries, irrespective of the state of their development. Furthermore, the electronics industry is technology intensive. It is increasingly influenced by the concept of technological disequilibrium i.e., at a given time, the component parts of a machine vary in their ability to exceed their level of performance. The latter is, in turn, determined by the performance capacity of some limiting component. The failure of any single component makes the electronic device undesirable not to mention
inoperative. Its high rate of obsolescence accompanied by high standards of quality, reliability, and high precision, implies a continuous pressure on the firms in the industry to modernize their technology.[7]

The choice of India lies in it being an excellent representative of developing countries actively emphasizing the growth of the electronics industry. It is the developing countries which have historically preferred an arms-length mode of technology transfer. A limitation of the existing literature is that it most considers the technology transfer decisions from the point of view of a supplier. The choice of the Indian Electronics industry therefore provides the much desired perspective of the buyer from a developing country.

It is a stylized fact that in all countries, the State plays a pivotal role in shaping, stimulating, and inhibiting various forms of technical change, and defining its mode of transfer.[Fransman, 1985] The State becomes even more important in the case of recipient developing countries because of the dominant position of the supplier and the presence of restrictive business practices in the licensing agreements. Consequently, there is a greater intervention by the licensee's government in the implementation of the technology transfer contracts. The logit analysis incorporates the restrictions imposed either by the seller of technology or by the recipient's government.
Contractor has observed the existence of a multiplicity of payment channels, which, he argues, can be used to circumvent the government-imposed ceilings.[8] However, the study lacks empirical evidence. This dissertation will also empirically test the existence of a trade-off between the two major types of payments viz., the royalty payments and the lump-sum payments.

The framework of the dissertation is as follows. Chapter Two will review the relevant literature on technology transfer, in general, and from the perspective of technology licensing agreements, in particular. Chapter Three will explain and analyze the electronics industry in India. Chapter Four will discuss the Public Policy environment of India which affects the supply of imported technology in the country. Chapter Five will develop a theory for modeling the choice of a technology transfer agreement under the given conditions of market imperfection. Chapter Six will synthesize the theory of the earlier chapter into a logit model of the choice of the licensee with respect to the nature of the agreement. The model will be tested empirically using the data from the Indian electronics industry. Chapter Seven will discuss the results of the empirical tests. Chapter Eight will evaluate the findings of the dissertation. It will also discuss policy implications and explore issues for further research.
NOTES

1. Rosenberg's conclusion with respect to the question "of the social determinants of a society's capacity for generating technical progress in the first place" is that "on this most fundamental issue, our understanding remains, at best rudimentary."


2. Ricardo argued that as long as there were comparative productivity advantages in a given field of production gains from trade would result for the sum of countries involved in international trade. The assumptions of resources and technology as given are central to the argument.

Hecksher & Ohlin in their theory made another bold assumption of identical technological knowledge everywhere. Knowledge was therefore not considered an important factor in the determination of trade and consequent specializations of different countries.

Schumpeter concluded that the synergistic combination of entrepreneurs and potential technological knowledge leads to an instability of the general equilibrium. An approach to the state of equilibrium leads to a declining profitability and consequently to an innovation which would decrease the long run marginal cost of production or to the introduction of a new product.


3. The classification of knowledge into these categories is attributed to Dunning. The question of knowledge as a factor endowment would, however, depend on the magnitude of the value-added by the "knowledge" inputs. The latter can, at times, be large enough to contend for a factor endowment in its own right.
4. The definition of an "Exclusive Licence" as per the agreement of an Indian firm with a foreign firm is as follows:

"Exclusive Licence" shall mean, subject to Article #, (relating to Direct Sales), a licence which gives the FIRM an exclusive right to [perform the activity granted by the SUPPLIER and to prohibit the SUPPLIER both from the manufacture and sale of the Products and from granting any other person, firm or corporation than the FIRM and right or license [sic] for the manufacture or sale of the Products except as otherwise stated in this Agreement or expressly agreed in advance between the supplier and the FIRM X.

5. This has been observed by a patent attorney.


7. The nature of the electronics industry is best summed up by what is termed as Bitton's Postulate on Electronics. It states: "If you understand it, it's obsolete." The equipments, designs and configurations in the electronics industry have an average life of approximately five years.


CHAPTER TWO

TRANSFER OF TECHNOLOGY: A REVIEW

2.1. INTRODUCTION

Recent studies have asserted that diffusion, absorption and application of technology are prerequisites to the process of economic growth and development.[1] Simon Kuznets [1966] has argued:

"...Whatever the source, the increase in the stock of knowledge and the extension of its application are of the essence of modern economic growth...No matter where these technological and social innovations emerge -- and they are largely the products of developed countries -- the economic growth of any given nation depends upon their adoption. In that sense, whatever the national affiliation of resources used, any single nation's growth has its base somewhere outside its boundaries -- with the single exception of the pioneering nation...Indeed this dependence of a single nation's growth on the transnational stock of useful knowledge is implicit in the concept of an economic epoch."[2]

Every form of economic activity is dependent on the technology or knowledge of how the activity is carried out. Technology is, however, a necessary but not sufficient condition for economic development. New technological innovations are rendering technology and its furtherance in the industry as the raison d'être of global competitiveness.
These considerations are, in some sectors, even taking precedence over variables such as low wages in determining international comparative advantage. [3]

Technological change is also recognized as a major determinant of national development. Many studies on developed countries have shown that over 50% of long term economic growth can be shown to stem from technological changes which either improve productivity or lead to new products, processes or industries. [4] Numerous other studies on the role of technical expenditures on industrial productivity, growth of industry, and exports [Scherer, 1982, 1983; Sevikauskas, 1983; Rothwell & Zegveld, 1985, Siddharthan, 1985] have all found the former to be an important determinant of industrial performance.

Scherer's work lends support to the idea that better industrial performance, in addition to expenditures on R&D, can be due to the purchase of machinery and other inputs that embody R&D incurred in the industry. Rothwell and Zegveld have argued that it is the ability to acquire technology that results in a rapid increase in productivity and economic growth rates in industrializing countries. Sevikauskas's study discovered considerable evidence in support of science and technology rather than more general forms of capital formation, to be fundamental to the economic advantages of the industrialized nations. [5] Most of the recent work on differences in price-cost margins in
different industries in the framework of a structure-conduct-performance paradigm includes the technology variable as a determinant.[6]

2.2. TECHNOLOGY & ITS TRANSFER

Technology has been defined as knowledge of how to do and make useful things [Stewart, 1979]. Merrill [1968] defines it as "skills, knowledge and procedures for making, using and doing useful things". In a broader sense, it also includes additional elements like management and marketing skills. For the purpose of this dissertation, technical change will be defined as improvements in the transformation of inputs into outputs, including improvements in the quality of output [Fransman, 1985] or even production of entirely new products.

Teece [1976] defines technology transfer as the process of transferring from one production entity to another the know-how required to successfully utilize a particular technology. "It represents the expression of a choice to import technology rather than to develop it within the firm."[7]

Transnational corporations [TNCs] formulate most production and organizational innovations. They are important actors in the process of transfer of technology from the industrially advanced countries because they form the core of an accelerating pace of technological
innovation. TNCs also play an important role in establishing the future direction of technology.[8]

The ability of the TNCs to engage profitably in multinational production stems from their possession of firm-specific intangible assets. Such assets include, inter alia, ownership of industrial property rights, unpatented know-how, product differentiation, management, marketing, and other promotional capabilities.

The proficiency of the TNCs in allocating and integrating the production, sale, and marketing of many products in different countries provides them with the advantage of reduced transaction costs on activities which are separate, yet interrelated. The ownership advantage also permits the TNCs to exploit market imperfections and/or government interventions.[9] These attributes not only lend competitive advantages to the TNCs over the domestic enterprises but also serve as rent creating characteristics. Consequently, direct foreign investment has been the mode of technology transfer traditionally favored by these corporations.[10]

All types of technology are not transferable across national boundaries. Nevertheless, a lot of the technology can be transferred either through the market or directly by the innovating firm depending on the approach which will allow it to maximize the economic rent.[11]
2.3. FORMS OF TRANSFER

There are essentially two forms in which the technology can be transferred. The first form, termed the embodied form consists of physical items such as blueprints, tooling and equipment. This arrangement transfers technology embodied in physical objects.

Disembodied technology is the information that must be acquired to ensure an effective and efficient functioning of the physical equipment or "hardware". This information is related to organizational methods and operational procedures of manufacturing, testing and quality control. The transfer of technology in embodied form is a relatively straightforward process while a transfer in the disembodied form is more involved and complex.[12]

2.4. MODES OF TRANSFER

The different modes of transfer of technology are essentially categorized into formal [or market mediated] and informal [or non-market mediated], [Fransman, 1985]. The two groups can be further subdivided, à la Dahlman & Westphal [1982], depending on the role of the licensor.

2.4.1. Formal or Market Mediated

a. With an Active Role for the Transferor
   i. Direct Foreign Investment [DFI]
   ii. Joint Ventures
iii. Licensing  
iv. Franchising  
v. Technical Service Contracts  
vi. Management Contracts  
vii. Turnkey Contracts

b. With a Passive Role for the Transferor  
i. Purchase of Machinery & Equipment

Most of the attention in literature has been devoted to the mode represented by the above two categories. In this formal division represented by direct foreign investment, joint ventures, licensing agreements, management contracts etc., the quantity and quality of technology transferred is directly dependent on the licensor. The transfer being market-mediated, the context and environment of transfer, which includes restrictions on the use of information, become important. Machinery and equipment imports represent an embodied form of technology transfer where the transferor exercises little control i.e plays a passive role in the use of knowledge by the licensee.

2.4.2 Informal or Non-Market Mediated

a. With an Active Role for the Transferor

i. Learning through Exporting
b. With a Passive Role for the Transferor

i. By Imitation

ii. Scientific Journals & Exchange

iii. Trade Journals, etc.

The Republic of Korea [ROK] provides a good example of the interaction between users and sellers in the international markets playing an active and important role in transferring knowledge to the country's export sector.[13] In such cases of learning by exporting, the licensor of technology plays an active role by telling the exporter the shortcomings of the products and suggesting improvements. However, it is not market mediated because this knowledge is rarely sold at a price.

The development of steel industry in Brazil and the growth of CNC machine tools in Taiwan are good instances where knowledge has been transferred to the developing countries through imitation, scientific exchange and/or trade journals.[14]

2.5. TECHNOLOGY TRANSFER IN DEVELOPING COUNTRIES

The principal industrialization strategy of the majority of developing countries in the early years of their development has been import substitution. Technological change in most of these countries is consequently a direct or indirect result of technology imports.
Direct foreign investment played an important role in the transfer of knowledge in the post World War II years. A shortage of investment funds in most of the countries associated by the search for new markets by the U.S. manufacturers provided the foreign direct investors a precious opportunity until the late 1950s.

Direct foreign investment has been treated as a simple capital flow motivated by differences in the return to capital between the investing country and the host country. [15] It has been observed that it is the ability of firms to combine surplus entrepreneurial resources with other resources to take advantage of the economies of joint production which leads to direct foreign investment. [16] The direct foreign investment represents operational control of the firm through a real capital transfer which distinguishes it from a portfolio foreign investment. Furthermore as Gilman [1981] observes, the selection of foreign assets is "logically separated in motive and extent from the financing of this real asset acquisition (the choice of liabilities)." [17] The ownership of capital ensures the foreign investor's degree of control on management and operation of the host country's firm. The proportion of equity participation determines the extent of the knowledge and/or other assets transferred.

A national self-awareness in the developing countries combined with a Keynesian approach to economic management
has brought DFI as a mechanism of technology transfer under closer scrutiny since the late 1960s. A change in the development emphasis from "growth" to "growth with equality" raised serious questions pertaining to the packaged nature of technology through direct foreign investment and the consequent transfer pricing. This mode has been seen to perpetuate "technological dependence."

The developing countries, simultaneously, became more aware that the direct foreign investment is neither necessary nor sufficient to achieve indigenous capabilities for generating or absorbing foreign technologies. Each of the developing countries would like to import technologies which are considered essential to accelerate growth and productivity in certain chosen sectors. Their objective then, is to improve the country's comparative advantage by developing an ability to absorb and utilize the imported knowledge. This would create local technology to satisfy the requirements of other sectors.[18]

As a result the emphasis of technology transfer shifted from physical objects to know-how and know-why. It is not only the know-how, but its modification potential that now attracts the interests of a developing country. The recipient firms often look for technologies that they can modify.[19]

It also initiated the developing countries to call for a "code of conduct on the transfer of technology" and a
"code of conduct for multinational enterprises" in the United Nations and other international forums. The controversy seems, implicitly, to be centered around the issue of compensation corresponding to a given size of "technology package". The overriding objective of most developing countries in transferring technology is, apparently, to minimize the cost of imported technology by regulating the form of technology inflows, by avoiding duplication, and by administering the conduct of technology suppliers. A good deal of attention has been paid in the literature to the ways in which the developing countries can lessen the price of the knowledge they purchase.[20]

Furthermore, the growing bargaining power of the domestic enterprises in many developing countries, more so in the Newly Industrialized Economies [NIEs], has led to a greater demand for the "unbundling" of the technology. Such pressures also find support in their government policies. In addition to restricting direct investment in certain sectors of the economy, the policies are increasingly laying emphasis on reduced equity or non-equity forms of technology transfer agreements.

Alternative arrangements such as joint business ventures, management contracts, and technology licensing contracts have, consequently become popular. Amongst the various modes of technology acquisition, a majority of the developing countries has favored arms-length negotiations
An increasing emphasis on arms-length agreements by the developing countries is presumably based on Japan's model of technological development. A central feature of Japan's successful assimilation of foreign technology and achievement of international competitiveness in less than forty years lay in the measures taken (following the import of technology) to minimize foreign control on one hand and to maximize the development capabilities on the other.[21] These measures were seen to facilitate an early adoption and improvement process. The success of technology transfer is, therefore, being increasingly seen in an early emergence of an indigenous technological capacity.[22]

2.6. TECHNOLOGY LICENSING CONTRACTS

An important characteristic of alternative arrangements of technology transfer, viz., technical collaboration agreements, joint business ventures, management contracts, etc., is the absence of large-scale ownership of capital by the foreign companies.[23] Consequently, the operational control continues to be vested in the domestic firms. These mechanisms not only provide a scope for negotiation in the purchase and acquisition of foreign resources and knowledge but also an ability to regulate the foreign firms. The licensors agree because these arrangements provide them with
a means to participate in the profitable and sheltered markets of the developing countries.

Licensing also presents the licensor with an opportunity to institute a manufacturing presence in countries with either an unfavorable investment climate or where the national policies restrict foreign ownership in some industries.[24] Alternatively, an innovating firm may often license other firms in the industry to market its product if it is unable to serve the large market for its product. This prevents other competing and innovative products to be adopted by the industry. For instance, Telefunken licensed PAL color television technology to numerous television manufacturers to prohibit the competing SECAM system an entry in the national television networks of Europe.[25]

Technology licensing contracts relate to the sale of technology and know-how by the foreign firms for specified royalties and technical fees. A licence consists of a transfer of technical know-how, technical assistance, or a proprietary advantage from one firm to another. A transfer of technology by means of a licensing agreement can involve the transfer of a capability in production, management, or marketing, or any combination thereof. It includes: [26]

i. Rights to use of patented information and trademarks in certain territories as decided by the terms of the agreement.
ii. Information that is proprietary but not patented.
   It is called Technical KNOW-how [TKH] or Technical Documentation [TD] and may take the form of
designs and drawings, models or other
specifications, manuals, forms, layouts,
checklists, charts, computer programs, video
tapes, etc.[27]

iii. Services such as equipment installation, training,
technical assistance, management development,
marketing assistance, buy back, etc.

2.7. EXISTING STUDIES

Technology licensing agreements should be perceived as
a relationship rather than as a one-time act of transfer of
proprietary and non-proprietary knowledge. Technology
imports by the firms in the developing countries have the
characteristics of a contract between two parties of unequal
bargaining strengths and negotiation abilities. Besides,
the contracting parties have differential knowledge or
sophistication. The costs of contracting will directly and
unavoidably increase with the "legalese" in the arrangement.
Williamson has also argued that "court ordering is arguably
inferior to private ordering" for enforcement of general
clauses in the contracts that permit adjustments in cases of
unanticipated events.[28] The private ordering has a
greater advantage over the court ordering of "ex post"
knowledge [including that of the magnitude of the profitability consequences] that must be examined to arrive at a judgement.

Some Eastern European firms procured only the technical documentation and patent rights from the Western technology suppliers during the 1970s. They were unable to make full use of the technology and start viable commercial production. A large proportion of these firms had to enter into supplementary contracts with the original suppliers for additional technical training and technical assistance. [29] Several of the technology importing firms in the Indian electronics industry were also vehement in emphasizing the importance of a congenial and long-term relationship with the foreign suppliers. This becomes of added importance especially, in the presence of increasing government restrictions. Some agreements, frequently influenced by the good relationship, provide for the transfer of new models and the update of technical changes and procedures during the contractual period. [30]

An explicit treatment of licensing in theories of the international firm and technology transfer became prominent around the 1970s. Economists do not hesitate to admit that, at both the analytical and the factual level, the knowledge about the transmission of know-how in general, and through licensing, in particular, is inadequate. [31] Most of the earlier research has been in the form of case studies [32]
or an analysis of data and issues at an aggregate macro level for public policy implications.[33] Another set of studies relate to the price of knowledge and to the cost associated with the transfer of technology.

Technology has one characteristic of a "public good," nonexclusivity [i.e. its sale does not reduce the magnitude of it available to the seller]. Models based on disembodied technical change assumed technology to fall like "manna" on all firms. Besides, the marginal cost of transmitting a given body of knowledge to the transferor is frequently very low because the first entity can attain knowledge at a large price and great effort but once it is acquired other firms or institutions can attain it with ease, subject to its availability. This school of thought therefore considered it appropriate to assume the transmission of knowledge by the licensor to be costless.[34] According to Caves, a successful firm manufacturing a differentiated product [especially a patented good or product] controls knowledge about serving the market that can be transferred to other national markets for this product at little or no cost.[35]

Subsequent studies [Contractor, 1981, 1985; Teece, 1976; Dahlman & Fonseca, 1978; Maxwell, 1977, 1982; Lall 1982; Teitel 1984] have shown that the direct costs of technology transfer, which can be overt or hidden, to be substantial. Overt prices appear in the contracted prices while the covert or hidden prices are implicit and include
restrictive clauses, transfer pricing, tied purchases of components and raw materials.[36] Arrow has also emphasized that considerable investment is necessary for making use of knowledge even if the costs imposed by artificial barriers in the form of patents and secrecy are excluded.[37] Mansfield's study confirms this view. He asserts that economists have often underestimated the costs of technology transfer by viewing technology as a stock of readily usable blueprints. In reality, the costs and "headaches" involved in transferring technology are quite high.[38]

The cost of transmitting knowledge seems far from negligible even though the marginal cost of transmitting a given quanta of knowledge may be low. These costs vary considerably depending on the number of previous start-ups of technology or the number of previous applications of the innovations. They will also vary with the experience of the contracting parties with respect to the innovation and the process of transfer.

The price of technology and its transfer will be, generally speaking, determined by its supply and demand. On the supply side, the licensor is to some extent a monopolist and will seek to sell the knowledge for the highest possible price. On the demand side, the uncertainty defined by Arrow's "fundamental paradox in the determination of demand for information" hinders the purchase of knowledge for the licensee.[39] The price of technology will consequently
range between a minimum level determined by the costs of producing [and transfer of] that knowledge to a maximum amount determined by the purchaser's estimated cost of the next best alternative including that of imitation or going without the knowledge. In view of this indeterminacy of the price of knowledge, a great deal will depend on the relative bargaining strengths and negotiation abilities of the contracting parties. The strengths will, in turn, be a function of respective resources, existing knowledge, government policies and other alternatives.[40]

The price of technology will also depend upon the "package" of technology being transferred. By "packaging" all the elements of the transfer, (such as the engineering work, supply of machinery and equipment, training, and technical assistance), the seller may be able to ask for a higher price (both covert and overt) than if the elements were to be sold separately. In other words, the seller's options will be determined by his monopoly over the knowledge and the extent of the licensee's need and alternatives related to that package of technology.[41]

Contractor's studies based on the bargaining model observe that the relative propensity to use licensing increases with the licensee's indigenous technological capabilities. The results of a study of U.S. Multinational firms confirm an increase in the proportion of licensing, ceteris paribus, with increasing government scrutiny and
regulation of direct investment. The licensing as a mode of technology transfer decreases, on the other hand, with more concessions and incentives offered on direct investment. [42]

2.8. TECHNOLOGY & INSTITUTIONS

Kuznets has pointed to the importance of the interaction of technology and existing institutions as a fundamental force behind economic growth. [43] This powerful interplay between institutions and technology is also a basic concept of institutional or evolutionary economics. Cultural values, legal provisions, government agencies, corporate managers and, traditional behavior are only some of the factors which impinge on a country's technological activity. [44]

In the interplay of technology and institutions it is the latter that is more dominant. [45] The efficiency of institutions is a function of the quality of manpower, both, directly and indirectly. The direct dependence emanates from the fact that the institutions are nothing but a group of people working in a relationship defined by a given pattern. The indirect dependence results from the quality of the policy formulation and policy enforcing environment created by the manpower. The policies in turn define the effectiveness of import absorption, dissemination and absorption of technologies. [46]
The choice of technology in a country is therefore a result of its industrial policy and trade policy in addition to the technology policy. This is supported by Ghayur Alam's study where he concluded that technological activities of Indian firms are far more sensitive to government policies pertaining to the nature of the market and to industrial structure than to those explicitly aimed at promoting technical development.[47]

In technical options with "identical" production functions, Enos concludes, that the choice of technique involves more than technology per se. It is based on the complicated political-economy of a bargaining process through which a country tries to maximize benefits in price, managerial learning, conservation of scarce foreign exchange, labor training, self-governance, and other factors. Enos therefore believes that, contractual agreements provide a greater number of meaningful permutations compared to the alternatives provided by the engineering considerations.[48]

In a subsequent study, Enos observes that the process of identifying, screening, selecting, utilizing, and adapting technology encompasses many more participants besides the entrepreneur of the licensee firm. The decision making is a complex process involving these actors with different attitudes and final objectives.[49] Hence the enigma of technology licensing contracts.
The review of literature also indicates that the analysis of the nature, content and determinants of technology transfer to the developing countries is still in its infancy. There is very little empirical work in international licensing per se; it reduces to "barely any" when we consider it from the viewpoint of the developing countries. Considering the significance of international licensing in technology transfer [50] more empirical studies are required to aid the contracting parties or the policy makers in taking suitable decisions.[51]

Most of the existing empirical studies have dealt with the determination of price of technology or the compensation scheme in a technology licensing agreement. This micro study will empirically analyze a sample of technology transfer contracts from the Indian electronics industry to identify the essential choice determinants of exclusive or nonexclusive agreements. The study is also important because it provides a licensee's focus on the issues involved.
NOTES


9. These include tariff barriers, taxation differentials which exists across national boundaries, fluctuations in exchange rates, export subsidies, differential interest and wage rates.

10. Ibid., p. 171.

The uncertain economic and political environment of the developing countries has, however, led to a cutback in the flows of DFI to them.

11. Ibid., p. 65.


23. For the purposes of this study, à la Telesio, it is assumed that more than 50% foreign ownership in a firm gives control. There may be instances where 50% or less ownership in a licensee gives the foreign investor effective control. This can happen in instances where the remaining shares are dispersed or if control is assured through prior agreements. Ownership of more than 50% provides for unequivocal control in all cases.


27. For instance, the agreement for Technical Documentation in the case of an important public sector firm stated:

"Technical Documentation" shall mean the latest documentation with and used by the XX Electronics Department of "Licensor" for the commercial production and testing of Contract Products, comprising:

i. Manufacturing drawings
ii. Drawings for jigs and fixtures
iii. Working Schedule
iv. Part list & Specifications on Materials
v. Rules & Regulations for working process
vi. Rules & Regulations for materials and components
vii. Rules and Regulations for testing and analysis of test results
viii. Erection & Commissioning details to erect and commission of the contract products at site

Technical Documentation comprises basic know how as well as application know how for the project work. Application know how will be supplied in accordance with any specific order received by the "Licensee" and will be projected jointly by the parties. Technical Documentation, however, shall not include detailed data on the manufacture of the raw materials nor on the manufacture of components not manufactured in the XX Electronics Department of the "Licensor", such as resistors, condensers, transistors, and printed circuits, and computer software. Technical Documentation will be supplied in the form of transparent copies preferably (one copy each) micro films or video tapes as is available. There was separate specification of technical documentation for project engineering.

Needless to say that the technical documentation varies for different firms, products and agreements.


30. The relatively commercially successful firms [KHEL, SAMTEL, ECPL, NGEF, etc.] strongly stressed a healthy relationship with the technology licensor. At times the licensor went beyond the terms in agreement in accommodating the training and technical assistance requirements of the licensee firms. It was also easier to come to an agreement pertaining to remuneration for technology and services. This also resulted in minimal wastage of time because of governmental queries and restrictions.


34. For example C. A. Rodriguez in "Trade in Technical Knowledge and the National Advantage," Journal of Political Economy, 88, February 1975, pp. 121 - 135 assumed transmission of knowledge to be costless. Thus, he contends, it is possible for the country which owns the technology to operate a plant in a foreign country without any transfer of factors.[p. 122]


39. The paradox arises from the fact that the purchaser is forced to make a bid for the knowledge before being able to assess its value completely.


40. This model of bilateral monopoly has been further discussed in the chapter on theory [Chapter Five]. The competitive situation is a special case of this bargaining model. A competitive supplier's market with little or no competition in the licensee's market will reduce the supplier's margin to zero. Most of the monopoly profits will accrue to the buyer. Converse will be true for a competitive buyer's market with little or no competition in the licensor's market. With considerable competition in both the markets, the margins for supplier and recipient will tend towards zero. The technology fees received by the licensor will approach the marginal cost of technology transfer i.e. they would equal the transfer costs of implementing the contract over its life.


45. Harry T. Oshima, Similarities underlying East Asia's High Growth & Contrasts with Other Regions, University of Philippines, School of Economics, Discussion Paper No. 8614, December 1986, p. 3.

46. Ibid., p. 3.


Enos examines the case of South Korea choosing Petrochemical technology for the production of low-density polyethylene and vinylchloride monomer [VCM]. Engineers informed the Korean government that there were thirteen patented processes for polyethylene production and six for manufacturing VCM. Essentially, production functions within each product category were identical. He therefore feels that the neoclassical emphasis on production functions is highly limiting and at times even misleading.


50. Global payments through licensing of technology in 1981 were of the order of $14 billion [of which U.S. firms alone received $6 billion].


51. There are only a few existing empirical studies [Contractor, 1981, 1985], [Teece, 1976], [Bidault, 1989] which have looked at the compensation scheme in technology licensing agreements.
CHAPTER THREE

ELECTRONICS INDUSTRY IN INDIA: A PROFILE

3.1. INTRODUCTION

A major problem in defining the concept of an industry arises from subtleties of product differentiation. The Indian electronics manufacturing sector is no different. Firms in this sector do make things which differ, to a lesser or greater extent, from the products of other firms. They frequently manufacture a range of products. For the purpose of this discussion, the term industry will be used, à la Waterson, to denote a group of firms which interact with each other while having qualitatively different relationships with outsiders.[1]

The definition of the electronics industry is both straightforward and complex. It is straightforward because it encompasses all enterprises engaged in the manufacture of electronics devices.[2] The complexity, on the other hand, is generated by the myriad of diverse activities which constitute electronics devices.[3] The electronics industry, unlike conventional industries, is centered on a
particular science or a methodology of accomplishing an objective.[4] It, consequently, incorporates both, input-producing (component supplying) activities, and significant input-consuming (component-using) activities. Appendix A represents a schema for a guide to the electronics industry which captures the elements of its definitional complexity.

The electronics industry in developing countries has drawn considerable attention in the literature. The reason lies, inter alia, in its backward and forward linkages with all other sectors of the economy. An awareness of this feature by the firms and governments has accorded it the status of being "strategically essential", or to use a cliche, a sunrise industry.

3.2. HISTORICAL BACKGROUND

It is the government which has, since independence in 1947, supported the growth of electronics industry. The industry began in 1948 with the setting-up of the Indian Telephone Industries [ITI] to manufacture telecommunications equipment for the country's telephone system. Bharat Electronics Limited [BEL] followed soon after in 1954, primarily to manufacture electronic equipment for defence. In addition it manufactured sound broadcast equipment and active and passive electronic components. Local production of radio receivers with participation of Transnational Corporations [TNCs] like Philips & Murphy was started in the
mid-1950s. Instrumentation Limited [IL], another company in the public sector was set up in the 1960s to manufacture process control instrumentation to satisfy the increasing demands of India's power, cement, oil, and other process industries. The production processes in all of the above were based on technology licensed from abroad.[5]

Electronics Corporation of Indian Limited [ECIL] was formed in the public sector in 1967 to cover nuclear, medical, test and measuring instruments, electronic control systems for nuclear and process plants, electronic components, and analogue and digital computers. Since ECIL was "parented" by the Bhabha Atomic Research Center [BARC] it was based entirely on technology developed indigenously.[6]

The Government of India [GOI] established an Electronics Committee in the Department of Atomic Energy in August 1963 to determine specific strategies for the electronics industry. The committee reviewed the entire field of electronic components and equipment with respect to research and development [R&D] and recommended the "shortest and most economical path" towards "self sufficiency" in the industry. As a result, the Department of Electronics [DOE] was established in June 1970 and the Electronics Commission soon thereafter in February 1971 as the policy making and executive bodies respectively for the development of the entire electronics industry in the country.[7]
Electronics in India, until the early 1970s, was largely limited to the production of consumer goods with radios and black-and-white [B&W] televisions forming the bulk. The total value of production of the electronics industry in 1964-65, at current prices, was US $63 million. This value was then produced by over 200 firms inclusive of the two public sector enterprises ITI and BEL.

3.3. PERFORMANCE OF THE INDIAN ELECTRONICS INDUSTRY

Data on the production of electronics equipment and components by the registered firms in India during the period 1971-1988 are provided in Table 3.1. These figures fail to include substantial unreported production from small-scale units seeking to avoid taxes.[8] The compound annual growth rate [nominal] from 1971-1988 is approximately 24%. In real terms [based on the wholesale price index (WPI) for the manufactured products] the growth rate between 1971 and 1988 was about 14%.[9] [Table 3.2]

Total output of the Indian electronics industry, in nominal values, amounted to the equivalent of $2.4 billion in 1985, $2.7 billion in 1986, $3.6 billion in 1987, and $4.4 billion in 1988.[10] The above figures are evaluated at the domestic prices. The magnitude of the output may, therefore, be exaggerated since the world prices are less than [or equal to] half of the domestic prices at the current exchange rates.[11] Although the value of
### TABLE 3.1. ELECTRONICS PRODUCTION IN IND (IN MILLION)

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**Source:** Annual Reports, Department of E
### Electronics Production in India from 1971 to 1988

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### Increment Until 1980

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<td>Sales (in Million Rupees)</td>
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<td>2800</td>
<td>3750</td>
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### Annual Reports, Department of Electronics, Various Years

TABLE 3.2

REAL GROWTH IN INDIAN ELECTRONICS INDUSTRY

<table>
<thead>
<tr>
<th>YEAR</th>
<th>INDEX [1970-71=100]</th>
<th>PRODUCTION [IN MILLION Rs.]</th>
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<td>1971</td>
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<td>1975</td>
<td>171</td>
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<td>1980</td>
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<td>1987</td>
<td>387</td>
<td>47200</td>
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<td>1988</td>
<td>401.5</td>
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SOURCE: DERIVED FROM TABLE 1 & ECONOMIC SURVEY, GOVERNMENT OF INDIA [VARIOUS YEARS]
production in 1985 accounted for approximately 6% of manufacturing value added in India it is relatively small by international standards. Even when compared with the production of $11.2 billion by the Republic of Korea [ROK] in 1986, the production of Indian electronics industry is less than one-eighth the size of the former.[12]

Table 3.3 presents the electronics industry output of selected countries.[13] The USA and Japan occupy the first and second places respectively. An overview of the electronics industries of India, Japan, ROK, and the USA in Table 3.4 clearly shows that output per capita in India is negligible even when compared to the per capita output of the Republic of Korea.[14]

Japan has strong consumer electronics and components sectors. In most areas other than computers, Japan's output, both in volume and value is greater than that of the USA.[Table 3.5] The large volume of production provides the Japanese electronics industry not only with advantages of economies of scale but also allows it to reinvest in development of technology.

Value added per worker for the Indian electronics industry in 1981-82 was about $2,440 per worker. This figure when compared with the corresponding figure per worker for ROK and USA of $10,000 [in 1982] and $25,000 [in 1980] respectively also exhibits the low level of
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CONSUMER ELECTRONICS</th>
<th>INDUSTRIAL ELECTRONICS</th>
<th>COMPONENTS</th>
<th>TOTAL OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>3.5</td>
<td>77.5</td>
<td>19.0</td>
<td>174.1</td>
</tr>
<tr>
<td>JAPAN</td>
<td>22.8</td>
<td>46.0</td>
<td>31.2</td>
<td>119.3</td>
</tr>
<tr>
<td>FRG</td>
<td>9.6</td>
<td>70.7</td>
<td>19.7</td>
<td>24.9</td>
</tr>
<tr>
<td>UK</td>
<td>5.5</td>
<td>77.6</td>
<td>16.9</td>
<td>18.3</td>
</tr>
<tr>
<td>FRANCE</td>
<td>4.8</td>
<td>76.3</td>
<td>18.9</td>
<td>16.9</td>
</tr>
<tr>
<td>ROK</td>
<td>34.8</td>
<td>18.8</td>
<td>46.4</td>
<td>11.2</td>
</tr>
<tr>
<td>ITALY</td>
<td>5.1</td>
<td>81.6</td>
<td>13.2</td>
<td>9.8</td>
</tr>
<tr>
<td>TAIWAN</td>
<td>26.6</td>
<td>29.7</td>
<td>43.7</td>
<td>6.4</td>
</tr>
<tr>
<td>SINGAPORE</td>
<td>15.1</td>
<td>30.3</td>
<td>53.6</td>
<td>5.6</td>
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<tr>
<td>CANADA</td>
<td>5.5</td>
<td>79.6</td>
<td>14.8</td>
<td>5.4</td>
</tr>
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<td>3.8</td>
<td>73.6</td>
<td>22.6</td>
<td>5.3</td>
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<tr>
<td>BRAZIL</td>
<td>23.5</td>
<td>51.0</td>
<td>25.5</td>
<td>5.1</td>
</tr>
<tr>
<td>HONG KONG</td>
<td>35.9</td>
<td>43.6</td>
<td>20.5</td>
<td>3.9</td>
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<tr>
<td>INDIA</td>
<td>34.6</td>
<td>45.2</td>
<td>19.2</td>
<td>2.7</td>
</tr>
<tr>
<td>WORLD</td>
<td>11.0</td>
<td>66.0</td>
<td>23.0</td>
<td>399.3</td>
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</table>

**SOURCE:** REFERENCE 12
### TABLE 3.4

**AN OVERVIEW OF ELECTRONICS INDUSTRY OF SELECTED COUNTRIES IN 1986**

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>Japan</th>
<th>ROK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Output [Billion US$]</td>
<td>2.71</td>
<td>119.30</td>
<td>11.20</td>
<td>174.1</td>
</tr>
<tr>
<td>Output/Capita [US$]</td>
<td>3.41</td>
<td>987.30</td>
<td>262.30</td>
<td>727.8</td>
</tr>
<tr>
<td>Exports as a % of Total Exports</td>
<td>1.79</td>
<td>26.33</td>
<td>19.26</td>
<td>NA</td>
</tr>
<tr>
<td>Output as a % of GDP</td>
<td>1.51</td>
<td>8.98</td>
<td>12.31</td>
<td>4.4</td>
</tr>
<tr>
<td>As a % of World Electronics Output</td>
<td>0.68</td>
<td>29.87</td>
<td>2.65</td>
<td>43.6</td>
</tr>
</tbody>
</table>

*Source: References 10 & 12*
<table>
<thead>
<tr>
<th>COUNTRIES IN 1986 [IN BILLION US $]</th>
<th>INDIA</th>
<th>JAPAN</th>
<th>ROK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSUMER ELECTRONICS</strong></td>
<td>0.99</td>
<td>29.89</td>
<td>3.90</td>
<td>21.6</td>
</tr>
<tr>
<td>Video Equip. (Total)</td>
<td>0.70</td>
<td>19.32</td>
<td>1.76</td>
<td>12.54</td>
</tr>
<tr>
<td>- VCR</td>
<td>0.09</td>
<td>11.16</td>
<td>0.76</td>
<td>4.11</td>
</tr>
<tr>
<td>- CTV</td>
<td>0.38</td>
<td>4.74</td>
<td>1.00</td>
<td>5.94</td>
</tr>
<tr>
<td>Audio Equip. (Total)</td>
<td>0.22</td>
<td>9.50</td>
<td>0.68</td>
<td>5.46</td>
</tr>
<tr>
<td>- Tape recorders</td>
<td>0.11</td>
<td>5.29</td>
<td>0.51</td>
<td>0.27</td>
</tr>
<tr>
<td>- Stereos</td>
<td>NA</td>
<td>4.20</td>
<td>0.17</td>
<td>1.71</td>
</tr>
<tr>
<td><strong>INDUSTRIAL ELECTRONICS</strong></td>
<td>1.00</td>
<td>50.33</td>
<td>2.11</td>
<td>95.60</td>
</tr>
<tr>
<td>- Wired Communication Equipment</td>
<td>0.39</td>
<td>9.50</td>
<td>0.73</td>
<td>6.80</td>
</tr>
<tr>
<td>- Wireless Communication Equipment</td>
<td>NA</td>
<td>4.40</td>
<td>0.23</td>
<td>3.97</td>
</tr>
<tr>
<td>- Computers</td>
<td>0.16</td>
<td>26.46</td>
<td>0.88</td>
<td>44.61</td>
</tr>
<tr>
<td>- Electronic Measuring Equipment</td>
<td>NA</td>
<td>3.39</td>
<td>0.06</td>
<td>5.50</td>
</tr>
<tr>
<td>- Other Applied Electronics Equip.</td>
<td>0.43</td>
<td>4.27</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- Office Automation Equipment</td>
<td>0.05</td>
<td>2.73</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>ELECTRONICS COMPONENTS &amp; DEVICES</strong></td>
<td>0.39</td>
<td>39.08</td>
<td>5.19</td>
<td>32.19</td>
</tr>
<tr>
<td>- Passive Components</td>
<td>0.15</td>
<td>7.06</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- Functional Compo.</td>
<td>NA</td>
<td>2.72</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- Mechanical Compo.</td>
<td>0.30</td>
<td>5.18</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- Electron Tubes</td>
<td>0.06</td>
<td>4.03</td>
<td>0.54</td>
<td>2.11</td>
</tr>
<tr>
<td>- Semi conductors</td>
<td>0.05</td>
<td>3.72</td>
<td>0.04</td>
<td>1.76</td>
</tr>
<tr>
<td>- ICs</td>
<td>0.01</td>
<td>11.98</td>
<td>0.16</td>
<td>9.15</td>
</tr>
<tr>
<td>- LCD</td>
<td>NA</td>
<td>0.42</td>
<td>NA</td>
<td>0.16</td>
</tr>
<tr>
<td>- Optoelectronics Devices</td>
<td>NA</td>
<td>0.86</td>
<td>NA</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>TOTAL OUTPUT INCLUDING DEFENCE ELECTRONICS</strong></td>
<td>2.66</td>
<td>119.30</td>
<td>11.20</td>
<td>174.10</td>
</tr>
</tbody>
</table>

**SOURCE:** REFERENCE 9
development of the Indian industry by international standards.[15]

3.4. THE STRUCTURE OF THE ELECTRONICS INDUSTRY

Three types of firms exist within the electronics industry of India: public sector firms [both, central government ownership and state government ownership], organized private sector firms, and small-scale firms. In 1988, there were over 2500 units in the electronics industry consisting of 11 Central Public Sector Units [CPSU] with 26 manufacturing establishments, over 60 State Public Sector Units [SPSU], approximately 400 units in organized private sector, and more than 2000 units in the small scale sector.[16] Actually the latter has over 3000 units but only 2000 units are estimated to be registered units. DOE reckons that out of a total of 2000 units which account for 75% of the total output in the electronics industry in India, the main contribution comes from 250 major units of which 100 units are in the small-scale sector.[17]

Table 3.6 gives the percentage of total electronics production by ownership in 1981. The public sector, which accounted for 60-80% of new investment, contributed 44% to the final output. Public sector along with the small-scale sector dominated the production. This is understandable because of the importance accorded to the public sector. Public sector firms dominate in industries producing communications and broadcasting equipment and in the aerospace
### TABLE 3.6

**TOTAL ELECTRONICS PRODUCTION BY OWNERSHIP IN 1981**

<table>
<thead>
<tr>
<th>PUBLIC (%)</th>
<th>PRIVATE (%)</th>
<th>TOTAL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIZED</td>
<td>SSI</td>
<td></td>
</tr>
<tr>
<td>Consumer Electronics</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>CIIE</td>
<td>39</td>
<td>31</td>
</tr>
<tr>
<td>Data Processing</td>
<td>31</td>
<td>34</td>
</tr>
<tr>
<td>Communications</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Aerospace &amp; Defence</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Components</td>
<td>28</td>
<td>45</td>
</tr>
<tr>
<td>TOTAL</td>
<td>44</td>
<td>25</td>
</tr>
</tbody>
</table>

**CIIE:** CONTROL, INSTRUMENTATION, & INDUSTRIAL ELECTRONICS

**SOURCE:** DOE ANNUAL REPORT, 1982-83

47
and defence industries. In addition, they accounted for over one-third of the output of control, instrumentation, and industrial electronics [CIIE] equipment. In fact, electronic items like very large scale integrated circuits [VLSIs] are still reserved for production by the public sector. It was only in 1987 that the main frame computers were allowed to be manufactured in the private sector.

Three public sector undertakings, viz., ITI, BEL, and ECIL dominate the large-scale electronics industry. They accounted for 25-30% of the total Indian electronics products in the early 1980s.[18] If small-scale firms are excluded the share of these three firms would rise to over 40%.[19] There has been very little overlap in their product domain and they have essentially thrived without any competition.[20]

Small-scale industrial units [S5Is] accounted for 31% of the total production in 1981. This is primarily because of their role in the consumer electronics sector. DOE estimates that in 1981, 61% of the production in consumer electronics segment was contributed by the S5Is. They also accounted for over one-fourth of the component production, which consisted mainly of components requiring low investments and simple assembly techniques for use in consumer electronics.[21]

The private organized sector which provided one quarter of output in 1981 accounted for 30% of total electronics
production in 1986. [Table 3.7] This share was marginally smaller than that of the public sector companies, both, central and state.

Since 1978, the emergence of the State Electronics Corporations [SECs] of the different states of India has played an important role in the development of Indian electronics industry. They had 57 units operational in 1986 and accounted for 6% of the total output. While the whole industry grew by 39% and 41% in 1984 and 1985 respectively, the SECs grew by 45% and 50%. [22]

The SSIs continued to play a dominant role by accounting for 38% of the total production. This can be attributed directly to the government's policy of reserving a number of activities for small-scale industries. [23]

There were over 750 firms in the electronics components industry in 1987. The top 5 companies contributed 35% of the output. The next 50 units contributed 30% of the output while the next 200 units contributed another 25% of the output. The remaining 400 units accounted for only 10% of the output. There are, therefore, a large number of firms with a marginal market share. In fact, only 150 units, inclusive of small scale units, can be considered as significant component manufacturers. These firms, in 1986, represented an annual output level of US $0.39 million [Rs 5 million] and above. [24]
### Table 3.7

**Electronics Production by Ownership in 1986**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Output [%]</th>
<th>Number of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Sector</strong></td>
<td>32</td>
<td>86</td>
</tr>
<tr>
<td>Central</td>
<td>26</td>
<td>29*</td>
</tr>
<tr>
<td>State</td>
<td>6</td>
<td>57</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>68</td>
<td>1770</td>
</tr>
<tr>
<td>Organized</td>
<td>30</td>
<td>220</td>
</tr>
<tr>
<td>Small-Scale</td>
<td>38</td>
<td>1550</td>
</tr>
</tbody>
</table>

* including Departmental Units

**Source:** DOE Annual Report, 1986-87
The total direct employment in the various sectors of the electronics industry [excluding computer software] has increased from 0.13 million in 1981 to 0.25 million in 1989. The public sector accounts for 40% of the total employment and provides the major employer units in the industry.[25]

3.5. ELECTRONICS EXPORTS

The Indian electronics industry has shied away from exports. Its orientation has been primarily to satisfy the requirements of the domestic market.[26] Total exports of electronics products constituted 2.9% of the total production in 1972-73 and were valued at approximately $8 million.[27] They increased to approximately $130 million in 1984 representing 8.2% of the total electronics production in the year. Electronics exports have averaged about 7% of the total production since the mid-seventies. [Table 3.8] Exports as a percentage of total production decreased to 5% in 1985 partly because of a slump in the global electronics market.[28]

Even this proportion of exports of electronics products in India is primarily due to the growth in the exports from the Santa Cruz Electronics Export Processing Zone [SEEPZ]. The exports from this zone, which was established in 1974, grew at a compound rate of 66% between 1980 and 1983 and 31% between 1980 and 1987. It accounted for over two-thirds of the total electronics exports in 1983 and 1984.
TABLE 3.8. EXPORTS OF ELECTRONICS PRODUCTS FROM INDIA: 1975 - 1988

(IN MILLION RUPEES)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSUMER ELECTRONICS</td>
<td>75</td>
<td>69</td>
<td>85</td>
<td>69</td>
<td>34</td>
<td>42</td>
<td>40</td>
<td>41</td>
<td>30</td>
<td>32</td>
<td>50</td>
<td>90</td>
<td>195</td>
<td>200</td>
</tr>
<tr>
<td>C I I E</td>
<td>54</td>
<td>39</td>
<td>18</td>
<td>18</td>
<td>31</td>
<td>29</td>
<td>30</td>
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<td>26</td>
<td>50</td>
<td>169</td>
<td>417</td>
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<td>0</td>
<td>0</td>
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<td>9</td>
<td>7</td>
<td>40</td>
<td>48</td>
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<td>280</td>
<td>420</td>
<td>580</td>
<td>850</td>
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<td>COMMUNICATION &amp; BROADCASTING</td>
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<td>18</td>
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<td>0</td>
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<td>0</td>
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<td>TOTAL DATA</td>
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<td>248</td>
<td>329</td>
<td>340</td>
<td>367</td>
<td>254</td>
<td>310</td>
<td>405</td>
<td>395</td>
<td>515</td>
<td>535</td>
<td>960</td>
<td>1820</td>
<td>3110</td>
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<td>EXPORT PROCESSING [EPZs]</td>
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<td>SEEPZ</td>
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<td>41</td>
<td>56</td>
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<td>165</td>
<td>255</td>
<td>485</td>
<td>750</td>
<td>1035</td>
<td>850</td>
<td>1005</td>
<td>1097</td>
<td>1442</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>TOTAL EPZs</td>
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<td>22</td>
<td>41</td>
<td>56</td>
<td>100</td>
<td>165</td>
<td>255</td>
<td>485</td>
<td>750</td>
<td>1035</td>
<td>850</td>
<td>1005</td>
<td>1097</td>
<td>1442</td>
</tr>
<tr>
<td>TOTAL EXPORTS</td>
<td>1.63</td>
<td>270</td>
<td>370</td>
<td>396</td>
<td>467</td>
<td>419</td>
<td>565</td>
<td>890</td>
<td>1145</td>
<td>1550</td>
<td>1545</td>
<td>2400</td>
<td>3120</td>
<td>4750</td>
</tr>
<tr>
<td>TOTAL PRODUCTION</td>
<td>3645</td>
<td>4092</td>
<td>5086</td>
<td>5886</td>
<td>6450</td>
<td>8060</td>
<td>8560</td>
<td>12050</td>
<td>13600</td>
<td>18900</td>
<td>26600</td>
<td>34600</td>
<td>47200</td>
<td>63000</td>
</tr>
<tr>
<td>EXPORTS AS A % OF PRODUCTION</td>
<td>4.47</td>
<td>6.60</td>
<td>7.27</td>
<td>6.73</td>
<td>7.24</td>
<td>5.20</td>
<td>6.50</td>
<td>7.39</td>
<td>8.42</td>
<td>8.20</td>
<td>5.81</td>
<td>6.94</td>
<td>6.61</td>
<td>7.54</td>
</tr>
</tbody>
</table>

SOURCE: ANNUAL REPORTS, DEPARTMENT OF ELECTRONICS, VARIOUS YEARS
Until 1986, the exports from the Domestic Tariff Area [DTA] were less than those from the Export Processing Zones [EPZs].[29] From 1987, the trend seems to have reversed. Initially the structure of exports was dominated by consumer electronics [viz., radio receivers, public address systems, etc.] but components and professional electronics have in recent years increased their share considerably. The figures in Table 3.8 do not fully bring out the significance of software exports which are almost wholly value added. The assembly operations in SEEPZ and other EPZs have value added in the range 15% to 40%.[30]

Electronics exports from India have been less than that of any other large, "domestically oriented countries" not to mention the "export oriented economies". Exports from Brazil averaged 11% and those from Indonesia averaged 18% of their total production in 1985. Table 3.9 presents the exports of electronics products from selected countries. It clearly indicates the relatively negligible contribution of the Indian electronics industry.[31]

Table 3.10 shows the export competitiveness of the electronics industry for India, Japan and ROK. The export competitiveness is defined in terms of the ratio of exports to total production. It is observed that the export competitiveness of India is extremely low compared to the other two countries. Although the export competitiveness of ROK is greater than that of Japan but the latter's exports
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>JAPAN</td>
<td>21.4</td>
<td>24.3</td>
<td>24.4</td>
<td>29.4</td>
<td>35.8</td>
<td>45.9</td>
<td>49.9</td>
<td>53.1</td>
<td>13.9</td>
</tr>
<tr>
<td>USA</td>
<td>21.0</td>
<td>23.5</td>
<td>24.3</td>
<td>26.7</td>
<td>31.8</td>
<td>31.0</td>
<td>33.5</td>
<td>34.6</td>
<td>7.4</td>
</tr>
<tr>
<td>FRG</td>
<td>9.8</td>
<td>9.0</td>
<td>9.9</td>
<td>8.8</td>
<td>8.9</td>
<td>13.0</td>
<td>17.6</td>
<td>20.5</td>
<td>11.1</td>
</tr>
<tr>
<td>UK</td>
<td>7.4</td>
<td>6.3</td>
<td>6.6</td>
<td>7.0</td>
<td>8.2</td>
<td>9.7</td>
<td>11.2</td>
<td>14.0</td>
<td>9.5</td>
</tr>
<tr>
<td>FRANCE</td>
<td>5.7</td>
<td>5.1</td>
<td>4.9</td>
<td>5.5</td>
<td>6.1</td>
<td>7.0</td>
<td>9.5</td>
<td>12.0</td>
<td>11.2</td>
</tr>
<tr>
<td>ROK</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
<td>3.0</td>
<td>4.4</td>
<td>4.6</td>
<td>7.2</td>
<td>11.0</td>
<td>27.6</td>
</tr>
<tr>
<td>TAIWAN</td>
<td>3.0</td>
<td>3.6</td>
<td>3.6</td>
<td>4.2</td>
<td>5.4</td>
<td>5.1</td>
<td>7.3</td>
<td>11.0</td>
<td>20.4</td>
</tr>
<tr>
<td>INDIA</td>
<td>0.05</td>
<td>0.06</td>
<td>0.09</td>
<td>0.11</td>
<td>0.13</td>
<td>0.126</td>
<td>0.19</td>
<td>0.24</td>
<td>25.1</td>
</tr>
<tr>
<td>OTHERS</td>
<td>27.0</td>
<td>30.0</td>
<td>31.5</td>
<td>40.5</td>
<td>43.9</td>
<td>34.7</td>
<td>53.0</td>
<td>60.8</td>
<td>12.3</td>
</tr>
</tbody>
</table>

Source: Reference 9, Table 3.8 & Economic Survey, 1988-89
<table>
<thead>
<tr>
<th></th>
<th>VALUE OF EXPORTS (MILLION $)</th>
<th>EXPORT COMPETITIVENESS [%]</th>
<th>VALUE OF EXPORTS (MILLION $)</th>
<th>EXPORT COMPETITIVENESS [%]</th>
<th>VALUE OF EXPORTS (MILLION $)</th>
<th>EXPORT COMPETITIVENESS [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSUMER ELECTRONICS</strong></td>
<td>6.6</td>
<td>0.67</td>
<td>17566</td>
<td>58.74</td>
<td>2926</td>
<td>75.86</td>
</tr>
<tr>
<td><strong>INDUSTRIAL ELECTRONICS</strong></td>
<td>13.2</td>
<td>3.26</td>
<td>3940</td>
<td>37.86</td>
<td>121</td>
<td>44.00</td>
</tr>
<tr>
<td><strong>COMPUTERS</strong></td>
<td>3.1</td>
<td>1.43</td>
<td>7913</td>
<td>29.89</td>
<td>707</td>
<td>80.24</td>
</tr>
<tr>
<td><strong>COMMUNICATION EQUIPMENT</strong></td>
<td>4.0</td>
<td>1.02</td>
<td>5706</td>
<td>42.39</td>
<td>426</td>
<td>43.10</td>
</tr>
<tr>
<td><strong>ELECTRONIC COMPONENTS</strong></td>
<td>6.3</td>
<td>0.16</td>
<td>18993</td>
<td>48.69</td>
<td>2989</td>
<td>57.88</td>
</tr>
<tr>
<td><strong>TOTAL INCLUDING OTHERS</strong></td>
<td>188</td>
<td>7.00</td>
<td>49900</td>
<td>41.83</td>
<td>7200</td>
<td>67.86</td>
</tr>
</tbody>
</table>

**Source:** References 9 & 10 & Tables 3.3 & 3.9
are approximately six times that of ROK. One of the reasons for low export competitiveness of India may lie in the high incidence of import duties on raw materials and components. In ROK, the customs duty is 15% while in India it is 80%, 90%, and 100% for components, computer components, and communication equipment respectively.[32]

3.6. ELECTRONICS IMPORTS

A World Bank study estimates import dependence of the Indian electronics industry to satisfy final demand as ranging from 25% to 30%.[33] The figures of the Directorate General of Commercial Intelligence & Statistics [DGCIS] in India estimate imports as percentage of total production [1979 to 1987] to be approximately 10% to 16%.[Table 3.11] These statistics report only CIF values and do not include customs duties.[34] Another study using import figures compiled from United Nations World Engineering Trade Statistics estimates imports of electronics industry as a percentage of total production during the years from 1975 to 1986 to be between 29% and 46%. [Table 3.11][35] In response to a question in the Lok Sabha, the minister concerned mentioned that India imported components and raw materials worth approximately US $930 million, US $738 million, and US $600 million respectively in 1987-88, 1986-87 and 1985-86 respectively.[36] These figures do not include foreign exchange outflow caused by imports of technology.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>3645</td>
<td>163</td>
<td>1057</td>
<td>NA</td>
<td>4</td>
<td>29</td>
<td>NA</td>
<td>80</td>
<td>NA</td>
</tr>
<tr>
<td>1976</td>
<td>4092</td>
<td>270</td>
<td>1107</td>
<td>546</td>
<td>7</td>
<td>27</td>
<td>13</td>
<td>83</td>
<td>94</td>
</tr>
<tr>
<td>1977</td>
<td>5086</td>
<td>370</td>
<td>1678</td>
<td>733</td>
<td>7</td>
<td>33</td>
<td>14</td>
<td>80</td>
<td>93</td>
</tr>
<tr>
<td>1978</td>
<td>5886</td>
<td>396</td>
<td>2067</td>
<td>694</td>
<td>7</td>
<td>35</td>
<td>12</td>
<td>78</td>
<td>95</td>
</tr>
<tr>
<td>1979</td>
<td>6450</td>
<td>467</td>
<td>2245</td>
<td>698</td>
<td>7</td>
<td>35</td>
<td>11</td>
<td>78</td>
<td>97</td>
</tr>
<tr>
<td>1980</td>
<td>8060</td>
<td>419</td>
<td>2853</td>
<td>832</td>
<td>5</td>
<td>35</td>
<td>10</td>
<td>77</td>
<td>95</td>
</tr>
<tr>
<td>1981</td>
<td>8560</td>
<td>565</td>
<td>NA</td>
<td>901</td>
<td>7</td>
<td>NA</td>
<td>11</td>
<td>NA</td>
<td>96</td>
</tr>
<tr>
<td>1982</td>
<td>12050</td>
<td>890</td>
<td>4562</td>
<td>1467</td>
<td>7</td>
<td>38</td>
<td>12</td>
<td>77</td>
<td>95</td>
</tr>
<tr>
<td>1983</td>
<td>13600</td>
<td>1145</td>
<td>6914</td>
<td>1772</td>
<td>8</td>
<td>51</td>
<td>13</td>
<td>70</td>
<td>96</td>
</tr>
<tr>
<td>1984</td>
<td>18900</td>
<td>1550</td>
<td>8477</td>
<td>2623</td>
<td>8</td>
<td>45</td>
<td>14</td>
<td>73</td>
<td>95</td>
</tr>
<tr>
<td>1985</td>
<td>26600</td>
<td>1545</td>
<td>11766</td>
<td>3355</td>
<td>6</td>
<td>44</td>
<td>13</td>
<td>72</td>
<td>94</td>
</tr>
<tr>
<td>1986</td>
<td>34600</td>
<td>2400</td>
<td>15842</td>
<td>4438</td>
<td>7</td>
<td>46</td>
<td>13</td>
<td>72</td>
<td>94</td>
</tr>
<tr>
<td>1987</td>
<td>47200</td>
<td>3120</td>
<td>NA</td>
<td>7428</td>
<td>7</td>
<td>NA</td>
<td>16</td>
<td>NA</td>
<td>92</td>
</tr>
</tbody>
</table>

M1: IMPORTS FROM WORLD TRADE STATISTICS, U.N
M2: IMPORTS FROM D.G.C.I.S., GOVT. OF INDIA
SOURCE: REFERENCES 24 & D.G.C.I. STATISTICS
All of these figures appear to be rough estimates. Most of the figures would under report imports because they fail to include imports through smuggling, under-invoicing [which are high for certain consumer electronics goods and for high-value components such as ICs], electronics incorporated in non-electronics goods, and incorrect declaration. A study by the Bureau of Industrial Costs & Prices under the Ministry of Industry reports:

The demand for components especially high tech and even medium technology components is met through imports. As there are import restrictions, a large percentage of imported components reach the country through illegal channels. The growth of the equipment industry, to some extent, depends on these illegally obtained components.[37]

Indian electronics industry is about 75% self sufficient in consumer electronics components but it imports more than two-thirds of its requirement of professional grade components. Over 95% of current consumption of integrated circuits [ICs] are imported. In fact 70% of material inputs used in electronics are imported.[38] The industry is also highly dependent on imported capital goods which are estimated to be as high as 85% of total requirements.[39] Table 3.11 shows a declining value of domestic availability ratios which reflects an increasing import dependence of the Indian electronics industry.[40]

An estimate of import content value involved in the total electronics production in 1988 [Table 3.12] is 11%. It is calculated on the assumption that percentage value of
TABLE 3.12. VALUE OF IMPORT CONTENT IN THE INDIAN ELECTRONICS INDUSTRY IN 1988

<table>
<thead>
<tr>
<th>PRODUCTION</th>
<th>IN MILLION RUPEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Electronic Equipment Production:</td>
<td>52750</td>
</tr>
<tr>
<td>Value of Components Produced</td>
<td>10250</td>
</tr>
<tr>
<td>Total Electronics Production</td>
<td>63000</td>
</tr>
</tbody>
</table>

**COMPONENTS**

Value of components used in equipments [Normally 30-35%, say one-third of equipments]: 17583

Indigenous production of components: 10250

Imported Components Used: 7333

**VALUE OF IMPORT CONTENT**

CIF Value of Imported Components [Average Customs Duty 75%]: 4190*

Import Content of Domestic Components [Value of Raw Material imported]: 3844**

CIF Value of Raw Material Imported in the above case [30% customs duty]: 2957***

Total Import Content: 7147

TOTAL IMPORT CONTENT AS A % OF TOTAL ELECTRONICS PRODUCTION: 11%

* 7333 / 1.75 = 4190

** Domestic components are evaluated to have 50% raw materials content and 75% of these raw materials are imported. [10250 x 0.5 x 0.75 = 3844]

*** 3844 / 1.30 = 2957

SOURCE: Personal Interviews & BICP Report
components used in manufacturing the equipment is about 33%. It further assumes an average customs duty on components and raw materials to be 75% and 30% respectively. Domestic components are assumed to have a 50% raw materials content. 75% of these raw materials are imported.

3.7. COST STRUCTURE

Table 3.13 presents an estimate of the cost structure for a finished product of the consumer electronics segment [CTV], computers segment (inclusive of mini and microcomputer production), and two different components, viz., an aluminium electrolytic capacitor [AEC] and a printed circuit board [PCB]. The cost of inputs are relative to the factory price exclusive of all taxes and excise.

The cost structure for a CTV reflects its assembly nature. The cost of labour and expenditure of capital [given by depreciation] are low as compared to the cost of materials. The latter constitutes approximately 70% of the factory price. In the case of a SSI [with relatively lower overhead], this figure can be as high as 80%.

At present there are about 40 CTV manufacturers of which the top five firms produce more than 0.1 million CTVs per annum. The rest produce less than 30,000. Although the market seems to be dominated by 10 firms which control about 80% of the market yet the profit margins have been steadily declining over the period. This is expected because the
### TABLE 3.13

**COST STRUCTURE OF SELECTED INDIAN ELECTRONICS FIRMS**

**FACTORY PRICE BEFORE EXCISE/SALES TAX = 100**

<table>
<thead>
<tr>
<th>COST ITEMS</th>
<th>CONSUMER ELECTRONS [CTV]</th>
<th>COMPUTER [*]</th>
<th>COMPONENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAPACITOR</td>
</tr>
<tr>
<td><strong>MATERIAL INPUTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imported</td>
<td>45</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Domestic</td>
<td>24</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Other Inputs</strong></td>
<td>9</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>[utilities, repair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maintenance etc.]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>64</td>
<td>70</td>
</tr>
<tr>
<td><strong>VALUE ADDED</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>4</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Interest</td>
<td>5</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Profit Before Tax*</td>
<td>12</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>22</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td><strong>EXCISE/SALES/OCTROI</strong></td>
<td>89</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td><strong>SALES PRICE</strong></td>
<td>189</td>
<td>128</td>
<td>128</td>
</tr>
</tbody>
</table>

[*] COMBINATION OF MINI & MICRO COMPUTER PRODUCTION

**SOURCE:** ADAPTED FROM INDIA: DEVELOPMENT OF THE ELECTRONICS INDUSTRY, THE WORLD BANK
Government of India has banned the imports of kits. The number of producers has also increased since 1982 when the CTV was first assembled in India. In addition, devaluation of the rupee with respect to Yen [from 24 Yens to a Rupee in 1983 to 10 Yens to a Rupee in 1988] has also affected the profit margins because of a large increase in material costs in the production costs.[41] A study indicates that although the turnover of a market leader in CTVs increased from, approximately, US $52 million in 1985-86 to US $66 million in 1986-87, its profit declined from US $3.2 million to US $1.09 million in the same period.[42]

The capacitor manufacture has the typical cost structure of production of a passive component. It is a capital intensive process as reflected by a relatively high depreciation. The material costs are also high and constitute 62% of the factory price.

PCB manufacture in India is essentially a labor intensive process. It exhibits a higher value added than the earlier two cases. The computer manufacture [mixture of micros and minis] represents a higher labor component. Although the labor costs required for assembly are only 1% of the total costs, the higher labor costs result from the requirement of substantial skilled labor for product development, systems designing, installation, service and repair.

Import duties and various taxes [sales tax, excise, octroi, etc.] account for a large proportion of the price of
a CTV which in the market varies from approximately US $540 to US $1156. They can be as high as 50% of the sales price. Import duties ranging from 85% to 145% on various imported components constitute approximately 30% of the sales price.[43] In the annual budget of 1989-90, the import duty on inputs for various components was raised by 5-10% and that on project imports was raised by 10%. In addition concessional excise duty on components was withdrawn and the excise duty on TV sets was increased substantially.[44] Table 3.14 presents a comparison of cost structure of components produced in India and abroad. It is based on an analysis of Profit & Loss accounts of various manufacturing units across different components.[45] Assuming the international price to be Rs 100, the table shows, that on an average, the indigenous components cost Rs 80 more than their international counterparts. Table 3.15 further shows the elemental distribution of this excess cost. The analysis is based on the assumption that the Indian scale of production is, on an average, ten times lower than the international level.

3.8. SCALE OF PRODUCTION

Production at a smaller scale is the most important factor in explaining the real differences in costs between manufacturer of components in India and their international counterparts. It accounts for approximately 46% of the
TABLE 3.14

COMPARATIVE COST STRUCTURE OF COMPONENTS MANUFACTURED IN INDIA & INTERNATIONAL MARKET

<table>
<thead>
<tr>
<th>COST ELEMENT</th>
<th>INTERNATIONAL MANUFACTURER</th>
<th>INDIAN MANUFACTURER</th>
<th>INTERNATIONAL PRICE=100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials</td>
<td>60</td>
<td>100</td>
<td>55</td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Long Term</td>
<td>2.5</td>
<td>8.5</td>
<td>5</td>
</tr>
<tr>
<td>- Short Term</td>
<td>3.5</td>
<td>13.5</td>
<td>7</td>
</tr>
<tr>
<td>Depreciation</td>
<td>6</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Salaries &amp; Wages</td>
<td>14</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Overheads</td>
<td>8</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Profits</td>
<td>6</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>180</td>
<td>100</td>
</tr>
</tbody>
</table>

SOURCE: INTERIM REPORT OF THE TASK FORCE IN ELECTRONIC COMPONENTS, SEPTEMBER 1988
### TABLE 3.15

**DISTRIBUTION OF EXCESS COST ELEMENTS**

<table>
<thead>
<tr>
<th>COST ELEMENT</th>
<th>TOTAL DIFFERENCE</th>
<th>DUTIES</th>
<th>INTEREST RATES</th>
<th>OTHER FACTORS [SCALE ETC.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials</td>
<td>40</td>
<td>33</td>
<td>-</td>
<td>7*</td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Term Loans</td>
<td>6</td>
<td>-</td>
<td>3.5</td>
<td>2.5**</td>
</tr>
<tr>
<td>-Working Cap</td>
<td>10</td>
<td>-</td>
<td>7.0</td>
<td>3.0***</td>
</tr>
<tr>
<td>Depreciation</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>6**</td>
</tr>
<tr>
<td>Salaries &amp; Wages</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3#</td>
</tr>
<tr>
<td>Overheads</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>7##</td>
</tr>
<tr>
<td>Profits</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>8###</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>33</strong></td>
<td><strong>10.5</strong></td>
<td><strong>36.5</strong></td>
</tr>
</tbody>
</table>

* Because of Bulk Buying

** Higher Project Costs [approximately twice the international cost] because of duty on capital goods, delays in implementation and scale of production.

*** Higher value of inventory because of higher cost of raw materials and higher lead time in their procurement. Also because of frequently changing and higher level of duties.

# Probably because of lower degree of automation and lower productivity of labor.

## Higher cost of infrastructural facilities and smaller scale.

### SOURCE: INTERIM REPORT OF THE TASK FORCE IN ELECTRONIC COMPONENTS, SEPTEMBER 1988
excess costs. Even for the entire electronics industry in India scale of production is next only to indirect taxes as the major reason for higher prices of electronics products in the country.

Economies of scale can arise as product specific [involved with volume of production of a single product, as is the case with learning effects] and/or plant-specific [related to the volume of production in the possibly multiproduct plant].[46] The electronics industry is a good example of the validity of the "learning curve" concept, which says that high technology can only be mastered through experiences of producing increasingly higher quantities with consequent decrease of per unit cost.

Scale is therefore important, both, in a technological [as defined above] as well as an organizational sense [economies of purchase, distribution and promotion] in an electronics industry. Technologically speaking, an adequate scale enables a firm to fully utilize incremental additions to equipment required to produce efficiently at acceptable levels of international quality and reliability. These scale minima therefore assume a "U" shaped long-run average cost curve for firms in the industry. A firm in the long-run, therefore, is expected to gravitate towards the lowest point on the average cost curve, also termed the minimum efficient scale [MES]. These scale minima are evidently
based on techno-economic judgements and are not precisely defined standards.[47]

Scale in the technical sense is important primarily for the electronics components industry which is relatively capital intensive and involves a longer gestation period. Large capacities then become necessary for economic viability on international scale and for ensuring product quality. This is, apparently a technical compulsion and made more so due to the increasing automation in the industry. Table 3.16 summarizes data related to prices and plant capacities of selected electronics components in the Indian and international context.

An example of items that need large scales for an efficient use include wave soldering machines, [c.i.f. price approximately US $40,000/machine] and in circuit testers used in computer and industrial electronics manufacturing [c.i.f price approximately US $300,000].[48] An Indian firm producing computers and its peripherals has been unable to use the two wave soldering machines, one semi-automatic assembly station and three board testers it imported at a substantial cost of approximately US $0.35 million. The reason lies in its producing only 20-30 boards/day as against its licensed capacity of 40-50 boards/day.[49]

The flexible nature of testing and measuring instruments is leading to a greater thrust on economies of joint production or economies of scope in the electronics
### Table 3.16. Prices & Plant Capacities in India and Abroad

**[International Price = Rupees 100]**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>Local Selling Price [In Rupees]</th>
<th>Typical Capacity IN INDIA [MILLION NOS.]</th>
<th>Typical Capacity ABROAD [MILLION NOS.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>B&amp;W Picture Tubes</td>
<td>170 - 180</td>
<td>0.5 - 1</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Semiconductor Devices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diodes</td>
<td>150</td>
<td>20 - 50</td>
<td>100 - 500</td>
</tr>
<tr>
<td>Transistors</td>
<td>140 - 150</td>
<td>20 - 40</td>
<td>300 - 500</td>
</tr>
<tr>
<td>Power Transistors</td>
<td>160</td>
<td>1 - 5</td>
<td>10 - 100</td>
</tr>
<tr>
<td>Integrated Circuits</td>
<td>150 - 180</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>LEDs</td>
<td>150</td>
<td>10 - 15</td>
<td>100</td>
</tr>
<tr>
<td>Hybrid Microcircuits</td>
<td>200</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Carbon Film Resistors</td>
<td>125</td>
<td>50 - 100</td>
<td>250 - 500</td>
</tr>
<tr>
<td>Metal Film Resistors</td>
<td>150</td>
<td>20 - 50</td>
<td>200 - 500</td>
</tr>
<tr>
<td>Potentiometers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Track</td>
<td>150</td>
<td>10 - 20</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Carbon Presets</td>
<td>130</td>
<td>5 - 20</td>
<td>100 - 500</td>
</tr>
<tr>
<td>Cermet Trimming Pots</td>
<td>230</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Metal Oxide Varistors</td>
<td>200 - 250</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>Plastic Film Capacitors</td>
<td>140</td>
<td>20 - 50</td>
<td>250 - 500</td>
</tr>
<tr>
<td>Aluminium Electrolytic Capacitors</td>
<td>150 - 180</td>
<td>30 - 60</td>
<td>500 - 1000</td>
</tr>
<tr>
<td>Ceramic Capacitors</td>
<td>150 - 170</td>
<td>75</td>
<td>300 - 500</td>
</tr>
<tr>
<td>Crystals</td>
<td>200 - 300</td>
<td>0.2</td>
<td>1 - 2</td>
</tr>
<tr>
<td>Loudspeakers</td>
<td>150 - 180</td>
<td>5</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Hard Ferrites</td>
<td>150</td>
<td>700 METRIC TONNES [MT]</td>
<td>10,000</td>
</tr>
<tr>
<td>Soft Ferrites</td>
<td>185</td>
<td>250 METRIC TONNES [MT]</td>
<td>5000</td>
</tr>
<tr>
<td>IFT's &amp; Coils</td>
<td>150</td>
<td>5</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Connectors</td>
<td>200 - 250</td>
<td>1.3</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Relays</td>
<td>250</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>Switches</td>
<td>150 - 200</td>
<td>0.5</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Deflection Components</td>
<td>150 - 200</td>
<td>0.2 - 0.5</td>
<td>3.5</td>
</tr>
<tr>
<td>D.C. Micro Motors</td>
<td>240</td>
<td>0.5 - 1</td>
<td>100 - 500</td>
</tr>
<tr>
<td>Tape Deck Mechanisms</td>
<td>180</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>Printed Circuit Boards</td>
<td>175 - 200</td>
<td>10,000 SQUARE METERS</td>
<td>100,000</td>
</tr>
<tr>
<td>Floppy Diskettes</td>
<td>170 - 200</td>
<td>1 - 3</td>
<td>60 - 100</td>
</tr>
</tbody>
</table>

**Source:** Electronics Components Industries' Association
industry. This concept is, in the Indian electronics industry, at too initial a stage to merit any consideration.

A number of electronics products are subject to what has been termed as "organizational" scale economies. The term organizational is used in the context of industrial economics and refers to scale or size which will lead to efficient marketing, distribution, services, economies of sourcing bulk purchases and effective research and development (R&D).

A high ratio of material inputs to final costs makes economies derived from bulk purchasing particularly important for the Indian electronics industry. As discussed in Table 3.12, DOE estimates that the raw materials constitute about 50% of the value of production of domestic components. Besides, 75% of the material inputs which constitute about 60% of the factory price of the components are imported. An international consulting firm has, [with data from international electronics industry], estimated that the cost of material inputs, viz., raw materials, semi-finished materials and components, declines in price by 5% to 8% for each doubling of quantity.[51] Industrialists in India also contend that savings of at least 15% can be achieved through bulk purchases of raw materials.[52] This figure is arrived at on the assumption that capacities of Indian firms are, on an average one-tenth of that of the firms abroad. As per the World Bank report bulk purchases
of imported materials in India can result in savings up to 40%. This in turn implies an increase in scale of 50 to 150 times the current levels of production in India. This may be true for some product lines in the Indian electronics industry.[53]

3.9. INDIRECT TAXES

Indirect taxes are import duties on raw materials and intermediate duties on raw materials (21%), central excise taxes (38%), state sales and excise taxes (29%) and state and central taxes (12%). The values in parentheses refer to the percentage contributed in each category by the electronics industry in 1983-84.[54] Table 3.15 shows that the incidence of duty on raw materials alone increases the prices of local components by 33 points out of the 80 point price difference with their international counterparts.

The duty on import of raw materials, components and piece-parts has been assumed to average 50% in the calculations. The duty on raw materials and on processed raw materials and piece parts since 1986 has been 30% and 45% respectively. The duty on moulds, tools and dies is 60%.[55] A study by the World Bank has found that the total indirect taxes contribute about 47% of the sales price for a CTV and about 22% to 23% for a micro computer, capacitor and PCB.[Table 3.13] The study also finds that while the duties on imported materials account for 8% to 12% of the final
sales price they comprise 26% to 43% of the total indirect taxes. Excise and sales taxes on final goods account for 10% to 29% of sales price. They comprise 40% to 62% of the indirect taxes.[56]

3.10. COST OF WORKING CAPITAL & FIXED ASSETS

Interest costs in the consumer electronics industry and associated components industry range from 4% to 7% of the factory price of the products. In capital and materials intensive products, represented by the components industry, the interest costs can be as high as 10-12% of the factory costs.[57] Firms in the public sector seem to have higher interest costs because of a higher proportion of the debt.

High interest costs reflect the high cost of working capital. The average nominal interest rate on term loans and working capital in India is 14% and 17% respectively. The working capital requirements are relatively higher for the equipment industry as compared to the components industry. The reason lies in higher inventory costs involved in the former. A six months inventory of imported raw material and components is considered a minimum by the firms given delays and uncertainties in delivery times, dealing with the government machinery and processing through customs. Inventory levels for indigenous materials and components also extend to three months because of transportation and other infra-structural bottlenecks.
In addition to the high cost of working capital, the banks insist on a 25% to 50% margin on working capital requirements in the electronics industry. This itself is much higher than what is required from the steel and aluminium industries in India where 10% to 15% margins are considered acceptable.[58] Furthermore, the banks carry out an independent appraisal of the project even after the financial institutions [which grant term loans] have accorded their approval. The delay supplemented by the higher margin requirement, escalates the project cost considerably and affects the working capital and interest thereon.[59]

Cost of fixed assets in India also tends to be substantially higher than in most other countries. It is because virtually all capital equipment for electronics production is imported. The domestic production of capital equipment is relatively new and lacks rigorous precision.[60]

The present duty structure for capital goods for the electronics industry has three rates of duties. It is 15% for a few specified items required for the manufacture of semiconductors, 30% for capital goods required for a new project and substantial expansion under project imports, and 60% for equipment for balancing/modernization. This and other existing policies for the electronics industry are
relatively more favorable to new units as compared to modernization/expansion of existing units. [61]

The construction and operation of an industrial unit in India takes longer than usual. Technical staff at DOE and project managers of electronics firms contend that a components project takes at least five years [as compared to two to three years abroad] from the application for a licence to the commencement of commercial production. The reasons range from delays in government's approval to infra-structural bottlenecks. [62]

High interest rates on term lending and working capital and other factors mentioned earlier are primarily responsible for lack of new investment in the Indian components industry. [63] Very low lending rates in Japan [compared to all other major countries] [Table 3.17] [64] has helped investments in facilities for research and production of semiconductors. Besides, the firms in Japan rely primarily on lending from banks rather than on the stock markets. [65] The high interest rates in India lead not only to a lower profit-ability but also to low debt-equity ratio of 2:1. The financial institutions feel that the components industry is not in a position to service a higher debt-equity ratio. It is therefore not surprising that Khandelwal Hermann Electronics Limited [KHEL] is the only company in the private sector to set up an automated
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>March 1988</th>
<th></th>
<th>March 1987</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>№%</td>
<td>№%</td>
<td>№%</td>
<td>№%</td>
</tr>
<tr>
<td>Bangkok</td>
<td>11.50</td>
<td>4.07</td>
<td>12.25</td>
<td>8.42</td>
</tr>
<tr>
<td>Bombay</td>
<td>14.00</td>
<td>4.62</td>
<td>15.00</td>
<td>5.65</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>6.00</td>
<td>-4.53</td>
<td>6.00</td>
<td>-1.38</td>
</tr>
<tr>
<td>Jakarta</td>
<td>23.00</td>
<td>14.35</td>
<td>23.00</td>
<td>14.96</td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>7.50</td>
<td>3.64</td>
<td>8.75</td>
<td>6.78</td>
</tr>
<tr>
<td>London</td>
<td>9.00</td>
<td>-2.15</td>
<td>10.50</td>
<td>5.68</td>
</tr>
<tr>
<td>Manila</td>
<td>16.00</td>
<td>-2.56</td>
<td>10.50</td>
<td>1.80</td>
</tr>
<tr>
<td>New York</td>
<td>8.50</td>
<td>1.86</td>
<td>7.50</td>
<td>3.53</td>
</tr>
<tr>
<td>Seoul</td>
<td>10.00</td>
<td>2.15</td>
<td>10.00</td>
<td>2.92</td>
</tr>
<tr>
<td>Singapore</td>
<td>6.25</td>
<td>2.37</td>
<td>6.50</td>
<td>4.99</td>
</tr>
<tr>
<td>Taipei</td>
<td>6.50</td>
<td>1.67</td>
<td>6.50</td>
<td>5.28</td>
</tr>
<tr>
<td>Tokyo</td>
<td>3.38</td>
<td>0.22</td>
<td>4.12</td>
<td>3.42</td>
</tr>
<tr>
<td>Zurich</td>
<td>5.00</td>
<td>-0.86</td>
<td>5.00</td>
<td>3.14</td>
</tr>
</tbody>
</table>

*Source: AsiaWeekly, March 18, 1988*
plant for the manufacture of semiconductors in the last ten years.[66]

3.11. PROTECTION

The domestic orientation of the industry is further encouraged by a high-protection environment. As a result, the firms lack any incentive to reduce costs and/or improve quality to lessen imports. The restrictive import policy provides protection through, both, high tariffs and quantitative restrictions which vary not only with different segments but even, frequently, with individual producers.[67]

It is a standard practice for the government to permit imports dependent on "deemed adequacy" of the local production. The imports can therefore be denied by the licensing authority if it considers the indigenous production [with no emphasis on quality or cost] to be sufficient to fulfill the domestic firms' requirements. The bias in favor of the domestic producer is based on the policy of "self reliance" and the onus is on the ultimate users to demonstrate inappropriate specifications and/or inadequate quality. However, it is not unusual for individual firms to influence the licensing authority in determining the products permissible for imports and extent of protection thereon.[68]
Imports of consumer electronics [and of personal computers] are, for the most part, "banned" despite nominal tariffs which, in certain cases, exceed 150%. Nominal protection remains high and varies from 30%-40% on electronics materials, 75% on certain components with 100% import duty on magnetic tapes for sound recording and 150% on video and computer magnetic tape. There is approximately 142% duty on all computer systems imported under Open General Licence and 140% on certain memory integrated circuits other than the eight standardized types. The duty on capital goods was raised from 25% to 30% in 1987. The moulds and dies, which constitute a substantial part of investment in electronics industry, carry an import duty of 55%.

Table 3.18 presents the nominal and effective protection rates on some of the components and final products in the Indian electronics industry. It is derived from a study by The World Bank and shows that the extent of effective protection is high, uneven, and anomalous. Quantitative restrictions practically provide infinite protection for domestically manufactured products except for software and most components. Moreover, customs duties on "non-electronic" materials used extensively in the electronics industry are quite high with no special exemption for uses in the electronics industry. As a result, costs to the downstream producers are high and the
<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>EFFECTIVE NOMINAL CUSTOMS TARIFF [%]</th>
<th>WATER IN THE TARIFF [%]</th>
<th>EFFECTIVE RATE OF PROTECTION [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPONENTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCB</td>
<td>75</td>
<td>36</td>
<td>-5</td>
</tr>
<tr>
<td>ALUMINIUM CAPACITOR</td>
<td>75</td>
<td>7</td>
<td>115</td>
</tr>
<tr>
<td>MICROMETER</td>
<td>93</td>
<td>-4</td>
<td>1312</td>
</tr>
<tr>
<td>BIPOLAR IC</td>
<td>75</td>
<td>-21</td>
<td>629</td>
</tr>
<tr>
<td>MEDIUM POWER DEVICE@</td>
<td>140</td>
<td>17</td>
<td>583</td>
</tr>
<tr>
<td><strong>WEIGHTED AVERAGE [COMPONENTS]</strong></td>
<td>79</td>
<td>21</td>
<td>114</td>
</tr>
<tr>
<td><strong>FINAL PRODUCT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLACK &amp; WHITE TV</td>
<td>111</td>
<td>39</td>
<td>38</td>
</tr>
<tr>
<td>COLOR TV</td>
<td>93</td>
<td>14</td>
<td>247</td>
</tr>
<tr>
<td>MICROCOMPUTER</td>
<td>150</td>
<td>4</td>
<td>#</td>
</tr>
<tr>
<td><strong>WEIGHTED AVERAGE [FINAL PRODUCT]</strong></td>
<td>107</td>
<td>23</td>
<td>150</td>
</tr>
</tbody>
</table>

* Refers to Tariff Adjusted for Excise & Other Indirect Taxes on Local Production, with no Equivalent Countervailing Duty Imposed on Exports or on Competing Imports.

@ Refers to the Types Manufactured in India

# Value Added at International Prices for the project was found to be negative.

**SOURCE:** ADAPTED FROM INDIA: DEVELOPMENT OF THE ELECTRONICS INDUSTRY, THE WORLD BANK
effective protection on products with competitive potential, viz., PCBs is negative.[72] Although the average effective rate of protection is approximately 114% and 150% for the components and final products respectively, it is over 1000% for some of the final products.

3.12. RESEARCH & DEVELOPMENT

Electronics technology is increasingly influenced by the concept of technological disequilibrium, i.e. at any given point of time, the component parts of a piece of equipment vary in their ability to exceed their level of performance. The latter in turn, is determined by the performance capacity of some limiting component in the system. It is therefore the performance capabilities of every component in the system which makes the final product attractive in terms of quality, reliability, durability and precision in the international market. This characteristic also makes research and development [R&D] with emphasis on new products, new technology, quality and reliability improvement, miniaturization combined with cost reduction particularly important for this industry.

It is mostly developed countries, viz., the USA, Japan, major West European countries and ROK [an exception], which are emphasizing R&D in all of the above factors. Table 3.19 presents an overview of R&D in the electronics industry in India, Japan, ROK, and USA. ROK and USA spend more than
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>49</td>
<td>10,169</td>
<td>363</td>
<td>17,469</td>
</tr>
<tr>
<td>ROK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL R&D EXPENDITURE BY MANUFACTURING INDUSTRIES (MILLION US$)**
- **India**: 337
- **Japan**: 45,680
- **ROK**: 938
- **USA**: 50,900

**R&D EXPENDITURE BY ELECTRONICS INDUSTRY (MILLION US$)**
- **India**: 49
- **Japan**: 10,169
- **ROK**: 363
- **USA**: 17,469

**PERCENTAGE SHARE OF R&D OF ELECTRONICS INDUSTRY**
- **India**: 14.60
- **Japan**: 22.26
- **ROK**: 38.74
- **USA**: 34.32

**R&D EXPENDITURE AS A % OF SALES IN ELECTRONICS**
- **India**: 1.99
- **Japan**: 5.25
- **ROK**: 4.11
- **USA**: 6.63

**TOTAL R&D PERSONNEL IN MANUFACTURING INDUSTRIES**
- **India**: 24,305
- **Japan**: 454,612
- **ROK**: 18,996
- **USA**: 749,560*

**R&D PERSONNEL IN ELECTRONICS INDUSTRY**
- **India**: 2,430
- **Japan**: 93,993
- **ROK**: 6,161
- **USA**: 444,500@

**% OF R&D PERSONNEL IN ELECTRONICS INDUSTRY**
- **India**: 10.00
- **Japan**: 22.00
- **ROK**: 32.40
- **USA**: 59.30

*Total Scientists & Engineers engaged in R&D in 1983
@Includes total employed in Electrical/Electronics in 1983

Source: Bowonder & Miyake, 1988
Science Indicators, 1985
one-third of their total R&D in the manufacturing industry in electronics while Japan spends approximately 22% of its total R&D in manufacturing sector in the electronics industry.

R&D expenditure as a percentage of sales should be interpreted with care when compared across different countries. For instance, although the overall R&D expenditure as a percentage of sales in the electronics industry of Japan has been 5.25% but the large firms like Hitachi, NEC, and Fujitsu spend more than 10% of their sales on R&D.[73] The corresponding figure in the case of Indian electronics industry is 1.99 but the magnitude of sales is between 1/5th to 1/10th of the firms in the other countries.[Table 3.20][74]

The nature of R&D is also very different in these countries. The USA, for example spent over $15 billion in 1980 in the areas of computers and office equipment and professional and scientific instruments.[75] Japan is increasingly spending higher R&D as a percentage of sales in development of semiconductors. ROK is also directing its R&D in the field of Integrated Circuits [ICs]. Samsung is the tenth firm in the world to produce 256K Dynamic Random Access Memory chips [DRAMs], after six Japanese and three US firms.[76] Indian firms are predominantly directing their R&D into indigenization of components and cost reduction of components related to the consumer electronics segment. The
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>FIRM</th>
<th>YEAR</th>
<th>R&amp;D EXPENDITURE [MILLION US$]</th>
<th>R&amp;D EXPENDITURE AS A % OF SALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIA</td>
<td>INDIAN TELEPHONE INDUSTRIES</td>
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<td>15.48</td>
<td>4.5</td>
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<td></td>
<td>BHARAT ELECTRONICS LIMITED</td>
<td>1986-87</td>
<td>7.90</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>ELECTRONICS CORPORATION OF INDIA</td>
<td>1986-87</td>
<td>1.89</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>SEMICONDUCTOR COMPLEX</td>
<td>1985-86</td>
<td>2.02</td>
<td>NA</td>
</tr>
<tr>
<td>JAPAN</td>
<td>HITACHI</td>
<td>1987</td>
<td>1934</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>NEC</td>
<td>1987</td>
<td>1846</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>TOSHIBA</td>
<td>1987</td>
<td>1220</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>FUJITSU</td>
<td>1987</td>
<td>1215</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>MITSUBISHI</td>
<td>1987</td>
<td>669</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>MATSUSHITA</td>
<td>1986</td>
<td>710</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>SHARP</td>
<td>1987</td>
<td>454</td>
<td>6.8</td>
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<tr>
<td></td>
<td>SONY</td>
<td>1986</td>
<td>390</td>
<td>4.9</td>
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<tr>
<td></td>
<td>SANYO</td>
<td>1986</td>
<td>389</td>
<td>6.0</td>
</tr>
<tr>
<td>ROK</td>
<td>GOLDSTAR</td>
<td>1985</td>
<td>429</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>SAMSUNG</td>
<td>1985</td>
<td>99</td>
<td>5.0</td>
</tr>
<tr>
<td>USA</td>
<td>IBM</td>
<td>1987</td>
<td>3998</td>
<td>7.4</td>
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<td></td>
<td>ATT</td>
<td>1987</td>
<td>2458</td>
<td>7.3</td>
</tr>
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<td></td>
<td>HEWLETT PACKARD</td>
<td>1987</td>
<td>901</td>
<td>11.1</td>
</tr>
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<td></td>
<td>DIGITAL EQUIPMENT</td>
<td>1987</td>
<td>1010</td>
<td>10.8</td>
</tr>
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<td></td>
<td>MOTOROLA</td>
<td>1987</td>
<td>524</td>
<td>7.8</td>
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<tr>
<td></td>
<td>UNISYS</td>
<td>1987</td>
<td>507</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>TEXAS INSTRUMENTS</td>
<td>1987</td>
<td>428</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>CONTROL DATA</td>
<td>1987</td>
<td>323</td>
<td>9.6</td>
</tr>
</tbody>
</table>

(Source: Bowonder & Miyake, 1988)
reliance is essentially on manual operations and semi-automatic techniques which act as a barrier in major R&D operations. However, there are exceptions. Hindustan Computers Limited [HCL], one of the primary computer manufacturing firms has successfully manufactured the world's second multi-processor. With more than 150 people, HCL's R&D team is considered fairly large in size by the standard of most vendors in India. [77]

Data on expenditure by the firms in the Indian electronics industry are not directly available because they are reported jointly with the firms in the electrical industry. The DOE proposes that 5% of the annual turnover should be spent on R&D and related activities. They however realize the difficulties in its enforceability. [78] The overall average expenditure by firms in all sectors of the electronics industry in India is approximately 2% of the annual sales. A recent study of Electronics Components Industries Association [ELCINA] indicates that approximately 20-25% of the component manufacturers have a serious ongoing R&D activity. These units are spending up to 3% of their sales on R&D. [79] R&D and design activities in CTV industry are practically non-existent. The majority of the CTV producers do not even have R&D facilities. Larger firms having an access to design departments and Computer-Aided-Design [CAD] facilities rarely use them for designing. Normal use of these facilities is for fault finding. [80]
In many of the firms interviewed, the R&D activity was nominal, non-existent or still under planning stage. Most of the firms seem to depend on the international firms for newer technologies and production processes. A number of firms in the consumer electronics industry have "informal arrangements" with major foreign suppliers which were predominantly Japanese firms. For instance Weston depends "informally" on Hitachi, ONIDA on JVC and ORSON on Sony for an access to new designs. The smaller firms have similar arrangements with firms in ROK and Taiwan. Such relationships also extend to manufacture of Personal Computers [PCs] where a lot of small manufacturers have made "unofficial" arrangements with firms in Singapore and Hong Kong. As these arrangements are not under government of India's [GOI] purview, the payments to them cannot be made through official channels. The foreign firms are more than adequately compensated through "tied" [unofficial] purchases of components at higher than usual prices.

Most of the R&D activity in India is carried out by the government laboratories, institutions, and the public sector. It is possible that the lower R&D activity in the rest of India's electronics industry is related to small scale of production which makes the former unprofitable. GOI tries to encourage R&D activities through liberalized imports, duty exemptions, tax incentives etc. A number of firms "misuse" these incentives because R&D expenditures are
not reported directly in the annual Profit and Loss statements of the firms. These expenditures are merged with salaries and wages and machines and equipment. Of late, GOI has been insisting that R&D expenditures be directly reported in the annual reports of the firms along with the corresponding achievements.[81]

3.13. FURTHER CONSTRAINTS

The basic shortcomings of a low quality-high cost industrial structure have been further compounded by infrastructural constraints and government policies on the supply side and slow growth of per capita income on the demand side. The electronics consumption has been found to be highly elastic to per capita income. A cross-sectional analysis covering 17 countries carried out by The World Bank estimated an income elasticity of 1.3. The elasticity increased to 1.5 when computed for 7 lower and middle income countries inclusive of India. The higher income countries therefore tend to have a greater demand for the electronic products. For instance, Turkey which has a per capita income six times that of India has a market equivalent although its population is barely 5% of the latter's.[82]

India's market size is constantly stressed as a catalyst for the growth of Indian electronics industry. Although the market has a considerable slack to absorb output, yet by international standards this is not
particularly large. As of 1983, it was barely larger than that of Indonesia. It was less than one-half of that of the People's Republic of China [PRC] and less than one-third of the market size of Brazil, Mexico, ROK or Taiwan. The potential, however, exists. In the words of The World Bank experts, "India's vast population does not translate into vast markets for electronics: at best it is the basis for potential markets." Similarly, as per the draft seventh five year plan, "The electronics industry in India is, however, small in size by international standards, though not in terms of inherent strength and potential for future growth."

The GOI's policies analyzed in the next chapter will discuss the supply side constraints further.
NOTES


   The definition given by Waterson is relatively more relevant in the case of an electronics industry than the alternative definition [Skinner & Rodgers] of an "industry" being a "set of firms in competition, manufacturing products which are of a like function and nature."


2. The electronics devices are defined as implements that make use of electronics moving in a vacuum, gas or a semiconductor.


3. A basic complexity is caused by the fact that a majority of the countries [including India] bracket the electronics industry with the electrical engineering industry for official statistical convenience. Distinguishing the magnitude of the electronics industry from this monolith is by itself a rigorous process.

4. It is therefore not surprising that electronics sales are not specifically segregated in standard industrial code classification. They are scattered among a number of different categories and, at times in different industrial segments.


This segment is estimated by the World Bank to be 10%-15% of the total consumer electronics sector production and may reach as high as 40% of reported production of radios and 25% of cassette recorders.

My interviews with the various firm owners in the consumer electronics sector indicated that a substantial amount of unreported production also exists in the case of B&W TVs.

9. Strictly speaking, the wholesale price index for manufactured products is inappropriate for calculating real values for the output of electronics industry. It is difficult to develop a common deflator because of the extreme diversity of different sectors. Besides, the electronic products are not adequately represented in this index. Moreover, there has been a significant fall in the prices of a large number of electronics products belonging to consumer sector, its associated components, and personal computers. At the same time prices of other components and prices of industrial electronics products has risen in the period under review. However, the price-performance ratio of electronics products has declined during the period. Also refer to note 4.


13. It is recognized that a large production is not necessary to reach a minimum efficient scale as long as the efficient firm size is not larger than the market. A comparison of the Indian electronics with the selected world leaders is, however, shown to emphasize its underdevelopment. In the developed countries the electronics consumption accounts for 7% to 10% of GDP. In India, the corresponding figure is less than 1%.
As per the World Bank report, [Op. Cit., The World Bank, 1987, pp. 5] the top four firms account for about 30% of the total production and the top ten for perhaps 60% in the organized sector. The figures on total concentration in the Indian electronics industry are misleading for two reasons. There are a number of segments in the total electronics industry and no two individual segments or sub-segments have similar concentration ratios. For instance, the public sector corporations have a near monopoly in Aerospace and Defence and Telecommunications. Other segments vary with respect to number of producers and the degree of competition. Besides, the product line of most of the firms is quite diversified. Consequently, it becomes extremely difficult to compute either a meaningful Herfindahl Index or even a Four-Firm concentration ratio.


The three public sector giants have an exclusive product area in different segments of the electronics industry. An overlap, if any, would at best be marginal. Their role is prominent in an overall performance of the electronics industry in India.


23. The Industrial & Licensing Policy Inquiry Committee presented its report to the parliament in 1969. In its opinion, an inadequate growth of small and medium scale entrepreneurs was the primary reason for the growing concentration of economic power in the hands of the larger houses. As a result the need for developing small and village industries to the maximum extent possible emphasized by the Industrial Policy Resolution of 1956 received a further fillip in the subsequent licensing policies of February 1970, 1973, etc.

At present there are approximately 24 items reserved for Small Scale Sector in the electronics industry. They range from T.V. Antennas to Digital Clocks to Low-Cost Radio Receivers.

The role of the small scale sector is being encouraged particularly for the manufacturing of assembly oriented equipments and smaller components which are required by the OEMs. SSI units are being helped further by exemption of excise duty. The organized sector was given three years to stop manufacturing the reserved items. Organized sector was also made responsible for purchasing 30% of their requirements of components/raw materials from ancillary units.


Background Papers of The Committee to Examine Principles of a Possible Shift from Physical to Financial Controls, Government of India, Ministry of Finance, New Delhi, 1985, p. 3.

Investing in India, Indian Investment Center, New Delhi, 1987, p. 27.


26. Interview of senior managers of public sector and private sector firms in the Indian electronics industry indicated that, in general, the firms do not even think of competing at an international level. The reasons are manifold. Some of them are discussed subsequently.


28. Ibid.

29. Domestic Tariff Area [DTA] is the geographical area in which domestic tariffs apply. It is distinguished from Export Processing Zones [EPZs] which operate on free zone principles. SEEPZ was the first of the EPZs to become operational in 1973-74. A recent incentive in EPZs allows an access of up to 25% of the total production into the DTA.


31. The exchange rates used for conversion from rupees to US dollars are mentioned in Appendix A.


The statistics relate to imports of merchandise into all the sea-ports, air-ports and land customs stations of the country. They do not include passengers' baggage. Quantity figures are net of packing and the values conform to C.I.F. The figures of this publication differ from the exchange control data compiled by the Reserve Bank of India [RBI] owing to differences in timing, coverage and valuation.

The various categories covered under the electronics industry are as per the Revised Indian Trade Classification, Revision-2 [I.T.C., Rev.2] with amendments. These categories were evolved on the basis of United Nations Standard International Trade Classification, Revision-2, [S.I.T.C., Rev. 2] and were adopted from April 1977.

Division 75: Office Machines & Automatic Data Processing
751: Office Machines
752: Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data into data media in coded form
and machines for processing such data not elsewhere specified [n.e.s].

759: Parts, n.e.s of and accessories (other than covers, carrying cases and the like) suitable for use solely or principally with machines of a kind falling within heading 751 or 752.

Division 76: Telecommunication & Sound Recording & Reproducing Apparatus & Equipment

761: Television receivers
762: Radio-broadcast receivers
763: Gramophones (phonograms), dictating machines and other sound recorders or reproducers (including record players and tape decks, with or without sound-heads; television image and sound recorders or reproducers).
764: Telecommunications equipment, n.e.s. and parts n.e.s. of and accessories for the apparatus and equipment falling within division 76.

776: Thermionic cold cathode and photo-cathode valves and tubes (including vapor or gas filled valves and tubes, cathode ray tubes, television camera tubes and mercury arc rectifying valves and tubes); photocells; mounted piezo-electric crystals; diodes; transistors and similar semiconductor devices; electronic microcircuits; and parts thereof, n.e.s.


36. Lok Sabha question No. 17, July 27, 1988. The figures have been converted into US dollars using the information in Appendix B.


38. Ibid., p. 7.


40. Domestic Availability = \( P/(P+M-X) \).

41. The Rupee devalued against all the major currencies. The electronics industry, in general, and the CTV industry, in particular, being import dependent, the increased prices of inputs directly affected the profit margins.


44. Although no excise duty is charged on the B&W TV up to 36 cms. a five fold increase from Rs 40 to Rs 200 was made on the excise duty on picture tubes of these sets. For B&W TV sets with screen size exceeding 36 cms the excise duty was ranged from Rs 300/set to Rs 500/set. In case of CTV three rates were fixed: Rs 2250 for sets without a remote control; Rs 2500 for sets with a remote control and Rs 4000 for sets with a picture-in-picture [PIP] facility.


47. The MES is also a function of prevalent and expected wage rate, the cost of capital, taxes, regulatory policies, etc. Needless to say, not all capital-intensive businesses are large-scale.


51. These are the findings of Arthur D. Little Incorporated. They are mentioned in "Global Sourcing Practice". 1985. These observations were also confirmed by Mr. G. K. Jiwarajaka, Director ECPL.


This was also confirmed by Mr. K. K. Khandelwal, Chairman & Managing Director, Khandelwal Hermann Electronics Ltd. He was a member of the Task Force and responsible for submitting recommendations on fiscal matters.

53. The Economies of scale define a relationship between the scale of use of a properly chosen combination of all productive services and the rate of output of an enterprise. The example of bulk-purchasing indicates its importance for the electronics industry. Cost advantages from bulk
purchasing are a necessary but not a sufficient condition for the economies of scale argument.


54. Ibid., p. 15.


57. Ibid., p. 29.


62. Personal Communication by officials at DOE & ITI.

63. The financial sector is not competitive in India. It was only with effect from April 1, 1988 that the rate of interest on deposits of scheduled commercial banks for 91 days and above but less than six months was raised from 6.5 percent to 8 percent [excluding Non-Resident External Rupee Accounts and Foreign Currency Non-Resident Accounts]. Effective April 11, 1987, the maximum lending rate for scheduled commercial banks was reduced from 17.5% to 16.5%. This ceiling of 16.5% was replaced by a floor rate of 16% effective from October 10, 1988 so as to grant greater freedom and flexibility to banks in fixing interest rates. A large spread between the lending and the deposit rate is an indicator of a financial market with little or no competition. This spread varies from 0.1% in case of Republic of Korea to approximately 3% for USA and Japan for the period under consideration.


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64. The Consumer Price Indexes [CPIs] are the most frequently used indicators of inflation since they reflect changes in the cost of acquiring a fixed basket of goods and services by the average consumer. The CPIs for the various countries in Table 17 are given in Appendix C. Real Rate of Interest = Nominal Rate of Interest - Rate of Inflation.


66. Personal Communication, Mr. K. K. Khandelwal, Chairman & Managing Director, Khandelwal Hermann Electronics Ltd. The cost of the project was Rs 15 crores.


68. It is the firms themselves which, after acquiring approval for technology imports, persuade the government to restrict entry of other firms in the industry and also for imposition of high import tariffs on the contract product. Political leverage enjoyed by the firm is therefore one of the important factors which determines the extent and nature of import restriction for a specific product. This also explains the frequent and often contradictory amendments to the Import Policy which the government of India issues from time to time. [Personal Communication by firms in the industry and also by the officials at ASSOCHAM and Greater Mysore Chamber of Commerce.]


70. Open General Licence is a category under the import policy where the imports of materials, components and/or capital goods are automatically permissible [subject to certain conditions and procedures laid down] for actual users.

71. The Effective Protection Rate is defined as the incremental value-added [due to the tariffs] divided by the value-added at c.i.f. prices.


"Water" in the tariff is defined as the percentage by which effective nominal tariff exceeds (or is less than) the percentage by which actual domestic price is greater than the landed c.i.f. price.
72. The most likely economic explanation for cases where, at international prices, value added becomes negative is that tariffs, quotas, exchange control, explicit subsidies to production, and/or implicit subsidization of public sector production facilitate investment to occur in such activities at obvious cost to the economy.


74. Personal interviews and questionnaires to major public and private sector firms in the Indian electronics industry.


77. Personal communication by Mr. Vishwanathan, Director HCL.


78. Personal Communication, Dr. S. M. Prasad, Director, Consumer Electronics, Department of Electronics, Lok Nayak Bhawan, New Delhi.


81. Personal interviews and inspection of annual reports of firms in the Indian electronics industry. Personal communication by Mr. Ajit Balakrishnan, Managing Director, PSI Data Systems Ltd.


83. Ibid.

84. Ibid.

CHAPTER FOUR

INDUSTRIAL POLICY: FRAMEWORK & PRACTICE

4.1. INTRODUCTION

The Industrial Policy Resolution [IPR] of April 6, 1948 defined the framework for the development of Indian industry. By envisaging a mixed economy, it demarcated the scope for industrial development in the private sector while simultaneously reserving some areas for exclusive development in the public sector.

Legislative sanction for the implementation of this resolution was provided in the Industries (Development & Regulation) Act [IDRA], 1951. The IDRA, by obligatory licensing, is instrumental in directing investments into various industries covered under its Schedule I.[1] Some industrial undertakings are exempted under the provisions of IDRA from obtaining a licence, but are required to be registered with the Directorate General Technical Development [DGTD] before they commence production.[2]

The Industrial Policy Resolution of April, 1956 incorporated into the industrial policy the national
objective of a "socialistic pattern of society" adopted by the Indian Parliament in December, 1954. It specified Schedule A industries as the exclusive responsibility of the state while the Schedule B industries were to be gradually state owned. The private sector was expected to supplement the state efforts. The right of the State to nationalize any existing industry in this category was explicitly specified. [3] Development of industries falling outside the two schedules was left to the private enterprise. [4] This resolution implicitly excluded foreign investment in vast sectors of the economy. It also sketched out the priority attached by the State to the growth of cottage, village and small-scale industries [5] on the one hand and to the development of backward areas through industrial dispersal on the other. [6]

4.2. REDUCTION OF CONCENTRATION OF PRIVATE WEALTH

The policy resolution of 1956 stressed the need for an equitable distribution of the gains of development. This implicitly assumed that the State, by its increased and active role, can achieve this objective efficiently. In addition to regulating the creation of new capacities in industry, the government of India [GOI] also introduced statutory provisions to curb concentration in the ownership of wealth.
The Monopolies & Restrictive Trade Practices [MRTP] Act of 1969 was based on the recommendations of the Monopolies Inquiries Commission of 1964. This commission viewed the industrial licensing as a source of concentration of economic power since the:

"...big business was at an advantage in securing the licenses for starting new industries or for expanding the existing capacity. We are convinced that the system of controls in the shape of industrial licensing, however necessary from other points of view, has restricted the freedom of entry into industry and so helped to produce concentration."[7]

The MRTP Act focuses on monopolies and restrictive trade practices by the firms in the Indian industries. It regulates the behavior of large industrial houses and/or dominant undertakings. Large industrial houses are those firms which by themselves or together with other interconnected firms have assets worth Rs 1000 million or more. Dominant undertakings, on the other hand are those firms which have a licensed capacity in excess of one-fourth of the total installed capacity in the country for that particular item. In addition, they have assets [singly or together with interconnected undertakings] of the value greater than or equal to Rs 10 million.[8]

For MRTP firms, prior approval of the GOI is necessary for substantial expansion, or for establishment of a new undertaking which, when established, would become inter-related, or for certain mergers, amalgamations, acquisitions
by purchase, and for takeovers. The MRTP Act does not discriminate between foreign and domestic companies.

4.3. PAYMENTS & TRANSACTIONS IN FOREIGN EXCHANGE

The Foreign Exchange Regulation Act [FERA], 1973 provides the regulatory framework for an investment by a foreign national or a foreign company in an Indian enterprise. It replaced an earlier Act of 1947 which did not have any provisions regulating the entry of foreign investment in India. Consequently, foreign branches and the expansion of foreign companies which were engaged in non-manufacturing activities and in acquiring control of other enterprises through purchase of shares or otherwise, were unregulated.

FERA applies to all non-residents, non-citizens of India, branches of foreign companies, and Indian companies having non-resident share holdings of more than 40%. It specifies permitted types of investment activity which must be approved by the Reserve Bank of India. In addition, foreign subsidiaries and Indian joint stock companies with non-resident participation of more than 40% have to obtain the Reserve Bank's permission to carry on in India, any activity of a trading, commercial or industrial nature.[9]
4.4. INDUSTRIAL POLICY STATEMENT OF 1980 & PRESENT POSITION

This statement followed the basis of the Industrial Policy Resolution of 1956. It enumerated eight socio-economic objectives. They were:

i. Optimum utilization of installed capacity

ii. Maximum production & higher productivity

iii. Higher employment generation

iv. Correction of regional imbalances

v. Strengthening of the agricultural base through agro-based industries and promotion of optimum inter-sectoral relationship.

vi. Promotion of export oriented industries

vii. Promotion of economic federalism through equitable spread of investment and dispersal of returns; and

viii. Consumer protection against high prices and bad quality.[10]

Numerous liberalizations were introduced in the industrial policy. The investment limit for small and ancillary industries was raised to Rs 3.5 million and Rs 4.5 million from Rs 2 and Rs 2.5 million respectively. The investment limit of MRTF companies in plant and machinery was raised from Rs 200 million to Rs 1000 million.

A new scheme was introduced for setting up of 100% export oriented units. This included facilities for duty-free import of capital goods, raw materials and components;
no restrictions were placed on foreign equity. In addition, a Special Board was constituted to ensure that single point clearances are given within 30 days from the date of receipt of an application.

Other major changes include schemes for re-endorsement of capacity expansion [11] and exemption from MRTP clearance of enterprises wishing to invest in backward regions and high priority areas.[12]

The government of India, recognizing the importance of economies of scale and the advantages of flexibility in manufacturing activities brought about by innovations in electronics, announced a plan of "broad-banding". The industrial enterprises can now apply for a licence to manufacture any items from a broad category of products rather than single items. The government contends this measure will facilitate capacity utilization and diversification of product range.

Industries with very high or high level of technical difficulty of production [13] and intensive use of skilled manpower constitute one of the criteria for "delicensing" an industry. Twenty-five different types of industries including those producing electrical equipment for exploration of other sources of energy, and electronics components were delicensed to facilitate investment. In addition, the investment limit for exemption of licensing was increased from Rs 30 million to Rs 50 million.[14]
The industrial policy changes in the eighties were initiated primarily to attract advanced technology for enhancing production for export and also to maintain the quality and competitive strength of the Indian industry. Consequently, in a practice typical of "interventionist economies," the Industrial Policy Statement of 1980 was followed by a comprehensive Technology Policy in 1983. This policy was enunciated to encourage efficient absorption and adaptation of foreign technology and to achieve technological self-reliance and competence. It was also decided to give export-import policies a term of three years rather than to introduce a new policy every year as was the previous practice.

The new Technology Policy encourages the import of technology which will increase production efficiency [or cost-effectiveness] or production of entirely new products. At the same time it re-emphasizes the primary objective of the GOI to be the development of indigenous technology and efficient diffusion of imported technology in accordance with national priorities and resources.[15]

4.5. POLICY CHANGES IN THE ELECTRONICS INDUSTRY

The policy structure governing the electronics industry until the eighties was closely linked to and guided by the policies and regulations governing other Indian industries. It evolved in the late sixties and early seventies as part
of a broader industrial policy change. These policies reflected the restrictions and regulations which were pervasive in the industrial sector. The emphasis on self-sufficiency, development of indigenous technology with minimal recourse to foreign technology, encouraging small-scale sector and reserving a large number of key products for manufacture in the public sector with a focus on geographical dispersion of the industry led to major constraints on the development of the electronics industry in India.[16]

A recognition of the importance of the electronics industry in industrial output and employment, and in productivity improvements in manufacturing and other sectors prompted the government to declare it a "sunrise" industry.[17] In addition, an awareness of the technology-intensive characteristic of this industry led to important policy changes pertaining to its growth and development.

4.5.1. **Policy on Electronic Components (1981):**

The beginning of liberalization of policies for the electronics industry can be traced back to the Policy on Electronics Components in 1981. This policy acknowledged the longer gestation period and capital-intensive nature of the components industry and recommended that the components should be manufactured on a large scale. Large capacities are consequently now considered beneficial for economic
viability on an international scale and for ensuring product quality. The import of technology is to be freely allowed to modernize and expand firm capacity.

The electronic components industry has been delicensed. Entrepreneurs desiring to set up production of components now only need to register with the Secretariat of Industrial Approvals [SIA] either before or after obtaining clearance for foreign collaboration and capital goods. Although no MRTP/FEFA clearance is required under sections 21 & 22 of MRTP Act, delicensing in case of MRTP/FEFA companies applies only if the units are set up in Centrally Declared Backward Areas.[18] In addition, there is no restriction on foreign equity for firms in 100% Export Oriented Units and for firms in industries with very high or high level of technical difficulty of production.


In February, 1983 a new policy encouraged all sectors of the industry except foreign equity companies to manufacture CTV sets. Foreign equity companies were included by a resolution dated January 1, 1986 and are subject to certain conditions [19]. The policy explicitly prohibited any foreign collaboration in the color television industry except on considerations of "special merit." Even in the exceptional cases, the collaboration has to be fully supported by a strong evidence of internal research and
development for continually updating the product line. [20]
The use of foreign brand names and CTV assembly from imported kits is not allowed. [21]

A set of fiscal and development measures pertaining to the electronics industry supplemented the above policies in August 1983. [22] The fiscal measures aimed to provide raw materials and other manufacturing inputs at the lowest cost. The customs and excise duties were reduced in order to accelerate the development of the electronics industry. Imports of computer systems and other finished systems were further liberalized. [23]

4.5.3. Private Firms & Telecommunication Equipment Manufacture (1984):

A major liberalization was introduced in March, 1984 in the form of a new Telecommunications Policy. It allows a relaxation from 100% Public Sector manufacture of telecommunication equipment. The private sector is now permitted to manufacture [with 100% ownership, if so desired] telecommunication equipment for installation at the subscriber's premises such as telephone instruments, electronic private branch exchanges [EPABXs], facsimile equipment, teleprinters, and data communication equipment. In addition, the cooperation of private enterprise may be secured in the manufacture of switching and transmission equipment with at least 51% share being held by the Central
or the State Governments and a maximum of 49% equity being held by the private sector entrepreneurs.[24]

4.5.4. **New Computer Policy (1984):**

A "New Computer Policy" was announced by the government in November, 1984. It allows any Indian company (including companies with foreign equity up to 40%) to manufacture micro-mini computer systems. However, 32-bit and higher bit supermini(mainframe computers are excluded. The manufacture of CPUs for mainframes and super mini-computers (as defined from time to time by the Department of Electronics [DOE]) was reserved for two years for manufacture by the firms in the public sector.[25] The policy also stated that a "price preference to public sector enterprises for government and public sector purchases of computers would be available as per prevailing government policy."[26]

Capacity restrictions in the computer industry were eliminated except for the minimum requirement of a viable capacity. The government allows capacity endorsements in accordance with the level of capital goods and other infrastructure availability. A liberal import of technology is allowed for the suppliers of CPU/Peripherals/Subsystems on an OEM basis. The import of designs and drawings, and systems/utility software is permitted in the initial period with a condition that the import of software should preferably be in the form of source code.[27]
4.5.5. **Integrated Policy Measures in Electronics (1985):**

In March, 1985 these reforms culminated with the Integrated Policy Measures in Electronics. It consolidated the earlier policy measures in a comprehensive policy statement allowing fiscal, licensing and procedural reforms in the industry. More areas of electronics components and electronics equipment were opened for all Indian companies including FERA companies. It proposed to issue "Broad band" industrial licenses in entertainment electronics, electronic toys, computer peripherals, electronic test and measuring instruments, and discrete semiconductor devices to "optimally" utilize the investments.

The policy emphasized provision of raw materials and manufacturing inputs at the "lowest cost." Consequently import duty on plant and machinery for modernization and balancing were reduced to 55%. For project imports i.e. projects involving initial investment or substantial expansion the import duty was fixed at 30%. In order to improve the R&D in the electronics industry, all equipment, raw materials and consumables were allowed on Open General Licence [OGL] and at zero percent duty. There are 83 instruments which are allowed at 55% duty to an institution of the manufacturer registered with the Department of Science and Technology [DST]. Computer peripheral devices which are imported for manufacture of computer systems for a
research institution are also exempted from custom duty. The electronics industry was included in Schedule IX of the Income Tax Act thereby allowing greater tax benefits. [28]


The Minimum Economic Scale guidelines were introduced in May, 1986. The government of India has laid out minimum scales for production of CTVs, printed circuit boards [PCBs], PABXs, VCR/VCP, ICs, etc. The minimum scale was defined to ensure that the industry does not lose out on scale economies. [29] The use of capacity minima represented a major shift from that of capacity maxima in determining licensing capacities, as had been the practice till then. It is an improvement over the earlier system because capacity maxima implied a fresh approval from the government in each case. The minimum scale guidelines have reduced the cumbersome and wasteful process of bureaucratic approvals.


A comprehensive policy on computer software export, software development, and training followed the MES guidelines in December, 1986. [30] This policy aimed at improving software exports by establishing a strong software industry in the country. Imports of hardware and/or software of computer/computer based systems were made easier for enterprises engaged in export-oriented software.

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development. The imports under this scheme, however, are tied to an obligation to export software. The export obligation is 250% of foreign exchange used if the imports are financed by the Government of India. Alternatively, if the imports are funded either by foreign participation, or with any other source permitted by the RBI [including foreign exchange entitlement as a result of excess exports], the obligation to export is 150% of the foreign exchange commitments.[31]

The electronics industry has also benefited from the industry-wide policy reforms, which include broadening the list of MRTP-exempted industries in 1982 and reducing controls on entry and growth of MRTP firms in 1985.[32]

4.6. POLICY & PROCEDURE FOR FOREIGN COLLABORATION

4.6.1. Objectives:

The government's Policy for Foreign Collaboration is selective and based on national priorities. Foreign collaborations are normally permitted in sophisticated and high priority areas. The priority may be defined by export-oriented manufacture or by an objective to attain competitiveness in the export market. Similarly, the firms which emphasize import-substitution or the firms which update existing technology to fulfill domestic requirements are eligible for foreign collaboration.[33]
The Government of India views foreign investment as a vehicle for the transfer of technology. Consequently, foreign investment unaccompanied by foreign technology is discouraged. The exceptions to the above rule relate to investments by Non-Residents of Indian origin [NRI] and those from Oil Exporting Developing Countries [OEDCs]. In the latter case, foreign investments, not exceeding 40%, in the equity of new ventures in specified industries, are allowed without being linked to technology transfer.[34] Similarly, the NRIs are allowed portfolio investments in Indian industrial units in certain schemes even in the absence of transfer of technology.

The foreign equity participation, even when accompanied with technology, is normally restricted to a 40% share. As discussed earlier, the GOI permits exceptions to the 40% rule for industries with highly sophisticated technology or for export-oriented units.

4.6.2. **Industrial & Intellectual Property Rights:**

Protection of industrial property rights and patents in the host country is a necessary condition for ensuring a smooth inflow of technology. The supplier needs to have confidence that his rights will be legally protected. The lack of such a legal system has been attributed to inadequate flows of investment and technology.
The two major laws on Industrial Property Rights [IPRs] in India are the Merchandising Marks Act of 1958 and the Indian Patent Act of 1970. Trade marks must be registered and renewed annually and are fully protected in India.

The Indian Patent Act of 1970 emphasizes self-reliant technological development. It does not allow product patents on food and drugs and on products related to atomic energy and space application. It provides protection to processes. Renewal of patents is required to ensure protection of the rights entailed therein.

Approximately seventy percent of patents registered in India are overseas patents. In 1985-86, 2,525 out of a total of 3,526 patents registered in India were foreign patents. The USA accounted for about 25% of these patents. [35] The patents registered by Non-Resident Indians steadily declined during 1971-1985 while the Indian and foreign patents remained at almost the same level during that period. [36]

4.6.3. Approval Mechanism:

The process of approval for a foreign collaboration agreement is a part of the industrial approval process. The entrepreneurs may apply for a collaboration either along with the application for the licence of a new firm or after setting up the undertaking. In the former case, the entrepreneur can submit a composite application requesting
approval for a foreign collaboration, for import of capital goods and raw materials, and either for the establishment of a new firm or for a technical modernization/modification/expansion of the enterprise, simultaneously.[37] In the second instance, the entrepreneur is first given a Letter of Intent which gives permission for the setting up of an undertaking. It also stipulates whether a foreign collaboration can be considered. The entrepreneur is expected to acquire land, secure finances, obtain approval for imports of capital goods and have a foreign collaboration within the validity of the Letter of Intent [one year]. An entrepreneur can make an application for converting the Letter of Intent into an Industrial Licence after fulfilling the above conditions.

Under the existing procedures, Letter of Intent, approval for foreign collaboration, and clearance for import of capital goods should be issued within 60 days of the application's receipt. In the case of MRTP companies, clearance is expected to take 90 days. The Government of India has fixed time-frame for disposal of composite applications, even in MRTP cases, at 90 days. The applications from Non-Resident Indians must be processed within 45 days and the proposals for 100% EOUs within 30 days of their receipt.[38]
4.6.4. **Approval Committees:**

The Secretariat for Industrial Approvals [SIA] in the Ministry of Industry & Company Affairs, Department of Industrial Development, functions as a centralized agency for processing applications for industrial licences, foreign collaborations and import of capital goods. SIA circulates copies of the non-MRTP applications to the Licensing Committee.[39] The MRTP cases are circulated to the Licensing-cum-MRTP Committee.[40] Both committees are chaired by the Secretary, Department of Industrial Development.

Proposals for foreign collaboration are first examined in consultation with the Technical Evaluation Committee [TEC]. TEC has regular meetings where representatives of the applicants are also invited, if necessary, to furnish detailed clarifications regarding indigenous availability of technology and with respect to efforts to locate alternate sources of technology.[41]

All proposals for approval of foreign collaboration from large, medium and small scale entrepreneurs are considered by the Foreign Investment Board [FIB]. The concerned Administrative Ministries have powers to deal with applications for foreign collaborations, without reference to FIB, in instances where the applicant does not have any foreign equity investment and no foreign equity is envisaged in the proposal. Besides, the proposed foreign exchange
outflow, on royalty and lump sum should not exceed Rs 10 million during the period of collaboration. The FIB, has supervisory functions to evaluate applications even when the primary responsibility rests with the concerned Administrative Ministry. The FIB normally makes decisions on applications within 45 days. It is chaired by the Secretary, Ministry of Finance.[42]

All composite proposals involving two or more clearances relating to industrial licence, foreign collaboration, and import of capital goods are approved by the Project Approval Board [PAB]. The PAB is chaired by the Secretary, Department of Industrial Development and has a composition similar to that of the Licensing Committee.

The Licensing proposals of MRTP/FERA companies are submitted to the Cabinet Committee on Economic Affairs [CCEA]. Similarly, cases with investment in plant, machinery, and fixed assets exceeding Rs 200 million are submitted to CCEA. Foreign investment, if exceeding forty percent of the equity or if it is more than Rs 20 million in equity, also requires a prior clearance by CCEA.[43]

The Capital Goods Committee considers requests for imports of a value more than Rs 10 million. Applications for import of capital goods from Rs 2.5 million to Rs 10 million are administered directly by the licensing authority, viz., Chief Controller of Imports & Exports [CCIE]. Applications below Rs 2.5 million are disposed of
by the respective regional licensing authorities. The capital goods committee is chaired by the Secretary, Ministry of Industry.[44]

A separate committee administers applications for setting up 100% Export Oriented Units [EOUs] in the Domestic Tariff Areas [DTAs]. It is chaired either by the Secretary or the Additional Secretary, Ministry of Commerce. The composition of this committee is similar to that of the Licensing-cum-MRTP committee with the Export Commissioner from the office of Chief Controller of Imports & Exports [CCIE] as an additional member.

In November, 1983, a special approval committee was constituted [with the Secretary, Department of Industrial Development, as chair], to clear all industrial investment proposals from Non-Resident Indians. This committee decides and monitors their applications regarding issue of industrial licence, approval for foreign collaboration and import of capital goods.[45] This facility was established to provide an incentive for industrial investments by Non-Resident Indians.

The registration for delicensed units is also done by the Secretariat for Industrial Approvals. There is no restriction on import of capital goods or foreign collaboration. The applicant can obtain approval for entering into a foreign collaboration or for importing capital goods, if required, either before or after the
registration. The entrepreneurs also have the option to register their units with DGTD provided the investment in fixed assets does not exceed Rs 50 million. Additionally, prior approval for the import of capital goods and foreign collaboration, if any, should have been obtained.[46]

Most of these committees meet at least once a month and consider applications on the basis of information supplied by the applicant, the comments received from technical authorities, views of the Administrative Ministries, the availability of indigenous capabilities, and the exigency of the imported equipment. In MRTP cases additional approval is required from the Department of Company Affairs. Appendix C provides a schematic representation of the foreign collaboration approval process.

4.7. STANDARD CONDITIONS OF FOREIGN COLLABORATION APPROVAL

The approval given for a foreign collaboration is valid for a period of six months from the date of issue. The Indian firm can execute the foreign collaboration agreement only if it accepts the terms of collaboration approved by the Government of India. The agreement is scrutinized by the concerned Administrative Ministry and, if found in accordance, is taken on record. A copy of the agreement is then transmitted to the Reserve Bank of India [RBI] through the Ministry of Finance on which basis the RBI authorizes remittance to the foreign collaborator.
4.7.1. **Guidelines for Foreign Collaboration Approval:**

The general guidelines for approval of the terms of foreign collaboration by the GOI are as follows:[47]

i. The foreign equity participation, if any, should not be linked to imports of machinery and equipment, technical know-how [TKH], trade marks, brand names, etc. Equity participation, if allowed on a non-cash basis, will be accompanied by a compulsory export obligation.

ii. Recurring Royalty payments will be considered depending on the nature of technology. They will, however, normally not be allowed to exceed 8%.[48] The royalty will be calculated on the basis of ex-factory selling price of the product minus the cost of excise duty, standard bought out components and the landed cost of imported components. The payments of the royalty will be restricted to 125 percent of the annual licensed/registered capacity. Payment of royalty for any production exceeding that quantum requires prior approval of the GOI. The GOI prefers the rate of royalty to be linked to a unit or volume of production. In no case is a minimum guaranteed royalty allowed. The royalty payments will be subject to applicable Indian taxes.[48]
iii. The GOI may approve lump-sum payments for import of drawings, documentation and know-how. Generally, the royalty payments and the lump-sum payments taken together are kept within 8% of ex-factory value of production during the period of agreement.[49] The lump-sum payments are to be phased out in three equal installments with the first part to be paid after the agreement has been taken on record. The remaining two installments are paid on delivery of technical documentation and on the commencement of commercial production or after completion of 4 years after the agreement is taken on record, whichever is earlier, respectively.

iv. The duration of the agreement will be for a period of five years from the date of record of agreement or five years from the date of commercial production provided the latter is not delayed beyond three years of taking the agreement on record. Although a maximum period of eight years from the date of record of the agreement is allowed but the period of royalty payments was restricted to five years. It has recently been extended to seven years in exceptional cases.[48]

v. The use of foreign brand names for internal sales will generally not be permitted. There is no objection to their use on products to be exported.
vi. The Indian licensee should be free to sub-license the know-how, product and engineering designs, to another Indian firm/institution. The terms of sub-licensing agreements will be jointly determined by the Indian firms, the supplier of technology and the Government of India.

vii. There will be no restrictions on exports of contract products to any country, except to countries where the foreign collaborator already has licensing arrangements.

viii. Deputation of licensors' technicians and other personnel to Indian firms or vice versa will be subject to the prior approval of the Reserve Bank of India.

ix. In the case of items of manufacture patented in India, the Indian company will be free to manufacture that item even after the termination of the technology collaboration agreement without any further payments. A separate clause to this effect will be inserted in the collaboration agreement.[50]

x. The agreement should not have clauses which in any way bind the licensee to the procurement of capital goods, components, spares, raw materials, pricing policy, or selling arrangements.

xi. There should be no provision for payment of interest on delayed payments.
xii. Suitable provisions should be made for the training of the firm's personnel in the fields of production and management. In addition, the Government of India has stipulated an additional measure to ensure an early and "effective" absorption of imported technologies. A condition in collaboration approvals requires companies to establish design and research facilities to avoid continued dependence on foreign technology. All firms having collaboration agreements involving technology payments of over Rs 20 million are obligated to involve R&D personnel in technology acquisition. In addition they are required to submit a time bound program for technology absorption, adaptation and improvement [TAAI] within six months of the issue of the foreign collaboration approval.

xiii. These firms must set up in-house R&D facilities recognized by DSIR or enter into a long-term consultancy arrangement with relevant R&D institution in the country within a period of two years of receiving the foreign collaboration approval letter. A failure to fulfill any of these conditions carries punitive measures as specified by the Government of India from time to time.[51]

xiv. The Government of India also stipulates that the collaboration agreement must allow an indigenous R&D institution, [identified for the purpose of examining
the TAAI plans], access to the production unit of the Indian enterprises.

4.7.2. **Extension of Foreign Collaboration Agreements:**

Applications for extension of collaboration agreements are scrutinized carefully. The extension approval is given subject to GOI's satisfaction of its necessity. In case where extensions are granted every effort is made to reduce the rate of recurring royalty.

The Government of India considers applications for extension based either on the sophistication of manufacture or if a longer duration is "deemed" necessary to enable the licensee firm to fully absorb the know-how. If the collaboration agreement involves manufacture of a large number of contract products then an extension is granted only to those few commodities whose production commenced at a later date. An extension is also favorably considered if it encourages exports of the contract product. Approximately 15% of the agreements approved in recent years have been extended.[52]

4.8. **LACK OF TRANSPARENCY IN POLICIES**

The objectives of the Indian industrial policy, apparently, are many. These are a varied mix of social and economic criteria and are therefore frequently conflicting. Regulations are pervasive and approvals of committees are
customarily required. It is interesting to note that the committees have common members except for the chairmanship which varies [relatively speaking] for different committees. The meetings of the approval committees are from once or twice a month to once a week. With common members it is obvious that there are strong possibilities of delays in making decisions not to mention the lag in their executions.

The approvals are often inconsistent, discretionary, and/or ad-hoc. The reason may lie in an inter-ministry conflict of interests. The conflict arises because different controlling ministries have diverse governing interests. For instance, the foreign exchange is earned by firms which are directly controlled by the Ministry of Industry. The earnings of foreign exchange are governed by the decisions of the Ministry of Commerce. Foreign exchange expenditure of the firms, on the other hand is controlled by the Ministry of Finance.

Lack of communication between the various government agencies further complicate the issue. In addition, frequent transfers of the middle and senior level bureaucrats confound the final outcome. To quote a member on the committee to Examine Principles of a Possible Shift from Physical to Financial Controls, [1985]:

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"...Our control system has become a combination of a dense jungle and a maze, mainly because of the operation in practice of the classical formula of the controlling organs of Government that 'decisions should be made having regard to the circumstances of each case'. This means, in practice, arbitrarily and even whimsically".[53]
NOTES

1. The industries not falling within the 1st Schedule to the IDRA are outside the purview of the Act. The Act applies to only those establishments which employ 50 or more workers with the aid of power or 100 or more workers without the aid of power.

   Background Papers of the Committee to Examine Principles of a Possible Shift from Physical to Financial Controls; Government of India, Ministry of Finance, 1985, p. 17.

2. Even in regard to industries covered by the 1st Schedule, GOI has exempted investments up to Rs 50 million in fixed assets and plant and machinery from the need for licensing subject to fulfillment of certain conditions. A large number of industries which do not require foreign exchange input or which are being established on the basis of technology by the national laboratories are totally exempted from licensing irrespective of the investment. However, it must be ensured that the manufactured product is not reserved for the small-scale sector. Additionally, the undertakings should not belong to MRTP/FERA houses.

   Ibid., p. 17.


4. In the first category [Schedule A] were industries of basic and strategic importance and public utility services. It lists 17 items with some of them, viz., Railways, Air Transport, Arms & Ammunition, and Atomic Energy exclusively intended for manufacture/providing service by the Central Government.

   The second category [Schedule B] includes important minerals, aluminium and several non-ferrous metals, machine tools, certain alloys, basic and intermediate chemicals, antibiotics and fertilizers. Twelve industries were included in this category.
Schedule C includes all other industries. The State reserves the right to enter this category too.

Ibid., pp. 1, 2.

5. Small scale units are units with investment in plant and machinery not exceeding Rs 3.5 million.

Investing in India, Indian Investment Center, New Delhi, 1987, p. 110.

A medium scale enterprise is one whose investment in plant and machinery is not more than Rs 50 million.

Personal Communication, Deputy Director General, DGTD.

A Large scale enterprise is one whose investment in plant and machinery is more than Rs 50 million.

Personal Communication, Deputy Director General, DGTD.


8. The threshold limit for MRTP companies' assets was increased from Rs 200 million to Rs 1000 million in March 1985. The concept of a dominant undertaking was also modified to include "....having licensed capacity in excess of one-fourth of total installed capacity...."


11. Under the scheme for re-endorsement of capacity expansion announced in September, 1980, excess capacity over licensed/registered capacity in the case of 34 basic and mass consumption industries could be recognized subject to the condition that the manufactured product is not reserved for small-scale sector. [Ibid., p. 17.]

12. In order to disperse the industries in "Backward Areas" and to provide an incentive for the industrialization of "No-Industry Districts" in the country, the Government of
India has a scheme of outright subsidy. Rates of subsidy on fixed capital investment, viz., land, building and machinery have been fixed on the basis of categories depending upon the level of backwardness. Category 'A' districts consist of no-industry districts and special regions. Industries in these areas are allowed an investment subsidy @ 25% s.t. ceiling of Rs 2.5 million. The rate of Central subsidy for category 'B' and 'C' districts has been fixed at 15% or Rs 1.5 million and 10% or Rs 1 million whichever is less, respectively. In the matters of licensing, also similar preferences are provided. [Ibid., p. 18.]


13. The products with very high level technical difficulty of production are characterized by fast-changing technology, and a difficulty of gaining access to the current technology because of its proprietary nature associated by the lack of industrial infrastructure and engineering and design services.


15. Foreign Direct Investment & Technology Transfer Policy in India & Korea, Indian Investment Center, Mimeographed, 1988, p. 52.


17. According to an estimate capital required per unit of employment in the electronics industry is approximately Rs 32,000. An investment of Rs 10 million will generate 312 new jobs. The number of jobs created with Rs 10 million investment in some of the major industries are: 33 for Chemicals and Petrochemicals; 35 for Power generation and distribution; 103 for Pulp, Paper and Paper products; 126 for Machinery Manufacturing and 246 for Electrical Equipment. However, a caveat is essential. This is not true at the margin. [Commerce, December 14, 1985, p. 1070.]

18. Refer to Note 10. All areas under the three categories are eligible [w.e.f. April 1, 1983] for outright Central Investment Subsidy as well as Concessional Finance. However, the block/taluka/urban agglomerations/extensions of township in Categories B & C, which have exceeded an investment limit of Rs 300 million as on March 31, 1983 are excluded. [Op. Cit., Jain, R. K., 1987, p. 195].

"....It has now been decided that foreign equity companies with foreign equity not exceeding 40% would be allowed to participate in this industry. However, these companies will be required to supply not less than 25% of their production in kit form to small scale units for five years from the date the unit goes into production."


22. These were formulated in "Measures to Further Accelerate the Rapid Development of Electronics," in August 1983.

23. 134 raw materials were allowed @ 30% duty. Diffused wafers, discs and chips for electronics industry attracted 60% duty. 30 electronic components were allowed at 75% duty while project import duty for setting up or substantial expansion of industrial units manufacturing electronic items was reduced to 30%.


Under the IPR-1956, Schedule `A' lists the industries whose future development will be the exclusive responsibility of the State. It mentions, "....Telephones and telephone cables, telegraph and wireless apparatus (excluding radio receiving sets)." Thus telephone and associated equipment could be manufactured only in the public sector. In view of this new liberalization a necessary amendment to the IPR-1956 is under consideration.


25. Mini-computers based on 32-bit chips or equivalent are permitted to any Indian company in the private or public sector. Manufacture of micro and mini-computer systems is permitted without any restriction on capacity except a
minimum requirement of a viable capacity and a phased manufacturing program.


26. Ibid.


28. Ibid., pp. 3, 6.


34. This liberalization was introduced by the GOI vide its Press Note dated 28 October 1980.


39. The Licensing Committee is constituted by Secretary, Planning Commission or his nominee; Secretary, Ministry of Finance [Department of Economic Affairs, (DEA)]; Secretary, Ministry of Commerce or his nominee; Secretary, Department of Science & Technology [DST] or his nominee; Secretary, concerned Administrative Ministry or his nominee; Director General, Directorate General Technical Development [DGTD],
or his nominee; Development Commissioner - Small Scale Industries [DCSSI]; Joint Secretary in-charge of SIA [Member Secretary]; Director General, Council of Scientific & Industrial Research [CSIR] or his nominee; Secretary, Department of Defence Production or his nominee; Secretary, Department of Environment or his nominee; Secretary, Ministry of Agriculture & Cooperation or his nominee.

40. Licensing-cum-MRTP committee is constituted by Secretary, Department of Company Affairs or his nominee in addition to the members of the Licensing Committee.


41. Technical Evaluation Committee has members from the DGTD, DST, CSIR, National Research and Development Corporation, Defence Science Organization and the Administrative Ministry. It has the benefit of advice from DCSSI and the Textile Commissioner in order to take a considered view of the proposals.

42. The FIB is composed of Secretary, Ministry of Finance [Department of Economic Affairs, (DEA)]; Secretary, Department of Industrial Development; Director General, Directorate General Technical Development [DGTD]; Secretary Department of Petroleum; Secretary, Ministry of Commerce; Secretary, Planning Commission; Secretary, Department of Company Affairs; Secretary DST; Secretary CSIR; Secretary of concerned Administrative Ministry; Executive Director of the RBI; Joint Secretary in charge of SIA [Member Secretary]


44. The membership of the Capital Goods committee consists of the Secretary, Ministry of Industry; Representatives of Department of Economic Affairs; Representatives of Planning Commission; Representatives of Company Affairs; Representatives of DGTD; Representatives of CCIE; Economic Adviser, Ministry of Industry; Joint Secretary, SIA [Member Secretary]. Representatives of administrative ministries (Ministry of Commerce; Ministry of Petroleum; Chemical & Fertilizers; Ministry of Steel & Mines; Department of Electronics [DOE]; etc.) are associated with the Committee when capital goods applications pertaining to their ministries are considered. Representatives of DCSSI, Industrial Finance Corporation of Indian [IFCI; Industrial Credit & Investment Corporation of India [ICICI]; Industrial Development Bank of India [IDBI] and the Indian Investment Center [IIC] are also invited to attend the meetings of the Capital Goods committee.

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45. The Board of Approvals for 100% EOUs is composed of the Secretary, Department of Industrial Development, Ministry of Industry; Secretary, Planning Commission or his nominee; Secretary, Ministry of Finance [Department of Economic Affairs, (DEA)] or his nominee; Secretary, Ministry of Commerce or his nominee; Secretary, Department of Science & Technology [DST] or his nominee; Secretary, concerned Administrative Ministry or his nominee; Director General, Directorate General Technical Development [DGTD], or his nominee; Development Commissioner - Small Scale Industries [DCSSI] or his nominee; Joint Secretary in-charge of SIA [Member Secretary]; Director General, Council of Scientific & Industrial Research [CSIR] or his nominee; Secretary, Department of Company Affairs or his nominee; Secretary, Department of Environment or his nominee; Secretary, Ministry of Agriculture & Cooperation or his nominee; CCIE or his nominee; Chairman, Central Board of Excise & Customs or his nominee; and Executive Director Indian Investment Center or his nominee.


48. In 1986 the withholding tax on royalties was lowered from 40% to 30% and in early 1987, the limit for royalty payments was increased from 5% to 8%. Higher rates of royalty payments can be allowed for more complex technologies. [Op. Cit., The World Bank, 1987, p. 44]

The period of royalty payments was increased to 7 years in July 1988. "A higher period of royalty payments can also be considered where the foreign collaboration proposals pertain to high technology and also in cases where the technology adoption would invariably take a longer time." [The Economic Times, July 6, 1988, p. 1.]

49. This is a general guiding principle, as per personal communication by an Industrial Advisor, DGTD. Another "internal" guideline is that the lump-sum payments should not exceed 50% of the total payments for the technology transferred. [Personal Communication, Assistant Advisor, Indian Investment Center].

50. This clause has the implicit effect of reducing the term of patent protection for the patent holders.
An estimate based on official Indian data indicates that 7.5% of the agreements from 1977 to 1980 were between the same two firms which had earlier made an agreement. They were also for the same class of products. Other data based on information from technology exporters suggest a greater frequency of renewals which are not always direct or overt.


CHAPTER FIVE

A THEORY OF LICENSING CONTRACTS

5.1. TECHNOLOGY & MARKET IMPERFECTION

Technology is the knowledge relating to transformation of inputs into outputs. The imperfections in the market for "knowledge" can be largely attributed to its having characteristics of a public good. It can be used in another "set up" without its value being substantially impaired. Moreover, the marginal cost of employing information in another environment is considerably less than its average cost of production and transfer.

The transfer of technology takes a number of different forms: "hardware", such as machines and/or equipment; "software", such as blueprints, formulae and/or process specifications; and the service of technicians, professionals and managers for quality improvement, management and marketing know-how, process and product design, testing, erection and commissioning of plant, etc. Market imperfections exist in each of these forms. The transfer of technology implies bringing one or more of these
forms together in a comprehensive package in keeping with the firm's objectives. The degree of imperfection increases with the size of the technology package.

The imperfection arises from what Arrow [1962] has termed "a fundamental paradox in the determination of demand for information." It arises because the purchaser is forced to make a bid for the information without being able to assess its value completely.[1] The licensor has pre-contractual superior information pertaining to the value of the product but he does not share it with the licensee for fear of imitation. The licensee as the less knowledgeable party "has to be educated as to the value of the technology without, paradoxically, revealing too much."[2]

An uneven distribution of information implies an informational asymmetry with consequent problems of opportunism and costly monitoring. The buyers have a lack of knowledge about the technologies to be purchased. In formulating a demand for technology, a buyer, as in the purchase of other commodities, needs information about the commodity to make an appropriate decision. However, in the case of technology, and unlike in the purchase of other goods, the commodity is information. A buyer is therefore searching for information about information.[3] Furthermore, the seller of know-how is in possession of the knowledge even after it has been transferred to a buyer.
There is, consequently, a structural weakness implicit in being a buyer of technology.

The problem for the purchaser is compounded by incomplete information about the relative merits of alternative technologies available. Further imperfection will be caused by the fact that the specific technology package transferred by each licensor firm will be defined by the rents it expects from the licensee. There are substantial differences in the relative size and bargaining strengths of both the buyers and sellers of technology.

5.2. TECHNOLOGY LICENCES & TECHNOLOGY PACKAGES

A technology licence consists of a transfer of technology or a proprietary advantage from one firm or an institution to another.[4] There exists a considerable overlap in the modes of technology transfer discussed earlier. For instance, direct foreign investment may be combined with licensing agreements between parent firm and subsidiaries.[5] Similarly, joint ventures between transnational corporations and indigenous firms often include licensing agreements in addition to management, marketing, and technical assistance contracts. Often a turnkey project between the multinational firm and a local enterprise may include provisions for licensing and other contractual agreements after start-up.
For the purpose of this study, a purchase of capital goods is considered the simplest form of a licensing contract because the supplier firm frequently agrees to offer informal assistance in setting up manufacturing capabilities. The international trade in capital goods has been an important vehicle for technology transfer. There are numerous industrial sectors where the "technological trajectories" are crucially dependent upon, inter alia, the complementary relations between producers and users of capital goods. Moreover, a transfer of technology in industrial sectors with inadequate experience in producing and/or operating equipment invariably includes the supply of capital goods in addition to technical know-how and technical assistance.

In spite of this, the studies of technology transfer have failed to consider the "technology packages" in general and capital goods in particular. In fact, an inadequate treatment of capital goods has been a major shortcoming of the earlier technology transfer studies. There are only a few empirical studies which have identified the nature of technology elements and the success of transfer. Rosenberg [1976] and Stewart [1978] have also frequently emphasized the treatment of the capital goods industry, both as a source of technology and as the locus for the accumulation of technological capacity.
5.3. **CLASSIFICATION OF LICENSING CONTRACTS**

The licensing contracts can vary along many dimensions. They can differ with respect to the following categories:

5.3.1. **Specification of Rights:**

Licensing agreements can be exclusive or nonexclusive. In the former case the licensor relinquishes all production rights [and frequently market rights too] in favor of the licensee. In a nonexclusive contract the licensee does not have any presumptive rights, either territorial or manufacturing. Empirical evidence suggests that more valuable technologies are normally licensed under a non-exclusive agreement.[11]

5.3.2. **Contents of the Agreement:**

The elements of a licensing agreement may include one or more of the following:

a. Technical Documentation & Know-how
b. Technical Assistance
c. Managerial/Marketing Assistance
d. Patent Rights
e. Trademark Rights
f. Supply of Capital Goods, Components and/or Raw materials.
g. Buy-back of the licensee's product.
5.3.3. **The Form & Size of the Payment:**

It has been observed that among the various types of payments received by the licensor, there are only a few whose explicit function is to compensate for the transfer of technology and the right to make use of it. This is because a licensing contract normally covers several ancillary services both preceding the application of the contract and those following the transfer of technical information to the licensee. Theoretically these services have been shown to be independent of the price paid for the technology. [12] Practically, however, they do influence the nature of the technology licensing contract.

Most licensing contracts include [13]:

a. Front-end or Lump-sum fees and/or

b. Royalties which can be a constant per unit royalty or a constant percentage of sales royalty or a sliding nonlinear royalty scheme with different amounts for internal sales and exports sales.

c. Net margins and commissions on materials and/or goods supplied.

d. Value of grant backs [innovations or improvements made by licensee].

e. Fees for other specific services rendered.
5.3.4. **The Division of Rents Between Licensor & Licensee:**

Even in the absence of patents and proprietary rights, the technology cannot be considered as freely available. An innovation imparts a control to its inventor which manifests in the market as a monopoly power. Based on the postulate of market theory that the objective of any business is to maximize profits, the seller will attempt to get the highest price for the knowledge being sold.[14] He will try to create a surplus between the income derived from the sale of technology and its cost. The transfer of technology by the supplier represents giving up the "first mover" advantage. Consequently, the licensor will sell the technology only if he receives income equivalent to his opportunity cost i.e. the revenue derived from using the technology himself. The costs may vary from direct costs of technology transfer to sunk costs for the technology developed and to the opportunity costs for losing export sales and opportunities for direct foreign investment in the technology recipient's country or in mutually agreed upon territories.[15] The State supports the concept of allowing the inventor to recover his outlay in terms of expenses and the risks borne. He is allowed to sell at a monopoly price which helps him to achieve a profit margin higher than the normal.

Figure 5.1 and Figure 5.2 indicate the rent received by the owner of a new product or process technology respectively which will determine the theoretical selling
FIGURE 5.1
REN T FOR THE LICENSOR OF A NEW PRODUCT

[Diagram showing the relationship between price and quantity with the equation $MC = 0$ at a certain point $Q$.]
FIGURE 5.2
RENT FOR THE LICENSOR OF A NEW PROCESS

[Diagram showing economic concepts with labeled axes and curves, including price, quantity, MC2, AC1, AC2, and shaded area representing rent.]
price of the given technology. The owner of a new product technology will maximize his profits by supplying a quantity $Q_s$ at the price $P_s$. The rectangular area $LMNP_s$ defines the economic profit or in financial terms, the monopoly rent.

In the case of a new process technology, the owner will increase his production where his lower marginal cost equals the market price $P_1$ which is the same for all suppliers. In this case the area $L_1M_1N_1P_1$ determines the monopoly rent or the theoretical selling price.

The licensor would like to get the entire monopoly rent before he agrees to transfer his property rights. He will, however have to share some of this rent with the recipient in order for him to enter the agreement. The share may allow the licensee enough remuneration to cover at least the opportunity cost for his factors of production. If there is perfect competition between the buyers of technology, the rent received by the licensor will reach the optimum. The proportion of the rent shared is thus dependent on the competitive environment of the contracting parties.

A technology transfer agreement will consequently be a function of the compensation formula for the payments to be received by the licensor over the period of the agreement and the contents of the agreement. The contents will specify not only the "quantum" of technology being transferred but also the restrictions imposed, obligations and other constraints on the two parties and the duration of
the contract. By "packaging" the knowledge with different elements of transfer, the seller may be able to obtain a higher price than if the elements were sold separately.

The buyer firm's objective is to maximize its profits. The firm owners attempt to pay the lowest price for a given package of technology. Their endeavor is frequently aided by the host government's policies regulating the transfer of technology.

5.4. DEVELOPMENT OF MODEL

5.4.1. Basic Model:

Gallini and Wright have used signaling theory to predict the incidence of exclusive and non-exclusive technology licensing contracts along with the accompanying compensation scheme. Their analysis is based on the implicit constraints of technology transfer, viz., pre-contractual asymmetric information by the principal [i.e. a licensor having superior information on the economic value of the technology] and the problem of imitation by the agent [i.e. sharing of information with the licensee eases the process of imitation by the latter].[16] The objective of the principal is to design a contract which will maximize the rent accruing from the transaction. Let

\[ Q = (n, F, r(x)), \]  

where

\[ Q = \text{Licensing Contract which may be exclusive or nonexclusive.} \]
n = Number of Licensees.
F = Up-front Fixed Payment.
r(\mathbf{X}) = General Payment Scheme as a function of observable Output \mathbf{X}.

If the imitation cost, I, is sufficiently high [i.e. \( I \geq \) simple monopoly profits from the new (low cost) technology - simple monopoly profits from the old or a (high cost) technology], such that imitation by the licensee is not a problem, the licensor can directly reveal the new technology to a potential licensee even before signing the formal contract. Full monopoly rent can then be extracted in the form of a lump sum payment equivalent to the licensee's increase in profit or the cost of imitation, whichever is lower.

If the cost of imitation, I, is less than the profit \( \pi_i \) of a simple monopoly with marginal cost \( C_i \), the possibility of imitation by the licensee becomes an important consideration for the licensor. The principal can then make a take-it-or-leave-it offer to the agent through a rent maximizing payment schedule which will discourage imitation. The acceptance of that offer by the licensee will be in the form of payment of an up-front fixed fee, F. It is only after the technology is fully transferred can a licensee decide on whether or not to imitate.

As a result, under symmetric information, when the type of innovation, i, were common knowledge (i.e. the technology type [superior] but not the specifics necessary for
imitation are public information), the licensor can extract maximum rent from the transaction by offering a contract to a single licensee with only a fixed fee, \( F = \pi_i \). The equilibrium contract will then be

\[ Q_i = (1, \pi_i, 0) \]

Under asymmetric information too, the objective of the licensor is to attempt to maximize total payments received in a manner which will dissuade the licensee from imitating. In this case, however, the licensor maximizes his total payments subject to the constraint of rationality and the constraint of no imitation.

\[ F \leq S_i(Q) - r(X_i(Q)) \quad [\text{Rationality}] \]

i.e the total payments received by the licensor are not greater than the profits \( S_i(Q) \), gross of the up-front fixed fee \( F \) and output based royalty \( r(X_i(Q)) \), earned under the contract \( Q \). \( r(X_i(Q)) \) is therefore the general payment scheme for an observable profit maximizing output \( X_i(Q) \) chosen by the licensee for a given technology under the contract \( Q \). Moreover

\[ S_i(Q) - r(X_i(Q)) \geq W_i(Q) - I \quad [\text{No Imitation}] \]

where \( W_i(Q) \) represents the profits expected under imitation. This equation suggests that the revelation of technology does not provide an incentive for the licensee to imitate at cost \( I \). The licensor with the superior [drastic] [17] technology will use an output-based royalty to extract additional rents because the upfront fixed fee is limited
and cannot exceed the amount of the profits from the run-of-the-mill (higher cost) technology. For drastic technologies, Gallini and Wright argue, that, both exclusive nonlinear contracts [also known as sliding royalty or a paid-up licence] and nonexclusive linear contracts can extract full monopoly rents [i.e. they are equally efficient] when imitation costs are sufficiently large.[18]

For a sufficiently small imitation cost, I, [i.e. where \( I < \) the difference between monopoly profit from using the new low cost technology and that from the high cost technology \( (\pi_A - \pi_B) \) or alternatively, there is a large rent differential between the innovations], and for a drastic technology, asymmetric information may force the licensor to share some of the technology rents with the exclusive licensee. This is true even in the case of a competitive market for the licensee and even if the licensee's opportunity cost of entering into the contract is zero. The licensor cannot increase the upfront fee to extract all rents left with the licensee to prevent imitation except, in the case of a run-of-the mill technology. The post-contractual payments cannot be increased for the fear of encouraging imitation. Such rent sharing is independent of the patent or trade secret laws and has been widely supported by empirical evidence. Since the equilibrium contract will yield some rents with the licensee, only nonexclusive contracts will be offered.[19]
For a non-drastic or run-of-the-mill technology [a less profitable or lesser known technology] [20], exclusive linear contracts will perform as well as exclusive nonlinear contracts. Linear contracts will, however, occur more frequently because of their robustness [especially of the payment mode] and also because of the prevalence of run-of-the-mill technology.

Let $S$ denote the setup costs required to use the technology. It is assumed that $S$ is incurred prior to production from the new technology and they apply to both the original innovation and any subsequent imitation. Since they are incurred after the technology is revealed and transferred they do not, unlike the upfront fixed payment, contribute to the asymmetry.

Then for a small setup cost i.e the difference in the marginal production costs is large and for low imitation cost non-exclusive linear contracts may dominate exclusive nonlinear contracts. Gallini and Wright finally conclude that for high marginal cost of production with the old technology so that the difference between the marginal cost of production with the old and new technologies is large, a higher per unit royalty will be observed accompanied by an increase in the number of licensees with nonexclusive contracts. "The option of nonexclusivity significantly expands the effectiveness of licensing as a means of appropriating rents from an innovation." [21]
5.4.2. **Technology Contracts & Industrial Regulations**

The above conclusions assume the contractual parties to be risk neutral. It is also assumed that the market for the licensees is competitive. Besides, neither the licensor nor (any of) the licensee(s) have an established reputation or have an incentive to establish one.

Their analysis has also assumed an environment which is free from government regulations and restrictions. The existence of government licensing of most manufacturing units, the policy of geographic dispersal and compulsory approvals for all foreign collaborations creates entry barriers. The market for the licensees is therefore far from competitive.[22]

The analysis has implicitly assumed an absence of capacity constraints for the licensee. It may be true in the case of a new manufacturing unit rather than an existing unit. This assumption will be true for an existing unit only if the time required for the transfer and operation of the new technology coincides with the time required for capacity expansion; or alternatively, if the licensee does not face any constraints in "taking over" the infra-marginal producer in the industry.

The licensing procedures in India have restrained domestic competition in a relatively small market. They have also prevented larger firms from expanding. In
addition there are a combination of factors which create a potential difficulty to exit. A favorable bureaucratic discretion, the amount of resources owned by a firm and the capacity to raise financial and human resources implicitly characterize a potential licensee of foreign technology. Additionally, the knowledge of the xenophilic consumer encourage these profit maximizing licensee firms to approach licensors with an international reputation.

The earlier model also presumes the contractual abilities of the licensees and the licensors to be identical. Killing's empirical study has shown that both the buyer and seller of technology are unclear about the value of the commodity in which they are trading. Other studies have shown that the purchaser of technology, especially in the case of developing countries, by having lesser information than the licensor of technology ["information paradox"] is often in an inferior bargaining position. The capacities, sizes and experience of the licensee firms in relation to the supplier firms also puts them at a competitive disadvantage in the market for technology.

The above studies confirm the hypothesis that the cost and mode of technology transfer are essentially a function of the negotiation skills of the contracting parties. Moreover, the rent received by the licensor will be
dependent on the competitive environment of the licensee and the licensor. Three different scenarios can be constructed:

i. The Licensor is a Perfect Monopolist:

This situation would imply that not only is there an absence of any other competitive technology but also that the licensee cannot obtain, either technically or legally, a similar technology. Technical information will define the availability of substitutes while the legal aspect defines, through patents, the boundaries of the monopoly. Although it is extremely uncommon to have a technology without any alternatives to supply the market needs yet a monopolistic situation can arise from the fact that the technology takes a number of different forms. Market imperfections exist in each of the sub-divisions of goods and services which constitute the technology bundle. Each supplier brings some or all of them together in a technology package in a way that increases the degree of imperfection. Consequently, no two firms can have an identical package of technology.[28]

ii. Existence of Competition amongst the Licensees for Access to the Technology

Such a situation may allow the supplier to extract all the monopoly rents. Even in the case of a competitive market for the licensees of technology Gallini and Wright have shown that the licensor will have to share some of his rents with the licensee.[29] The presence of asymmetric
information and possibilities of imitation are a sufficient condition for this rent sharing. If asymmetric information was the only problem, the licensor can extract rent by substituting an output-based royalty for the constrained fixed fee. On the other hand if imitation was the sole problem the rents could be extracted with an upfront fee.

However, the licensees may frequently enjoy market power because of their size or because of the sector they belong to, or because of the political connections they represent. Public sector enterprises in certain countries may be an example of such a scenario. Rent sharing then becomes a factor of the negotiations.

iii. Perfect Symmetry of Knowledge between the Licensor and the Licensee

This case was discussed by Gallini and Wright. However, the determination of price depends on information which is far from perfect. In addition to the uncertainty involved in the data there is a lack of reliability on the information supplied to one party by the other. It creates problems of "moral hazard." The quantity and price of technology in a given agreement are therefore based on negotiations rather than on any "calculations."

The market for information can therefore be analyzed in terms of a bargaining model of an imperfect market. The technology transactions display aspects of bilateral monopoly at the level of an individual transaction.[30]
The outcome of two person bargain is unpredictable except for the fact that it will occur within the Edgeworth's "trading area." It is only in the absence of transaction costs that the bargaining parties will arrive at a pareto optimal solution i.e. a solution lying on the contract curve. But even then the price is indeterminate, except that it must be high enough to make the seller at least as well off as with no sale and low enough to make the buyer at least as well off also.

The price of a technology package cannot be deduced from any theoretical equilibrium. In view of this wide range of indeterminacy, the outcome will depend on the relative bargaining strengths of the seller and the buyer, their technical capacities, the technology package, contents of the agreement, etc.

In accordance with Contractor's analysis [31] we can estimate the ceiling and floor prices for a typical licensee and a licensor. The licensor's costs will include the total of sunk or development costs for the technology being transferred, the transfer costs in the form of direct and overhead costs of technical services provided, direct and overhead costs of legal services, costs of marketing assistance to the licensee, travel and management personnel costs not included above and other direct costs associated with executing the agreement. In addition, he will have to include the opportunity costs of forgoing sales from exports
and/or other direct investment opportunities in licensee's country and other mutually agreed upon areas. Normally only variable costs will determine the licensor's floor price. The opportunity costs will be added to the variable costs depending on the country of transfer and the agreement. The licensee's floor price will theoretically be zero. However, realistically, the licensee's floor price will include his estimate of the supplier's variable costs. Needless to say he will not include the opportunity cost to the licensor making his floor price lower than that of the licensor.

The licensor firm will maximize its rents from the licensee. Practically speaking, the licensor cannot ask for a compensation more than the value of technology to the licensee. In a competitive seller's market it cannot exceed the international technology supplier's price for a similar package of goods and services. In an imperfect market the licensor's ceiling price will be the maximum of incremental profitability stemming from licensee's sale of the product manufactured under the technology transferred or of the licensee's cost saving achieved by the use of a new process under the knowledge provided. The licensee's ceiling will be comprised of, as in Gallini and Wright's model, the minimum of the present value of either developing his own technology or of imitating licensor's technology or the present value of his estimate of incremental profit or the cost saving derived from the technology. For a competitive
seller's market, the payments asked by an alternative supplier of a similar technology package may determine the licensee's ceiling price. The difference of the ceiling price of the licensee and the floor price of the licensor will establish the negotiating range. It is assumed that the ceiling price of the licensee is greater than the floor price of the licensor. This is necessary before any negotiations can take place. Normally speaking, the licensee's ceiling price will be lower than that of the licensor. However, the converse can be true too.[32] Total compensation over the period of agreement has to be considered because of the temporal asymmetry between the costs incurred and the payments received by the licensor. The compensation, in turn, defines an agreement.

5.4.3. **Restrictive Business Practices & Licensee Government's Restrictions**

It is the existence of elements of bilateral monopoly that has led the recipient (developing) countries to promote regulation of the market for know-how.[33] One of the principal mechanisms to achieve this objective is by the elimination of "restrictive business practices."

The "restrictive business practices" are the restraints placed by the licensor on the licensee. They include restrictions on exports, tied purchases of machinery and outputs, use restrictions, exclusive dealing, etc. Clauses like export restrictions and other territorial
restrictions are apparently imposed on the licensee to define market sharing arrangements by protecting the exports of the principal in the third markets.

It is obvious that the ceiling price will rise as we move towards the exclusive agreement part of the spectrum. An exclusive right for a licensee ensures limited competition in the product market from other manufacturers and also from the licensor. The licensor's floor price will also rise on movement away from the nonexclusive mode of contract because of decreasing business opportunities in the licensee's country. His awareness of the potential benefits of the exclusive contract to its recipient would either raise his floor price because of increased opportunity costs or it would result in a higher estimate of licensee's ceiling price. Either way the negotiation range will move upwards.

The licensor would like to reach an equilibrium at a point closer to the licensee's ceiling price while the licensee would like to reach an equilibrium at the minimum price point closer to the floor price of the licensor. The licensor would therefore use measures to raise either his floor price or raise the ceiling price of the licensee. The licensee, on the other hand, would strive to maneuver a lower floor price for the licensor or a lower ceiling price for himself.
The clauses pertaining to restrictive business practices are used by the licensor:

i. As another form of signaling to indicate the superior quality of the technology under consideration.

ii. To extract additional rents from the licensee by imposing these intangible costs of technology package.

iii. To take care of the problems of information asymmetry and to account for problems of moral hazard.

A licensor therefore makes use of the restrictive practices to bargain for better terms. These are the contextual factors which would affect the transaction costs of bargaining. As a result, the restrictions imposed by the licensor raise his floor price for the bargaining negotiations. It is difficult for the licensee to precisely assess the affect of such practices on his incremental profit or cost saving, as the case may be.

The licensee government's restrictions serve as a bargaining aid for the purchaser. It helps to lower the floor price for the licensee. Since both the restrictive practices by the licensor and the licensee government's restrictions exist simultaneously their net effect will vary from one situation to another. For instance, a longer period of royalty payments or a longer period of an agreement would imply a higher ceiling price for the licensor and also for the licensee. The restriction on the agreement period may either result in "no-agreement" or
the supplier may increase restrictions on the use of technology or simply reduce the content of the technology package being transferred.

There may be other attributes which would affect the negotiating ability of the licensee or the licensor. For instance, a licensee may enjoy market power because of its research and development [R&D] abilities. It is this factor which may also distinguish it from its competitors. The R&D expenditure of a licensee will determine his capability to imitate. It will consequently increase the licensee's leverage to negotiate. Similarly the ownership of a licensee firm will influence its bargaining power. The licensee - licensor relationship may be different for transactions between affiliates and nonaffiliates. Besides, this would suggest a distinction among the negotiation abilities of the private sector firms and the public sector or State-owned enterprises. The latter are in a stronger position not only in bargaining but also in the event of their making a loss. The State is likely to step in and subsidize the loss.

On the other hand, an inclusion of other types of assistance in services in marketing, sales, or management will tend to increase the supplier firm's leverage over the licensee. In addition, the licensor's perception of risk attributed to the licensee and the licensee's country will affect the negotiations of a licensing contract similar to
the case of a direct foreign investment. Risker ventures will be accepted only when they are more remunerative.

The different types of payments mentioned under section [5.3.3.] can be reduced to three constituents viz., One-time fees [include lump-sum payments, technical service fees, other service fees]; Fees relating to Licensing Activity [include royalty payments for internal sales and export sales], and Other Returns [include margins on components/raw materials/capital goods, returns from participation in licensee's equity, grant-back values, etc]. Existing studies have observed that some of the licensor firms trade off a higher lump-sum payment against lower royalties.[37] This happens particularly for licensees in countries that restrict ceilings on all types of royalty rates. It can therefore be hypothesized that there exist possibilities of substitution among different types of payments. Furthermore, if the objective function of the licensor specifies maximization of returns from the technology transfer transaction, then there are possibilities of the supplier tailoring the package of technology to the payments received. Such a tailoring has been implied in a number of studies in the literature.[38]

There are thus substitute margins available in the case of transactions involving technology transfer which prevent the government restrictions from adequately achieving the desired objectives.[39] Contractor has argued that an
inability of governments in significantly reducing the total payments made by the nation's licensees lies in multiple channels or types of payments that can be made. Although, the different modes of payments may not be "perfect substitutes" yet they are substitutable enough to leave "legislation focusing on one form of payment filled with loopholes." [40]

It is well known that the substitute margins are expensive because they introduce deadweight losses either in the form of increased transaction costs or by having an effect on the quality of the final product. [41] In addition there will be dissipation of rent through changes in contractual behavior when the nonexclusive income [arising from, for instance, restriction on royalty payments or restriction on the period of agreement] will be absorbed by a parallel rise in transaction costs of an alternative contract of higher cost. In general, the increase in transaction costs will be dependent on the restrictiveness of the law on alternative contractual arrangements. However, the contractual agreements under restrictions will be negotiated so as to minimize the dissipation of nonexclusive income. [42] Teece's study has observed that despite the identifiable shortcomings of the restrictions by the licensees government or restrictive business practices by the licensors of technology, it is difficult to unequivocally conclude that these restrictions can
substantially improve the efficiency of market operation.[43] In general, economic restrictions can be directed to benefit "some" at the expense of "others." But, to quote Teece, "almost everyone is likely to end up worse off if they all succeed."[44]

5.5. OBJECTIVE FUNCTION OF THE LICENSEE & THE LICENSOR

Let $X_t$ be the firm's output in period $t$ so that the demand curve for the product is given by $P(X_t)$. It is downward sloping. The firm's costs, product quality and therefore the profits will be determined by the provisions of the imported technology. The latter will be a function of the technology licensing agreement. The total costs can therefore be defined as

$$C = [X_t, f(Q_s)]$$

where $f(Q_s) = W = \text{Technology Package Imported by the firm.}$ $Q_s = \text{nature of the licensing agreement defined by the total discounted stream of payments to the licensor.}$

or

$$Q_s = r*R + F + T + N$$

where $r$ is an ad valorem rate of payment for the imported technology expressed in relation to the firm's sales revenue. In terms of the earlier discussion, it relates to the fees pertaining to the licensing activity. $R$ is the sales revenue represented by $[P(X_t)*X_t]$. $F$ represents the fixed one-time payments and other returns i.e it includes lump-sum payments, technical assistance fees, margins on
sales of capital goods, other fixed costs, etc. \( T \) and \( N \) are representative of the transaction costs and the costs relating to the non-modal attributes which include the socio-economic-political variables. These two variables include, \textit{inter alia}, the effects of government restrictions and the restrictive business practices of the licensor. Inclusion of these variables delineates the bargaining nature of the technology transfer transaction. Therefore,

\[
C = C_v + r*R + F + T + N
\]

where \( C \) denotes total costs and \( C_v \) is the variable production costs and hence inclusive of the domestic and imported inputs.

The domestic firm's objective is to maximize its discounted stream of profits arising from the new technology, i.e. maximize

\[
V = \sum_{t=0}^{T} (\tau^t \cdot \pi_t)
\]

where \( \tau \) is the licensee firm's discount factor and \( 0<\tau<1 \).

\[
\pi_t = P(X_t)^*X_t - C_v(X_t, W) - rP(X_t)^*X_t - (F + T + N)
\]  \[1\]

In accordance with Katrak [45], let us define the demand function by

\[
X = A P^\sigma Z^\theta
\]  \[2\]

where \( A \) is a constant, \( P \) is the price of the product, \( Z \) is a measure of the product quality, \( \sigma \) and \( \theta \) are the elasticities with respect to price and quality respectively. \( \sigma \) is negative and \( (1+\sigma) < 0 \) i.e. a decrease in price results in
an increase in revenue. \( \theta \) is assumed to be positive because a higher quality product will fetch a higher price.

\[
\pi_t = [P(1 - r) - c_V]*X - (F + T + N) \tag{3}
\]

and

\[
c_V = \frac{\delta C_V}{\delta X}
\]

\[
MC = \frac{\delta C}{\delta X} = (\frac{\delta C_V}{\delta X}) + \frac{\delta (\delta R)}{\delta X} \tag{4}
\]

The marginal revenue \( MR \) is given by

\[
MR = P(1 + 1/\sigma) \tag{5}
\]

Under profit maximization, \( MR = MC \)

or

\[
MR = [c_V + r*MR] = c_V / (1 - r) \tag{6}
\]

From [5] and [6], the price \( P \) can be written as

\[
P = \frac{c_V}{[(1 + 1/\sigma)(1-r)]} = \frac{c_V}{H} \tag{7}
\]

is the equilibrium price.

\[
X = A (c_V)^\sigma \frac{H}{\sigma} Z^\theta \tag{8}
\]

From equations [3], [7], and [8] we get

\[
\pi_t = - \frac{c_V}{[(1 + \sigma)]*X - (F + T + N)}
\]

or

\[
\pi_t = - \frac{c_V}{[(1 + \sigma)][A (c_V)^\sigma \frac{H}{\sigma} Z^\theta] - (F + T + N)} \tag{9}
\]

The profits will therefore depend on the compensation for technology, the quality attributes of the product and other costs including those of imported and indigenous inputs and those arising from the restrictions of the government, restrictive practices of the licensor and other attributes of the licensee and the licensor. The latter will be a function of the bargaining and negotiation.
abilities of the licensee and the licensor. The signs of $T$ and $N$ will be determined by the proxies used for their representation. From the above equation, it can be seen that the profits will vary inversely with the fixed payments. The relation between the profits and the variables $N$ and $T$ will be dependent on the specific proxies for these variables and the negotiation abilities of the licensee. The following derivatives will show the dependence of royalty payments and the costs of variable [imported] inputs on the licensee's profits.

$$H = 1 / [(1 + 1/\sigma)(1-r)] = B / (1-r)$$

$$\frac{dH}{dr} = B / (1-r)^2 > 0$$

$$\frac{d\pi_t}{dH} = -\sigma [c_\nu / [(1 + \sigma)][\Lambda (c_\nu) \sigma \Lambda^{\sigma-1} z^\Theta]$$

Since $\sigma$ is negative and $(1+\sigma) < 0$, the above expression is less than zero. Higher royalties shall therefore reduce the profits. Similarly,

$$\frac{d\pi_t}{dc_\nu} < 0$$

The profits also vary inversely with respect to the imported inputs.

The licensor will maximize returns from the technology transfer transaction. The objective function of the supplier for the technology transfer transaction will therefore be defined by

Maximize $\nu_L = \sum_{t=0}^{T} [\Gamma_t (x'^{P}(x_t)*x_t) + (F + T + N)$

The signs of the set of variables represented by $T$ and $N$ will be opposite to those in the case of the licensee and
they will depend on the bargaining abilities of the licensor. $r_t$ represents the discount rate of the licensor and as in the case of the licensee $0 < r < 1$.

5.6. CONCLUSION

The above discussion shows that irrespective of the competitive or a monopolistic market of a licensee the rents will be shared by the licensor for an imperfect technology market. The licensor will prefer to have lump-sum and royalty payments with possibilities of substitution between them depending on the existence of a restrictive regime in the country.

To extract the monopoly rents from the licensee, the licensor needs to have an estimate of the former's capacity and the market for the product. Due to informational asymmetries, the opportunistic representations of the contractual parties cause difficulties in estimating the desired data. In the absence of a capacity constraint for the licensee [and with the licensor having a good estimate of the licensee's capacity] the former will prefer an exclusive contract because the transaction costs will increase [though not proportionally] with an increase in the number of the licensees. The licensor can extract full monopoly rents with simply an up-front fee. The uncertainty involved for the licensor in assessing the licensee's ability to imitate supplemented by a lack of precise
knowledge about the licensee's operational capacity will
serve as an incentive for the licensor to have exclusive
nonlinear contracts to maximize his rents. Furthermore,
when the imitation costs are small, nonexclusive contracts
with both royalty payments and fixed sum payments will
predominate.

The distribution of rents will be governed by the
bargaining environment which is a factor of the negotiation
capabilities of the licensee and the licensor. An exclusive
or a nonexclusive contract will be governed by the
compensation margin and other variables defined by the
transaction costs and the socio-economic-political
characteristics of the contractual parties.

It is with this perspective that a Logit model is
developed. It will analyze the determinants of the
technology licensing contracts in the Indian electronics
industry.
NOTES


5. A study by UNCTC has shown that a large proportion of technology receipts by companies in the developed market economies is from their affiliates. The percentage of receipts from affiliates varied from 88.2% in 1970 to 81% in 1985 for USA and from 45.6% in 1975 to 40.9% in 1980 for UK.


6. Personal Communication by various Indian firms during interviews.

A "Technological Trajectory" à la G. Dosi & Luigi Orsenigo in Coordination & Transformation: An Overview of Structures, Behaviors & Changes in Evolutionary Environments, in Op. Cit., Dosi et al., 1988 is defined as an activity of technological progress along the economic and technological trade-offs defined by a technological paradigm. A Technological Paradigm embodies relatively ordered paths shaped by the technical properties, the problem solving heuristics and the cumulative expertise of a technological advance.


11. Pressman observes that "nonexclusive licenses are usually used where a very valuable invention exists and several manufacturers want licences to get into the business.


13. In an empirical study of technology transfer contracts in Portugal, it was observed that the licensing contracts were paid by royalties in the majority of cases [56.7%]. It was further observed that in service contracts, fees are the more usual form of payment [54.9%] followed closely by fixed amounts [53%]. Royalties were sometimes combined with the payment of initial lump-sum.

14. This has been a debatable point. It has been argued that such behavior would be acceptable if selling technology were the company's only (or even its primary) activity. It may be more rewarding to give up a part of the rent in order to build up a long-term commercial relationship with the partner, or "even to lay the ground for a financial takeover." Bidault, Francis, Technology Pricing, St. Martin's Press, New York, 1989, p. 51.

However, the existing studies on technology transfer to Indian industries have shown "that the technology that has found large markets in India has often been a sideline for European firms in which they saw no profit prospects and invested little R&D effort." Desai, Ashok, Indigenous & Foreign Determinants of Technological Change in Indian Industry, Economic & Political Weekly, Vol. XX, Nos. 45-47, November 1985, p. 2081.

Another study of the technology transferred by the U.K. firms to Indian firms concluded that securing direct revenue from technology exports is neither the only objective nor the main objective of the supplier firms. Nevertheless they did not see any evidence to confirm that the suppliers have any common objective or motivation other than that of enhancing profits. Bell, Martin & Don Scott-Kemmis, Technology Import Policy. In Ashok Desai [ed.], Technology Absorption in Indian Industry, Wiley Eastern Ltd, New Delhi, 1988, p. 42.

15. Costs of transfer include cost of technical services [both, direct and indirect], legal costs, cost of marketing or technical assistance to the licensee, travel and management costs and other direct costs associated with the contract.


17. A drastic (nondrastic) innovation is one for which $P_m < (> C$ where $P_m$ is the monopoly price of the product manufactured with the new process and $C$ is the competitive price under the existing technology. Thus product innovations are drastic.

18. Sliding royalty implies a licence for which $r_1$ is a per unit royalty only for the first $x_1$ units, where $x_1$ is less than monopoly output under the technology. Moreover, $r_1 = 0$ for $x > x_1$. Gallini and Wright also state that for drastic innovations a linear royalty scheme cannot maximize rent. A constant royalty will reduce output and consequently the monopoly profit.


20. Refer to Appendix D; and


22. The policy of geographic dispersal started in 1970s with an objective of balanced regional growth by the development of backward areas. The incentives offered along with the licensing procedures succeeded in getting both the public sector and private sector firms in the backward areas.

23. These include labor regulations that make layoffs and reduction of work force either difficult or costly or both; restrictions on asset transfers; commercial bank and financial institutions lending norms that encourage lending to sick firms and discourage restructuring and use of bankruptcy procedures.

24. The interviews of the managers of firms in the Indian electronics industry confirm this observation.


28. It is difficult to make general statements about the degree of competition in international licensing. The studies by Teece [1976], Davies [1977], Stobaugh [1971] are some of the studies which have indicated the uniqueness of technology supplied by the licensors and the limited competition faced by the licensees. These studies however suffer from the limitation of a specific industry or a specific regional focus or too small a sample size.


The word monopoly has been used in the perspective of the modern business where the contribution margin arising out of a significant excess of revenues over variable costs is taken for the large R&D and marketing overheads borne by such firms.

The competitive situation is a special case of the bilateral monopoly analysis. Competition in the seller's market with little or no competition in the buyer's market will result in supplier's margin going to zero with most of the monopoly profit accruing to the licensee. In the event of similar competition in the buyer's market too, the margins for both the supplier and the buyer will approach zero and the technology fees will approach their marginal cost value i.e. equal to the costs of transfer and implementation of the agreement.


32. This has apparently happened in the case of technology transfer from the US firms to the eastern block countries. Licensor's ignorance of the licensee's market resulted in the technology being sold at a lower value than what the licensee would have been willing to pay.


The UNCTAD objective as stated in the international code of conduct on the transfer of technology is

"to encourage the transfer of technology transactions, particularly those involving developing countries, under conditions where bargaining positions of the parties to the transaction are balanced in such a way so as to avoid abuses of a stronger position and thereby to achieve mutually satisfactory agreement."


35. Personal communication by most of the managers of the firms interviewed. They were categorical in stating that the government's restriction have helped them in negotiating for a lower price.

36. It is based on the assumption that an increase in period of agreement will increase the present value of licensee's estimate of incremental profit or cost saving from the transferred technology.


38. Contractor, Bidault, UNIDO, Desai have all indicated that the level of margin received by the licensor is a function of, inter alia, the contents of the agreement. Bidault mentions that the strategy followed by the licensor in the transfer of technology will also determine the level of margins received from the transaction.

Technology Payments Evaluation: Summary Results of a Pilot Exercise, 8th meetings of Heads of Technology Transfer Registries, Caracas, Venezuela, UNIDO, 1983.


39. Personal Communication by firms during field research. The licensee firms were, at times, willing to "work around" the government of India's restrictions and regulations by agreeing for increased technical assistance, purchase of raw materials, and capital goods, etc.


41. As per Steven Cheung:

"When the right to receive income is partly or fully taken away from a contracting party, the diverted income will tend to dissipate unless the right to it is exclusively assigned to another individual. The dissipation of nonexclusive income will occur either through a change in the form of using or producing the good, resulting in a decline in its value, or through a change in contractual behavior, resulting in a cost of forming and enforcing contracts, or through a combination of the two."


42. Ibid., pp. 62-66.


44. Ibid., p. 96.

CHAPTER SIX

LICENSEE CHOICE MODEL

6.1. LOGIT ANALYSIS OF TECHNOLOGY LICENSING CONTRACTS

The probability models can all be derived from an underlying random utility maximization model with a linear additive utility function. These models, nevertheless, continue to be "useful and convenient parametrizations even when utility maximization or stochastic thresholds are not appropriate as underlying models."[2]

The model will consider the choice of a consumer, who can be a firm, or an independent research unit, or an individual contracted by the government to choose a new technology, in purchasing an exclusive or a nonexclusive package of technology. An object has no value unless it has utility.[3] The model will therefore be derived with utility maximization as the intrinsic hypothesis. The objective of a firm to maximize its profit, subject to the production function and its market opportunities for selling outputs or buying inputs, is the maintained hypothesis in the case of the buyer being a firm.[4] The arguments of the
utility function are so defined that they will easily reduce the objective function to a profit maximization function, if so desired. The general assumptions [5] true for the consumer choice theory will be applicable here. In addition, the model concentrates on product or drastic process technology. It is also assumed that the technology received by the various firms is identical in vintage.[6]

6.1.1. Assumptions:

i. Rationality: It is assumed that an economic unit makes rational decisions in making a choice which maximizes wealth. The profit maximization assumption for a firm is, however, more sweeping than the corresponding assumption of utility maximization in consumer theory.[7]

ii. Limited Resources: The consumer, unlike a firm, is subject to the limited economic resource constraint. The technology buying firm has a limited initial endowment. In addition, the existing technical, human, and organizational resources of the economic unit are bounded. The objective of an economic agent is then to maximize his utility subject to given boundary limits.

iii. Imperfect Knowledge: The market for information, as discussed earlier, suffers from transactional difficulties of recognition and disclosure. The licensee does not have
perfect knowledge to recognize the alternatives and components of technology under transfer. The consumer, being the less informed party, has to be circumspect of an opportunistic orientation of the seller. Appropriability issues exist from the stage of negotiation to the transfer of technology.

iv. Modal Attributes: Each mode of technology transfer is a function of mode characteristics, \( Z \), defined by royalty payments, length of the agreement, size of the technology package, total project costs, etc. The attributes of the mode vary with individual consumers. The modes are mutually exclusive for a given technology transfer contract and for a given economic unit.

v. Non-Modal Attributes: The choice of the mode of technology transfer will also be motivated by the social, economic, and political characteristics of the existing environment. They will influence the consumer's preference.

vi. Utility of Characteristics: The economic unit derives utility from the attributes constituting a given mode.[8] The consumer is, therefore, in accordance with the Lancaster Utility function [9], interested in the bundle of services provided by a mode rather than with its physical specifics.
The quality of the product will be directly proportional to "characteristic density" of the product i.e. characteristic per unit of the product.

6.2. MODEL

Each consumer has a vector, $Z$, of mode attributes and social-political-economic characteristics, $W$. These attributes and characteristics are representative of his preferences, technology package, other specifics of technology transfer, technological capability, etc. The consumer is faced with $j$ choices where $j = 1, 2, \ldots, m_i$ for a univariate multi-response model. The dependent variable takes $m_i + 1$ values. It is important to let $m_i$ depend on $i$ because individuals [may] face different choice sets.

Let us define $U_{ij}$ as the $i$-th consumer's indirect utilities associated with the $j$ choices. This utility function is assumed to be linear and stochastic. The utilities of different individuals are also assumed to be independently distributed. The utility function has the form:

$$U_{ij} = A_j + z_{ij} B + w_i G_j + E_{ij}$$  \[1\]

$$i = 1, 2, \ldots, n$$

$$j = 1, 2, \ldots, m_i$$

$E_{ij}$ represents the error term. In accordance with McFadden's interpretation, the error terms represent those
mode characteristics and individual non-modal attributes which are unobservable to the researcher. [11]

We assume that \( j = \{0, 1\} \). In other words, the dependent variable takes only two values as is true for a univariate dichotomous model. Each of the two choices represent a particular and mutually exclusive mode of technology purchase from the supplier.

\[
U_{i0} = A_0 + Z'_{i0} B + W'_i G_0 + E_{i0} \quad [2]
\]

\[
U_{i1} = A_1 + Z'_{i1} B + W'_i G_1 + E_{i1} \quad [3]
\]

By the rationality assumption the \( i \)-th licensee enters an exclusive technology licensing agreement if \( U_{i1} > U_{i0} \) and enters a non-exclusive agreement for the transfer of technology if \( U_{i1} < U_{i0} \).

Since the utility functions are stochastic, we can only talk of probabilities that the above inequalities will hold. Thus, defining \( Q_i = 1 \) if the \( i \)-th licensee has an exclusive technology licensing contract, we have

\[
P(Q_i = 1) = P(U_{i1} > U_{i0})
\]

\[
= P((E_{i0} - E_{i1}) < (A_1 - A_0) + (Z_{i1} - Z_{i0})' B + W_i'(G_1 - G_0))
\]

\[
= P[(A_1 - A_0) + (Z_{i1} - Z_{i0})' B + W_i'(G_1 - G_0)] \quad [4]
\]

The above equation can also be written as

\[
P_{ij} = F_{ij} \quad [5]
\]

where \( F \) is the distribution function of \( (E_{i0} - E_{i1}) \). It is
assumed that \((E_{10} - E_{11})\) has a logistic distribution. \(G_1\) and \(G_0\) appear in eqn. [4] only as the difference \((G_1 - G_0)\). Any variable representing a social-political-economic characteristic should, therefore, only appear in the final formulation, if its coefficient is different for different modes. The subscript \(i\) on \(Z\) indicates that the mode characteristics vary with the individuals. It is also assumed that the probability of a given choice is a linear function of the individual attributes. The bundle of services provided by each mode has been termed an "abstract mode".

Equations [2] & [3] have different constant terms. It is inconsistent with the idea of "abstract modes" because it implies recognition of effects of a specific mode beyond the effect of attributes. It has been included for "a pragmatic reason, since the fit is much better if we include it."[14]

Equations [4] & [5] indicate that the probability of an event depends on a vector of independent variables and a vector of unknown parameters. It tells us the probability that an individual choice with a given set of attributes will be made rather than [an] alternative chosen. \(P[Q_i = 0] = F_{i0}\) need not be specified since it must be equal to one minus \(P[Q_i = 1]\).
6.3. DEFINITION OF THE VARIABLES

The dependent variable is defined by the nature of the technology licence. The agreements can be either exclusive or nonexclusive. The latter deprives a licensee from presumptive territorial rights. In the exclusive case, the licensor willingly withdraws in favor of the licensee. The main determinants of a firm's choice of the licensing agreement can be evaluated under the following categories:

i. Price of the Technology Licence Mode

ii. Attributes of Information & Transaction Costs in a Mode

iii. Additional Utility from Non-Modal Attributes

6.3.1. Price of the Technology Licence Mode:

The independent variables under this category include the overt and direct costs of knowledge transfer and pertain to the form and size of the payment to the licensor. The price of a given technology licensing agreement is expected to be inversely related to the "quantity" purchased. The price elasticity will depend on the nature of technology, number of suppliers, number of competitors, etc. It has been reiterated in numerous studies that a major objective of the developing countries is to minimize the costs of technology purchased.[15]

Licensing contracts specify a particular product or a process and the terms of payment for the product or process. Most contracts, as already mentioned, include an up-front
fixed fee associated with some form of royalty. Various studies in the seventies and eighties have shown that royalties occur as one form of payment in approximately 80% of the sampled agreements.[16] Other fees include, amounts paid by the licensee for technical assistance, technical training, other services, etc.

Licensees, [in general], prefer payments linked to their final outputs because they can be paid out of the profits. The royalty payments ease their cash-flow situation. The licensees perceive that with the ongoing payments, the licensor will continue to have an interest in the licensee's ability to produce and sell the contract product. The licensee has a greater "control" over the royalty payments and can readjust them in the event of a performance failure on the part of the licensor. This is the licensee's perspective of sharing risk with the licensor of technology.[17] Royalty payments have been a major source of concern pertaining to the payments for technology agreements in view of their impact on the balance of payments.[18] Most technology importing countries, therefore, restrict royalty payments in one form or another.[19] The lump-sum fees are either paid at the inception of the agreement or, as in India, it is paid in three [or more] equal instalments as specified in the approval letter.[20] This mode is preferred by the licensor for reasons discussed later.
1. **Royalty Payments [TOTRYLTY]**

Two different specifications will be tested for this variable. In the first specification, the independent variable for royalty [TOTRYLTY] will be defined by the average of the royalty rates for domestic sales and that for the sales for exports. This process will ascertain that the price discrimination by the licensor in rates of royalties, if any, is also incorporated. Frequently a licensor insists on an increased rate of royalty for exports because the governments of licensee countries tend to limit the royalty rate for internal sales while leaving the corresponding rate for exports flexible. Alternatively, royalty on internal sales [RRINT] and royalty on exports [RREXP] will be used as separate independent variables in the Logit regression.

2. **Period of Agreement [PRD]**

An associated variable having an impact on the price of technology is the duration of the agreement and the duration of royalty payments. Maximum duration of technology licensing period has also been subject to the licensee government's guidelines.[21] Two specifications will therefore be utilized. One regression will try the period of the technology agreement [PRD] as an independent variable. In the second instance, the variable [RYLTYPRD] defined as a percentage ratio of the period of royalty payments to the
total period of the technology licensing agreement will
delineate this aspect of the price. This variable has to be
interpreted with care since it will tend to bias technology
licensing contracts to those with shorter economic lives.

3. **Lump-sum Payments [LSPROJ]**

Up-front or Lump-sum payments are demanded in instances
where the negotiation process necessitates a disclosure of
information, which, once revealed, diminishes the licensor's
bargaining leverage. Lump-sum payments may also serve to
trade off the impact of lower royalties and vice versa.
This helps the suppliers to achieve the desired rents even
in the presence of a royalty constraint. The licensors
prefer lump-sum fees because, unlike royalties, they are not
subject to nonperformance, default, foreign exchange
fluctuations and other future risks.[22] Besides, they are
normally paid within the initial period of the contract. It
has been shown that a monopolist always prefers a large
entrance fee subject to the condition that the consumer
purchases a positive amount of a product.[23]

For the purpose of testing this model, the lump-sum
includes the fees relating to technical assistance and
technical training. The variable [LSPROJ] has been defined
as a ratio of total lump-sum payments to the total project
cost. The ratio serves to normalize the lump-sum payments
which may, within the given sample, vary considerably in
size. This is an adequate procedure within an industry where the capital investment is large and capital-labor substitution possibilities are limited. [24]

Inclusion of project costs also helps to accommodate the technology-specific costs required for the adoption of new technology for a licensee. The extent of capital investment (set-up costs) to be incurred by each licensee for utilization of the new technology will influence the industry profits and accordingly the choice of technology licensing contract.

4. Package of Technology [TECHPKG]

The compensation made by the licensee over the agreement's life is also a function of the contents of the technical package. Desai has argued that the government by constraining the payments for imported technology prevents the firms from obtaining technology "in its full breadth and depth." [25] The price of technology is a function of its vintage. Within a vintage, it varies with the level of technical assistance, technical training and availability of components, raw materials and capital goods. There exists, therefore, sufficient opportunities for tailoring the package of technology transferred to the price paid. In the Indian context the possibilities of such tailoring have been extensive. [26]

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The independent variable representing the magnitude of a technology package [TECHPKG] is defined as follows:

\[
\text{TECHPKG} = 1 \text{ for Capital Goods only}
\]

\[
\text{TECHPKG} = 2 \text{ for Capital Goods + Technical Know-how}
\]

\[
\text{TECHPKG} = 3 \text{ for Capital Goods + Technical Know-how + Technical Assistance [Includes Training too]}
\]

The vintage of technology in all contracts has been assumed to be the same [1-4 years].

6.3.2. **Attributes of Information & Transaction Costs in a Technology License Mode:**

Williamson postulates that firms transact with an objective to minimize the sum of production and transaction costs.[27] The transaction costs refer to the expenses incurred for entering into and for enforcing contracts, bargaining over terms of agreement and contingent claims, and the costs induced for administering a transaction.

Transactions are defined by their frequency of recurrence, the degree of uncertainty involved, and the condition of asset specificity. Uncertainty is present in a non-trivial degree whenever agents are subject to bounded rationality. Asset specificity refers to exchanges in which the "full productive values are realized only in the context of an ongoing relation between the original parties to a
transaction."[28] The transactions have, therefore, to be organized to economize on bounded rationality. simultaneously, they have to be protected against the risks of opportunism.[29]

1. **Foreign Equity [FORNEQIT]**

   The magnitude of foreign equity in the licensee firm in the transfer of technology [particularly from the licensor who is also the equity holder] will influence the mode of the contract. The presence of foreign equity diminishes problems arising from unaccounted future contingencies and from uncertainties over specifying and monitoring performance. An equity represents a particular type of internalization where cooperation is administered within an organizational hierarchy. It therefore provides for a superior environment for transacting in dedicated assets i.e. it aids in bargaining in contracts which are supported by specific assets.[30]

2. **Regulation of Technology Imports**

   The costs of contracting inevitably increase when more "legalistic" approaches to contract are adopted.[31] Restrictions and regulations manifest themselves in terms of excessive legalizations. As Stewart Macaulay has argued:

   "...If one side insists on a detailed plan there will be a delay while letters are exchanged as the parties try to agree on what should happen if a remote and unlikely contingency occurs."[32]
It is possible that under these circumstances some agreements may not be reached while in others "one gets performance only to the letter of the contract."[32] The licensor's objective is to maximize his rents accruing from the possession of a specific intangible asset. An existence of substitute margins encourages the licensor to achieve his goal by indulging in restrictive business practices.

All long-term contracts are necessarily incomplete since they fail to provide for all future contingencies. In addition, the economic actors are subject to the Herbert Simon's notion of bounded rationality, i.e. the human agents are "intendedly rational, but only limitedly so."[33] Furthermore, as discussed earlier, the informational asymmetries lead to problems of disclosing information on value in a manner which is both convincing and also a foundation for exchange negotiations. Each of the contractual agents is aware of his opportunity to gain. The less informed party [licensee] has therefore to be cautious of "opportunistic representations" by the licensor.[34] A recognition of the problems of incompleteness of contracts, bounded rationality of the economic agents and implicit threats of opportunism present in technology negotiations, manifested through the presence of restrictive business practices, motivates the licensee's government to impose restrictions. The restrictions are seen to help the country's licensees in achieving stronger bargaining

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position principally by countering the threat of restrictive business practices.

2.1. **Restrictive Business Practices**

Imperfections in the market for information lead the licensors to impose restrictions and introduce other transactions in the licensing agreement. These constraints, as argued earlier, serve to capture the rent for the supplier. Restrictions of this kind are specific to the market for technology.[35]

2.1.a. **Export Restrictions by the Supplier [EXPREST]**

The most common type of restriction imposed by the licensor is to specify the market for the contract products of the recipient. The degree of restrictions on exports by the licensee may range from a total ban on exports to prior approval from the licensor before exporting.

The Fourth Survey Report on Foreign Collaboration in Indian Industry by the Reserve Bank of India, found that more than 80% of restrictive clauses by the supplier related to exports. Agreements with export restrictive clauses formed 61% of the total number of agreements. It also observed that the penchant for imposing export restrictions has increased over the period.[36] The extensive occurrence of the export restriction in the technology licensing contracts of the Indian firms indicates
that its effect on the choice of the mode of contract be analyzed independently of other restrictions. The export restriction, \( \text{EXPREST} \), has been defined as follows:

\[
\begin{align*}
\text{EXPREST} &= 1 \quad \text{if export restrictions exist in one form or another.} \\
\text{EXPREST} &= 0 \quad \text{if export restrictions are absent.}
\end{align*}
\]

2.i.b. Other Restrictions by the Licensor [RESTSUPP]

In addition to restricting the market of licensees, the licensors may seek to increase the returns from the sale of technology by constraining them to "tied purchases" i.e. requiring recipients to purchase machinery, components and other materials from them.[37] Other restrictions may include conditions of confidentiality, appointment of sales agents, conditional payment clauses such as fixed minimum payment of royalty per year, price fixing, etc.[38]

The independent variable for other restrictions by the supplier, [RESTSUPP], has been defined as:

\[
\begin{align*}
\text{RESTSUPP} &= 1 \quad \text{if there are any of the above restrictions} \\
\text{RESTSUPP} &= 0 \quad \text{in the absence of above restrictions}
\end{align*}
\]

2.ii. Regulation by Licensee's Government

It is, more or less, a stylized fact that in all countries, the State plays a central role in shaping, stimulating, and inhibiting various forms of technical
change and in defining its mode of transfer. [39] The State has used the technology policy to effect changes in the structure of industry and also to influence the price of technology, the composition of technology, and the form in which technology is imported. [40] The role of the State assumes greater significance in the case of technology licensing contracts because of the bargaining involved in the negotiations. The restrictive clauses represent "hidden costs" of technology transfer and are considered parametric in the model.

2.ii.a. Government Restrictions [RESTGOI]

The regulation of technology transfer emerged in the 1970s in a few Asian and Latin American countries. The first developing country to evaluate and scrutinize technology agreements was India, which introduced rather strict administrative guidelines concerning technology agreements as far back as the early 1950s. The Government of India restricts payments of royalty, up-front fees, duration, foreign equity holdings, etc. These restrictions have become, broadly speaking, a guiding principle in any technology transfer agreement in the country. Their effect on the mode of technology licence, as discussed earlier, is directly accounted for by the respective variables. The variable RESTGOI therefore includes restrictions, if any, besides those mentioned above. These may vary from
restrictions on the purchase of capital goods and import
content in the project, and/or exclusion of certain products
from payment of royalty, and/or disallowing imports of kits
and subassemblies, and/or compulsory submission of Technical
Absorption, Adaptation & Improvement [TAAI] scheme, and/or
inclusion of certain elements [eg. software codes] at no
extra charge, to having the final product approved by a
relevant government institution or by a specified ministry.

2.ii.b. Export Obligation [EXPOBLG]

In order to ensure an access to the latest technology,
and to increase exports by the Indian firms, either through
"buy-back" arrangements with the licensor, or through their
own initiatives, the Government of India imposes an export
obligation. It is an obligation imposed on a recipient firm
to export a part or whole of its output. It has been
observed that export obligations have been imposed more
often in electronics industry than in other industries.[41]
This seems to be true even in recent years.[42]

The variable accounting for the existence of an export
obligation, [EXPOBLG], has been defined as follows:

[EXPOBLG] = 1 in the presence of an export obligation
[EXPOBLG] = 0 in the absence of an export obligation
3. Licensee's Relative Plant Size [LICSIZE]

The relative size of the licensor is also expected to have an impact on information and transaction costs. The size of the licensor influences the resources available for the transfer of technology to the licensee and hence the mode of the technology agreement. Several studies have indicated that smaller licensor firms are more prone to transfer technology through licensing since they lack the managerial and financial resources to make direct investments.[43]

The relative size of the licensee will determine his ability as a potential competitor in the international market. The technology suppliers to Indian firms have been observed to prefer licensees who can manage a large market share.[44] It makes it easier for the larger Indian firms to find technology licensors. The relative sizes will also formulate the bargaining strengths of the negotiating parties. Contractor's study has argued that larger recipient plants lead to higher returns for the technology supplier.[45]

The variable for recipient's plant scale, [LICSIZE], is defined by the licensee's sales as ratio of the technology supplier's sales on a scale of 0-8. The measure represents descending order of differences in relative sales of the licensee and the licensor. Such a calibration also makes it convenient to respond to the question of scale.[46]
LICSIZE = 8 when licensee's sales > licensor's sales
LICSIZE = 7 when licensee's sales = licensor's sales
LICSIZE = 6 when licensee:licensor [sales] = 1 : 1.5
LICSIZE = 5 when licensee:licensor [sales] = 1 : 2
LICSIZE = 4 when licensee:licensor [sales] = 1 : 3
LICSIZE = 3 when licensee:licensor [sales] = 1 : 5
LICSIZE = 2 when licensee:licensor [sales] = 1 : 10
LICSIZE = 1 when licensee's sales < 0.1 of licensor's.

4. **Commercialization of Technology [STARTUP]**

This variable represents the previous manufacturing start-ups of the licensor's technology. [STARTUP] takes the value of 1 if the observation represents the first commercialization and the value of zero otherwise. The transaction costs are expected to be higher for the international transfer of a technology that has not been previously sold abroad. These costs will be higher for a technology which is to be transferred before even it has undergone its first production run. The variable can, consequently, effect the mode of technology transfer. Teece's analysis found the dummy variable representing the number of previous start-ups to be significant in the chemical and petroleum refining sub-sample.[47]
6.3.3. **Additional Utility from Non-Modal Attributes:**

Non-modal attributes refer to the social-economic-political characteristics which influence a consumer's utility from a given mode. Different variables under this category will include:

1. **Licensee's expense on Research & Development (RND)**

The research and development (R&D) expenditure of a firm is an investment which allows an efficient absorption of imported technology. Industrial R&D in India generally concentrates on product diversification, replacement of imported inputs and market adaptation of products. [48] Alam's study also indicates that 75% of the Indian firms engaged in R&D concentrate on adaptation as their main activity. [49] The R&D expenditure of a firm will therefore influence its bargaining ability because a technology importer needs a "skills minima" to successfully absorb the given package of technology. The expenditures on indigenous R&D are complementary and not a substitute for the imported technologies. [50] Besides, the extent of adaptive R&D varies with the complexity of the technology imported. [51] It is also the latter which has, of late, encouraged the technology recipient countries to permit joint ventures. [52]

The firms that do their own R&D receive a better return on their imports of technology. Studies have also shown that larger firms have a higher research intensity and that
they find a comparative advantage in both technology imports and in R&D.[53] Hence, the firm's expenditure on R&D will influence its bargaining position and consequently its choice of the mode of technology transfer.

The variable representing expenditure on R&D by a technology recipient firm, [RND], is defined by the expenditure on R&D as a percentage of its annual sales.

2. **Ownership of Enterprises [SECTOR]**

Indian industrial development has been characterized by two strategic groups viz., the public sector [or the government controlled] enterprises and the private sector companies. The public sector firms are relatively larger firms. As a matter of policy the industries having a direct impact on the future development and involving large investments are reserved for the State sector. Although both the sectors have proceeded with imports of technology as a primary source of new technology but the public sector has been relatively more skeptical in accepting technical collaborations with foreign equity.

Unlike the electronics industry globally, the Indian electronics industry has been the result of a public sector, rather than private, initiative. The firms in the public sector have been observed to preempt the private sector in investments in areas which are not formally reserved for them. The State also supports them by allowing them price
preference on procurement of materials and an access to preferential sources of financing. [54] The Indian Five Year Plans have often been termed public sector plans. [55] As a result, in certain product areas, the public sector plans sanctioned for the year are a deterrent to the private investment, particularly if the potential market is small relative to the efficient scale of production.

The support of the state therefore allows the public sector firms a greater access to resources. Theoretically, this should imply a stronger bargaining power. Although Pillai has argued that a public sector corporation is no better than a private sector firm in bargaining with the suppliers of technology but no data exists on the differences in the relative terms of transfer between the two strategic groups of firms. [56]

[SECTOR] is a variable that takes the value of 1, if the recipient of the technology transfer is a private enterprise and takes the value of zero otherwise.

3. **Competitors to Licensee's Technology [NUMCOMP]**

Ashok Desai has argued that, both, the technology supplier and the technology recipient have a strong incentive to enter the Indian market early. [57] The policy of import substitution leads to high profits for the initial entrant. The licensee can therefore afford to pay a larger amount for the technology package. The existing number of
competitors in the technology recipient's market [NUMCOMP] will influence, both, the licensee and the licensor in determining the mode of the technology licensing agreement.

4. Assistance with Management Functions

Licensing of technology raises the possibility of establishing competitors for the licensor. He, therefore, has very little incentive to help the recipient of technology with problems of adaptation, marketing and updating the latter's technology. Davies, in his study of licensing agreements between Indian and U.K. firms, has observed that when the licensing of technology was accompanied with equity participation, the licensor took a greater interest in tailoring the technical know-how to Indian conditions.\[58\] Such assistance could also be extended in cases where the licensor either passes on those costs to the licensee through higher fees \[59\] or through greater restrictions or by having a reciprocal access to the improvements in technology made by the licensee. Alternatively these provisions could simply be a reflection of the long-term and long-standing relationship between the supplier and recipient of technology.\[60\]

The following variables will therefore measure the significance of managerial and adaptive support by the licensor in the choice of the mode of technology transfer.
4.i. **Future Improvements of Technology** [FUTIMP]

Frequently, a licensing agreement includes the disclosure of future improvements of technology by the licensor during the period of the agreement at no extra cost. **FUTIMP** will therefore take the value of 1 if this clause is present and will be zero otherwise.

4.ii. **Managerial Assistance** [MGRLASST]

\[ MGRLASST = 1 \text{ if the agreement includes managerial assistance by the licensor.} \]

\[ MGRLASST = 0 \text{ otherwise.} \]

4.iii. **Help In Adapting Technology** [INDGNIZE]

\[ INDGNIZE = 1 \text{ if the licensor helped the licensee in adapting or developing the technology for his use.} \]

\[ INDGNIZE = 0 \text{ otherwise.} \]

4.iv. **Buy-back of Contract Product** [BUYBACK]

\[ BUYBACK = 1 \text{ if the licensor agrees to buy all or a part of the licensee's final product} \]

\[ BUYBACK = 0 \text{ otherwise.} \]

6.4. **ROYALTY - LUMP-SUM TRADE-OFF**

OLS and LOGIT models will be analyzed to examine the existence of possibilities of a trade-off between royalty and the lump-sum payments for a given package of technology.
Contractor's study [1981] observed the presence of such a trade-off from interviews of the licensor firms.

Models with interaction terms will be used to estimate interaction, if any, between these two methods of payment. The sign, size, and relative significance of the interaction term will determine the trade-off possibilities.

An OLS model with an interaction term will be represented by:

\[ U = A + BX + GW + I(XW) + E \]

where \( E \) is the error term and the impact of \( X \) on \( U \), holding \( W \) constant, is measured by \( B+IW \).

An interactive LOGIT model can be written as

\[ \log \Omega = U = A + BX + GW + DZ + I(XW) + E \]

The effect of a unit increase in \( X \) on \( \log \Omega \), holding \( W \) and \( Z \) constant, is to increase \( \log \Omega \) by \( [B+IW] \). Denoting this new value by \( \Omega^* \), we have

\[ \log \Omega^* = \log \Omega + [B+IW] \]
\[ \Omega^* = \Omega e^{[B+IW]} \]
\[ \Omega^* = \Omega e^B e^{IW} \]

Thus the multiplicative effect of \( X \) on \( \Omega \) depends on the level of \( W \), and the multiplicative effect of \( W \) on \( \Omega \) depends on the level of \( X \).

The dependent variable for these models will be the package of technology [TECHPKG] transferred. The trade-off will then be analyzed between royalty payments [RRINT], [RREXP], [TOTRLTY] and the lump-sum payments [LS].
period of payment of royalty [RYLTYPRD] will also be considered as an independent variable.

6.5. RESEARCH METHODOLOGY

The most important data source in this dissertation was a series of interviews conducted by the author in India from end of May, 1989 to beginning of August, 1989. A stratified sample [61] of firms based on the technology collaboration in the Indian electronics industry as an exogenous variable was chosen in consultation with government ministries, Reserve Bank of India [RBI], Indian Investment Center [IIC], and private associations like Electronic Component Industries Association [ELCINA], & the Associated Chambers of Commerce & Industry of India [ASSOCHAM], and on the basis of existing data and literature. [62] Keeping in view the constraint of interviewer's access time, firms were chosen on the basis of geographical cluster. [63] Accordingly, the electronics firms in Bangalore, Bombay and New Delhi were selected. Managing Directors or other senior branch managers of over thirty firms were interviewed. Majority of the public sector firms, both central and state, have either their manufacturing units or branch offices in one or more of these cities. This ensured that the firms selected were representative of both, the private and the public sector. The interviews were supplemented by detailed questionnaires.
Appendix F shows the information required from the respondents.

In addition, senior government officials in the Directorate General Technical Development [DGTD], Secretariat of Industrial Approvals, Department of Electronics, Industrial Development Bank of India, Reserve Bank of India, State Bank of India, Indian Investment Center, Electronics Trade & Technology Development Corporation Limited, and Bureau of Industrial Costs and Prices were interviewed at length.

Detailed discussions were also held with private organizations like ELCINA, ASSOCHAM, Greater Mysore Chamber of Commerce, and with officials in the Asian & Pacific Center for Transfer of Technology. Several other secondary sources, such as Government of India publications, and publications of Indian Institute of Foreign Trade, and Indian Investment Center contributed useful supplementary information.

The interviews of the firms in the electronics industry were interspersed with the interviews with government officials and other agencies. The government officials provided insights about relevant legislations, regulations, and about the policy framework but were hesitant to discuss the administration and enforcement of the same.

However, the following caveats should be observed prior to any generalization of the results. The sample of the
firms interviewed is not entirely random. These may or may not differ systematically from the firms which could not be interviewed. The designated firms seem to typify the "success" stories of technology transfer in the Indian electronics industry. Contrary to the above companies, several other enterprises were hesitant in discussing any issues relating to the transfer of technology or even the impact of government policies on the performance of the firm or the industry.

The data collection may suffer from the implicit drawback associated with gathering information through interviews. It may appear to be a generalization from an inadequate sample. Ideally speaking, the sample, rather than being stratified, should have included firms from Tamilnadu, Kerala and other parts of eastern and northern India. Constraints of time and money disallowed such a possibility. However, even with a large sample the problem of gathering false and misleading information remains.

Although most of the information on technology transfer contracts were supplied by the respondents on the spot; at times I had access either to their agreements or to another source to verify their authenticity.

6.5.1. Observations from Interviews:

Most of the respondents from firms cited government delays and approval processes to be the main cause of
increase in project costs. They were, however unanimous in acknowledging that the government restrictions relating to technology transfer help them in bargaining for cheaper technology. The criteria for the choice of a technology supplier by a licensee are dominated by cheaper terms and conditions followed by the reputation of the licensor. Size of the technology package seems to be a tertiary consideration.

Interestingly, most of the firms interviewed preferred a joint venture rather than simple licensing as a mode of technology transfer. A majority of the firms do not shop around for technology. They only approach a few known suppliers. Precedences and reputations of the suppliers dominate the decisions. In a few of the public sector firms the Government of India had put restrictions on the choice of a licensor. In another instance, the government placed similar restrictions on public sector as well as private sector firms in the guise of helping the firms acquire cheap and up-to-date technology. The project was termed "Centralized Purchase of Technology."

The Government of India, under this scheme chose three suppliers of technology each for Electronic Push Button Telephones [EPBTs] & Electronic Private Automatic Branch Exchanges [EPABXs]. The Indian firms were then invited to enter into collaboration with either of them. The firms were unhappy with the arrangement because they felt that
they were a "fait accompli." They perceived that they could have negotiated a better bargain. The government officials involved in the scheme tacitly agreed that it was a failure.

Very few of the firms in the electronics industry use discounted present values or internal rates of return to calculate the price they are willing to pay for a technology package. They are dependent on the supplier to define a package and the price for them. It is at this point that they cite their inability to pay beyond what is permitted by the Government of India. Hence their contention that the restrictions by the government help them in bargaining for a lower price.

Export restrictions in one form or another by the supplier of technology are found to be pervasive. There were numerous cases where such a restriction was implicit in higher royalty rates for the products to be exported as compared to the royalty rate on the contract product for the domestic market. However, only a few of the firms interviewed were contemplating exports in the near future. Most of the firms concentrate on the domestic market and consequently do not view the export restrictions with any grave concern.

As per the Government of India's approval procedure for foreign collaboration, any clause that binds the Indian party with regard to the procurement of capital goods, raw materials, etc., is normally to be avoided. The Indian firm
should be free to import such item from any source. Although, theoretically, tied imports of capital equipment, components and/or raw material are disallowed yet in practice, it invariably happens to be so. This was confirmed by all the interviewees. The reason lies, as discussed earlier, in the high import propensity of the Indian electronics industry. Some element of plant and equipment is always proprietary and hence it has to be purchased from the licensor. Besides, the supplier insists on the inspection and approval of the materials, components, etc purchased from other sources before extending any "performance guarantee" on the technology transferred.

The licensees are, prior to the collaboration, quite ignorant about the nature and type of equipment, raw materials and components required. The licensor has to help them with the precise details. The former imparts this knowledge only after a part of the lump-sum is paid. It is for this the reason that most of the licensee firms do not file a "composite application" for licence approval with the government. The application for import of capital goods is always filed after the clearance for the technology collaboration is accorded.

The method of royalty assessment also encourages imports. Royalty, as per the government regulation, is to be paid on the basis of ex-factory selling price of the product less excise duties less the cost of standard bought
components and the landed cost of imported [and not indigenous] components. The government of India's reason in excluding imports from the royalty base apparently lies in reducing the amount payable to the licensor. The policy makers perceive that payments of royalty including imports in the calculation base will tantamount to paying the licensor an extra margin. There may be some veracity in the argument. Nevertheless, the present method of calculation [even if the issues of quality and compatibility are disregarded] builds up an incentive for continued imports, in spite of an adequate availability of indigenous components and raw materials.

A public sector firm was categorical in stating that the components and other materials received from the licensor cost about five times more than the price at which they can purchase if allowed total flexibility. Government restrictions practically make it necessary to purchase the requirements from the licensor.

Most firms therefore accept this situation of least action. This tends to be expensive and makes it virtually impossible for them to compete in the international market. Nevertheless, it is still profitable to manufacture in the domestic market.

There were also a number of cases where the licences issued to the firms stipulated an export obligation. Most of the firms on whom this obligation was imposed were
contesting it. One of the firms objected on the grounds that the collaborator is unwilling, at this stage, to enter into any buy-back arrangement to fulfill this requirement. Besides, they mentioned,

"...The indigenization and development of various components has to be taken up through various vendors. In fact, the assimilation and absorption of technology will have to be achieved at vendor stage itself which will be time consuming. In house manufacture of the critical components would be possible only after production volume is reasonably high. It will not be possible to achieve world quality standard within a span of first two to three years. Wherever machines are exported sales and services set up will have to be established which will entail outflow of foreign exchange in terms of men and materials. This may not be economically viable in the initial stage."

Some of the buy-back agreements had an inherent "price asymmetry" in the contract. The agreement bound the licensee to sell a given amount annual projected output of the contract product at a price which was 25% less than the international price in one case and at a price 7% below the three month average of selling price at which the licensor or its affiliated companies have supplied the items to industry in Europe in the other.[68]

Neither of the agreements had an explicit mention of the raw materials and components to be supplied by the licensor. The agreements did provide the supplier a right to inspect the raw materials, the method of production and the finished goods on a regular basis. The "price asymmetry," therefore arises from the fact that the licensee is totally unprotected from movements in the prices of raw
materials and components which are divergent from the movement in the prices of the final product. The agreement made no reference to issues relating to the payment of royalty to the licensor in the event of his failure to buy the required proportion of the output. A further complication regarding imposition of penalties to the licensee or the licensor, in the event of their not fulfilling their respective commitments, is caused by the agreement clause specifying the determination and payment of the penalty only after a specified period of time. It creates problems of "moral hazard" and provides an opportunity for the licensee and the licensor to collude in disregarding the imposed obligation. The policy makers agree to the inefficacy and unenforceability of the export obligation commitment.[69]
NOTES


4. The analysis will not change considerably if the licensor strives to maximize sales rather than profits. The sharing of rent will not change because the price of a technology package is determined by its intrinsic value, i.e. by an amount allowed by the technology, and not by the rent effectively drawn by the licensee. The situation will therefore be similar to that of profit maximization.

It is, however, not possible to consider different cases separately. For instance, the behavior of nonprofit organizations or the behavior of firms whose profit is regulated will require different treatments.


6. The age of the technology received by the firms is assumed to be between 1-4 years.


Given the input-output prices $P_1, P_2, \ldots, P_w$ for output or input quantities $Z_1, Z_2, \ldots, Z_w$, the profit function is defined as
\[ \pi = \pi(P) = \sum P_i Z_i^0 \]

where \( Z_i^0 \) is the solution of the maximization problem i.e of the problem

Maximize \[ \sum P_i Z_i \]
subject to \( f(Z_1, Z_2, \ldots, Z_w) \leq 0 \)

10. This assumption may not always be met in reality since the unobservable error term may be correlated among certain consumers. The assumption is made for convenience since it is usually not possible to specify an accurate correlation structure.

Ibid., p. 1491.
11. This is akin to the omitted variables interpretation of the error term in a regression model. It suggests that a zero correlation between different values of \( E_{ij} \) is unreasonable. The existence of such a correlation causes no complication because the form of the probability function, by definition, depends only on the difference of the corresponding error terms.

Ibid., p. 1490.

13. This nomenclature is attributed to Quandt & Baumol.


The firms interviewed in the Indian electronics industry unanimously agreed that they preferred to pay royalties rather than lump sum for the reasons discussed.


20. Generally, first one-third of the lump-sum payment is made after the agreement is filed with the Reserve Bank of India [RBI] and the Capital Goods clearance, if any is obtained. The second one-third payment is contingent on the delivery of the Technical Documentation. The final one-third payment is made on the commencement of commercial production or four years after the agreement is filed with RBI, whichever is earlier.


21. Under Mexican law, the maximum duration period is 10 years which is also the maximum period allowed in some other countries like Spain & Venezuela. In the case of India, Brazil, Republic of Korea, the period generally permitted is five years. Longer period is possible in instances where complex technology is involved.


22. Desai has observed that there have been cases where the Indian firms have not paid the royalty due to the supplier.


29. Ibid., p. 184.


"It is only because the individual human beings are limited in knowledge, foresight, skill, and time that organizations are useful investments for the achievement of human purpose.


In an analysis of technology agreements from 1979-1981 in the Republic of Korea it was found that 24% of the agreements had clauses which restricted exports in some fashion. In the case of Thailand, 25% of the technology licensing contracts in 1981-1982 had restricted export market conditions. For Malaysia, approximately 30% of the total agreement studied between 1970-1980 had market restrictions of one type or another. A study in Chile showed that 175 out of 399 contracts [nearly 44%] revealed some form of export restriction. Moreover two-thirds of these stipulated a total ban on exports.


37. This restrictions is imposed by the licensor apparently to ensure quality control of the product manufactured by the transferred technology. The quality of the components and the raw materials defines the quality of the contract product. Interviews of the firm managers revealed that the components and raw materials sold by the licensor are considerably more expensive than what can be obtained in the international market. Frequently the licensor insists on "tied purchases" of components and raw materials even when he does not manufacture them. These supplies are then purchased for the licensees from either his sub-contractors, subsidiaries, or associates, or from the international market.

38. The fourth survey report also found that for the private sector companies in India, the conditional payment clauses formed 4.3% of the total number of agreements.
Miscellaneous restrictive clauses, on the other hand, formed 12.7% of the total regulatory clauses.


A study of technology contracts in Spain found that 60% of the 101 contracts were found to be overpriced by over 100%. Vaitsos's study also indicates overpricing in the pharmaceutical industry by foreign subsidiaries were as high as 199%.


In case of Thailand too, provisions specifying tied purchases of machinery and raw materials were found to be less prevalent than export restrictions and were found to be only in 7% of the contracts. However, approximately 60% of the contracts stipulated some form of confidentiality condition; 19.3% of the contracts had conditions prohibiting the use of know-how upon expiration of the contract.


42. Ibid.


212
46. Adapted from Contractor, 1981. 
   Ibid., p. 112.


48. Desai, Ashok V., "Market Structure & Technology in 

49. Alam, Ghayur, "India's Technology Policy," Economic & 
   Political Weekly, Special Number, November 1985, p. 2077.

50. Bluementhal, T., "Japan's Technological Strategy," 

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52. Balasubramanayam, V. N., International Transfer of 

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54. India: Development of the Electronics Industry, The 

55. Lakdawala, D. T., Experience of Planning. In The 
   Development Process of the Indian Economy, P. R. Brahma­
   nanda & V. R. Panchamukhi, Himalaya Publishing House, Delhi, 
   1987, p. 691.

56. Pillai, P. Mohanan, "Foreign Collaboration in Public 
   Sector," Economic & Political Weekly, May 27, 1978, 

57. Desai, Ashok, Technology Acquisition & Applications: 
   Interpretations of the Indian Experience, Mimeographed, 
   1985, p. 11.


59. Contractor rejected the hypothesis [except at an 8% 
   significance level in a two tailed test] that licensors 
   bearing extra cost of adaptation pass them on to the 
   licensees by charging extra fees.
60. Several licensee firms in India vehemently contended to the help accorded by the licensor much beyond the words of agreements, if they had a long-standing and cordial relationship with the latter.

61. In accordance with Cosslett's definition, the term stratified sampling has been used in the context where all the variables defining the subsamples are exogenous; all other stratifications are referred to as choice based sampling.


64. A firm mentioned that their foreign approval took over 2 years. Approval to get the Phased Manufacturing Program took another 6 months. They had started production two years ago but had not received the operating licence yet.

65. These firms were critical of the government for this restriction because, they felt, that a limited choice of suppliers did not allow them to get the desired technology.

66. OKI, Japan; Jeumont Schneider, France; & GTE, Belgium; were selected for technology transfer for EPABXs while Siemens AG, FRG; Ericsson, Sweden & ITT-FACE, Italy were chosen for transferring technology for the manufacture of EPBTs.

67. Correspondence related to the technology transfer agreement of a firm.

68. Personal interview


69. Personal communication by officials in DGTD & Department of Electronics.
CHAPTER SEVEN

ANALYSIS & RESULTS

7.1. INTRODUCTION

This chapter will describe the results of the model discussed in the previous chapter. The theoretical model explained the determinants of choice of an exclusive versus a nonexclusive technology licensing contract. Four different empirical models were used to predict this choice.

A contingency table test was used to determine if the mode of license is independent of the sector to which a firm belongs. In addition, a model was tested to verify the trade-off, if any, between the royalty and the lump-sum payments for a given technology package.

7.2. RESULTS FROM THE BINARY CHOICE MODEL

The variables for each of the four models used to estimate the choice of an exclusive or a non-exclusive technology licensing contract are presented in Table 7.1. The results of corresponding equations are presented in Table 7.2.
TABLE 7.1

DEFINITION OF VARIABLES

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>SET 1</th>
<th>SET 2</th>
<th>SET 3</th>
<th>SET 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. PRICE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royalty Payments [TOTRYLTY]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Period of Agreement [PRD]</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lump-Sum Payments [LSPROJ]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Technology Package [TECHPKG]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>II. INFORMATION &amp; TRANSACTION COSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Foreign Equity [FORNEQIT]</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Restrictions by the Supplier [EXPREST]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Other Restrictions by the Supplier [RESTSUPP]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Restrictions by the Licensee's Government [RESTGOI]</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Obligation [EXPOBLG]</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
TABLE 7.1.  (Continued)  DEFINITION OF VARIABLES

| LICENSEE’S RELATIVE PLANT SIZE [LICSIZE] | X | X | X | X | X |
| COMMERCIALIZATION OF TECHNOLOGY [STARTUP] | X | X |

III. NON-MODAL

| LICENSEE’S EXPENDITURE ON R&D [RND] | X | X | X | X | X |
| OWNERSHIP OF ENTERPRISES [SECTOR] | X | X | X | X | X |
| NUMBER OF COMPETITORS [NUMCOMP] | X | X | X | X | X |
| FUTURE IMPROVEMENTS IN TECHNOLOGY [FUTIMP] | X | X |
| MANAGERIAL ASSISTANCE [MGRLASST] | X | X |
| HELP IN ADAPTING TECHNOLOGY [INDIGNZE] | X | X | X | X | X |
| BUY-BACK OF CONTRACT PRODUCT [BUYBACK] | X | X | X | X | X |
### TABLE 7.2. LOGIT RESULTS OF CHOICE OF MODE OF TECHNOLOGY LICENSING AGREEMENTS

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>SET 1</th>
<th>SET 2</th>
<th>SET 3</th>
<th>SET 4</th>
</tr>
</thead>
<tbody>
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<td>CONSTANT</td>
<td>$-5.89^*$</td>
<td>$-5.61^*$</td>
<td>$-5.80^*$</td>
<td>$-5.22^*$</td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td>(1.56)</td>
<td>(1.66)</td>
<td>(1.51)</td>
</tr>
<tr>
<td>TOTTRYLTY</td>
<td>$0.31^*$</td>
<td>$0.295^*$</td>
<td>$0.312^*$</td>
<td>$0.29^*$</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.097)</td>
<td>(0.103)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>PRD</td>
<td>$-0.05$</td>
<td>$-0.072$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0905)</td>
<td>(0.089)</td>
<td></td>
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</tr>
<tr>
<td>LSProj</td>
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<td>$0.020^*$</td>
<td>$0.017$</td>
</tr>
<tr>
<td></td>
<td>(0.0151)</td>
<td>(0.0145)</td>
<td>(0.015)</td>
<td>(0.014)</td>
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<td>TECHPKG</td>
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<td>$2.46^*$</td>
<td>$2.67^*$</td>
<td>$2.35^*$</td>
</tr>
<tr>
<td></td>
<td>(0.67)</td>
<td>(0.596)</td>
<td>(0.67)</td>
<td>(0.58)</td>
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<td>$0.016$</td>
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<td>(0.014)</td>
<td>(0.014)</td>
<td></td>
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<td>EXPREST</td>
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<td>$-0.85^*$</td>
<td>$-0.78^*$</td>
<td>$-0.945^*$</td>
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<td>(0.56)</td>
<td>(0.53)</td>
<td>(0.55)</td>
<td>(0.521)</td>
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<td>RESTSUPP</td>
<td>$-1.64^*$</td>
<td>$-1.74^*$</td>
<td>$-1.75^*$</td>
<td>$-1.82^*$</td>
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<td></td>
<td>(0.52)</td>
<td>(0.489)</td>
<td>(0.49)</td>
<td>(0.445)</td>
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<td>RESTGOI</td>
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<td>$-0.355$</td>
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<td></td>
<td>(0.57)</td>
<td>(0.57)</td>
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<td>EXPPOBLG</td>
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<td>$1.81^*$</td>
<td>$1.847^*$</td>
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<td></td>
<td>(1.331)</td>
<td>(1.325)</td>
<td>(1.32)</td>
<td>(1.318)</td>
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<td></td>
<td>(0.24E+06)</td>
<td>(0.25E+06)</td>
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<td>RND</td>
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<td>$-0.776$</td>
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<td>(0.084)</td>
<td>(0.0786)</td>
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<td>(0.077)</td>
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<td>SECTOR</td>
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<td>1.45*</td>
<td>1.14*</td>
<td>1.395*</td>
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<td>--------</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.427)</td>
<td>(0.45)</td>
<td>(0.42)</td>
</tr>
<tr>
<td>NUMCOMP</td>
<td>-0.109*</td>
<td>-0.111*</td>
<td>-0.104*</td>
<td>-0.109*</td>
</tr>
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<td>(0.025)</td>
<td>(0.024)</td>
<td>(0.023)</td>
<td>(0.022)</td>
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<tr>
<td>FUTIMP</td>
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<td>-0.314</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.53)</td>
<td>(0.526)</td>
<td></td>
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<tr>
<td>MGRASST</td>
<td>-0.548</td>
<td>-0.59</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.555)</td>
<td>(0.549)</td>
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<td></td>
</tr>
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<td>INDIGNZE</td>
<td>0.35</td>
<td>0.34</td>
<td>0.19</td>
<td>0.186</td>
</tr>
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<td></td>
<td>(0.53)</td>
<td>(0.52)</td>
<td>(0.48)</td>
<td>(0.462)</td>
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<td>BUYBACK</td>
<td>1.936*</td>
<td>1.378</td>
<td>2.04*</td>
<td>1.38</td>
</tr>
<tr>
<td></td>
<td>(1.481)</td>
<td>(1.405)</td>
<td>(1.47)</td>
<td>(1.395)</td>
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<tr>
<td>CHI-SQUARE</td>
<td>120.798*</td>
<td>119.101*</td>
<td>116.238*</td>
<td>113.192*</td>
</tr>
<tr>
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<td>18 D.F.</td>
<td>15 D.F.</td>
<td>15 D.F.</td>
<td>12 D.F.</td>
</tr>
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<td>MCFADDEN'S</td>
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<td>0.343</td>
<td>0.334</td>
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<td>R-SQUARE</td>
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</tr>
<tr>
<td>PERCENTAGE OF RIGHT PREDICTIONS</td>
<td>0.86495</td>
<td>0.84566</td>
<td>0.85852</td>
<td>0.84887</td>
</tr>
</tbody>
</table>

* Statistically Significant at 10% Level (one-tailed test)

Values in parentheses are estimates of Standard Error
The most suitable estimation technique for logit models with individual observations is that of maximum likelihood. The likelihood ratio test was performed to test the null hypothesis \( H_0: z_i = w_i = 0 \) i.e. the coefficients in the estimated equation are equal to zero. The value of the chi-square statistic exceeds the prescribed critical value for each of the models under consideration.[1] The null hypothesis can therefore be rejected. The values of the MCFADDEN's R-Square vary between 0.33 to 0.36 for the different models.[2] The percentage of right predictions have a substantial value lying between 85% to 87% for the four models.[3] This indicates that the model is robust in explaining the choice of exclusive versus non-exclusive technology licensing contracts.[4]

The estimated coefficients do not signify an increase (decrease) in the probability of the event occurring given a one unit increase (decrease) in the corresponding variable. The parameter estimates express the effect of a given change upon \( \log[p_i/(1-p_i)] \). The amount of change in the probability depends upon its original value and hence upon the initial values of all independent variables and their coefficients.[5] The derivatives of the probabilities with respect to the given independent variables are calculated for each model and are presented in Table 7.3. The values of the independent variables have been evaluated at their
### Table 7.3. Derivatives of Probability with Respect to Independent Variables

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>MEAN VALUES</th>
<th>SET 1</th>
<th>SET 2</th>
<th>SET 3</th>
<th>SET 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTRYLTY</td>
<td>2.61</td>
<td>0.0001*</td>
<td>0.0005*</td>
<td>0.0001*</td>
<td>0.0003*</td>
</tr>
<tr>
<td>PRD</td>
<td>6.32</td>
<td>-0.00002</td>
<td></td>
<td>-0.00003</td>
<td></td>
</tr>
<tr>
<td>LSPROJ</td>
<td>12.68</td>
<td>0.00001*</td>
<td>0.00003</td>
<td>0.00001*</td>
<td>0.00001</td>
</tr>
<tr>
<td>TECHPKG</td>
<td>2.87</td>
<td>0.00082*</td>
<td>0.0043*</td>
<td>0.0012*</td>
<td>0.0021*</td>
</tr>
<tr>
<td>FORNEQIT</td>
<td>9.12</td>
<td>0.000003</td>
<td></td>
<td>0.00001</td>
<td></td>
</tr>
<tr>
<td>EXPREST</td>
<td>0.61</td>
<td>-0.00002*</td>
<td>-0.0015*</td>
<td>-0.0004*</td>
<td>-0.0008*</td>
</tr>
<tr>
<td>RESTSUPP</td>
<td>0.24</td>
<td>-0.00005*</td>
<td>-0.003*</td>
<td>-0.0008*</td>
<td>-0.0016*</td>
</tr>
<tr>
<td>RESTGOI</td>
<td>0.11</td>
<td>-0.00009</td>
<td>-0.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPOBLG</td>
<td>0.097</td>
<td>0.00006*</td>
<td>0.0034*</td>
<td>0.0008*</td>
<td>0.0016*</td>
</tr>
<tr>
<td>LICSIZE</td>
<td>1.21</td>
<td>0.00006</td>
<td>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>STARTUP</td>
<td>0.013</td>
<td>0.0086</td>
<td>0.049</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RND</td>
<td>2.11</td>
<td>-0.00003</td>
<td>-0.0013</td>
<td>-0.00005*</td>
<td>-0.00007</td>
</tr>
<tr>
<td>SECTOR</td>
<td>0.67</td>
<td>0.0004*</td>
<td>0.0025*</td>
<td>0.0005</td>
<td>0.0001*</td>
</tr>
<tr>
<td>NUMCOMP</td>
<td>8.30</td>
<td>-0.00003*</td>
<td>-0.0002*</td>
<td>-0.00005*</td>
<td>-0.0001*</td>
</tr>
<tr>
<td>FUTIMP</td>
<td>0.26</td>
<td>-0.00009</td>
<td>-0.0005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGRLASST</td>
<td>0.19</td>
<td>-0.0002</td>
<td></td>
<td>-0.0003</td>
<td></td>
</tr>
<tr>
<td>INDIGNZE</td>
<td>0.50</td>
<td>0.0001</td>
<td>0.0006</td>
<td>0.00009</td>
<td>0.0002</td>
</tr>
<tr>
<td>BUYBACK</td>
<td>0.045</td>
<td>0.0006*</td>
<td>0.0024*</td>
<td>0.001*</td>
<td>0.0012*</td>
</tr>
</tbody>
</table>

* Statistically Significant at 10% Level (one-tailed test)
respective mean values to ensure a unique estimate of the derivative.

The logit model may be considered as an additive model or a multiplicative model depending on how the response variable is conceived. In order to get a better perception of the effect of the independent variables on the dependent variable, we can construct "odds" and an "odds ratio" for each independent variable. [6]

The original coefficients $B_i$ and $G_i$ represent the additive effect of a one unit change in a given variable, ceteris paribus, on the log of odds of choosing a technology licensing contract. Equivalently, the "odds ratio" $\exp[B_i]$ and/or $\exp[G_i]$ represents the multiplicative effect of a one-unit change in a given variable, ceteris paribus, on the odds of choosing an exclusive technology licensing contract.

Table 7.4 presents the odds ratios as the response variable of the given logit models. The values correspond to the multiples of the odds by which the choice variable will change when the individual independent variable will change by a unit under ceteris paribus conditions. For instance, a unit percentage increase in the royalty, holding all other variables constant, multiplies the odds of choosing an exclusive technology licensing contract by approximately 1.35 i.e. the odds increase by 35%.

The dummy variables also have a similar interpretation. If the restrictions imposed by the technology supplier are
TABLE 7.4

ESTIMATION OF ODDS RATIOS FOR THE CONTRACT CHOICE MODELS

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>SET 1</th>
<th>SET 2</th>
<th>SET 3</th>
<th>SET 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTTRYLT</td>
<td>1.36*</td>
<td>1.34*</td>
<td>1.37*</td>
<td>1.34*</td>
</tr>
<tr>
<td>PRD</td>
<td>0.95</td>
<td>0.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSProj</td>
<td>1.02*</td>
<td>1.02</td>
<td>1.02*</td>
<td>1.02</td>
</tr>
<tr>
<td>TECHPKG</td>
<td>14.01*</td>
<td>11.70*</td>
<td>14.44*</td>
<td>10.49*</td>
</tr>
<tr>
<td>FORNEQIT</td>
<td>1.01</td>
<td></td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>EXPREST</td>
<td>0.93*</td>
<td>0.43*</td>
<td>0.46*</td>
<td>0.39*</td>
</tr>
<tr>
<td>RESTSUPP</td>
<td>0.19*</td>
<td>0.18*</td>
<td>0.17*</td>
<td>0.16*</td>
</tr>
<tr>
<td>RESTGOI</td>
<td>0.74</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPOBGL</td>
<td>6.85*</td>
<td>6.92*</td>
<td>6.11*</td>
<td>6.34*</td>
</tr>
<tr>
<td>LICSIZE</td>
<td>1.22</td>
<td>1.15</td>
<td>1.23</td>
<td>1.14</td>
</tr>
<tr>
<td>STARTUP</td>
<td>$10^{12}$</td>
<td>$10^{12}$</td>
<td>[approximately]</td>
<td></td>
</tr>
<tr>
<td>RND</td>
<td>0.90</td>
<td>0.46</td>
<td>0.89*</td>
<td>0.92</td>
</tr>
<tr>
<td>SECTOR</td>
<td>3.46*</td>
<td>4.26*</td>
<td>3.13*</td>
<td>4.03*</td>
</tr>
<tr>
<td>NUMCOMP</td>
<td>0.90*</td>
<td>0.89*</td>
<td>0.90*</td>
<td>0.90*</td>
</tr>
<tr>
<td>FUTIMP</td>
<td>0.76</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGRласst</td>
<td>0.58</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDIGNIZE</td>
<td>1.42</td>
<td>1.40</td>
<td>1.21</td>
<td>1.20</td>
</tr>
<tr>
<td>BUYBACK</td>
<td>6.93*</td>
<td>3.97*</td>
<td>7.69*</td>
<td>3.97*</td>
</tr>
</tbody>
</table>

* Statistically Significant at 10% Level (one-tailed test)
increased by one unit [from 0 to 1], keeping all other variables constant, then the odds of choosing an exclusive contract will be multiplied by approximately 0.18. The odds, in this case decrease by 82%. [7]

For large samples the parameter estimators are consistent and also efficient asymptotically. They are asymptotically normal and the analog of regression t tests can be applied. [8] Each of the variables was tested to determine its significance in the regression model.

7.3. SIGNIFICANT VARIABLES

From Table 7.2 it is observed that all other coefficients except those corresponding to royalty payment [TOTRYLTY] [9], package of technology [TECHPKG], ownership of firms [SECTOR], restrictions imposed by the supplier [RESTSUPP] and the number of competitors [NUMCOMP] are insignificant at the 1% level. The variables representing restriction on exports by the suppliers [EXPREST] and the export obligation [EXPOBLG] imposed by the recipient's country also attain significance if tested at the 10% level. The estimators of lump-sum payments [LSPROJ] and of buy-back [BUYBACK] of the contract product are significant at 10% level in two of the four models while the variable of research and development [RND] is found significant at 10% level only in one of the four models. [10] Each of the significant variables has the expected sign.
The payments for the technology play an important part in the determination of the choice of a mode for transfer. The returns to the supplier on the sale of technology can therefore be a major constraint on the supply of technology.[11] The significance of the technology package and lump-sum payments as a proportion of project costs [though limited] reflects the existence of payment accruing through mark-ups on sales of capital goods, raw materials, and/or components. Davies has also shown that the extent of the technology package provided is significantly related to the type of agreement involved.[12]

The negative sign of the variable representing the number of competitors in the licensee's market with similar technology confirms the hypothesis that the Indian firms import technology to gain a comparative advantage in the industry. The firms, as a result, emphasize an early entry which would enable them to take advantage of the large "rent" furnished by a protected market.[13]

A presence of export restrictions by the supplier inversely affect the choice of the mode of a technology licensing agreement. Although these restrictions are pervasive in the technology contracts in the electronics industry, they do not have a causal relationship with the unsatisfactory export performance of the Indian firms.[14] The export restrictions represent "hidden costs." They act
as a "trade-off" against other modes of payment for the technology supplier.[15]

The variable denoting the imposition of an export commitment by the government of India and the variable representing the suppliers' acceptance to buy a part or all of the contract product were significant at the 10% level. In a majority of the agreements studied the two were complementary. Although the obligation of exports is difficult to enforce, its presence or absence is important in the choice of the agreement mode. The possibility of buy-back of the output plays a similar role.

The expenditure on research and development as a percentage of sales approached statistical significance at 10% level in only one of the four models. Its inverse relation to the choice of the technology contract confirms the fact that the Indian firms depend on the foreign technology suppliers for new developments.[16] The research effort in the Indian electrical and electronics segment is less than 1% of their sales value.[17] Even when excluding the relative effectiveness of this expenditure, the effort by the Indian firms is considerably less than the 8% to 12% of sales in the firms of primary electronics-producing countries.

Approximately 85% of the research and development effort in India is concentrated in the public sector firms.[17] The public sector enterprises are government
owned. They are consequently larger and have a greater access to resources. There is evidence that these enterprises suffer from the deficiencies of public sector management which frequently leads to unsuccessful or inappropriate projects.[18] The significance of the variable representing the firm ownership confirms that there are differences in the choice of technology contracts in the two sectors. Since there were firms belonging to the joint sector in the sample a "goodness of fit" test was conducted to confirm this hypothesis. Its results are discussed later.

7.4. INSIGNIFICANT VARIABLES

The variables representing the previous manufacturing start-ups of the licensors' technology, \( \text{[STARTUP]} \), agreement period, \( \text{[PRD]} \), the magnitude of foreign equity in the licensee firm, \( \text{[FORNEQIT]} \), other restrictions imposed by the government of India, \( \text{[RESTGOI]} \), relative plant size of the licensee, \( \text{[LICSIZE]} \), availability of future improvements of technology \( \text{[FUTIMP]} \), managerial assistance, if any, \( \text{[MGRLASST]} \), and help in adapting the technology to local conditions, \( \text{[INDIGNZE]} \), are found to be trivial even at 10% level. It can be surmised that these variables do not play an important role in the choice of a technology licensing contract.
STARTUP represents the number of start-ups that a licensor has conducted for a given technology. It therefore reflects the capability of a firm in efficiently transferring a given package of technology. This variable may, in some instances, affect the cost of transfer to the supplier of technology. It, however, does not have an impact on the decision of the recipient in choosing a licensing contract. Apparently, once the new technology is commercialized, there exists a greater opportunity to adjust the basic parameters for an electronics technology. [19]

The variable PRD, which denotes an agreement's life was found to be insignificant. [20] This has important policy implications since limiting the period of a technology licensing contract is a principal concern of the government of India. Licensors also view this restriction with reservation since it effectively reduces the rents accruing to them from the technology transfer. [21] An earlier study of the returns from licensing agreements has also found this variable to be peripheral. [22] Its insignificance may, therefore, reflect that, both, the licensees and the licensors take this constraint as given and work around it thereby rendering the restriction as ineffective in the choice of the mode of an agreement.

It is, perhaps, for identical reasons that the variable RESTGOI is also insignificant. This variable depicts restrictions on import content in the technology, on the
location of a project, etc. Imports of capital goods, raw materials, and components have, in spite of government regulations, become an implicit element of all technology agreements. Furthermore, most of the firms set up their projects in "backward areas" where they are eligible for a subsidy from either the state government or the central government.[23] These restrictions have, consequently, been internalized by the licensee firms. They are consequently ineffective on the recipients' choice of the mode of a technology agreement.

The effect of the dummies representing managerial assistance [MGRLASST] by the licensor, help by the supplier in adapting or developing the technology for the licensee's use [INDIGNZE], and the communication of future improvements of technology by the licensor during the period of agreement at no extra cost [FUTIMP], did not approach acceptable significance in any of the models. This indicates that the relationship of the Indian licensee in the electronics industry with their licensors is indeed an "arms-length" as is promoted by the government. The reasons can be attributed to, both, the licensees and the licensors.

The restrictive public policies in India discourage the technology importers from long-term strategic planning. Instead, as discussed earlier, they have an incentive to enter the market early and realize the high profits brought about by the protective quantitative restrictions. The high
The numerous restrictions imposed by the government of India may cause the importers to constrain the flow of technology to Indian firms. Bureaucratic controls were cited as the greatest source of discontent for the licensors by the technology importers in the electronics industry. In dealing with adapting technology to the local conditions the Indian firms have received marginal help from the technology suppliers. Frequently, the licensor is averse to any modification of the transferred technology for producing the contract product.

In addition, the consent to supply the modifications of technology by the supplier during the period of agreement is, per se, contingent on a reciprocal agreement by the licensee for a similar access to any of his improvements to the licensor. Many of the Indian firms, who possess the capacity to improvise and improve, are unwilling to share the profits, if any, resulting from adaptation.

Other plausible explanations may be, either, that a majority of the licensing agreements do not require a significant technology adaptation to conform to the local conditions; or that the adaptation of technology necessitates substantial costs. Licensors may not agree to supply the modifications in the absence of additional
remuneration. Besides, the successful adaptations of technology have been observed to be mostly for less sophisticated and older technologies.[28] The technology imported by the electronics industry is of recent vintage and subject to rapid transition.

In addition, the variable denoting the relative size of the licensee as compared to that of the licensor in terms of sales [LICSIZE] and the variable representing the magnitude of foreign equity in the licensee firm [FORNEQIT] did not approach acceptable significance in any of the models. The small scales of production of the Indian firms associated by the high import propensity of the Indian electronics industry offer a probable explanation. Irrespective of the presence of foreign equity in the recipient firm, the latter imports most of its requirements of capital goods and/or materials, specific or otherwise, from the supplier of technology. In addition, extensive delays caused by a plethora of bureaucratic approvals eliminates the disparity in costs of transaction between a simple licensing contract and a joint venture.[29] Appendix G shows a typical PERT chart for implementation of a project based on imported technology.

7.5. CONTINGENCY TABLE TEST

The sample of licensing agreements pertains to firms in the private sector, public sector and the joint sector. As
indicated previously the nature and quantum of resources available to the various sectors are dissimilar. [30] Besides, different sectors predominate in separate segments of the electronics industry. [31] The public sector firms are obligated to accomplish social objectives and they are consequently allowed to preempt private sector firms even in areas not formally reserved for them. Frequently, the public sector firms continue to produce even when the costs of production are greater than the selling price because their larger size permits them to cross-subsidize this loss by more profitable lines. [32]

A contingency table was used to carry out the test of independence to test the following hypothesis:

\[ H_0 = \text{The Mode of Technology Licensing Contract is Independent of the Sector of the Firm.} \]
\[ H_1 = \text{The Mode of Technology Licensing Contract is not Independent of the Sector of the Firm} \]

Table 7.5 and Table 7.6 describe the situation by presenting the observed and the predicted frequencies of the choice of the technology licensing agreement in the three sectors. [33]

The computed value of Chi-Square based on the observed and expected frequencies is 11.89. [34] It is greater than the critical value of Chi-Square for 2 degrees of freedom and at 1% level of significance. The null hypothesis of independence can therefore be rejected and it is concluded
TABLE 7.5. OBSERVED FREQUENCIES OF SECTOR-WISE LICENCE MODE PREFERENCE

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>EXCLUSIVE</th>
<th>NON-EXCLUSIVE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIVATE</td>
<td>161</td>
<td>34</td>
<td>195</td>
</tr>
<tr>
<td>JOINT</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>PUBLIC</td>
<td>70</td>
<td>33</td>
<td>103</td>
</tr>
<tr>
<td>TOTAL</td>
<td>238</td>
<td>73</td>
<td>311</td>
</tr>
</tbody>
</table>

TABLE 7.6. PREDICTED FREQUENCIES OF SECTOR-WISE LICENCE MODE PREFERENCE

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>EXCLUSIVE</th>
<th>NON-EXCLUSIVE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIVATE</td>
<td>149.23</td>
<td>45.77</td>
<td>195</td>
</tr>
<tr>
<td>JOINT</td>
<td>9.95</td>
<td>3.05</td>
<td>13</td>
</tr>
<tr>
<td>PUBLIC</td>
<td>78.82</td>
<td>24.18</td>
<td>103</td>
</tr>
<tr>
<td>TOTAL</td>
<td>238</td>
<td>73</td>
<td>311</td>
</tr>
</tbody>
</table>

CHI-SQUARE = 11.89

CHI-SQUARE [CRITICAL VALUE: 2; 0.01] = 9.21
that the choice of mode for the technology licensing agreements is not independent of the sector-wise ownership of the firms in the electronics industry of India.

7.6. ROYALTY - LUMP-SUM TRADE-OFF

The Government of India regulates the price paid for a given package of technology by stipulating a limit for not only the royalties to be paid but also on the period for which royalties can be paid. In addition, the technical fees are not allowed to exceed a certain proportion of the expected sales.\[35\] The most important objective of a technology supplier is to maximize his profits. The supplier, therefore, has an incentive to modify the package of technology according to the payments received. There is sufficient evidence to indicate the existence of an ample opportunity for adapting the content of the imported technology to the price paid. Such a tailoring has been extensive in India.\[36\]

OLS and a LOGIT model were tested to analyze the dependence of the technology package on royalty payments, lump-sum payments and the period of royalty payment. The OLS results are shown in Table 7.7.

The F statistic [with 5 and 305 degrees of freedom] is significant, allowing us to reject the null hypothesis that all explanatory variable coefficients are jointly zero. The
### TABLE 7.7

**OLS RESULTS OF TECHNOLOGY PACKAGE & TECHNOLOGY PAYMENTS**

**DEPENDENT VARIABLE = TECHNOLOGY PACKAGE**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>COEFFICIENTS</th>
<th>T-VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>2.63</td>
<td>75.43*</td>
</tr>
<tr>
<td>ROYALTY PAYMENTS [TOTRYLTY]</td>
<td>0.092</td>
<td>3.82*</td>
</tr>
<tr>
<td>LUMP-SUM PAYMENTS [LSM]</td>
<td>0.12E-04</td>
<td>0.77</td>
</tr>
<tr>
<td>ROYALTY PAYMENT PERIOD [RYLTYPRD]</td>
<td>0.0034</td>
<td>3.44*</td>
</tr>
</tbody>
</table>

**INTERACTION TERMS:**

<table>
<thead>
<tr>
<th>TERMS</th>
<th>COEFFICIENTS</th>
<th>T-VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSM*TOTRYLTY [LSRRPRD]</td>
<td>-0.19E-05</td>
<td>-0.53</td>
</tr>
<tr>
<td>TOTTRYLTY*RYLTYPRD [TOTRLPRD]</td>
<td>-0.0009</td>
<td>-2.61*</td>
</tr>
</tbody>
</table>

**R-SQUARE: 0.183**

**F STATISTIC = 13.655***

**CRITICAL VALUE F STATISTIC [5, 305] AT 1% LEVEL: 9.06**

*Statistically Significant at 1% Level (one-tailed test)
R-Square has a very small value probably because it is a cross-section model.[37]

The estimated coefficients for the lump-sum payment \([\text{LSM}]\), and for the interaction term of lump-sum payment with royalty payment \([\text{LSRRPRD}]\), are insignificant even at a 10% level. On the other hand the estimated coefficients for the royalty payment \([\text{TOTRYLTY}]\), period of royalty payment \([\text{RYLTYPRD}]\), and the interaction term of the two \([\text{TOTRLPRD}]\), are significant at the 1% level. Apparently, it is the royalty along with the period of payment of royalty in the agreement period which define the contents of a technology package. All the significant coefficients have the correct sign. The negative sign of the royalty-period interaction term shows that the effect of an increase in royalty payment period will decrease the explanatory effect of royalty on the technical package.[38]

Two different models were analyzed using a LOGIT regression. The first model contained the same independent variables as the OLS regression. The other model excluded the variable denoting the period of royalty payments. The observations of technology package for the LOGIT regressions exclude values of the variable representing the purchase of capital goods only.[39] The results of the regressions are shown in Table 7.8.
TABLE 7.8

LOGIT RESULTS OF TECHNOLOGY PACKAGE & TECHNOLOGY PAYMENTS

DEPENDENT VARIABLE = TECHNOLOGY PACKAGE

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COEFFICIENTS</th>
<th>DERIVED COEFFICIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MODEL I</td>
<td>MODEL II</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>0.59*</td>
<td>0.64*</td>
</tr>
<tr>
<td>ROYALTY</td>
<td>1.84*</td>
<td>0.38*</td>
</tr>
<tr>
<td>PAYMENTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[TOTROYLTY]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUMP-SUM</td>
<td>0.8E-03*</td>
<td>0.8E-03*</td>
</tr>
<tr>
<td>PAYMENTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[LSM]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROYALTY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAYMENT PERIOD</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>[RYLTYPRD]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTERACTION TERMS:

<table>
<thead>
<tr>
<th></th>
<th>MODEL I</th>
<th>MODEL II</th>
<th>MODEL I</th>
<th>MODEL II</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSM*TOTROYLTY</td>
<td>0.021*</td>
<td>0.022*</td>
<td>[0.016]</td>
<td>[0.017]</td>
</tr>
<tr>
<td>[LSRRPROD]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTROYLTY *</td>
<td>-0.019*</td>
<td></td>
<td>[0.014]</td>
<td></td>
</tr>
<tr>
<td>RYLYPRD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[TOTRLPRD]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHI-SQUARE</td>
<td>70.67*</td>
<td>68.06*</td>
<td>5 D.F.</td>
<td>3 D.F.</td>
</tr>
<tr>
<td>MCFADDEN'S R-SQUARE</td>
<td>0.34</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERCENTAGE OF RIGHT PREDICTIONS</td>
<td>0.89</td>
<td>0.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically Significant at 10% Level (one-tailed test)
Values in parentheses are estimates of Standard Error
The value of the maximum likelihood estimator is significant. The likelihood ratio test was performed to test the null hypothesis \([H_0: \beta_1 = \beta_2 = 0]\) i.e. the coefficients in the estimated equation are equal to zero. The values of the chi-square statistic exceeds the prescribed critical value. The null hypothesis can therefore be rejected. The model is, therefore, robust in explaining the choice of a technology package. The derivatives of the probabilities with respect to the given independent variables are also presented in the Table 7.8.

It is found that all variables except the period of royalty payments \([\text{RYLTYPRD}]\) are found to be significant at the 10% level. However, the interaction term between the total royalty payment and the period of royalty payment \([\text{TOTRLPRD}]\) is found to be acceptable at the 10% level. The variable representing the lump-sum payments \([\text{LSM}]\) is also significant at the 10% level in this model. The signs of the coefficients are, as expected, identical to the OLS model. The positive sign of the variable denoting interaction of lump-sum payments and royalty payments indicates that the presence of one enhances the effect of the other in determining the choice of a technology package.

The derivatives of the probability with respect to the independent variables have a very small value. The reason may lie in the fact that the interaction terms have very large mean values with, in many cases, larger standard
Consequently, the value of the derivatives are sensitive to the values used in the calculations. The values of the odds ratios are therefore analyzed. Table 7.9 presents the calculated values of the odds ratios for the two models. The interpretation of these values is similar to the earlier discussion. The presence of interaction terms, however, changes the value of an odds ratio to $\exp[B_i + IW_i]$, where I represents the coefficient of the interaction term.

The Table 7.9 indicates that the value of the odds ratio for the royalty variable, holding other variables constant becomes very high when the interaction terms are considered. In the absence of the interaction terms this value is approximately 6.3 for model I and 1.46 for model II. The presence of a lump-sum along with the royalty payments increases the odds of choosing an exclusive licensing contract tremendously. The overwhelmingly high value of odds ratio for the royalty variable is caused by the mean value of the lump-sum variable. This calculation is also sensitive to the value of the lump-sum variable.

Similarly the odds ratio for the lump-sum variable is increased to 1.07 for both the models. In the absence of the interaction term this value was approximately unity for both the models. As a result it can be concluded that there exists a certain amount of trade-off between the two types of payments, viz., royalty and the lump-sum. The model I
TABLE 7.9. ESTIMATION OF ODDS RATIOS FOR THE TECHNOLOGY PACKAGE MODELS

DEPENDENT VARIABLE = TECHNOLOGY PACKAGE

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MODEL I</th>
<th>MODEL II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROYALTY PAYMENTS [TOTRYLTY]*</td>
<td>5,555,445*</td>
<td>6,992,999*</td>
</tr>
<tr>
<td>LUMP-SUM PAYMENTS [LSM]*</td>
<td>1.07*</td>
<td>1.07*</td>
</tr>
<tr>
<td>ROYALTY PAYMENT PERIOD [RYLTYPRD]*</td>
<td>0.96</td>
<td></td>
</tr>
</tbody>
</table>

CALCULATIONS OF ODDS RATIOS

# = e^{1.84+0.021(MEAN VALUE LSM)-0.019(MEAN VALUE RYLTYPRD)}
   = e^{0.38+0.022(MEAN VALUE LSM)}

^ = e^{0.008+0.021(MEAN VALUE TOTRYLTY)}
   = e^{0.008+0.022(MEAN VALUE TOTRYLTY)}

^- = e^{0.01-0.019(MEAN VALUE TOTRYLTY)}

* Statistically Significant at 10% Level (one-tailed test)
also indicates that the presence of the period of royalty payments variable and its interaction variable with the royalty payment tend to reduce the odds in the selection of a given package of technology. The size of the technology package will, in turn, have an impact on the choice of an exclusive technology licensing contract.
NOTES

1. The Likelihood ratio $L$ is defined as

$$L = \frac{L_0}{L_{max}}$$

$$-2 \log L = -2(\log L_0 - \log L_{max})$$

The above equation follows a chi-square distribution with $k$ degrees of freedom where $k$ is the number of parameters in the equation (other than the constant)

$L_0$ = Likelihood function when all parameters (other than the constant) are set equal to zero.

$L_{max}$ = Likelihood function evaluated at its maximum.


2. MCFADDEN's R-Square = $1 - (L_{max} / L_0)$

A dichotomous dependent variable model is unlikely to yield an R-square close to 1. Such a result can occur only in the extreme cases where all predicted probabilities are either 0 or 1. Consequently if R-square is used as a measure of goodness of fit then it must be realized that its upper limit is likely to be substantially less than 1.


3. A prediction is "correct" when $P_i \geq 0.5$ and $Q_i = 1$ or $P_i < 0.5$ and $Q_i = 0$. For a Logit model the Percentage of Right Predictions = Number of Right Predictions / Total Number of Observations.


4. In all of the models in Table 7.2 the observations under Joint Sector ownership were put under the category of Private Sector ownership with the variable SECTOR = 1. Various other models, viz., with SECTOR = 0 [Joint Sector = Public Sector] and actual values [%] of export obligation rather than a dummy variable were also analysed. The results were relatively identical to those presented in the Table 7.2.
5. The partial derivatives in the Logit model are

\[ \frac{dP_i}{dx_{ij}} = f(x'\_iB) \times B_j \]

where \( P_i = F(x'\_iB) \)

and \( f(.) \) is the probability density function associated with \( F(.) \). The sign of the coefficient does indicate the direction of the change. The magnitude of change depends upon \( f(x'\_iB) \), which, reflects the steepness of the Cumulative Distribution Function [CDF] at \( x'\_iB \). Thus, the steeper the CDF, the greater the impact of a change in the value of an explanatory variable will be.

The value of the derivative of probabilities with respect to a particular independent variable is consequently given by:

\[ \frac{dP_i}{dx_{ij}} = f(x'\_iB)B_j = \left( \frac{\exp(x_iB)}{1 + \exp(x_iB)} \right)^2B_j \]

The right-hand side is evaluated at the sample mean of \( x_i \) as \( i \) ranges from 1 to \( n \), if a unique estimate of the derivative is desired.


The definition of the Odds corresponds to its regular dictionary usage. For instance, "three-to-one" odds on winning a lottery are 0.75:0.25 or 0.75 / [1 - 0.75].

A Logit Function can be written as

\[ P = \frac{1}{1 + e^{-U}} \]

or

\[ 1/P = \frac{1}{1 + e^{-U}} \]

\[ e^{-U} = [1 - P] / P \]

\[ e^U = P / [1 - P] = ODDS = \hat{\Lambda} \]

\[ \log e^U = \log P / [1 - P] = \log ODDS = \log \hat{\Lambda} \]
\[ \log \Omega = \ln U = A + BX + GW + DZ \]

where B, G, D, are any coefficients and X, W, and Z are any given independent variables.

\[ \Omega = \exp [A + BX + GW + DZ] \]

Let us increase the variable X by unity. Then,

\[ \Omega^* = \exp [A + B(X+1) + GW + DZ] \]
\[ = e^{[A + BX + GW + DZ]} \cdot e^B \]
\[ = \Omega \cdot e^B \]

Therefore,

\[ \frac{\Omega^*}{\Omega} = e^B = \text{ODDS RATIO} \]

From the above result, it is obvious that a one-unit increase in X, holding other predictor variables constant, multiplies the "odds" by the factor \( \exp(B) \).

7. Ibid., p. 15.

8. The asymptotic \( t \) value is calculated by dividing the parameter estimate by its standard error giving in the parentheses. It follows a normal distribution. It is, therefore equivalent to Student's \( t \) distribution with \( n-k \) degrees of freedom. \( k \) refers to the number of elements in the equation and \( n \) is the total number of observations.


9. Logit regressions with the independent variable for total royalty [TOTRLTY] replaced by separate independent variables for royalty on product for internal sales [RRINT] and royalty on product for exports [RREXP] were also tested. The two variables were not only insignificant but also had opposite signs.

10. Since there are over 300 observations, consideration of a 10% level of significance becomes consequential.

11. A study by Lutz Hoffman and his team regarding sales of technology by the West German high technology firms to Indian firms revealed that inadequate returns from the sale were a major apprehension for the suppliers.

A UK study carried out within the overall EEC/India project on technology transfer also suggested the prominent role played by the "returns on sale" to the supplier of technology. To quote one of the firms:

"As we had nothing to lose, we wouldn't agree to transfer if the returns were inadequate."


13. Most of the firms interviewed contended the superiority of their technology compared to their other competitors. In fact that is one of the reasons why the Indian firms always approach technology leaders with "known" names for importing technology.

Alam's study of 279 foreign collaborations in 211 Indian firms also confirms this hypothesis. He argues:

"...The decision to import technology ... was not always based on a long-term view of the firm's technological capabilities and activities and was a hasty step to maintain its market position."


14. A majority of the firms interviewed mentioned the domestic market as the focus of their operations. The high import intensity of the Indian electronics industry supplemented by the high duties make the Indian products internationally uncompetitive. This is true even if the quality considerations are ignored.

15. Lall has also argued that the removal of export clauses may result in higher royalties and fees.

16. Nearly all of the firms interviewed expressed that they will like the agreements extended or that they will approach the Government of India for a new technology collaboration approval when they are ready to market a product requiring the new international technology. The R&D expenditure of Indian firms is directed primarily at adaptation of imported technology to local conditions and environment.


According to the industrial census figures for 1981-82 the electronics industry contributed about one-third the value of production of the electrical machinery segment.

Except for a few, [< 5], none of the agreements analyzed contained a clause for R&D assistance. Approximately 15% of the firms in the sample did not have any R&D expenditure. It is extremely difficult to assess the precise R&D expenditures incurred by the firms in any Indian industry. Part of the reason lies in the fact that the annual reports or income statements do not explicitly mention this figure. As per the accounting practices adopted by the Indian firms, the R&D expenditure is included in wages and salaries and costs of capital goods and equipment. There are therefore possibilities of manipulating these expenses, especially when the Government of India offers numerous incentives and subsidies dependent on the R&D expenditure incurred by a firm.


19. Teece, in his study, found that the variable representing the first commercialization was found to be significant only in the chemical and petroleum refining sub-sample. It was insignificant for the machinery sub-sample. He concluded that there is insufficient latitude for manufacturing experimentation with continuous flow technologies [in contrast to machinery type] where the fixed investments are frequently large and any change in design parameters inordinately expensive.

20. I also tried a model where PRD was replaced by RYLTYPRD. The latter refers to the percentage ratio of the period of royalty payments to the total period of technology licensing agreement. The results were identical and this variable too did not approach acceptable significance. Its sign [+] was, however, opposite to that of PRD [-]. This aspect is inconsequential under the circumstances.


23. The interviews of Managers and a study of project reports of the firms in the Indian electronics industry shows that over 85% of the firms in the private sector choose to manufacture in an area which has been declared "backward" by the Government of India. This entitles them to a subsidy as follows:

I. CATEGORY A: [No-Industries & Special Regions]
   Subsidy of 25% subject to a maximum of Rs 2.5 million.

II. CATEGORY B: [Former Central Investment Areas excluding I]
   Subsidy of 15% subject to a maximum of Rs 1.5 million.

III. CATEGORY C: [Former Concessional Finance Areas Excluding I & II]
   10% subject to a maximum of Rs 1 million.
   [MRTP/FEPA firms are ineligible for this concession]

In addition, there are a number of other concessions present.


24. This argument is also supported by Ashok Desai.


Davies reports that "One very experienced licensing executive explained that GOI pressure on returns encouraged the adoption of a 'hit-and-run' philosophy on the part of licensors in India."


29. The Indian bureaucratic procedures and delays in getting approvals have been considered a disincentive for any foreign collaboration. As per a study conducted by the Indian Institute of Foreign Trade, the non-transparent policies and guidelines of Government of India and the discretionary powers of the bureaucrats in approving the projects is the major concern of the foreign collaborators. These have also been the cause of inordinate delay in taking decisions. In the 51 cases studied by the Trade Development Authority, delays were observed to have occurred in almost all cases. Against the specified number of 45 to 60 days for approvals the study showed that the average time taken is between 51 and 2189 days. Delays in approvals have been, at times, estimated to be about 6 years.

Trade Development Authority, Study of Delays in Decision Making with respect to Non-Resident Indian Investment & Other Investment Proposals, Mimeographed, Indian Investment Center, New Delhi, 1987.

30. Lending norms to central public sector firms allow them a greater debt in their capital structure. In addition, they have 10% price preference on procurement and also have an access to preferential sources of financing. As a result the overall levels of interest are lower for them. A comparison of the financial statements of a sample of public sector and private sector firms for the year 1982-83 and 1983-84 by the World Bank showed that effective interest rates [defined as total interest divided by total liability] were 12.5% and 17.2% for the public and private sector firms respectively. Besides, the public sector firms are not subject to pay dividends on equity.

31. For instance, the manufacture of Jelly Filled Cables is predominantly in the Joint Sector. In super minicomputers, a public sector corporation ECIL was given exclusive production rights for a two year period. It ended in November 1987. ITI in the public sector is the only firm to manufacture Electronic Switching Systems. BEL in the public sector is the only firm to produce Aerospace & Defense equipment. All telecommunications [except for equipment at subscriber's premises] and defense electronics are still in the public sector domain.


33. The Expected Frequencies for a Contingency Table Under the Assumption of Independence are given by:

\[ E_{ij} = \frac{[\text{Row } i \text{ Total}] [\text{Column } j \text{ Total}]}{\text{Sample Size}} \]

34. The Chi-Square value based on the observed and expected frequencies is computed as follows:

\[ \text{CHI-SQUARE} = \sum \sum \frac{(f_{ij} - e_{ij})^2}{e_{ij}} \]

Degrees of Freedom = [Number of Rows - 1] [Number of Columns - 1]

\[ f_{ij} = \text{observed frequency for contingency table category in row } i \text{ and column } j \]

\[ e_{ij} = \text{expected frequency for contingency table category in row } i \text{ and column } j \]

35. A guideline for approval of the foreign collaboration agreements is that both the royalty payments and the lump-sum payments should not exceed 8% of the total value of the production during the period of collaboration. Another internal guideline stipulates that the total lump-sum should not be allowed to exceed 50% of the total payment involved.

Personal communication by the Industrial Advisor DGTD and the Assistant Advisor Indian Investment Center.


37. The R-Square & Adjusted R-Square are very close in magnitude, since there are a large number of degrees of freedom in the model.
38. In a model with an interaction term

\[ U = A + BX + GW + DZ + I(XW) + E \]

the impact of \( X \) on \( U \) is measured by \( B + IW \). This is obtained by differentiating the above equation with respect to \( X \).

39. All earlier values when TECHPKG was = 1 are being excluded. In the present case

- \( TECHPKG = 1 \) when its earlier value was = 3
- \( TECHPKG = 0 \) when its earlier value was = 2.

40. The Logit distribution is based on the functional form of a sigmoid curve. The property of the logistic function

\[ P = \frac{1}{1 + e^{-U}} \]

is that when \( U \) becomes infinitely negative, \( e^{-U} \) becomes infinitely large. \( P \) therefore tends to zero. Alternatively, when \( U \) becomes infinitely positive, \( e^{-U} \) becomes infinitesimally small. As a result, \( P \) approaches unity. When \( U = 0 \), \( e^{-U} = 1 \) and \( P = 0.5 \). The logistic function has its center at \([U,P] = [0,0.5]\) which is also the inflection point. The effect of \( U \) on \( P \) is maximum at the inflection point. Effects are not constant over the range of the predictor, as they are for the simple regression model.

The mean values and the standard deviations are given in the APPENDIX H.

41. As discussed in Chapter Six,

\[ n^* = \Omega e^B e^{IW} \]

Thus the multiplicative effect of \( X \) on \( \Omega \) depends on the level of \( W \), and that the multiplicative effect of \( W \) on \( \Omega \) depends on the level of \( X \).
CHAPTER EIGHT

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

The concluding chapter will summarize the important results of this dissertation. The above discussion will be followed by the policy implications of the study and suggestions for further research.

The dominant theme of this dissertation is the analysis of determinants of the choice of a technology licensing contract by the licensee under the implicit characteristics [asymmetric information and the possibility of imitation] of the market for information. It has provided a much needed examination of the technology licensing market from the recipient's perspective, which, until now, has been studied only minimally.

The price for technology is determined through bargaining. It is thus implicitly assumed that both the licensee and the licensor have market power. The analysis has shown that the technology package, a proxy for the amount of technical goods and services provided to the licensee, and the compensation paid to the licensor are
important criteria for the choice of an exclusive or a nonexclusive technology contract.

The dissertation, by considering the scope of the technology package in general and the capital goods in particular, has contributed to the existing literature on technology transfer. Although the earlier studies (Rosenberg, [1976]; Stewart [1978]) have emphasized the importance of the capital goods as a source of technology, but there has been an inadequate empirical analysis of the same. The analysis revealed that an increase in the technology package from capital goods only to capital goods and technical know-how, ceteris paribus, multiplies the odds of choosing an exclusive technology licensing contract by 13 i.e. the odds increase by 1200%.[2] It also validates the result of Contractor's [1981] study which found that the extent of "services" provided to the recipient to be the most important criterion in determining compensation for the supplier during negotiation.

The entire compensation for the technology transfer and services, for the purpose of analysis, was essentially assigned into lump-sum payments and royalty payments. This was done because the services are rarely apportioned as per the remuneration for technology, remunerations prior to the agreement and remuneration for complementary services. This was confirmed by the consultants in technology transfer and the managers of the technology importing firms. The
definitions of specific payment categories were particular to individual transactions. Laying down theoretical principles, consequently, is of little interest to the functionaries for their practical applications. Another important contribution of this dissertation is that it has empirically tested the existence of a trade-off between the royalty and the lump-sum mode of payment for a given package of technology. The results confirm Contractor's [1981] observation of an existence of different channels of payment which can be intra-substituted to circumvent the licensee government's restrictions.

Out of the various complementary services which could be provided by the licensor to the licensee only the clause for buying back of the contract product was significant for the choice of an exclusive technology licensing contract.

It is also assumed that the essential objective of the licensor is to maximize rents from the sale of his technology.[1] The maintained hypothesis for the licensee is also that of profit maximization from the technology transaction. The rent for an equilibrium contract will be shared between the licensee and the licensor depending on the market power of the former. The significance and sign of the coefficient of the variable defining the number of competitors of the licensee with competitive technology confirms this view.
The extent of imperfection faced by the licensee is a function of his own technological, commercial, marketing, and managerial capabilities. It is the latter abilities that facilitate a licensee not only in improving demand determined technology transfer conditions but also in creating opportunities for the sources and terms of its supply. The competence of the licensee will allow him to "shop around" for technology and to bargain effectively for the purchase of technology with the desired "unpackaging." The negative and significant sign of the variable denoting the expenditure on research and development as a percentage of sales by the licensee firm, corroborates this contention. A firm with ample research and development experience can assimilate technology from different sources and reduce the extent of "market failure" for its transaction. Per contra, a firm with little or no experience [or proficiency] in research will be solely dependent on the licensor for current and future progressions of technical knowledge.

Instances of restrictive business practices by the licensor and the restrictions imposed by the government of the licensee were also discussed in the dissertation. The limitation, in one form or another, of the exports of the contract product by the licensee is the most common "indirect" cost imposed by the licensor. The analysis indicated a(n) (inverse) significant [at 10% level] effect
of the export restrictions imposed by the licensor on the choice of a licensing contract.

It supports Lall's [1980] contention that an export restriction may typify a "trade-off" against restrictions on the compensation for the technology package. An absence of such restrictions will have to be associated with an increase in royalties and/or fixed payments. This result is, nevertheless, unexpected in the Indian context because the firms solely concentrate on the domestic market. An absence of export restrictions will not result in an expansion of exports, except when accompanied by buy-back arrangements. The licensors, apparently, in the presence of limitation on payments are averse to risking the rents accruing to their technical superiority by unexpected threats to the appropriation of returns on sales elsewhere. Licensees also perceive it as a hidden cost and use it as a bargaining instrument. It is perhaps, the recognition of such economic elements that have motivated the Government of India to allow "legitimate" export restrictions.

In addition, other restrictions imposed by the licensor were also found to have a(n) (inverse) significant [at 1% level] effect on the choice of an exclusive licensing contract. These restrictions may range from the tied purchases of raw materials, components and capital goods to issues of confidentiality of the transferred knowledge, to conditional payment clauses, to quality control, and to
other restrictions on the use of industrial property rights during or after the expiration of the agreement. These regulations were found to apply equally to agreements between parent firms and their affiliates and to the arm's length agreements. However, it is not possible to say if they tend to be relatively more restrictive in one than the other. Such restrictions are also indicative of "indirect costs" of entering into a contract. They are reflected in the increased transaction costs of bargaining over the terms of the agreement.

The analysis also indicates that the imposition of an export obligation by the Indian Government encourages the licensees to choose an exclusive technology licensing contract. This result has to be interpreted with caution, especially, for policy implications. A majority of the firms who agree with the government's export obligation do so because the supplier agrees to buy back a part or all of the product. Such a dependence serves to further weaken the bargaining position of the recipient firm. The licensee firms frequently attempt to get the export commitment waived off on the grounds of unfavorable international prices. The Government of India concedes the point and a rethinking of this policy is already in the offing.[3]

The government policy framework has deliberately placed the public sector firms in an advantageous position in terms of accessibility of financial and other resources. The
public sector firms are, as a result, in a better bargaining position than the private sector firms. The joint sector firms will be somewhere between the two. The results of the analysis amply illustrate that the choice of an exclusive technology licensing contract is dependent on the licensee firm's ownership. The public sector firms may have, relatively speaking, minor interest in obtaining an exclusive contract because of their inherent "monopolistic position" created and aided by the policy structure.

Dummy variables could have been used in the logit regression model to observe differences in the choices of the technology licensing agreements amongst the firms belonging to public sector, joint sector, and private sector. The contingency table test was done because the proportion of observations corresponding to the joint sector were a small fraction of the observations corresponding to the public sector and private sector respectively.

There were a number of other independent variables in the model which were found to have an insignificant [at 10% level] influence on choosing an exclusive technology licensing contract. The theory suggested their presence in the model. However, empirical analysis discovered their insignificance. The possible reasons for the unimportant role played by these variables in the preference of a particular mode of a technology licence were discussed in

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detail in Chapter Seven because of their potential policy implications.

The variable representing the magnitude of foreign equity in the licensee firm was observed to be extraneous in the choice of an exclusive or a nonexclusive technology licensing agreement. This result corroborates Contractor's [1981] finding that the licensor-licensee relationship does not vary significantly between licensing agreements with affiliates and nonaffiliates. Despite the presence of equity in firms and equity control in subsidiaries, the bargaining behavior of the licensees is based on the objective of local profit maximization.

Insignificance of the foreign equity variable in the choice of an exclusive technology licensing contract also indicates the desirability of delinking the capital inflow from the technology imports. A reason for the Republic of Korea's success in acquiring the latest foreign technology may be attributed to its treatment of direct foreign investment separately from the imports of technology.

In addition the variables representing managerial assistance, period of agreement, assistance to help in the indigenization of the imported technology, future improvements of technology, other restrictions imposed by the Government of India, relative size of the licensee and previous commercializations of technology were all found to be non-essential in defining the choice of an agreement.
These findings have important implications for the policy makers. Licensor firms usually incorporate restrictive clauses wherever it is legal or feasible to do so. The restrictions imposed by the licensee's government, on the other hand, fail to fully achieve their desired results. It is true that the licensees use the government's restrictions on payment of royalty, lump-sum and other forms of payment to negotiate for a cheaper price but other restrictions in terms of restrictions on purchase of capital goods, submission of research and development plans, etc. do not effect their choice of an exclusive agreement. The policy makers agree to the difficulties in enforcing and monitoring the restrictions on import content in the final product, or in making the licensee comply with the agreed program of phasing out imported components and materials.

From the results it would appear that restricting the period of the agreement has an implicit inconsistency. The objectives of limiting the agreement period are, apparently, to hasten the process of transfer of technology and also to minimize the costs of transfer. It seems to be unsuccessful on both the counts. This variable does not influence the choice of an exclusive agreement. Moreover, its imposition increases the costs of negotiation by increasing the bureaucratic approvals required.

The dissertation, therefore, also has organizational implications. The exemplary success of Japanese policies,
which serves as a model of technological development principally through arms-length transfer of technology, was a result, *inter alia*, of close coordination of Foreign Investment Council and Ministry of Trade and Industry, the implementation capability of administrators and a fairly well-developed technological infrastructure.[4] The process of obtaining licences and approvals in India, supplemented by the discretionary interpretations of regulations and procedures, and the infrastructural bottlenecks are so compelling that "easy access to governmental authority is itself an important factor of production." [Kidron, 1965] The process of approval frequently degenerates into the concerning officer's fervor of interpreting government's policy and procedures to the given "merits of the case." Nothing, apparently is "dearer to the hearts of the officials than dealing with a case on merits."[5] The needless and avoidable delay in obtaining approvals from the ministries continues to be the most serious concern of the technology importing firms. The cost as reflected by the loss in executive time and the expenses involved in furnishing new information, clarifications and maintaining "goodwill" with New Delhi, are considerable and unnecessary.

The results of the dissertation are subject to the following caveat. The empirical analysis is narrow for two reasons. It emphasizes only a single industry and therefore macro policy conclusions are not unequivocal. Furthermore,
an arms-length transaction is a relationship between the licensee and the licensor. The information and data, ideally speaking, should be collected from both the contractual parties with respect to the given agreement.

The theoretical and empirical analysis use a static framework. A dynamic model may be more appropriate. Time plays an important role in the determination of price because the value of technology is inversely proportional to the time elapsed. Furthermore, the costs and benefits of technology transferred accrue at different points of time. Transfer of technology involves long-run decisions and choices. The future research should therefore focus on amounts and timing of royalty and other payments and also of different types of assistance and restrictions. A better definition of package of technology and the relative size of licensee seems also to be required.

Besides, the working hypotheses having been supported by a sample size which is limited [although it complies with or even exceeds the norms in this field] and biased because, unfortunately, many firms were hesitant to participate in the study. Any policy measures, based on this dissertation, may therefore be exercised with caution.

8.1. CONCLUDING REMARKS

The technology market being imperfect, intervention in the market for transfer of technology may marginally improve
the "second-best" solution. India, like any other
developing country, is in a policy related paradoxical
predicament. A strict regulation of technology contracts
may improve the bargaining position of the country's
licensees, but it may simultaneously prevent the domestic
firms from acquiring needed skills and knowledge to become
internationally competitive.

In spite of the liberalizations of public policies by
the Government of India, investment conditions have not
encouraged firms with majority foreign equity to enter the
industry either in the domestic tariff area or in the export
processing zones. Such firms have, in many countries,
played a significant role in providing an easy access to
foreign technology.[6]

The transnational corporations are increasingly
expanding the use of non-equity arrangements which take on
the characteristics of direct foreign investment.[7]
However, it is apparently the policy environment which has
failed to encourage the Indian electronics industry from
achieving the benefits of potential foreign
collaborations.[8]

The Government of India accepted the principle of a
mixed economy from the very outset. It was meant to direct
the development of strategic, capital intensive, and infra-
structural industries in the public sector. It is therefore
incongruous [even if the issues of relative management
efficiency of public and private sectors are ignored] to observe major public sector enterprises preempts the private sector and manufacturing in segments not directly reserved for them. Frequently, the preemption even extends to products pertaining to consumer electronics segment. The inconsistency becomes more puzzling in the presence of a reverse trend in many developing countries of Asia and Latin America.[9]

The procedures for various approvals implicitly favor firms with access to "resources." As a result, a nexus of "bureaucrats" and "self-interest groups" proliferates. A high rate of nominal protection on electronics materials and components results in increased input costs to the downstream producers. A negative effective protection rate undermines the policies for export promotion. As a result products with export potential fail to be internationally competitive. An effective protection rate of over 1000% is, economically speaking, meaningless.[10] A tariff system needs to allow for foreign competition at some price because the latter can serve as a stimulus for the domestic firms to be efficient. An uneven and incongruous tariff rate, therefore, corroborates the above hypothesis. Evidently, the policy benefits do not reach across the industry.[11]

The science-intensive nature of the electronics industry has created an international inter-dependence of technology. Besides, the electronics and information-based
technologies are notably firm-specific or system-specific. Transfer of this technology therefore implies the necessity of a cooperative, and perhaps long-term approach between the supplier of technology and the host country licensee. It also suggests that the regulation of technology contracts should not only be flexible but also be based on the attributes of the technology and the changing circumstances of the nation's economy.

In conclusion, this dissertation has presented significant empirical results and implications which warrant the attention of researchers and policy makers alike.
NOTES

1. This is true for the supplier firm pursuing a "technology strategy". In cases of the market-oriented or production-oriented strategies of the technology supplying firm, the pricing policy will be different because the licensor may have different objectives, viz., of improving supplies of his output, finding new outlets, etc.


2. However, the capital goods imports are not differentiated into simple purchases and turnkey purchases.

3. Personal communication, Joint Secretary, Department of Electronics, Government of India, New Delhi.


"...More than the nature of restrictions, it was the delay involved in processing of applications for collaboration that came under fire. The loss in executive time and the expense involved in furnishing the detailed information and in keeping in touch with New Delhi were a recurring theme. Most firms reported that the gestation period involved in getting a collaboration agreement finalized was two to three years."


Journal of Asia Electronics Union, July 1982
The combined value of exports by wholly owned subsidiaries and joint ventures amounted to 70% and 99% of electronics exports from the Republic of Korea and Singapore respectively in 1975. The corresponding figure for Argentina was 90% in 1979. Even for the developed countries it is observed that trade in electronics has been dominated by large international firms. A study on SEEPZ in India has argued that, on empirical grounds, foreign controlled units yield positive welfare effects than purely domestic units in the specific context of export processing zones in developing countries.


The non-equity arrangements include supply of goods and services by the TNCs for investment projects or enterprises in the host countries. At times, the TNC may not make any equity contribution.

8. The World Bank study observes that India figures at the bottom of a list of industrializing countries in which the foreign firms would be interested in undertaking investment or other types of collaborative activities.


The number of public sector enterprises is currently decreasing [in contrast to previous decades] in many of the Asian and Latin American developing countries. Extensive privatization programs have been announced in Argentina, Chile, Pakistan. The industrial segments vary from Banking to Telecommunications. Mexico is one of the few countries which moved in the opposite direction. It nationalized Banking in 1982.

10. "Most economists would consider any effective tariff over 50% to be high, and over 100% to be very undesirable."


11. Additional support is provided by the Background papers of the Committee to Examine Principles of a Possible Shift from Physical to Financial Controls [Ministry of Finance, Government of India, 1985, p. 93]. A member stated:
"...Licensing of industries was misused by a large number of business houses to preempt capacity, regional pulls developed to attract industries without locational advantages, public sector enterprises were set up to satisfy political demands and licenses were issued to all and sundry irrespective of the licensee's ability to implement them."
APPENDIX A
THE ELECTRONICS INDUSTRY CLASSIFICATION

SOURCE: Daniel Todd (1990)
## APPENDIX B

**EXCHANGE RATE USED FOR CONVERSION FROM RUPEES TO US $**

[RUPEES/DOLLAR]

<table>
<thead>
<tr>
<th>Year</th>
<th>Exchange Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>4.762</td>
</tr>
<tr>
<td>1961</td>
<td>4.762</td>
</tr>
<tr>
<td>1962</td>
<td>4.762</td>
</tr>
<tr>
<td>1963</td>
<td>4.762</td>
</tr>
<tr>
<td>1964</td>
<td>4.762</td>
</tr>
<tr>
<td>1965</td>
<td>4.762</td>
</tr>
<tr>
<td>1966</td>
<td>6.359</td>
</tr>
<tr>
<td>1967</td>
<td>7.500</td>
</tr>
<tr>
<td>1968</td>
<td>7.500</td>
</tr>
<tr>
<td>1969</td>
<td>7.500</td>
</tr>
<tr>
<td>1970</td>
<td>7.500</td>
</tr>
<tr>
<td>1971</td>
<td>7.501</td>
</tr>
<tr>
<td>1972</td>
<td>7.594</td>
</tr>
<tr>
<td>1973</td>
<td>7.742</td>
</tr>
<tr>
<td>1974</td>
<td>8.102</td>
</tr>
<tr>
<td>1975</td>
<td>8.376</td>
</tr>
<tr>
<td>1976</td>
<td>8.960</td>
</tr>
<tr>
<td>1977</td>
<td>8.739</td>
</tr>
<tr>
<td>1978</td>
<td>8.193</td>
</tr>
<tr>
<td>1979</td>
<td>8.126</td>
</tr>
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<td>1980</td>
<td>7.908</td>
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<td>1981</td>
<td>8.968</td>
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<td>1982</td>
<td>9.666</td>
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<td>1983</td>
<td>10.340</td>
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<td>1984</td>
<td>11.889</td>
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<td>1985</td>
<td>12.235</td>
</tr>
<tr>
<td>1986</td>
<td>12.778</td>
</tr>
<tr>
<td>1987</td>
<td>12.966</td>
</tr>
<tr>
<td>1988</td>
<td>13.917</td>
</tr>
</tbody>
</table>

**SOURCE:** INTERNATIONAL FINANCIAL STATISTICS YEARBOOK, 1989

ECONOMIC SURVEY, GOVERNMENT OF INDIA, 1988-89.
### APPENDIX C

**CONSUMER PRICE INDEX & RATE OF INFLATION**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HONGKONG</td>
<td>168.0</td>
<td>180.4*</td>
<td>199.4*</td>
<td>7.38</td>
<td>10.53</td>
</tr>
<tr>
<td>INDIA</td>
<td>118.3</td>
<td>129.4</td>
<td>141.5</td>
<td>9.38</td>
<td>9.35</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>115.6</td>
<td>124.9</td>
<td>135.7</td>
<td>8.04</td>
<td>8.65</td>
</tr>
<tr>
<td>JAPAN</td>
<td>100.7</td>
<td>101.4</td>
<td>104.6</td>
<td>0.70</td>
<td>3.16</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td>101.6</td>
<td>103.6</td>
<td>107.6</td>
<td>1.97</td>
<td>3.86</td>
</tr>
<tr>
<td>PHILLIPINES</td>
<td>104.6</td>
<td>113.7</td>
<td>134.8</td>
<td>8.70</td>
<td>18.56</td>
</tr>
<tr>
<td>REPUBLIC OF KOREA</td>
<td>105.9</td>
<td>113.4</td>
<td>122.3</td>
<td>7.08</td>
<td>7.85</td>
</tr>
<tr>
<td>SINGAPORE</td>
<td>99.1</td>
<td>100.6</td>
<td>104.5</td>
<td>1.51</td>
<td>3.88</td>
</tr>
<tr>
<td>SWITZERLAND</td>
<td>102.2</td>
<td>104.1</td>
<td>110.2</td>
<td>1.86</td>
<td>5.86</td>
</tr>
<tr>
<td>TAIWAN@</td>
<td>122.7*</td>
<td>124.2*</td>
<td>130.2*</td>
<td>1.22</td>
<td>4.83</td>
</tr>
<tr>
<td>THAILAND</td>
<td>104.4</td>
<td>108.4</td>
<td>117.1</td>
<td>3.83</td>
<td>7.43</td>
</tr>
<tr>
<td>U.K.</td>
<td>107.8</td>
<td>113.0</td>
<td>125.6</td>
<td>4.82</td>
<td>11.15</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>105.7</td>
<td>109.9</td>
<td>117.2</td>
<td>3.97</td>
<td>6.64</td>
</tr>
</tbody>
</table>

* REFER TO BASE 1980 = 100

@ TAIWAN PROVINCE, REPUBLIC OF CHINA.

**SOURCE:** INTERNATIONAL FINANCIAL STATISTICS, MAY 1990

MONTHLY BULLETIN OF EARNINGS & PRODUCTIVITY STATISTICS TAIWAN AREA, FEBRUARY 1990.
APPENDIX D

FOREIGN COLLABORATION APPROVAL PROCESS IN AN INDIAN INDUSTRY

Diagram showing the process flow from applicant to approval.
APPENDIX E
DRASTIC AND RUN-OF-THE-MILL TECHNOLOGIES
APPENDIX E. (Continued) DRASTIC AND RUN-OF-THE-MILL TECHNOLOGIES

1. Initial Production Under Competitive Conditions:

Constant Unit Cost = Price = \( C_0 \).

2. Run-Of-The-Mill Technology Case:

Unit Cost Decreases to \( C_1 \).

Monopoly Rent = \( C_0LMC_1 \)
[Technology Licensee cannot charge a price > \( C_0 \)].

3. Drastic Technology Case:

Unit Cost Decreases to \( C_2 \).

There will be an Output Expansion effect.

Since the producer's surplus cannot be accurately estimated, the licensor will charge royalty in addition to the lump-sum fee.

APPENDIX F. QUESTIONNAIRE TO FIRMS IN THE INDIAN ELECTRONICS INDUSTRY

Dear Participant:

Thank you for helping in my research effort. I am a doctoral candidate at the University of Hawaii, Honolulu, U.S.A. The purpose of this study is to determine if there is a significant relationship between government policies and the technology transferred by the firms in the transeree country.

Although this research is a part of my dissertation but I intend to make the results of the study available to all participating firms and institutions. In addition the findings will be published as recommendations to the government for policy analysis.

Needless to mention that all information will be treated with strict confidentiality and at no point will any names be mentioned or identities revealed.

I greatly appreciate your cooperation.

Thank you very much.

Arun Kashyap
Asian Development Bank Fellow
University of Hawaii

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I. GENERAL FIRM CHARACTERISTICS:

Name of Company ________________________________
Location of Company ________________________________
Name of Collaborator ________________________________
Year of Agreement ______ Term of Agreement _______

1. What is your Position in the Company:
   President, Executive Vice President ______
   Factory Manager, Director of Subsidiary ______
   Production Manager ______
   Department Head ______
   Staff Position Equivalent to Department Head ____
   Other ______

2. What is your educational background:
   Engineer or other professional degree ____________
   Post Graduate Degree _________________________
   Graduate Degree ____________________________
   High School _________________________________
   Self Educated _______________________________
   Others ________________________________

3. In which country were you *professionally* educated
   (after high school or secondary school). Please mark all that apply.
   India ______
   U.S.A. ______
   U.K. ______
   U.S.S.R ______
   Japan ______
   Other ______

4. What is your main Line of Business:
   ____________________________________________
5. When was the firm established (age of the firm)?

__________ years

6. Why was this firm organized initially?
Do the reasons include:

a. High Tariffs on Import of the Product __________

b. Other Import Restrictions on _______________

c. Local Content Requirements _______________

7. What products do you produce?

____________________________________________

8. What is the firm's Production Capacity?

____________________________________________

9. Has the firm established commercial production?

Yes _______  No _______

If yes, when:

Product ____________________  Year ___________

Product ____________________  Year ___________

Product ____________________  Year ___________

10. If the above reply is 'yes', what percentage of
deployed capacity is presently being utilized:

Product ____________________ _____

Product ____________________ _____

Product ____________________ _____

11. If the plant capacity is under utilized what are the
reasons?

Smaller size of the demand for the product _______
Licensed Capacity is less than Installed Capacity ______
Shortage of Raw Materials/ Infra Structure _______
Labor Problems _________________________________
Technical Problems _____________________________
Government Regulations __________________________
Others ________________________________
12. What experience does the firm have in the production of each product?

<table>
<thead>
<tr>
<th>Product</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product 1</td>
<td></td>
</tr>
<tr>
<td>Product 2</td>
<td></td>
</tr>
<tr>
<td>Product 3</td>
<td></td>
</tr>
</tbody>
</table>

13. How many workers does the plant require to operate at full capacity?

Skilled (those with professional degree / training) approximately
Unskilled approximately

14. Total annual sales (in lakh Rupees) of each product in the last three years

<table>
<thead>
<tr>
<th>Product</th>
<th>Domestic Market</th>
<th>Export Market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td></td>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td></td>
<td>198</td>
<td>198</td>
</tr>
</tbody>
</table>

15. Size of the firm:

<table>
<thead>
<tr>
<th>Total employment</th>
<th>Total assets (In Lakh Rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td>198</td>
<td>198</td>
</tr>
</tbody>
</table>

16. Is Foreign Collaboration more extensive in the Electronics Industry compared to other industries?

Yes _______ No _______ Do not Know _______

17. Does the government encourage it?

Yes _______ No _______ Do Not Know _______

18. Does a foreign firm play a significant role in this firm's management?

Yes _______ No _______
19. How is the ownership of the firm distributed?

Private Limited
Indian Shareholders
Foreign Collaborator
Other Foreign Shareholders

20. What is approximate cost of Plant & Equipment required for the project? (Please indicate estimated current replacement cost).

Rs.  

21. What Interest Rate do you pay on loans

Short Term %  Long Term %

22. What is the Wage Rate paid by the firm to

Skilled Workers  Rs.  
Unskilled Workers  Rs.  

23. What is approximate Cost of Materials (Product wise)

Product  Rs.  
Product  Rs.  
Product  Rs.  

24. In your opinion approximately what percentage of total production costs is contributed by

Plant and Equipment %
Rent on Land Buildings %
Labour Costs %
Cost of Materials %

25. What is the nature of Research and Development (R&D) activities of the firm?

Modifying & Adapting Technology
Modifying & Adapting Product
New Products
New Technologies
Others
None

26. Expenditure on R&D as a Percentage of Sales:

198  198  198

278
27. How does the price of your product/s compare to other competitors in India:

<table>
<thead>
<tr>
<th>Product</th>
<th>Same</th>
<th>Higher</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Same</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Product</td>
<td>Same</td>
<td>Higher</td>
<td>Lower</td>
</tr>
</tbody>
</table>

28. Would you know the price of same product in the International Market?

Yes _________ No _________

29. If yes, what is the price of your product as a Percentage of the international price?

__________ %

30. In your opinion, how will the consumption of materials, employment, and amount of assets change with an expansion in capacity?

Year in which capacity expansion undertaken _________
Capacity Expansion not yet undertaken _____________

<table>
<thead>
<tr>
<th>Change in Capacity (%)</th>
<th>Change in Employment (%)</th>
<th>Change in Assets (%)</th>
<th>% Change in Cost of Materials (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II. TECHNOLOGY TRANSFER:

1. Does the firm have both, long term and short term objectives in transferring technology?

Yes __________________________
Only Short term __________________
Only Long term __________________
Purchase as and when the need arises _________

2. If yes, what are the firm's objectives in transferring technology?

Introduce New Product _______________________
Achieve Domestic Competitiveness ______________
Achieve Export Competitiveness ________________
Diversification of Product Line ___________________
Other ________________________________
3. Does the project intend to serve

Mainly Export Markets __________________________
Only Export Markets __________________________
Mainly Domestic Markets __________________________
Only Domestic Markets __________________________
Both Domestic & Export Markets __________________________

4. Please mark the appropriate column.
Did you approach the licensor __________________________
Or You were approached by the licensor __________________________

5. How many suppliers of technology were approached?

_____ Only 1 Supplier
_____ 2-5 Other Suppliers
_____ 5-10 Suppliers
_____ 10-20 Suppliers
_____ > 20 Suppliers

6. What were your reasons for approaching a supplier?

Technical Ability of the Supplier __________________________
Marketing Ability of the Supplier __________________________
Cheaper Technology __________________________
Any Other __________________________

7. How would you rank the following factors in the selection of a licensor? (Please Rank)

Past association with the licensor __________________________
Cheaper terms and conditions __________________________
Licensor's experience in and outside India __________________________
Licensor willing to help in procuring finances __________________________
Reputation of the licensor (trade marks etc.) __________________________
Any other __________________________

8. Characteristics of the licensor:

Percentage of sales manufactured abroad:
  Less than 25% __________________________
  Between 25% and 39% __________________________
  Greater than 40% __________________________

Products produced __________________________

Number of plants set up globally in this field by the supplier __________________________
9. Nature of the agreement and contents of the package:
Please tick mark all that apply. Please also rank by
degree of importance of value in the total package as
considered by you. 1 is the highest.

Knowhow
Technical Assistance
Patent Rights
Managerial Assistance
Trademark Rights
Component Supply
Buyback of your production
Any Other

10. Do you import raw materials and/or components?
Yes ________  No ________

11. What percentage of total cost of production is
constituted by the imported raw materials and/or
components?
<table>
<thead>
<tr>
<th>Product</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. What are the reasons for import of raw materials and/or
components

Local substitutes are not available
Local substitutes are not competitive
Local substitutes do not meet quality specifications
Others

13. Does any other firm in the country have same or similar
technology?
Yes ________  No ________
If yes, how many
If no, does your firm have exclusive right in India to
knowhow/patents/trademarks obtained in the agreement

14. Was the same technology available in India at the time
you imported the technology?
Yes ________  No ________
15. Are the Skills for this type of technology available in India?

Yes
Yes, But we prefer to import
No, they are not available
Do not know

16. Has the licensor sold the same technology to other firms abroad?

Yes No
If yes, to how many?

17. If you have a choice of acquiring technology would you be a:

Subsidiary of a Multinational Corporation
Entertain a Joint Venture
License Technology

18. The technology transferred involved:

i. A product ii. A process
Finished As a cost saving or
Intermediate efficiency improvement

19. If the technology transferred is a process, is it

Central
Peripheral
Other

20. If the technology transferred is a product, does the government allow trade in the item?

Yes No

21. Do tariffs or other restrictions hinder trade?

Yes No
If yes, What are they

22. If this is a product, would you that over years, the price has

Dropped
Risen
Remained the same

282
23. How long has the technology been available in India?

Product ___________________ _________ years
Product ___________________ _________ years
Product ___________________ _________ years

24. How long has the technology been available abroad?

Product ___________________ _________ years
Product ___________________ _________ years
Product ___________________ _________ years

25. What in your opinion would be the age of the technology (age of the licensed product or process in years) in years.

Product ___________________ _________ years
Product ___________________ _________ years
Product ___________________ _________ years

26. Would you describe the acquired technology as a

Radical departure __________________________
Incremental advance over older methods _________

27. As an approximation, how many years will elapse before this technology is obsolete?

______ years

28. Does the technology transferred include Patent rights?

Yes __________ No __________

29. If yes, when will the patent expire?

_______

30. What is the duration of the agreement?

______ years

31. In your opinion is the time period sufficient for complete transfer of the technology package?

Yes __________ No __________

32. If no, what in your view will be the time required for completion of the agreement?

______________ years
33. What will be, ideally speaking, the minimum time required to complete the transfer of the given technology package? 

_____________ years

34. Would you like the agreement to be renewed at the end of the agreement?

Yes
No, we will borrow technology from a new supplier
No, we will develop technology ourselves

35. If yes, would the government allow a renewal of agreement:

Yes No May be

36. The reasons for approaching a new supplier include:

Newer Technology
Better Technology Package
Cheaper Technology Package
Easier to deal with
Required by the government

37. At the end of the agreement would the firm be able to compete with the licensor firm:

No likelihood of competing outside the country because:
Your product will be technologically inferior
Your product will be quality wise inferior
Your product will be higher in price
Because of export restrictions by the licensor
Others

Yes, the firm will be competitive immediately

No likelihood of even competing in the domestic market

38. Generally speaking, how do you determine the price of a given package of technology?

Vintage of Technology
Extent of Technology Package
Uniqueness of Technology
Demand for the Product
Costs of Transfer
Profits of the Technology Supplier
Your costs of adapting/modifying Technology
39. Royalty is payable on
Sales less duties and taxes
Sales less duties and taxes, cost of imported materials/components and cost of standard items used in the product but are bought from outside
Value Added
Volume of Production
Sales at domestic price or international price, whichever is lower

40. What rate of interest do you use to calculate the future costs of royalties and other fees?

% Not Computed.

41. Types of compensation paid to the licensor:
(Please mark all that apply)
Lump sum fee
If yes, is it paid at signing start-up
or later
Running Royalty (pay as you earn situation)
If yes, what is the rate

Technical Assistance fee
Per diem charges for technicians/personnel loaned
Patent royalty (if treated separately)
Trademark royalty (if treated separately)
Management consultancy fee
Purchase of plant and equipment
Purchase of components
Purchase of other products from supplier
Provide shares in firm's stock and dividends thereon

42. Does the agreement provide for training of your firm's personnel?
Yes No

43. If yes, where will the personnel be trained?
In your firm's plant by licensors specialists
In licensor's plant/training center

44. Will such training be provided on payment of additional charge?
Yes No
45. How will you compare your annual sales with that of the supplier of technology?

Larger ________________
Same ________________
Two-Thirds ________________
Half ________________
One-Third ________________
One-Fifth ________________
One-Tenth ________________
Even smaller ________________

46. Total costs of technology transfer as a percentage of total project costs ________ %
Technical costs as a % of technology transfer costs ________ %
Negotiation costs as a % of technology transfer costs ________ %
Royalty Rate ________ % of ____________

47. What percentage of transfer costs were borne by the technology supplier.

____ ________ %

48. Is the technology transferred of the same vintage as that of other firms in the country?

Yes ________  No ________  May be ________

49. Is the technology transferred of the same vintage as that of firms producing the same products in other countries?

Yes ________  No ________  May be ________

50. By what percentage would your R&D expenditure change/ or has changed because of the new technology package?

Increased by ________ %  Decreased by ________ %
No Change ________________

51. How did you finance the payment for technology transfer?

Own Funds (Retained Earnings) ______________________________
Borrowed from Financial Institutions ______________________________
Supplier helped in the financing ______________________________
If yes, was such assistance/tied to import of raw materials, machinery, services etc. ______________________________
52. What are the restrictions imposed by the government on the acquisition of technology?

On Choice of licensor of technology  
On period of agreement  
On size of Royalty Payment  
On the size of Lumpsum Payment

53. Please mention major problems, if any, which you faced because of government policies, in importing the desired quantity and quality of required/desired technology:

Limited choice of technology suppliers  
Had to purchase a smaller package of technology  
Had to purchase cost inefficient technology  
Increased the time of negotiations considerably  
No problem at all  
Others

54. Did you have any problems obtaining the most cost efficient technology because of

Bureaucratic Bottlenecks  
Custom duties  
Inability to meet Licensor's Selling Price  
Lack of sufficient finances  
Others

55. In your opinion does a restriction on rate of allowed royalty leads to

An Increased Payment of Lump Sum  
An Increase in the Import of Components/ Raw Materials  
Smaller Package of Transferred Technology  
An Increase in Restrictions Imposed by the Supplier of Technology  
Older Vintage of Technology  
Others

56. What are the benefits of government restrictions in obtaining the desired technology?

Helps in Negotiating  
Aids in Getting Cheaper Technology  
Helps Obtain a Better Technology Package  
No Benefits At All  
Others
57. What are the restrictions, if any, imposed by the licensor?

- No Restrictions
- Total Ban on Exports
- Prohibition of exports to licensor's country
- Prohibition of exports to countries in which the licensor operates through branches, subsidiaries, affiliates or where he has similar collaboration arrangements
- Restriction on sources from where raw materials/components and plant and machinery are to be procured
- Stipulations regarding advertising
- Restrictions on sub licensing patents/knowhow/trade marks to another Indian firm
- Others

58. As a general policy, was there any reservation on the part of the supplier to license the technology?

- Yes
- No

59. If yes, the reasons stem from:

- Competition from your firm, now or later
- In the Domestic Market and/or
- In the International Market
- Inadequate Number of Suppliers
- Inadequate Compensation from Your Firm
- Bureaucratic Formalities in India
- Advanced Nature of Technology Involved
- Others

60. Did the supplier adapt the technology (for your purposes -- in terms of scale etc.) during transfer?

- Yes
- No

61. Did the licensor help you in adapting or developing the technology for your use?

- Yes
- No

62. If yes, which of the following aspects were adapted/modified?

- Production Equipment
- Product Design
- Production Techniques
Scaling down to lower volume of production
Change in product design to adapt to local tastes
Others

63. Will your dependency on the licensor change after the agreement expires because of

<table>
<thead>
<tr>
<th>Trademark</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>New models</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Components</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Others</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

64. Are there any conditions on the transfer of future improvements of technology by the supplier:

Yes | No | Not discussed

If No, will they be Free of Charge
or on Additional Payment

If yes, the involve a New Agreement
or Other Conditions

65. Any conditions by the licensor for an access to the technology improvements made by your firm (a reciprocal access to the technology).

Yes | No

66. Has your firm ever failed to reach an agreement with a foreign firm because of a discord on the amount of payment for the technology transfer package or a restriction on the period of agreement?

Yes | No

67. What, in your opinion are the impediments considered serious by the technology suppliers (Please Rank Them, 1 is the highest):

Bureaucratic Inefficiency
Restriction on Rate of Royalty
Unsatisfied with Price of Technology
Industrial Licensing Policy
Import Restrictions
Phased Manufacturing Programme
Higher Taxes
Difficulties in Repatriation of Profits
Lack of Skilled Labour
Reliability of Indian Partner
Quality of Local Management
Trade Unions
III. GENERAL:

1. What problems do you encounter in obtaining

   Equipment
   Very Expensive
   Import Restrictions
   Inadequate Quality
   Others

   Raising Capital
   High Cost
   Govt. Regulations
   Others

   Labor
   High Wages
   Lack of Skills
   Unions
   Others

   Materials
   Have to import
   High Cost
   Phased Manufacturing Programme
   Others

2. What is the impact of government policies on

   Acquisition of the Technology You Desire
   Help Considerably
   No Influence
   Act as a Barrier

   Amount Paid for the Technology
   Help Considerably
   No Influence
   Act as a Barrier

   Quality of Technology
   Help Considerably
   No Influence
   Act as a Barrier

   Export subsidies
   Help Considerably
   No Influence
   Act as a Barrier
**Tax provisions and other provisions** (eg. permission to import materials and machinery without tariff)

Help Considerably _______________________
No Influence _______________________
Act as a Barrier _______________________

3. How would you rate the bureaucratic formalities of the government as compared to other developing countries:

Excessive _______________________
Same _______________________
Lesser _______________________
Do Not Know _______________________

4. In your opinion does the restriction of competition in the domestic market discourage exports?

Yes ________ No ________ May be ________

5. Is it easier to obtain capital for production for exports than for production for the domestic market?

Yes ________ No ________

6. What, in your view, is the size of the domestic market for the product/s?

Product _______________________
Product _______________________
Product _______________________
Do Not Know _______________________

7. What is/was the stage of development of the technology in India at the time of transfer of technology?

Same as the International Market _______________________
Behind the International Market by ________ years

8. What steps can the government take to help the industry?

Import Policies should be relaxed _______________________
Import Policies should be further tightened _______________________
Competition in domestic market should be increased _______________________
Competition should be restricted _______________________
Greater Emphasis on Exports _______________________
Others _______________________

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9. Would you like to mention any important issues which the questionnaire has failed to cover:

________________________________________________________________________
________________________________________________________________________

10. Do you have any general comments about the current problems and/or the future of the electronics industry in the country.

________________________________________________________________________
________________________________________________________________________
APPENDIX G

IMPLEMENTATION OF A PROJECT BASED ON IMPORTED TECHNOLOGY

(Time In Months)
APPENDIX G. (Continued) IMPLEMENTATION OF A PROJECT BASED ON IMPORTED TECHNOLOGY

INDEX:

A = Feasibility Study.
B = Application for Industrial Licence/Foreign Collaboration.
C = Negotiations with the Licensor.
D = Financing Arrangement [No Objection Certificate for Capital Issue].
E = Approval from the Foreign Investment Board.
F = Agreement becomes Effective.
G = Issue of an Industrial Licence.
H = Issue of Import Licence.
I = Receipt of Capital Goods.
J = Receipt of Components/Materials.
K = Completion of Civil Works.
L = Installation of Machinery.
M = Commencement of Commercial Production.

SOURCE: Based of Information from a Public Sector Firm.
### APPENDIX H

**MEAN VALUES & STANDARD DEVIATIONS [STD. DEV.]**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>MEAN</th>
<th>STD. DEV.</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROYALTY PAYMENTS [TOTROYLTY]</td>
<td>2.61</td>
<td>2.14</td>
<td>2.65</td>
<td>2.14</td>
</tr>
<tr>
<td>LUMP-SUM PAYMENTS [LSM]</td>
<td>709.78</td>
<td>2291.20</td>
<td>699.11</td>
<td>2299.30</td>
</tr>
<tr>
<td>ROYALTY PAYMENT PERIOD [RYLTYPRD]</td>
<td>51.49</td>
<td>39.72</td>
<td>52.16</td>
<td>39.54</td>
</tr>
<tr>
<td>NATURE OF LICENCE [LICNAT]</td>
<td>0.77</td>
<td>0.42</td>
<td>0.77</td>
<td>0.42</td>
</tr>
<tr>
<td>PERIOD OF AGREEMENT [PRD]</td>
<td>6.32</td>
<td>2.75</td>
<td>6.38</td>
<td>2.71</td>
</tr>
<tr>
<td>PACKAGE OF TECHNOLOGY [TECHPKG]</td>
<td>2.87</td>
<td>0.38</td>
<td>0.89</td>
<td>0.31</td>
</tr>
<tr>
<td>LUMP-SUM AS A % OF PROJECT COSTS [LSPROJ]</td>
<td>12.68</td>
<td>15.27</td>
<td>12.11</td>
<td>14.12</td>
</tr>
<tr>
<td>SIZE OF LICENSEE [LICSIZE]</td>
<td>1.21</td>
<td>0.55</td>
<td>1.21</td>
<td>0.55</td>
</tr>
<tr>
<td>EXPORT OBLIGATION [EXPOBLG]</td>
<td>0.097</td>
<td>0.30</td>
<td>0.094</td>
<td>0.29</td>
</tr>
<tr>
<td>FOREIGN EQUITY [FORNEQIT]</td>
<td>9.12</td>
<td>15.88</td>
<td>9.03</td>
<td>15.65</td>
</tr>
</tbody>
</table>

N = 311  
N = 307

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APPENDIX H. (Continued) MEAN VALUES & STANDARD DEVIATIONS

| Supplier's Restrictions on Exports [EXPREST] | 0.61 | 0.49 | 0.62 | 0.49 |
| Supplier's Other Restrictions [RESTSUPP] | 0.24 | 0.43 | 0.25 | 0.43 |
| Restrictions by Licensee's Government [RESTGOI] | 0.11 | 0.32 | 0.11 | 0.32 |
| Commercialization of Technology [STARTUP] | 0.013 | 0.11 | 0.013 | 0.11 |
| Licensee's Expenditure on R&D [RND] | 2.11 | 2.36 | 2.13 | 2.36 |
| Ownership of Enterprises [SECTOR] | 0.67 | 0.47 | 0.62 | 0.49 |
| Number of Competitors [NUMCOMP] | 8.30 | 9.22 | 8.27 | 9.25 |
| Future Improvements in Technology [FUTIMP] | 0.26 | 0.44 | 0.26 | 0.44 |
| Managerial Assistance [MGRALSST] | 0.19 | 0.40 | 0.19 | 0.39 |
| Help in Adapting Technology [INDIGNZE] | 0.50 | 0.50 | 0.50 | 0.50 |
APPENDIX H. (Continued)  MEAN VALUES & STANDARD DEVIATIONS

BUY-BACK OF CONTRACT PRODUCT
[BUYBACK]  0.045  0.21  0.042  0.20

INTERACTION TERMS:

LSM*TOTRILTY
[LSRRPRD]  2215.50  10108.00  2244.40  10170.00

TOTRILTY * RYLTYPRD
[TOTRLPRD]  200.97  180.41  203.59  180.11
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