TECHNOLOGY TRANSFER:
AN INTERNATIONAL PERSPECTIVE

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The transfer of technology is playing an important role in the intellectual property portion of the Uruguay Round GATT negotiations. To obtain a better understanding of technology transfers, the varied and complex aspects of this important activity must be clarified. This study has focused on the international transfer of technology. Although the analysis applies to technology transfers in general, greater attention was given to transfers from developed to developing countries. We felt that by improving our knowledge of the specific problems faced by developing nations attempting to import foreign technology we would be in a better position to understand these countrys' positions on issues where there has been long standing disagreement.

The first part of the paper focuses on technology itself. Technology is defined, as is the process of technology transfer. This includes a listing of the main types of technology there are and the methods used to transfer them. Next, we point out the importance of technological innovation for economic growth, following the research of people like Schmookler, Solow, Denison and Stewart. We have found that the process of technology transfer is a complex matter which deserves further research: there are no clear answers on the importance of intellectual property (IP) in the technology transfer process.

The two main methods used to transfer technology are licensing agreements and transfers to a wholly owned subsidiary. Many factors affect the decision to transfer the technology, as well as its mode of transfer. The monopoly power given to owners of technology has prompted many developing countries who use this material to complain about the abusive behaviour of those firms who licence their technology. To counteract such behaviour, numerous restrictions on the import of technology have been put in place by the governments of some of these countries. However, this can only be seen as a sub-optimal solution to the problem.

To understand the many alternatives that developing countries must consider when planning their socio-economic growth, the paper illustrates two of these approaches by providing evidence on the experiences of India and South Korea. In the case of India, priority was given to the appropriation of foreign technology in order to render the country more self-sufficient. This policy goal has, to a certain extent, been attained. In the case of Korea, the government has successfully adopted an open approach to the acquisition of foreign technology in order to improve their export capacity, thereby stimulating economic growth.

The differences between India and South Korea in the area of technology transfer, and the subsequent development of their economies, can not be explained by the variations in their IP systems alone. Both countries provided relatively equal protection to owners of IP throughout the 50s, 60s, and 70s. The unequal levels of development in these countries were caused by other factors which are important and relevant to any discussion of IP. Many of these factors are rather complex and go beyond the scope of this paper. The areas that have been investigated are education, investment and taxation, science and technology policies, as well as the role that IP plays in the movement and assimilation of technology from developed to developing countries.

However, it would seem inappropriate to assess the policies put in place by these countries solely on the basis of criteria put forward by developed countries. By looking at the results of Less Developed Country's (LDC's) policies and comparing them to the original objectives, we can then assess their effectiveness. As stated by Lall (1976), "it is not enough to discuss policies to promote transfers of technology... We must also specify:

- which products are conducive to national welfare;
- what technologies are available to produce these products, and of them, which one is the most appropriate;
- how can these technologies be acquired at the lowest social cost, bearing in mind the necessity of developing local scientific/technological expertise; and
- if they are purchased abroad, is it better to buy them outright or to have them transferred by means of direct investment."

Although this list is far from complete it does point out the complexity of the task which faces any LDC government. Assuming that the government has determined what its targets are for the goals listed above it must decide how to attain these goals. When one takes into account the difficulties involved in the transfer of technology, as well as the validity of LDC developmental objectives, it becomes apparent that governments must "influence" the amount and type of technology transferred. However there are negative externalities associated with excessive control of the transfer process. Unfortunately, it is difficult to say how far governments should go towards adopting a laissez-faire attitude. The authors of this paper feel that government intervention should focus on macro-level, legislative policies which foster the transfer of appropriate forms of technology to specifically chosen sectors of the economy which can "lead" the country towards technological development. Excessive restrictions placed on the domestic market, in the hope of improved international competitiveness, are ill-advised.

According to Stewart(1979) "...local innovation is more likely the greater the pressures from the local environment which make local technological change necessary and worthwhile. Such pressures include natural pressures occurring as a result of differences in physical environment, market size, resource availability and cost as compared with the environment for which the foreign technology was designed and artificial pressures created, for example, by restrictions on technology imports... This suggests that a competitive environment (both nationally and internationally) and factor prices broadly in line with factor availability would be more conducive to technical change than an environment in which firms are highly protected and are able to survive and prosper without innovation or adaptation."

The preceding discussion must be viewed in the light of the empirical evidence on the effectiveness of government policies aimed at the control of technology transfers. After studying Argentina, Brazil, Colombia, Korea, Mexico, Peru and Venezuela, Sagasti (1979) found, for example, that science and technology policy instruments were relatively ineffectual. He attributed this to the characteristics of these instruments, the asymmetry of information, institutional delays, and the limited assessment of the impact these policies had on the economy. The research also indicated that firms made decisions without considering some instruments. It was only after decisions had been made that firms either took advantage of the benefits or looked for ways of getting around the penalties specified in the policies. There is also growing evidence that tax incentives in LDCs, which are designed to promote foreign investment, are extremely ineffective. They persist, nonetheless, increasing the cost of technology transfers. One reason is that each country believes it is on a kinked demand curve, which means that increased tax rates would cause a large drop in foreign investment. A better approach to maintaining incentives might be to provide foreigners with subsidies rather than tax allowances.

One of the most contentious issues studied in this paper was the value of the patent system in the technology transfer process. From a theoretical standpoint the existence of a patent system rests upon three basic propositions: first, that it induces more invention and innovation than in its absence; second, it encourages the development and the commercial use of inventions; and third, it encourages inventors to disclose their inventions publicly. Although inventions would still occur without a patent system, their discovery would be hastened, and their numbers would be increased in the presence of patent protection. It is also argued by those who defend the system that the social costs resulting from the grant of a monopoly right to inventors are outweighed by the social benefits to society.

As suggested by Scherer (1980), in order to assess the value of the patent system, one must compare "the net benefits associated with inventions that would not have been available without patent protection against the net social losses associated with inventions that would be introduced even if no patent rights were offered." In an extensive empirical study Mansfield et. al. (1977) tried to determine what proportion of innovations would be delayed or not introduced at all if they could not be patented. To answer this question each of the companies in the survey were asked whether they would have introduced the patented innovations in the sample if patent protection had not been available. According to the corporate respondents, about 50 % of the patented innovations would not have been introduced without patent protection. When pharmaceutical innovations are excluded from this sample the lack of patent protection would have affected less than 25 % of the patented innovations that were studied.

In addition, in a study of 27 British companies operating in R&D industries, Taylor and Silberston (1973) found that, without patent protection, R&D expenditures would be reduced only marginally in most industries -- 5% in machinery and mechanical components, 5% in basic chemicals, and negligibly in the electrical industry -- except for the pharmaceutical industry where it would drop by 64%. Mansfield (1986) also found that only the pharmaceutical and chemical industries considered patents as essential, in the sense that more than 30% of their inventions would not have been developed without patent protection. Three industries (petroleum, machinery, & fabricated metal products) thought patents were important and the remaining seven industries questioned in the sample viewed patents as unimportant or only marginally significant in promoting R&D. With respect to the pharmaceutical industry, Comanor (1980) found that competitive research has led to the development of a large number of products which had therapeutic effects comparable to those already existing. This led him to conclude that society would lose relatively little if fewer resources were devoted to this duplicative R&D.

Our analysis of this topic has brought to light little empirical <u>economic</u> evidence which supports the developed countrys' argument that the existence of a patent protection system in developing countries would stimulate innovations and foster the transfer of technology. Nevertheless, one must realize that the international IP system has significant political and psychological benefits for developing countries which do produce economic growth. By adhering to this system these countries will be able to obtain the cooperation of firms from developed countries in introducing and developing new technology.

However, we believe that bargaining which is based solely on the purported economic value of the patent protection system may lead to confrontation and the failure of any set of negotiations. It is only by understanding the real problems faced by these countries that we will eventually be able to come to an agreement in the interest of all parties involved.

In 1988, CCAC piloted an extensive and comprehensive research and study program on the use and significance of intellectual property rights (IPRs) for a number of industries. One of the fundamental tools in this program was a survey of various firms (over 700) by Price-Waterhouse. The survey was designed to obtain information on the impact of intellectual property rights on the performance of Canadian firms and their trade and investment decisions. The study has involved asking the companies about many aspects of their business which involve IPRs, including their use of licensing agreements as vendors or purchasers.

Within the context of this survey, the companies were asked to define some of the specific problems they might have had in connection with the use of IPRs. For the analysis of licensing agreements, the firms were asked to list the reasons why they might be discontented with these alliances. In the case of patent licences, the major irritant is the conduct of vendors after the transaction. In some cases they reject any form of cooperation with the purchasers and the latter have sometimes been confronted with false representations. Some criticisms were also noted concerning the exclusivity of licences, especially when firms are working with the government.

Perhaps the most interesting and controversial result which came to light in this study is the limited consideration firms give to IP when contemplating their R&D activities. Some people believe that this may be due to the fact that firms view patents as unimportant because they only weakly disrupt the imitation process, forcing reliance on other protective mechanisms. This may also have something to do with the number of biotechnology and computer software firms involved in the survey (two areas where IP protection, at the time of the survey, was uncertain), as well as the rapid pace of technological innovation many high technology and R&D intensive companies face at this point in time. One must realize that some forms of IP protection, namely patents, are not suited to this type of environment and firms are finding it necessary to rely on other forms of protection (such as trade secrets). This evidence seems to support the conclusions reached by Mansfield & Taylor and Silbertson: IP protection is not vitally important for many industries, but they are used because they are available.

I. INTRODUCTION

The transfer of technology is going to play an important role in the intellectual property portion of the Uruguay Round negotiations. To obtain a better understanding of technology transfers, the varied and complex aspects of this important activity must be clarified. This study will focus on the international transfer of technology. Although the analysis applies to technology transfers in general, greater attention will be given to transfers from developed to developing countries. We believe that by improving the developed countries knowledge of the specific problems faced by developing nations attempting to import foreign technology they will be in a better position to negotiate, and eventually come to an agreement with these countries on issues where there has been long standing disagreement.

The first part of the paper focuses on technology; what is technology, how does technology relate to economic growth, and what are the different methods used to transfer it. Next, the transfer of technology itself is analyzed. This will include a discussion of important issues arising in the negotiations over a transfer, the obstacles to transfers of technology, as well as the important question of the mode of transfer (internal vs external) chosen by the parties.

This is followed by an analysis of the influence LDC government programs and policies have on the adoption of technology into the economy. Due to the varied nature of government activity in the Third World this work will focus on India, a major player in the IP negotiations at the GATT, and South Korea, a Newly Industrialized Country (NIC). The manner in which these economies affect technology transfer will also be included in this section.

Finally, the last section of the paper will look at the general policy implications that can be derived from the analysis. Special attention will be paid to the role of educational, investment and tax policies, science and technology policies, as well as the relevance of a patent protection system for the stimulation of innovative activity and the transfer of technology to developing countries. Finally, there will be a review of the empirical results of a survey conducted by CCAC, in 1988, on the use of IP in Canada.

II. WHAT IS TECHNOLOGY?

One of the major problems that must be dealt with when studying the transfer of technology is the inability to attach a clear and concise definition to technology. The wide variety of components which make up any single technology are diverse, and

sometimes their relationship is not obvious. According to the World Intellectual Property Organization (WIPO),

> "Technology means systematic knowledge for the manufacture of a product, the application of a process or the rendering of a service, whether that knowledge be reflected in an invention, an industrial design, a utility model, or a new plant variety, or in technical information or skills, or in the services and assistance provided by experts for the design, installation, operation, or maintenance of an industrial plant or for the management of an industrial or commercial enterprise or its activities."

On top of this there are "sub-definitions" which outline and describe certain types of technology. A prime example of this is the often used, but poorly understood term "high-technology". Two proxies widely used to estimate the degree to which technology, being used by a firm or industry, can be considered as high technology are:

1. the number of scientists and engineers engaged in research and development as a percentage of the firm or industry workforce, and

2. expenditures on R&D as a percentage of value added or total sales

There are other techniques for measuring technology intensity that are industry-based and product based. On a more general level, high technology simply refers to a sophisticated range of products, components, services, and production techniques.

To deal with the wide variety of possible definitions of technology Robinson (1988) has suggested that it may be easier to think in terms of technology transfer packages. Such a package may consist of some or all of the following pieces:

1. One or more indivisible technology modules,[1] which may consist of either;

   a. "core technology", that which is indispensable to a process or the use of a product or performance of a service, or
   b. "peripheral technology", which is all other modules,

   and which may be transferred via technical documents and blueprints and/or personal explanation, demonstration, or training (technical assistance);

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[1] A module is a distinct section or portion of an entire technology which cannot be broken down further.

2. Permission to use the intellectual property rights, or assets (i.e. under a licensing agreement, franchise, or lease);

3. Hard goods (embodied technology), which may take the form of;

    a. capital equipment,
    b. intermediate goods, or
    c. final goods (which cause the user to alter the manner of production); and

4. Soft goods (disembodied technology), which may take the form of;

    a. written documents, computerized packages, and photographs, or
    b. oral transmission, whether telephonic, recorded, or face-to-face.

Technological capabilities can also be broken down into three broad areas: production, investment, and innovation. These refer to, in order, the operation of productive facilities, the expansion of capacity and the establishment of new productive facilities, and the development of technologies. Proficiency in production capability is reflected in technical or x-efficiency and in the ability to adapt operations to changing market circumstances. Proficiency in investment capability is reflected in project costs and in the ability to modify the design of a project to meet any special investment circumstances. Proficiency in innovation capability results in the development of cheaper and more effective technologies.

III. THE IMPORTANCE OF TECHNOLOGY

According to Schmookler(1966), the technology that a country has at its command, weighted by its distribution amongst the labour force, can be referred to as the nations "technological capacity". Stewart(1979) states that the ability to make independent technological choices, to adapt and improve upon chosen techniques and products, and eventually to generate new technology endogenously (the accumulation of technological capacity) is at least as important to economic development as the accumulation of capital. Therefore, the rate at which this capacity grows will act as a limit on the long-term rate of economic growth. In turn, the rate of growth of technological capacity is dependent on two factors:

(1) the rate at which "new" technology is produced; and

(2) the rate at which "old" technology is disseminated throughout the economy (the rate of replication).

This is an important distinction because an element of new technology affects the rate of technological progress only once and only in one location, but it may enter the rate of replication at an indefinitely large number of places and over an indefinitely long period. The accumulation of technological capacity is the outcome of many elements including "learning by doing" and an educational, infrastructural and institutional setting which fosters the learning process. Unfortunately, these elements are difficult to measure at both the macro and micro levels.

At the macro level it is difficult to separate the effects of growth due to technical change from those of investment in physical capital. Nor can the effects of technological change be easily separated from the impact of education since the two are so closely related. In an attempt to quantify the impact of technology on the economy Solow (1957) measured the rate of technological change in the U.S. between 1909 and 1949. Based on his findings, he concluded that approximately 90% of the increase in output per capita was attributable to technological change. Denison (1962), using a more accurate model, estimated that technological change was responsible for 40 percent of the total increase in national income per person employed from 1929-57 in the U.S.

In a developing country context these methods are highly dubious since they exaggerate the extent of indigenously generated technological change. This is due, in part, to the fact that a portion of the technical change identified comes from improved imported techniques. Another problem with this method is it's inability to capture the development of independent decision making which is an important element in the accumulation of technological capacity. To deal with these problems it is beneficial to attempt micro-case studies. Maxwell showed that technological change was responsible for over half the increase in output capacity for a steel plant in Argentina. The main causes of technological change were:

(1) exogenously determined changes in demand - leading to the need to diversify output;

(2) exogenously determined changes in operating conditions; and

(3) endogenously generated changes arising from the routine activities of engineers, etc.

At both the micro and macro level it seems apparent that advances in technological capacity are an important component of growth for any economy.

IV. THE TRANSFER OF TECHNOLOGY: DEFINITION AND METHODS

Now that we have a better understanding of what technology is, we need to define what is meant by technology transfer. According to Teece (1976) technology transfer is defined as:

> "the process of transferring from one production entity to another the know-how required to successfully utilize a particular technology."

There are two basic types of technology transfer. The first is the horizontal transfer which involves transfer of technical information from one project to another. The second is the vertical transfer which involves the transfer of information from one stage of an innovative process to another.

The transfer of technology can take the following forms:

1. **Contracts and Agreements**: Licensing of patents, trademarks, tradenames, and know-how, contracts for manufacturing, construction, management, marketing, engineering and training services, equipment maintenance and service facilities.

2. **Projects**: Foreign direct investment, turnkey projects; other construction projects; coproduction; and other joint ventures.

3. **Trade in Goods and Services**: Export and import of equipment and capital goods embodying technology, and consulting services.

4. **Research and Development**: Location of research and development operations in foreign countries, research subcontracting, joint R&D projects.

5. **Personnel Exchanges**: Employment of nationals by foreign firms, employment of foreign technicians, migration of trained personnel and development assistance under bilateral and multilateral aid programs.

6. **Other**: Transfers through international tender invitations, reverse engineering, investment in or acquisition of companies, industrial espionage, government-to-government agreements and professional publications,

The main methods used to transfer technology are licensing agreements, the supply of know-how, and direct investment (subsidiary). A license typically gives one permission to do certain acts covered by the exclusive rights that intellectual property law provides, as regards a patent, a trademark, a tradename, etc. An agreement on the supply of know-how is used to communicate technical information and skills concerning the use and application of industrial techniques.

The form of technology transfer differs with the type of firm involved in the process. For instance, multinationals and large enterprises usually have their own investment plans and their technology is often transferred through subsidiaries or direct investment. On the other hand, small enterprises, which are more limited in terms of resources, will often resort to licensing and joint venture agreements in order to transfer their technology. In addition, some authors (see Jeantils (1987) and Robinson (1988)) have argued that a number of developing countries prefer technology transfer through joint ventures, licensing and technical assistance agreements rather than through direct investment or transfer to a subsidiary of a foreign multinational firm.

The type of technology transferred also varies with the receiving countries. Since newer technologies are often inappropriate and expensive for developing countries, we could expect the technology transferred to be older than that transferred to developed countries. According to a study by Mansfield and Romeo (1980) of 65 technologies transferred overseas by U.S.-based multinational firms for the period 1960-78, the average age of the technology transferred to subsidiaries in developed countries was about six years compared to about 10 years for developing countries. On the other hand, it was found that the technologies transferred through licences, joint ventures and other channels are older than those transferred through subsidiaries. This could be explained by the profit maximizing behaviour of firms trying to minimize their costs, especially when younger technologies are more expensive to transfer than older ones.

In addition to being older, Contractor (1981) found from a survey of 102 licensing agreements that technology transferred to developing countries (as compared with developed countries) have the following characteristics: they have a smaller scale of production, greater adaptation for the licensee, higher technical costs of transfer for the transferor, shorter agreement life, involve fewer patent inclusions in the agreement, involve legal costs for the supplier, and a lower export tendency from the licensee.

V. TECHNOLOGY TRANSFER: THE NEGOTIATION PROCESS

Economic, political and social environments vary widely from country to country. This will affect the nature of any technology being transferred as well as the conditions under which transfers are being operated. In general, we can say that the host country receiver and the transferor have divergent interests during negotiations. The latter aims at getting the maximum rent for his technology and possibly trys to keep the transferee in a state of dependence towards his services. On the other hand, foreign companies and governments will seek to acquire technology at the lowest price and foster the ownership and control of the imported technology. Since this stage is crucial in the success of a transfer it would be relevant to look at some of the more important issues which are likely to come up during the negotiation process.

The first step towards the transfer of a technology has to do with the identification of the needs for a technology, and with the choice of a potential transferor or transferee. This is also where the first problem appears. Although all sorts of increasingly sophisticated information channels are available for firms, individuals, or government institutions or agencies to buy or supply technology, the general lack of information and expertise of developing countries makes it such that either profitable opportunities are sometimes wasted or, their bargaining power is seriously weakened.

Once the identification process is completed, parties enter negotiations over the conditions under which the technology transfer will take place. There does not exist a standard type of contract or license. The terms of a license depend on the specific conditions existing at the time of the agreement. They vary according to the type of technology transferred, the development stage of the technology, the industry in which the technology is transferred and the environment surrounding the transfer. In cases where complex technologies are involved separate agreements, covering different elements of the transfer (i.e. licensing of patents, trademarks, supply of know-how, etc), might have to be negotiated. These negotiations are often complex and can take many months or years before a final agreement is reached.

Although non-exhaustive, the following is a list of the most important areas to be covered during the negotiations:

a) The definition of the terminology used in the contract. It is important to precisely define all the terms, i.e. transferor, transferee, patent, license, know-how, technical information, product, field of activity, process, components, improvement, net selling price, subsidiary, etc;

b) The scope of the agreement with respect to the field of activity, the territory of manufacture, the exclusivity of the territory, and the acquisition of competing technology by the transferee;

c) The disclosure of technical information (know-how) and the supply of technical services and assistance. It is often argued that the sale of a patent or a licence does not transfer in any way a technology but transfers only the right to use that technology. Thus, together with know-how, professional expertise to provide for training, marketing and management services, R&D, etc., are often crucial to the production process and the viability of a project for a transferee;

d) Tied purchase of inputs from the transferor or sources designated by him and prevention of purchases from any other sources. Special provisions can also be included in order to limit the volume of production by the technology recipient;

f) The determination of the price of the technology being transferred as well as the form of compensation. The monetary compensation for the acquisition of a technology may take the following forms: lump-sum payment, or royalties and fees (see next section);

g) The use of sub-licensing and sub-contracting. Given that a contract is the result of a mutually beneficial agreement by the transferor and the transferee, provisions with respect to limitations in the inclusion of a third party may have to be specified;

h) The life of the agreement and termination rights; and

i) Improvements in the licensed technology by both the transferor and the transferee (grantback provisions), and warranties.

In addition, there are external factors that influence an agreement. Among those factors are the intervention of the receiving country's government, the extent of competition on the licensee's market, the extent of competition among suppliers of the technology, product and industry norms, and political and business risk in the receiving country.

VI. THE PRICE OF TECHNOLOGY: SOME CONSIDERATIONS

As briefly mentioned in the previous section, the determination of the price of a technology to be transferred represents one of the most important issues in the negotiation process. As suggested by Contractor, the licensor and licensee are expected to begin negotiations with a price range for each. They both have a floor and a ceiling and an agreement will be reached in the area where these two ranges overlap (see Figure 1). The ranges and the final price of a technology will depend on a number of factors among which are:

- its nature;
- the cost of R&D associated with its development;
- the age of the technology;
- the life of the agreement;
- its profitability for the transferee;
- its potential use by the transferee;
- the prospect for technological advances and the use of grantback provisions;
- the need to adapt the technology;
- the income flow that transferor would receive from the transfer to other transferees (opportunity cost);
- the costs of alternative technology;
- industry norms;
- the prospect of supplying inputs and controlling output; and
- the relative bargaining power of the two parties involved in the negotiation.

Compensation for the use of a technology usually takes one of two forms: lump-sum payment or royalties and fees. The lump-sum payment is a fixed payment made on the conclusion of the technology transfer agreement or at the time of the actual transfer. This payment scheme is often used where the technology or know-how can be transferred all at once without any need for continuing technical assistance from the transferor. In some cases, lump-sum payment will be used in conjunction with other forms of compensation. For instance, it could be used to pay for the disclosure of information and the research and development required by the transferee to assess the technology.

Royalties are defined as the economic rents paid for the rights to use intellectual property. They are determined as a function of the economic use or the result of the technology. The calculation is usually based either on the volume of production, the sales price of the product, or the profits resulting from the sales of the product. Royalty payments represent the most common form of remuneration for the use of a technology. Fees are usually paid, over and above royalty payments in order to cover the technical services needed for a successful transfer.

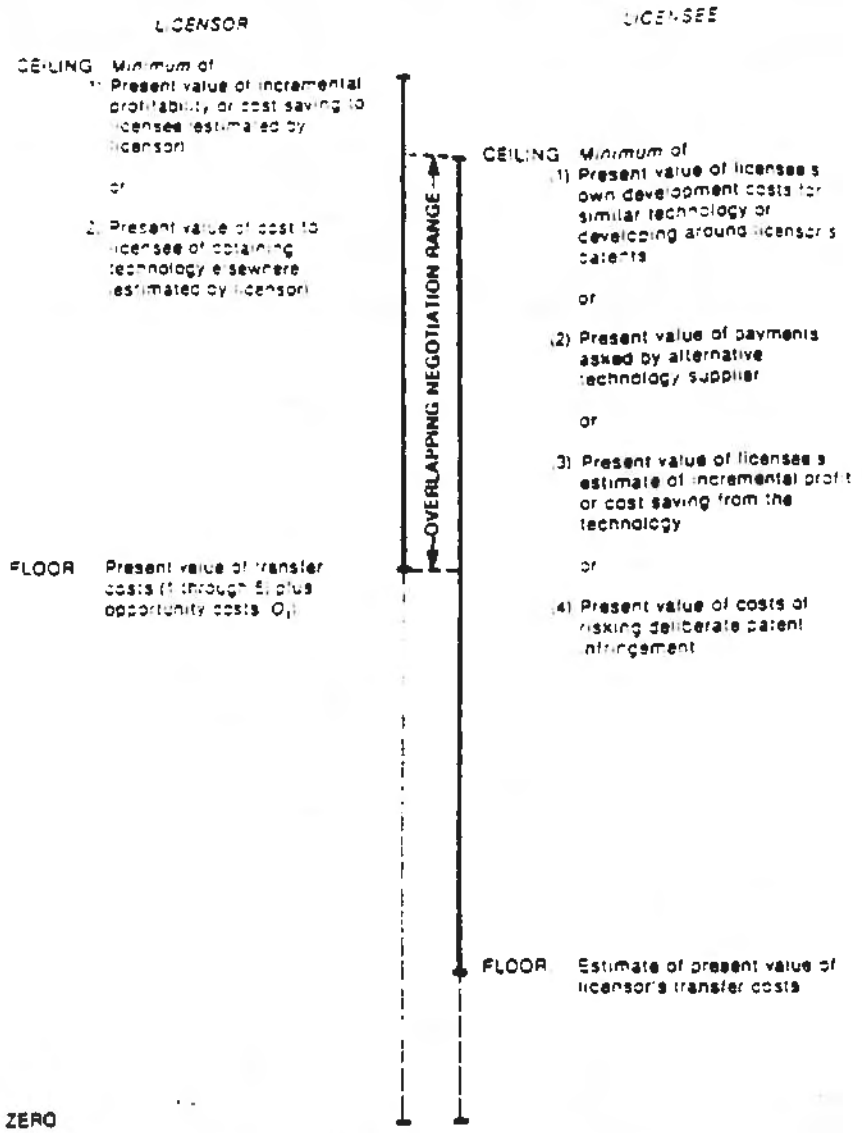

Figure 1 . A Possible Configuration of Bargaining Ranges for Licensor and Licensee

Whatever the calculation method, it has been observed that in some cases (i.e. exclusive licenses) a minimum royalty provision will be included in the agreement. This provision will reduce the uncertainty faced by the transferor in association with the granting of exclusivity to one recipient.

In practice, it seems that there is no formal framework for the pricing of a technology and that it follows, more or less, a rule of thumb depending on the above factors. It is often argued that a 25 percent share of the licensee's incremental profits resulting from the use of the technology is a reasonable target for licensors. However, in practice, numerous factors such as demand, growth, scope of technology, know-how, restrictive practices, etc, reduce the expected percentage return to licensors. In a study by Basche and Duerr (1975), a Swedish technology supplier indicated that:

> " Royalties and other fees...seem to vary depending on the type of product. However, assuming a figure of 3 to 5% on net sales as royalty payment (which seems to be rather common for technically complex products) and 1 to 2% for less sophisticated goods,... these are very reasonable compensations."

In theory, we could expect the price of the technology to be the outcome of the negotiations between the two parties. However, it is observed that, in some countries, government authorities have to give their approval. These authorities could compare the actual price specified in the agreement with the benefits for the national economy and then define a price structure by sector, industry or product that has to be respected by the transferee, etc. The limits imposed on the technology supplier as to what return he could get on his investment could have serious repercussions on the actual provisions of the contract, especially with respect to so-called "restrictive" business practices. To compensate for the low return for the use of their technology, licensors will impose additional restrictions on the licensee, such as tie-in sales, market and production restrictions, etc. In cases where the price of the technology is calculated as a markup over the transfer cost, restrictions on compensation can possibly hinder the feasibility of a transfer by driving down the revenues of the transferee below its average cost.

On the other hand, these restrictions could be used to control the monopoly power of the transferor. As pointed out by Penrose (1973) price ceilings, when properly administered, can substitute for competition in reducing the price and increasing

the output. However, in the case of technology transfers, price ceilings represent only a second-best policy since the transferor has the possibility of imposing additional restrictions on the use of its technology in order to compensate for the lower return.

VII. OBSTACLES TO THE TRANSFER OF TECHNOLOGY AND THEIR IMPACT

Obstacles to technology transfer can be classified into three categories:

A. Those arising from imperfections in the market for technology and information;

As pointed out by many authors, the market for technology can be analyzed as a market for intangible assets or information. In this respect, it is prone to market failure. The imperfections arising on this market are manyfold:

Small number of participants - a specific technology is usually held by only a few firms and the number of competent licensees can be relatively small;

Asymmetry of information - the licensor and the licensee have different information on the technology. Moreover, transferees in developing countries often lack information about the resources of the technology and have neither the means to determine the best possible technology adapted to their needs, nor to negotiate fair and reasonable terms for its acquisition;

Uncertainty - the transferee is often uncertain about the future performance of the acquired technology while the return to both the transferor and the transferee is difficult to predict;

Risk aversion - the licensor faces the possibility of losing control of its technology to potential competitors (although Mansfield and Romeo (1980) found no substantial evidence of a leaking effect of transfers via a subsidiary. However, the possibility is certainly present in licensing agreements) while the licensee has to invest in a project with an uncertain return; and

Transaction costs - the cost of negotiating an agreement and transferring the technology can be important. Teece (1976) estimated these costs to be on average equal to 19% of the recipient's total project cost. As suggested by Coase (1937), the presence of transaction costs could force the firm to internalize the transaction (direct investment or use of a subsidiary).

B. Those related to the lack of resources of receiving countries; and

The scarce financial resources of developing country transferees also seriously affects the actual transfer of technology as well as the type of technology being transferred. The most recent and sophisticated technology is usually expensive and is either non-affordable or, if acquired, could impose an excess burden on the national economy. In addition, many of these technologies are inappropriate and could be harmful to a developing country's economy. Hence, the kind of technology transferred is often less up to date and the agreement often imposes more restrictions on the use of the technology by the transferee. This is especially so given that transferees in developing countries often lack experience and skills in concluding legal arrangements for the acquisition of technology. The existence of these problems has led some authors to argue that in their search for new technologies, developing countries should first look towards neighbouring countries that have a similar industrial base before looking for technologies from more advanced countries that are not well suited to their needs.

To the scarce financial resources of the developing countries' transferees, we need to add the scarce financial resources of the countries themselves. By definition, their economy is underdeveloped and the control of their external debt usually represents a major problem. In many countries this has given rise to foreign exchange control boards which overlook and even approve technology transfer agreements with foreigners.

C. Those related to government attitudes, legislative and administrative, in both developed and developing countries.

In developed countries, the outflow of technology is often subject to a certain number of control measures such as export control which imposes restricted access to information by certain individuals in certain countries as well as tax, foreign investment, and currency exchange regulations which affect the type and amount of technology transferred to certain countries. On the other hand, receiving countries, especially developing countries, have been observed to impose a number of restrictions on the importation of foreign technology. They intervene through restrictions on the royalty rate paid to licensors, the duration of the agreements, etc. For instance, in India the average royalty rate of U.K. firms licensing to Indian firms was pushed down from 4.25% in 1951 to 2% in 1967 while the length of agreements went from 10 to 5 years during that same time period (Davies 1977). As we have seen, these restrictions can work against both the licensee and the receiving country if it inhibits the transfer of technology. However, the existence of

government intervention might be an indication of market imperfections. In trying to limit the total payment to foreign owners of technology, the government will want to look at all the elements of a contract since many provisions are used as alternate means of compensation for the use of their technology.

But over and above the control measures imposed by governments, developing countries claim that technology transferors themselves are imposing restrictive measures on the transfer of their technology. For instance, in a communication document entitled "Standards and Principles Concerning the Availability Scope and Use of Trade-Related Intellectual Property Rights" (1989), the government of India has argued that technology owners often impose a series of restrictive and anti-competitive conditions on the acquisition of technology (see section VIII on India for further discussion). These restrictions include:

- Tied purchase of inputs from the licensor or sources designated by him and prevention of purchases from any other sources.

- Prohibition or restriction of exports from the host country.

- Prohibition of the licensee or the recipient from using articles, processes or technology which do not belong to the licensor or the supplier or his nominee.

- Restrictions on the use of the patents, trademarks and know-how, especially in matters such as the volume of production, marketing, distribution and pricing of the product.

- restriction on the use of the technology after the expiry date of the agreement.

- Restriction on competition as between various licensees as well as between the licensees and third parties.

- Abusive transfer pricing practices in the supply of raw materials, intermediates and components.

- Grant back provisions, obliging the licensee or the recipient to assign improvements and innovations free of charge.

- Package licensing obliging the licensee or the recipient to make unwanted purchases.

- Use of patent licenses as a device for carving up markets among patent owners.

According to the government of India, these restrictive licensing conditions reduce the value of the technology transferred to developing countries and limit their opportunities to develop world class competitive industries based on such technology. In some countries, such as India, effect may not be given to some of these provisions specified in the transfer agreement. In contrast however, current western economic and legal thinking does not accept "a priori" categorization of these measures as anti-competitive. In many ways they may lead to more technology being licensed than would be the case if they were prohibited. Hence, they may in fact be pro-competitive.[2]

Caves, Crookell, and Killing (1983) have stated that the restrictions imposed by licensors follow from the imperfections on the market for technology. Transfers through arm's length sources (licensing) are subject to Arrow's Paradox of information (Arrow 1962). In order to appropriate the full rent from the use of his technology, the licensor needs to reveal all the details of the technology to the licensee. However, once this is done, there is no need for the licensee to acquire the technology since he now possesses all the relevant information to exploit the technology. Therefore, transfers through licensing agreements will be characterized by asymmetry of information. To secure that rent, licensors will often impose restrictions such as those described above. Although the impact of the latter is difficult to estimate, we can expect that the receiving country will incur a social cost by being deprived of the opportunity to utilize its resources in the best possible manner. This is especially true for developing countries relying on technology imports in order to develop their export potential.

When discussing the incidence of restrictions, we need to differentiate between those that are binding from those that are not. A provision prohibiting exports from the host country cannot be considered as binding if the technology recipient was not planning to export the production resulting from the use of the technology. In the case of tie-in arrangements, the licensee does not have much to lose if the licensor is more efficient than its competitors at producing the tie-in product. In this respect, the impact of restrictions will depend on the nature of the technology as well as on the value of lost opportunities to the recipient. However, the prohibition of some restrictions could result in the use of indirect provisions which may restrict the flow of technology. For instance, multinational firms can patent their technology in many countries, as a substitute for export restrictions, in order to prevent imports.

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[2]There is little empirical evidence on the pro-competitive effects of restrictions, especially in developing countries. The authors feel that this topic deserves further research.

The acceptance of some restrictive business practices by a licensee could in some cases be used as a strategic element in the bargaining process. The acceptance of restrictions that are non-binding on the licensee could help him in obtaining concessions in other areas. For instance, although licensors often desire to include grantback provisions in the agreement, it is observed that actual grantbacks of improvements to the licensor are relatively rare. In agreeing to include such an innocuous clause in the agreement, a licensee can improve his bargaining strength in other aspects of the deal.

In a survey of 393 Australian firms in the manufacturing, mining and construction industries, Parry (1988) looked at their access to foreign technology and the extent, and the nature of, the restrictions imposed on the transfer of technology. The survey showed that foreign owned firms have relatively greater access to foreign know-how (through their parent firm or affiliates) and that domestic firms have limited access to technology. In general, it was found that Australian firms using imported technology are not subject to widespread binding restrictions. However, in a study of restrictive provisions in licensing agreements to Poland for the period 1949-80, Janiszewski (1983) found that 85% of the agreements contained provisions which prohibited sub-licensing of the technology. Export restriction provisions were present in 80% of all agreements, and total export restrictions were found in 4% of all agreements. Trade mark rights were not granted in 20% of all agreements signed. Finally, in a survey of licensees in the U.K. and Canada (Caves et al.) it was found that market and production location restrictions were imposed in 34% of the agreements while technology flow back requirements were present in 43% of all agreements signed. However, no reference was made to the extent that these restrictions were binding on the transferee.

In sum, a licence is a contract between two parties for the transfer of a technology. It is a means by which the technology owner confers a right on another to use his technology and formalizes the extent to which the receiver can use it. In theory, we could imagine that there exists a continuum of contracts with specific price-restriction combinations going from a "high price-few restrictions" contract to a "low price-many restrictions" contract. Ceteris paribus, the less restrictive the contract, the higher the price the transferee can be expected to pay. Licence terms are all interrelated and are all negotiable. In the presence of market imperfections or government regulations the licensor will look for other forms of compensation. On the other hand, if these regulations are so severe that the licensor cannot realize a fair return, the firm will either internalize the transfer, send only second rate technologies or no transfer will take place at all.

VIII. TECHNOLOGY TRANSFER: INTERNAL OR EXTERNAL?

Among the aspects or dimensions of technology influencing the form or mode of transfer, the inherent differences between all types of technology are the most important. These differences have a strong influence on the manner in which technology is transferred, at what cost, and at what price. A number of studies (Baranson (1970), Zenoff (1970), Teece (1976), Davidson and McFetridge (1984) and Robinson (1988)) have looked at factors affecting the propensity to transfer a technology via the market mechanism (externally) or through subsidiaries (internally). According to these studies, the propensity of a multinational firm to transfer technology through a subsidiary is positively correlated to the following factors:

- complexity of the technology;
- longevity of the product or the production process;
- centrality of the technology to the firm's principal line of operation;
- ease of reverse engineering;
- the younger the technology;
- completeness of the technology;
- the more primary the technology;
- firm's availability of financial and human resources;
- the broader the line of product involved in the transfer;
- existence of affiliates in receiving countries before the actual transfer;
- degree of the firm's inexperience in technology transfer agreements;
- perceived risk and uncertainty by management;
- need to protect product standards or trade names;
- possibility of giving away know-how through licensing;
- the lower the level of international competition in that technology;
- the stronger the antitrust aspects of licensing to third parties; and
- host government attitudes towards direct foreign investment.

As seen in the previous section, the costs associated with transferring a technology can play an important role vis-a-vis the profitability of the operation. Yet it also affects the mode in which the transfer is done. Factors such as lower administrative costs, and reduced risk of non-payment, make an internal transfer less costly than an external transfer (see Teece (1976)). For instance, the average increase in total project costs is about 5% for transfers to joint ventures, about 9% for transfers to independent private firms and about 17% for transfers to government enterprises. It also appears that the total project costs for technologies not previously commercialized is much higher when the transfer is not done to a wholly owned subsidiary.

As previously mentioned, transfers of technology are characterized by information asymmetries. Since licensing agreements cannot cover all contingencies, transfers via this mode may result in an inefficient allocation of resources and higher project costs that could be avoided or minimized by the use of an internal transfer. In this respect, the choice of foreign governments to intervene in favour of licensing agreements over direct foreign investment could impose additional costs on the local economy. Another advantage of transferring technology through a subsidiary is related to the incentive, the control and the information structure within the firm which could induce lower transfer costs.

Finally, some authors argue that foreign direct investment has indirect benefits on the local economy (Das (1986) and Globerman (1979)). It could promote a greater efficiency in the industry (Globerman found that it had a positive impact on labour productivity in the Canadian manufacturing industry), increase the migration of competent labour, improve management practices and the mobility of financial capital. On the other hand, foreign direct investment could truncate the managerial structure in the host country and might be seen as a loss of control by the local government over its economy.

Among factors promoting the use of licensing over direct foreign investment are the following:

- large minimum efficient scale and fixed cost in production;
- small target market in the receiving country;
- lack of firm's resources or experience in marketing technology;
- short lifespan for technology;
- high level of diversification of the firm;
- importance of process innovation;
- existence of legal constraints and risk associated with direct foreign investment; and
- possibility of avoiding patent litigation or competitive technological development.

Considering the uncertain exchange rates, rapid changes in the political regimes and laws, and changing inflation rates, it could be argued that many firms prefer not to be locked into any fixed assets. Although studies have shown that foreign direct investment generally offers a better return to owners of technology, constraints imposed by foreign governments, especially in developing countries, with respect to foreign ownership of local assets, have made licensing a "second best" form of transfer and have resulted in better local control of the technology.

A case study by Robinson (1988) showed that the gross margin on licensing agreements is lower on technology transfers to LDC's than to more developed countries. Therefore, one can assume that, ceteris paribus, a greater flow of technology via licensing is done with developed countries while it is more internalized with developing countries.

To get an idea of the situation in Canada a study by De Melto, McMullen and Wills (1980), of 283 major Canadian innovations introduced for the period 1960-79, was reviewed. This study provides us with some interesting empirical evidence in Canada. For instance, they found that 34% (96 cases) of all transfers involved externally controlled technology and that in 85% (82 cases) of these 96 cases, the technology was acquired outside of Canada. In 54% of the 96 cases, the technology was transferred from a multinational to one of its subsidiaries while in the remainder, the technology came from arm's-length sources (i.e. suppliers (14%), consultants (12%), joint ventures (9%) and customers (5%)). Most technology transfers, where the innovation was foreign controlled, were covered by agreements allowing Canadian subsidiaries to have full access to the multinational R&D and 80% of them provided for a continuous flow of technology. Provisions with respect to right to sell were present in 66% of the cases, while 75% of the cases involved rights to manufacture. Finally, in 33% of the agreements, the territory of sales was specified and in 80% of these cases, Canada was specified as the only territory of sales.

IX. IMPACT OF GOV'T POLICIES ON TECHNOLOGY TRANSFER: INDIA & KOREA

The imperfections in the market for technology and information, and the lack of resources in countries receiving technology are two prime examples of why it is necessary for the governments of developing nations to get involved in the technology transfer process: either at the legislative or administrative level. However, the role for government intervention goes well beyond the process of technology transfer itself. The overall developmental objectives of the country must be taken into account when the government considers its course of action in technology transfer. The economies limited resources must be allocated in a manner which encourages the innovative diffusion of technology while allowing the nation to achieve other important objectives. Furthermore, there is a great need for developing the capacity for meaningfully evaluating various technology options and assessing sources of supply. All of this must be done within the confines of fiscal restraint: excessive levels of debt and limited supplies of foreign exchange must, in many instances, take precedence over other objectives. For many developing countries, including South Korea and India, several inadequacies remain in their approach to technology transfer and development (Kindra, 1985):

(1) there is a weak link between technology importation and its local promotion and diffusion;

(2) with regard to the acquisition process, there is very little coordination between those organizations that are responsible for, or are affected by, a given technology transfer; and

(3) there is an inadequate framework for determining the appropriateness of a technology acquisition.

A scheme to deal with these problems was put forth by Kindra and it focuses on the technology acquisition and adoption processes. Two charts have been provided which outline the steps that should be taken by a country considering the purchase of a specific technology. This scheme coordinates the objectives underlying the governments policy initiatives and promotes the efficient utilization of indigenous resources. In general, these types of policies are loosely categorized as Science and Technology policies (S&T). A more detailed exposition of these and other policies is covered in the next section of the paper. The remainder of this section deals with India's, and then Korea's, experiences in the acquisition and utilization of technology from a historical perspective.

A. India

Over the past thirty years India has pursued an industrial strategy which was based upon the following goals:

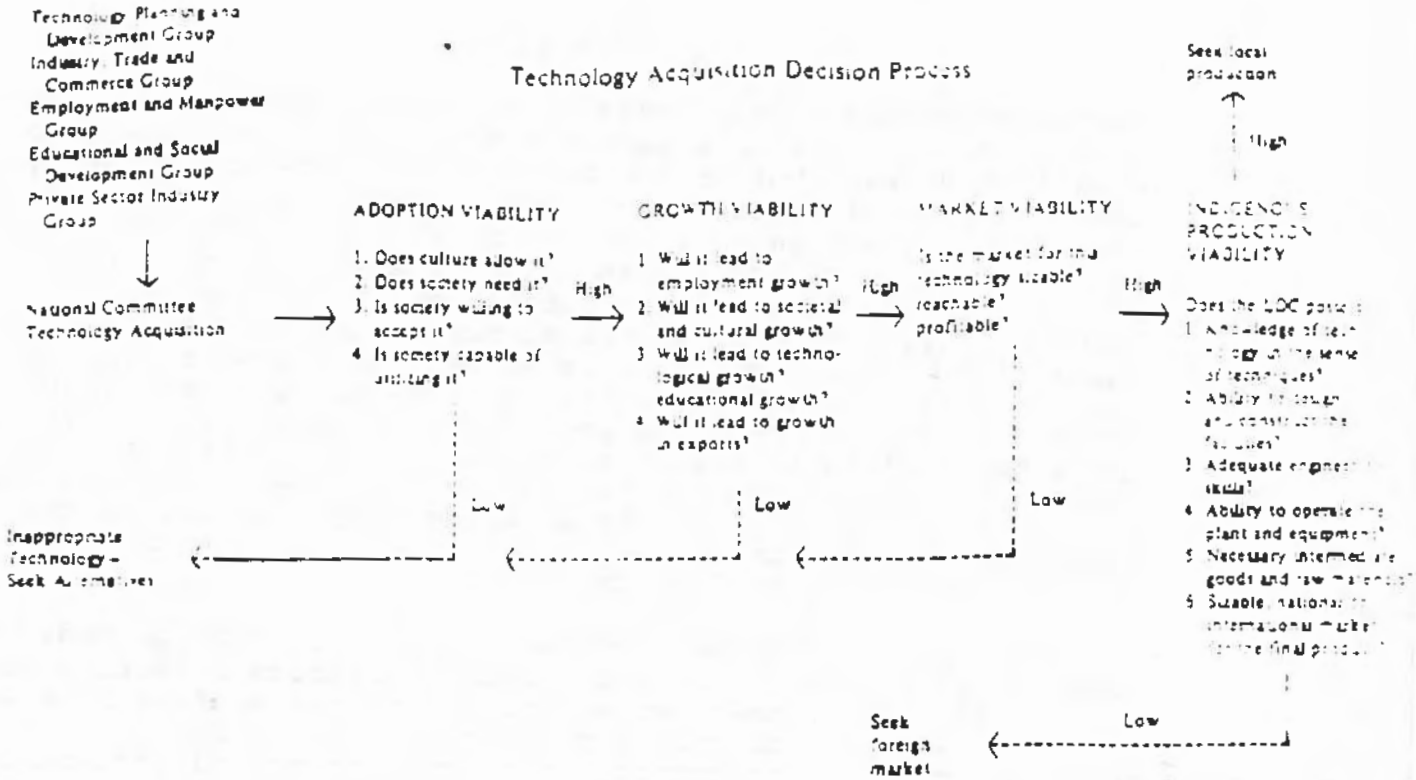
1. conservation of foreign exchange, via the domestic production of many goods, especially those which are capital intensive and intermediate goods (import substitution);

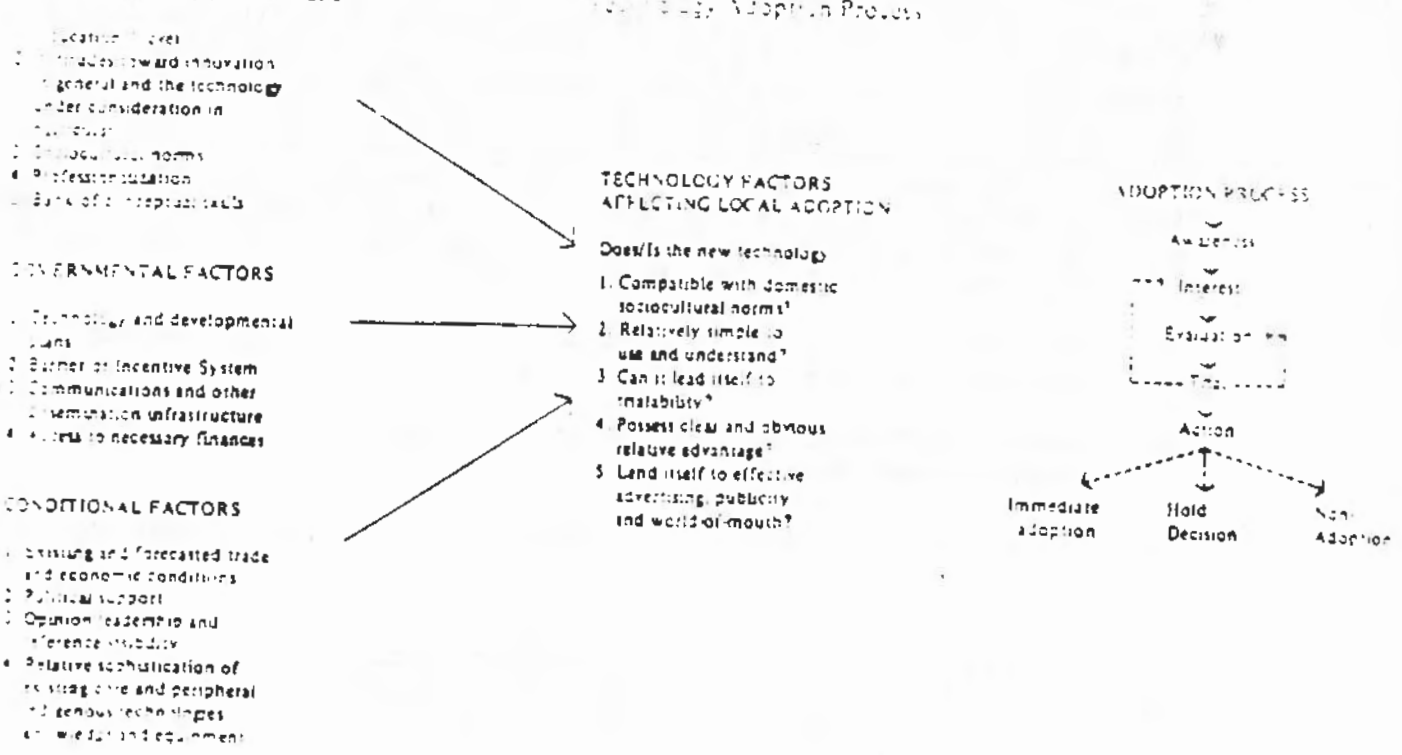
2. the development of a scientific/technological infrastructure and self reliant industrial technology;

3. the national ownership of industrial enterprises; and

4. the encouragement of small enterprises and the control of large private enterprises.

These goals have been a matter of administrative regulation and discretion rather than being enacted into law. As a result, the apparatus is extremely complex and it has been used to meet a


Technology Planning and Development Group
Industry, Trade and Commerce Group
Employment and Manpower Group
Educational and Social Development Group
Private Sector Industry Group
National Committee Technology Acquisition
Technology Acquisition Decision Process
ADOPTION VIABILITY
1. Does culture allow it?
2. Does society need it?
3. Is society willing to accept it?
4. Is society capable of utilizing it?
High
GROWTH VIABILITY
1. Will it lead to employment growth?
2. Will it lead to societal and cultural growth?
3. Will it lead to technological growth? educational growth?
4. Will it lead to growth in exports?
High
MARKET VIABILITY
Is the market for the technology sizable? reachable? profitable?
High
INDIGENOUS PRODUCTION VIABILITY
Does the LDC possess
1. Knowledge of technology in the sense of techniques?
2. Ability to design and construct the facilities?
3. Adequate engineering skills?
4. Ability to operate the plant and equipment?
5. Necessary intermediate goods and raw materials?
6. Suitable national or international market for the final product?
Seek local production
High
Low
Low
Low
Inappropriate Technology – Seek Alternatives
Seek foreign market
Low


CHARACTERISTICS OF ADOPTER
1. Education level
2. Attitudes toward innovation in general and the technology under consideration in particular
3. Sociocultural norms
4. Professionalization
5. Role of interpersonal networks
GOVERNMENTAL FACTORS
1. Technological and developmental plans
2. Extent of Incentive System
3. Communications and other information infrastructure
4. Access to necessary finances
CONDITIONAL FACTORS
1. Existing and forecasted trade and economic conditions
2. Political support
3. Opinion leadership and reference mobility
4. Relative sophistication of its strategic and peripheral technologies
5. Skilled labor and equipment
Technology Adoption Process
TECHNOLOGY FACTORS AFFECTING LOCAL ADOPTION
Does/Is the new technology
1. Compatible with domestic sociocultural norms?
2. Relatively simple to use and understand?
3. Can it lead itself to trialability?
4. Possess clear and obvious relative advantage?
5. Lend itself to effective advertising, publicity and word-of-mouth?
ADOPTION PROCESS
Awareness
Interest
Evaluation
Trial
Action
Immediate adoption
Hold Decision
Non-Adoption

number of public policy goals.[3] To a great extent these complex government policies have made the transfer of technology to India equally complex. This has reduced the quality and quantity of technology transferred and has been a factor in the declining industrial growth rates experienced in the 1960's and 1970's. On the other hand, India also seems to have had the lowest relative reliance on foreign technology of all the Newly Industrializing Countries (NIC's) during the past two decades. India also has the lowest value of capital goods imports among the NIC's (20% in 1970-71 & 15% in 1977-78), and the import content of locally produced goods is also very small. Evidently, India has managed to travel a long way in its quest for self-reliance in production and technology, but the country has paid a price for the effort. To get a better understanding of the situation in India it is useful to refer to some data on the more common forms of technology transfer.

The amount of direct foreign investment (DFI) in India fell from the 1950's to the 1960's. Indian policies affecting foreign capital inflows became increasingly restrictive after 1968 and, from 1974 on, the internal expansion of foreign owned subsidiaries was also controlled. This led to only $80 million worth of approved equity inflows between 1969-82. Of these approvals only half occurred, so that just $40 million entered the country. Once again, this is far less than the inflows into other NIC's. In fact, the net inflows of equity to India for the 1970's was negative.

For turnkey projects, and the licensing of technology in general, similar problems have been noted. A large number of government approved licensing agreements in India were never taken up. A study done by the Indian Investment Centre (1982) of a sample of 1815 agreements approved between 1975 and 1981 indicated that only 37% were actually implemented. On top of this, there are a number of government imposed restrictions on the licensing of technology which have undoubtedly affected the quality, quantity and usefulness of the technology acquired by Indian firms. These restrictions include:

1. The low royalty rates received by the licensor after the mid-1960's (1.8-3.0 % after tax);

2. the requirement to permit sublicensing of any technology transferred; and

3. the five year limit on any technology transfer agreement.

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[3] These goals include; the accommodation of political pressures, the promotion of the public sector, and the implementation of very high tax rates.

One of the results of the goals and policies of the Indian government has been the overwhelming support of public sector enterprises. Public sector investment has gone from 10% of GNP in 1974 to more than 15% after 1980, and the aggregate value of this investment has more than doubled. There is, however, a great contrast between the performance of the public and private sectors. Among the top 100 companies in 1978-79, in respect of their economic profitability and performance, the private firms did much better than the public enterprises.[4]

	CAPITAL	NET ASSETS	PRE-TAX PROFITS
PUBLIC SECTOR	85%	74%	28%
PRIVATE SECTOR	15%	26%	72%

The poor economic results of the public sector, and its dominance over private enterprises has had a significant negative impact on technology transfers. Given the implementation of the Foreign Exchange Regulation Act in 1973, the flight of foreign capital out of India during the 1970's is easy to understand.

A survey of 300 top companies conducted by Shririnian & Associates (in Nayar,1983) points out the major reasons Indian firms enter into collaborations with foreign enterprises. These include:

(1) Obtain technology to meet existing or expected demand.....60%;
(2) to move from the distribution of imports to local manufacturing.....25%; and
(3) diversification.....12%.

However, anyone wishing to obtain foreign technology has to run the gauntlet of regulatory agencies involved in the evaluation of scientific and technological imports. There are a number of agencies working in this area, including:

(1) Foreign Investment Board;
(2) Council of Scientific & Industrial Research;
(3) Industrial Licensing Policy Group;
(4) Monopoly & Restrictive Practices;
(5) Project Approval Board; and
(6) Directorate General of Technical Development.

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[4] This should not come as a great surprise since many public sector enterprises are "essential services" which are operated regardless of profit margins.

An entrepreneur who wishes to import technology is given a letter of intent which stipulates whether or not foreign collaboration will be considered for the project. If this is allowed he can enter into the negotiation process. To assist the entrepreneur in these negotiations guidelines have been laid down.[5] Although most countries screen possible technology transfers and investments in general, the process seems to be somewhat more cumbersome in India.

An important outcome of India's rigid control of technology imports has been the inefficient use of and/or inadequate nature of technology within the country. Producers utilizing inferior technologies remain in business since they are allotted a certain level of output. However, these same controls prevent firms from moving into market-dictated areas of profitable activity, thereby allowing "profitably sheltered inefficiency" to expand. By increasing the level of control on technological imports, the government of India has forced Indian firms to enter into agreements with foreign suppliers which, in many instances, provides them with inadequate technology. In order to obtain appropriate material, information, etc. suited to their specific needs, and to encourage its diffusion, a strong package of incentives are necessary. Provision of risk capital, soft taxes on profits and capital gains should go a long way in encouraging potential entrepreneurs.

The Indian government believes that the development of indigenous R&D and local enterprise, as a means of reducing India's reliance on foreign technologies can provide the country with a relatively deep technological base, which could allow the country to undergo sustained long-term growth (Japan being the prime example). However, it has been noted by Lall (1984) that there are some problems with this line of reasoning. The difficulty lies in the resource endowments of a "typical" developing country. The development of deeper technological capabilities may occur so slowly (and at so great a cost) that the rate of growth of the economy is less than it might have been. There is, in other words, a very real scale of comparative advantage in the development of technological capability. Once that advantage has been exhausted, it is undesirable to push that learning further.

Another factor which affects the rate of technological change is a country's trade regime. The literature on innovation in developed countries indicates that competition is vitally important to the process of technological change. By reducing the level of competition, India has allowed a good portion of its industrial sector to operate inefficiently. This highlights the

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[5] The complete list of guidelines can be found in Appendix I.

fact that there must be greater liberalization of policy in India not just in technology imports, since injections of new technologies in the present protected, inward-looking, fragmented structure of industry would not really be desirable. What is needed is liberalization in the policies that have fostered this structure. These arguments are supported when looking at the situation in South Korea.

B.South Korea

The rapid rate of industrialization in South Korea only goes back to 1965. Prior to that, its economy had greatly suffered from two wars and its industrial expansion was only considered as respectable. However, the mid-1960s, characterized by the increasing use of modern technology, marked the beginning of a new era for the South Korean economy. For instance, the average annual growth of manufacturing production was twice as high during 1965-81 than from 1955-65, the share of exports in gross manufacturing output rose from one-tenth in 1965 to one-third in 1981 and the ratio of exports to GNP more than quadrupled during the same period. The initial stages of this growth occurred in the light, labour-intensive industries. According to Choi(1979), Korea initiated a pattern of import substitution and export promotion at the same time. The apparent success of this approach can be attributed to several factors:

(1) the capacity of the labour force to deal with technologies which were relatively sophisticated;

(2) close trade relations with the United States and Japan, both of which are big markets;

(3) full exploitation of the technical advantage of being latecomers in industrialization; and

(4) the capacity to adapt to the international economic environment - a capacity that was actively supported by the government through the creation of a favourable climate for foreign investment.

An important distinction between Korea and India is the role played by the government as a producer. Due to India's size the government had to take an active part in production whereas the Korean government enhanced its role as a goal setter and fiscal agent to catalyze development. In Korea, the state played a key role in financing industry and they placed a great deal of emphasis on financial mechanisms. However, the state, at the most, provided basic services and/or basic inputs to industry.

In other words, the Korean government allowed for as much laissez-faire as possible while providing a broad set of goals for the economy to pursue.

It was during the mid-70s that the government of South Korea started giving priority to technological development and export activity. New legislation to promote technological development was enacted and new programs were designed to foster the education and training of qualified personnel, and to establish the infrastructure of scientific and technological institutes. The acquisition of technological capability has played a key role in the industrialization of South Korea. Moreover, the manner in which the technology was acquired is also an important part of Korea's success. Direct foreign investment (DFI) has only played a minor role in the industrialization of South Korea. Between 1945 and 1960, DFI was nonexistent in the country. Following the first legislation on inflows of foreign capital in 1960, DFI increased modestly and most of it was approved on the condition that it involve exports. However, evidence shows that DFI in the form of establishing new lines of local production, although not very important numerically, has been an important means of transferring technology, especially in sectors such as chemicals, electronics, and petroleum refining. The key to understanding the value of the DFI which did occur lies in its utilization. About 50 per cent of the total foreign capital in Korea, as well as over 70 per cent of the total public loan funds from overseas, were spent on infrastructure.

The role of other modes of technology transfer such as technical assistance and licensing also played a modest role in the industrialization of South Korea. The use of these methods were mainly concentrated in the chemical basic metals and machinery sectors and the principal source of licensed technology was Japan. According to Westphal, Kim and Dahlman (1985), the weak reliance on formal sources of technology can be, in part, explained by the nature of the technology and product differentiation in the industries that sustained the rapid growth of its economy. Many of these industries use mature technologies and the products are usually standardized. Thus, these industries had little advantage in using licensing or DFI to acquire the technology.

In contrast, informal sources of technology such as the importation of capital goods, export of domestic products, turnkey plant construction and study or work abroad have contributed heavily to the development of Korea's economy. According to a survey by Pursell and Rhee (see Westphal, Kim and Dahlman (1985)) of 113 South Korean exporting firms in 1976, on the relative importance of sources of process technology, local know-how represents an important domestic source of technology transfer. Domestic sources are also more important in traditional rather than in non-traditional sectors. For domestic

and foreign sources taken together, the import of capital goods and the export of domestic products were considered as the most important sources of technology. They were followed by the knowledge of workers who have worked overseas. This brings to light the importance of education, a topic that will be covered in the next section of the paper.

Foreign sources such as buyers of exports have been a very important source of information leading to product innovation. These buyers contributed to product innovation through the characteristics they required from the exported products. From the Pursell & Rhee study, 74% of the 92 firms that responded to the questions on the influence of foreign buyers said that they either modified the characteristics of their product on buyers' requests or produced according to buyers' specifications. Foreign buyers also contribute by periodically visiting the sellers' production plant in order to inspect the production process, the quality of the products, etc. Production for exports has therefore been a great opportunity for South Korea to acquire product-design technology through learning by doing.

Local technological learning has played an important role in the introduction of technology in South Korea. In many industries, projects were first undertaken on a turnkey basis and on a small scale. Gradually, new plants were being constructed in order to operate closer to world scale. In the meantime, engineers, technicians and workers were getting involved in the projects and acquiring valuable experience in the design and the implementation of a project, as well as in the operation of a plant. South Korea's mastery of technology is now reflected in their rapidly increasing exports of industrial know-how (i.e. turnkey projects, DFI, licensing of various technical services, etc.). Thus, the assimilation of technical know-how has had an enormous impact on the rate of industrialization in South Korea.

The South Korean experience could be valuable to other developing countries. With its abundance of entrepreneurial capacity, South Korea became more independent towards direct foreign investment. This allowed them to be more selective in the use of foreign resources. This talent has been used by industry and by the government, and it has resulted in the enactment of legislation which fosters the efficient use of foreign and domestic technology. More importantly, however, the experiences of South Korea are a good example of how foreign technology can be used to a countries advantage. Through the import of capital goods and the use of exports and turnkey plant construction, they have managed to acquire precious know-how that would eventually decrease their reliance on formal methods of technology transfer. The country's industrial competence and its increasing industrial power are the results of indigenous effort and proficiency in production

X. POLICY IMPLICATIONS

The differences between India and South Korea in the area of technology transfer, and the subsequent development of their economies, cannot be explained by the variations in their intellectual property (IP) systems alone. Both countries provided relatively equal protection to owners of IP throughout the 50's, 60's, and 70's. The unequal levels of development in these countries were caused by other factors which are important and relevant to any discussion of IP. Many of these factors are rather complex and go beyond the scope of this paper. The areas that will be investigated are education, investment and taxation, science and technology policies, as well as the role that IP plays in the movement and assimilation of technology from developed to developing countries.

Prior to studying the impact various policies have on technology transfer, the utilization of technology, and ultimately economic growth, one must look at the goals a developing country considers when it devises policy options. In the area of technology most LDC's must perform a complicated balancing act. The goals of a typical LDC are extensive and quite often contrary to one another. These objectives include:

1) respectable levels of economic growth;
2) promotion of technological independence;
3) efficient utilization of labour and capital in relation to the resources of the economy;
4) promotion of appropriate technologies; and
5) maintenance and hopefully improvement of the balance of payments.

Although this list is far from complete it does point out the complexity of the task which faces any LDC government. Assuming that the government has determined what its targets are for the goals listed above it must decide how to attain these goals. When one takes into account the points raised in the first half of this paper, as well as the validity of LDC developmental objectives, it becomes apparent that governments must "influence" the amount and type of technology transferred. However there are negative externalities associated with excessive control of the transfer process. Unfortunately it is difficult to say how far governments should go towards adopting a laissez-faire attitude but the authors of this paper feel that government intervention should focus on macro-level, legislative policies which foster the transfer of appropriate forms of technology to specifically chosen sectors of the economy which can "lead" the country towards technological development. This does not mean that there is no place for micro, or firm-level, policies, but their use should be confined to situations where general controls won't work.

As an example consider the problem of asymmetric information. At first one might believe that this firm specific problem must be dealt with in the same manner, yet it is a condition which arises out of the variation in development between First and Third World countries. One should not expect a firm in India to be able to bargain effectively with a high technology electronics company from Silicon Valley. This is a situation that the government of India must deal with. However, there are several ways in which the outcome of these negotiations can be influenced for the benefit of the domestic firm. These options include:

1) restrictions on the type of contract which can be signed;
2) restrictions on the number of contracts that domestic firms can enter into with foreign suppliers of technology;
3) the institution of educational programs aimed at raising the level of knowledge of domestic entrepreneurs; and/or
4) government assistance in the negotiation process.

Of these four options numbers 3 and 4 are preferable since they allow the market to operate in the absence of restrictions which may adversely affect the quality and/or quantity of technology transferred. Excessive restrictions placed on the domestic market, in the hope of improved international competitiveness, are ill advised. According to Stewart(1979)

> "...local innovation is more likely the greater the pressures from the local environment which make local technological change necessary and worthwhile. Such pressures include natural pressures occurring as a result of differences in physical environment, market size, resource availability and cost as compared with the environment for which the foreign technology was designed and artificial pressures created, for example, by restrictions on technology imports... This suggests that a competitive environment (both nationally and internationally) and factor prices broadly in line with factor availability would be more conducive to technical change than an environment in which firms are highly protected and are able to survive and prosper without innovation or adaptation."[6]

Contractor and Sagafi-Nejad(1981) also point out that there is growing evidence that protectionist and limited-business-entry policies diminish competition and create rents for subsidiaries and licensees - rents which are shared with the licensor. The conclusion one reaches when studying this evidence is that firms are better able to reach "quasi-optimal" contracts in the absence of strong government intervention. Perhaps the best option for an LDC involves limited government involvement which does not affect the operation of the market for technology.

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[6]See Beranek and Ranis(1978) for empirical evidence.

A. The role of educational policy

The level of education in any country will have a significant impact on the ability of it's residents to assimilate, adapt and utilize any technology in an efficient manner. By comparing the situation in India and Korea one can see the role education plays. Modern industrialization in Korea began in the late 1800's due to the integration of their economy into the Japanese empire. Mason (1980) and Westphal et al.(1985) have pointed out that this early level of industrialization was unlike that of most developing countries. Although there is some argument it seems plausible that the 'demonstration effect' of exposure to modern technology and forms of organization gave Koreans a level of competence in the operation of various industries not found elsewhere. This certainly was not the case in India due, in part, to the fact that a very small percentage of the population benefited from the colonial period.

Another factor which separated these two countries even more was the tremendous expansion in education, funded by the U.S., during the 1950's in Korea. By 1960 Korea had achieved nearly universal adult literacy and had sent thousands of it's residents overseas for training.[7] Furthermore, the countries close ties with the U.S. provided Koreans with a greater level of industrial competence and a better understanding of modern concepts and techniques of management and organization.

On the other hand, India chose a more insular route to development after it gained independence from Great Britain. Even though many Indians are highly educated this does not extend to the general workforce. The outcome of this variation in overall education is a greater ability, on the part of the Koreans, to learn from any given technology transfer at <u>all</u> levels of the production process. Educated production employees are able to suggest changes to the process/product they are working on and managers have the skills to enact these changes in an efficient manner. One can see that the communication between all levels of the production process - worker,manager,buyer - facilitates the adaptation/improvement of any technology transferred from abroad. Nevertheless, the implementation of education policies which effectively deal with the knowledge gap within firms, and at all other levels of society, is not easy. Korea was successful only after receiving a great deal of support, therefore, it does not seem likely that any significant changes will occur in India in the near future.

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[7] See appendix II. for details on the level of education and investment in India and Korea.

B. Investment and Taxation Policy

India permits foreign investment only if it comes in a package with sophisticated technology, or if it is intended for an export-oriented project.[8] In comparison, Korea does not foreclose foreigners from any industrial sector, and up to 50% foreign equity investment is allowed. The government especially encourages foreign investment in the machinery and electronics industries due to the fact that they require larger establishments and facilities than domestic entrepreneurs can afford.

Korea also gives special consideration to foreign investors after production has started: the principal and duly earned profit and dividends are guaranteed for remittance or reinvestment. Foreign financed enterprises also benefit from tax reductions and other privileges. According to Whaba (1981), investors in Korea are granted a five year tax holiday from corporate and property taxes and a 50% tax reduction for three years thereafter. Foreign investors are completely exempt from taxes on their dividends for the first five years and enjoy a 50% tax reduction for the next three years. No customs duties and commodity taxes are levied on capital goods brought into the country for projects in which foreign investment has been approved. While free remittance of royalties, technical fees, interest and dividends on capital are allowed in India, the government does tax lumpsum payments, royalties, and dividends at the rate of 20%, 40% and 25% respectively.[9]

Unfortunately, there is growing evidence that tax incentives in LDC's, which are designed to promote foreign investment, are extremely ineffective.[10] They persist, nonetheless, increasing the cost of technology transfer. One reason is that each country believes it is on a kinked demand curve, which means that increased tax rates would cause a large drop in foreign investment. A better approach to maintaining incentives is to provide foreigners with subsidies rather than tax allowances.

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[8]The government of India has begun to allow equity investments of as much as 40%.

[9]These figures for India and Korea are from 1981. They may well be different today but it seems likely that taxes are still lower in Korea.

[10]See King(1970), Hinricks(1974), Chen-Young(1967), Phillips(1968), and Hughes & Seng(1969).

C. Science and Technology (S&T) Policies

In Korea, considerable portions of domestic science and technology programs have been geared to developing the ability to identify, select, digest, and adapt imported technologies.The government has provided support to selected industries in a specific but intensive manner. It has also integrated technological considerations into the country's industrial policy, which complements the steady support given to the expansion of R&D infrastructure in areas of importance to industry. By designating certain industries as strategic the Korean government has enabled the country to learn and develop technology suitable to the Korean situation, thereby laying the foundation for expansion and development of other sectors in the economy. Overall, Korea has created a comprehensive institutional framework that effectively deals with the analysis and implementation of S&T policies and instruments.

India also set up many groups (see p.24) that instituted various S&T policies. However, there was a fundamental difference in the way these groups were operated in India, as compared to Korea. The country had chosen, at the time of independence, to become more self-sufficient, therefore, it chose not to promote development via the efficient use of foreign technology. In many instances, India promoted the development of outdated, inefficient methods of production which resulted in the creation of several large firms that were free of any pressure to change (i.e. no competition). Yet one cannot condemn India for doing this because the country did achieve a very respectable level of technological independence - their main goal from the start. Nevertheless, the next step for India on the road to technological independence should be in a new direction. The promotion of internal competition and the efficient use of technology, foreign or domestic, would be more beneficial.

The preceding discussion must be viewed in the light of the empirical evidence on the effectiveness of government policies aimed at the control of technology transfers. After studying Argentina, Brazil, Colombia, Korea, Mexico, Peru and Venezuela Sagasti (1979) found that science and technology policy instruments were relatively ineffectual. He attributed this to the characteristics of these instruments, the asymmetry of information, institutional delays, and the limited assessment of the impact these policies had on the economy. The research also indicated that firms made decisions without considering S&T instruments. It was only after decisions had been made that firms either took advantage of the benefits or looked for ways of getting around the penalties specified in the policies. This factor and others prompted Sagasti to suggest that "...S&T policies and instruments must be specific. There is a need to avoid sweeping generalizations and the elaboration of 'standard' models or frameworks... A country must delineate the areas in

which indigenous technologies are to be made the basis of productive activities, the areas in which capabilities for choosing, modifying, and absorbing imported technologies must be built up, and the areas in which traditional technologies must be preserved and developed."

D. The role of patent protection

Up to now, we have been discussing the question of technology transfer in the context of the patent system. It is often assumed that the existence of a good patent system provides benefits to society and is essential to the transfer of technology, especially from developed to developing countries. However, we will see that the evidence does not appear to fully support these arguments.

The existence of a patent system rests upon three basic propositions: first, that it induces more invention and innovation than in its absence; second, it encourages the development and the commercial use of inventions; and third, it encourages inventors to disclose their inventions publicly. Although inventions would still occur without a patent system, their discovery would be hastened, and their numbers would be increased, in the presence of patent protection. It is also argued, by advocates of the patent system, that the social costs resulting from the grant of a monopoly right to inventors are outweighed by the social benefits to society.

As suggested by Scherer (1980), in order to assess the value of the patent system, one must compare "the net benefits associated with inventions that would not have been available without patent protection against the net social losses associated with inventions that would be introduced even if no patent rights were offered." In an extensive empirical study Mansfield et. al. (1977) tried to determine what proportion of innovations would be delayed or not introduced at all if they could not be patented. To answer this question each of the companies in the survey were asked whether it would have introduced each of its patented innovations in the sample if patent protection had not been available. According to the firms, about 50 percent of the patented innovations would not have been introduced without patent protection. When pharmaceutical innovations are excluded from this sample the lack of patent protection would have affected approximately 25 percent of the patented innovations that were studied.

The arguments used to justify the existence of a patent system do make sense in the context of pure and perfect competition where inventors would lose their return to investment in the hand of imitators as soon as their product is introduced on the market. However, there are a number of market

imperfections which bring such a conclusion into doubt. According to Mansfield et. al. (1981) imitation can be both costly and time consuming. In a sample of firms in four industries, average imitation costs totalled 65% of innovation costs and imitation time equalled about 70% of innovation time. Evidently, the advantage of competitive product leadership, and the importance of know-how in the innovation process enables firm's to maintain their position in the marketplace. Thus, even without a patent system, inventors can be expected to fully benefit from their innovations for some years, which may be enough time in some sectors of the economy to earn a positive net return on their investment.

In addition, Mansfield (1986) found that only the pharmaceutical and chemical industries considered patents as essential, in the sense that more than 30% of their inventions would not have been developed without patent protection. Three industries (petroleum, machinery, & fabricated metal products) thought patents were important and the remaining seven industries questioned in the sample viewed patents as unimportant or only marginally significant in promoting R&D. Indeed, in office equipment, motor vehicles, rubber, and textiles, the firms were unanimous in reporting that patent protection was not essential for the development or introduction of any of their inventions during the period 1981-1983. Yet, in each of the seven industries which stated that patent protection was of little importance at least 50 percent of the patentable inventions made during this time period were patented.

In another study, which looked at 27 British companies operating in R&D industries, Taylor and Silberston (1973) found that without patent protection, R&D expenditures would be reduced only marginally in most industries -- 5% in machinery and mechanical components, 5% in basic chemicals, and negligibly in the electrical industry -- except for the pharmaceutical industry where it would drop by 64%. With respect to the pharmaceutical industry, Comanor (see Scherer) found that competitive research has led to the development of a large number of products which had therapeutic effects comparable to those already existing. This led him to conclude that society would lose relatively little if fewer resources were devoted to this duplicative R&D.

If we add these arguments to the social costs of the patent system resulting from the administrative costs incurred by the government and patent recipients, the misallocation of resources, through higher prices and lower output, the potential use of "patent portfolios" to reduce competition and to possibly suppress inventions that could have benefited society, one could argue that the existence of patent protection has imposed a net

cost on society. Nevertheless, this conclusion does not indicate that the patent system should be abolished. On the contrary it seems that, in the words of Machlup (1958), "...if one does not know whether a system 'as a whole' (in contrast to certain features of it) is good or bad, the safest policy conclusion is to 'muddle through' - either with it, if one has long lived with it, or without it, if one has long lived without it."

Now that we have looked at the appropriateness of the patent system for developed countries, we need to study its role in developing countries. Statistics on patent protection in developing countries reveals that most patents are foreign owned. Between 1957 and 1961, the patents granted to foreigners as a percentage of the total patents granted was 15.7% in the U.S.A. compared to 89.4% in India, 91.7% in Turkey and 95.8% in Pakistan (Vaitsos (1972)). If this number is weighted by the economic value of the patents, the ratio of patents belonging to nationals of developing countries would amount to 1% of the total number of patents granted by these countries. These figures have changed little in the past thirty years. The important concentration of patents in the hands of foreigners could be a factor explaining the intervention of developing countries' governments in the negotiation process between a licensor and a licensee.

It is argued that patent protection stimulates the innovative effort of small inventors who have been, historically, responsible for many important inventions. Evidence shows that most of the patents granted to nationals in developing countries are to individual, small inventors but they are often of little importance. Taylor and Silberston (1973) found that, even in developed countries, industries that rely heavily on patent protection are dominated by large firms. In areas where small inventors have made the greatest contributions (i.e. mechanical engineering and related fields) patent protection was found to have, in general, a marginal impact on innovative activity. Accordingly, Taylor and Silbertson argue that "the assistance given by the patent system to the exploitation of the small man's inventions may be therefore something of an illusion on the whole... However, it seems likely that attempts at innovations by small firms of the more adventurous kind would be discouraged, which could be a real loss."

Based on this evidence, the main argument used to justify the existence of a patent system, namely to stimulate domestic inventive activity, seems unjustified in developing countries. To quote Kaufer (1989), "the historical experience with industrialization in Holland, Germany and Switzerland shows that it may initially be advantageous not to have a patent law, assuming that domestic inventive capabilities are sufficient to "free-ride" by imitating the technologies already developed by foreign enterprises. Only after industrialization has progressed further and technical skills have developed to a higher level

does the nation introduce a national patent system to guide its domestic inventive activity away from imitation towards more original work." In comparing the patent history in Switzerland and China, Kaufer finds that " China's policy closely replicate Switzerland's policy at the turn of the century. Both nations began by allowing patents in areas where they had an established industrial base, but Switzerland like China, excluded chemical and pharmaceutical fields, where they were attempting to lay the basis for industrial development."

The review of literature has shown that there is some difficulty in determining if the patent system is a necessary condition for domestic inventions to take place. For small inventors, the absence of patent protection might result in a few individuals being worse off but it might not make a big difference in their overall effort to invent.

These facts suggest a new meaning for the principle of equal treatment and common standards to nationals and foreigners as stipulated in the Paris Convention. These principles only make sense when the parties themselves are generally equal. In the present case, the equality treatment simply means giving more power to the stronger party in order to exploit the weaker.

Statistics also show that the majority of patents granted in developing countries are not exploited. From a sample of 4872 patents granted between 1960 and 1970 in some industrial sectors in Peru, only 1.1% have been exploited. In Argentina, patent exploitation does not exceed 5% for the period 1957-67 (Vaitsos (1972)). The existence of compulsory licensing provisions has not changed the situation a great deal since unpatented know-how is often essential to the use of any technology. This suggests that the primary motive for foreign firms to use patent protection in developing countries is to preserve and secure import markets from competitors. This could have an important economic impact, especially with respect to the ownership structure in certain industries.

Although the existence of a patent system in LDCs does not appear to induce a great deal of domestic innovative activity, it could be argued that it will enhance the transfer of technology from developed countries. This is believed to increase productivity and contribute to the growth of the developing countries' economy. Two assumptions underlie the argument that the transfer of technology to LDCs depends on patent protection. First, the co-operation of the patent owner is needed for a successful transfer since the disclosure of know-how often represents an essential element of a transfer. Second, the transfer of know-how would not take place in the absence of patent protection. Thus, patents become a necessary, although not sufficient, condition for the transfer of technology.

By looking at the research on this question, the authors of this paper have some doubts with respect to the above arguments. A number of studies have found that the majority of licensing or co-operation agreements between LDC firms and foreigners involved unpatented know-how (Lall (1976), O'Brien (1974), Greer (1973), Penrose (1973) and Vaitsos (1972)). For example, at the beginning of the 1960's, the percentage of asset transfers involving patents was 34% in India and 44% in the Philippines. On the other hand, the percentage of transfers involving know-how were 92% in India and 64% in the Philippines. Unpatented know-how seems to play a greater role than patented technology in such transfers. In fact, Lall (1976) argues that "a large number of industries do not seem to bother with patenting at all, and the transfer of their technology is totally unrelated to the patent system... Even in a highly innovative industry like pharmaceuticals, the essence of market power and high profits lies not so much in the patenting system as in the marketing technique."

In addition, according to Kahn (1962) "companies presumably keep secret whatever they can and patent what they cannot." Hence, the argument that patents allow a greater disclosure of information to the public seems to have limited relevance in LDCs. This is especially true when we know that information on technology can be acquired from publications or patent offices in developed countries and that the patent information is often useless without the know-how associated with it. Given the rapid advances in technological innovation during the 1980's one can expect patent information to play a decreasing role, over time, in the transfer of technology. It is also apparent that foreign firms use the patent system in order to secure their market not so much from domestic producers but from external competitors.

Another argument used to justify the existence of a patent system is that it allows for the possibility of cross-licensing. But given the small number of patents owned by nationals of LDCs, one must realize that there are very few opportunities for potential benefits in this type of activity.

Evidently, there is no evidence that the existence of a patent system in developing countries, in and of itself, has a positive impact on their economy. The great majority of patents are owned by foreigners and are not exploited. By giving foreigners a monopoly right, it restricts the flow of technology within an LDC that would otherwise arise from competition or through imitation and adaptation, and it could also hinder the possibility of R&D activity in the country. This monopoly right also results in higher prices for the technology (some evidence shows that the use of overpricing of imports by foreign firms can be very important, especially in the pharmaceutical industry

(Lall (1973)) thereby creating unfavourable terms of trade, a deterioration in a country's balance of payments and it can induce a monopolist to impose excessive restrictions on the use of the technology.

This negative view of the effect of the patent protection system in developing countries can only lead to one question: why do these countries adhere to such a system? After all, they themselves by their own laws have allowed such developments.

First, it would seem appropriate to look more carefully at some of the criticisms. For instance, the non-use of the great majority of patents represents a social cost to the society only in cases when local production or imports would have been beneficial and is prevented by the patent holder. On the contrary, if the exploitation of the technology is not economically beneficial, non-use restrictions impose no extra cost to the economy.

Second, it is argued that giving a monopoly right for a specific technology hinders the possibility of acquiring it from other competitors and serves as an exclusive import permit for the foreign producer. However, we have seen earlier that one of the imperfections arising on the market for technology has to do with the small number of participants. Not granting a monopoly right to a particular firm which owns a specific technology does not imply that it will be available from competitors. What it might mean is that potential users might be able to imitate and adapt the technology for their use.

Third, the same kind of arguments can be applied to the excessive use of restrictive business practices. Again, these practices could result from market imperfections. But in practice, there is no indication that this would change with the abolition of patents. It could be argued that the solution to the problem lies more in the reinforcement of antitrust laws.

Fourth, the impact of the patent system might differ from industry to industry. For instance, the existence of patent protection seems to be much more important to the pharmaceutical industry and areas of finished and specialty chemicals than to the basic chemicals industry which involves economies of scale in production, or engineering industries which requires a great deal of know-how. A solution to this problem could then be to define patent terms which differ by industries rather than patent terms which apply equally to all industries.

It seems obvious that these arguments alone cannot explain the decision of developing countries to adhere to a patent system. A number of reasons have been suggested, none of which are based on purely economic arguments. For instance, Machlup (see Scherer 1980) argued that the adoption of a patent

protection system in many developing countries results from pressure originating in developed nations and for prestige motives, suggesting that developing countries seem irrationally eager to "have the honour of paying higher prices for imported products" (see Scherer). On the other hand, authors such as Lall (1976) and Penrose (1973) have suggested that in general, it seems that the gains for LDCs to follow the international framework of patent protection are more political and psychological. As pointed out by Penrose, "...given the existence of national patent systems, and given the interests, motives, and policies of multinational firms, which are the chief international investors, it may be that co-operation in this system on the part of less-developed countries will help them to obtain the co-operation of such firms in introducing and developing new technologies."

However, in order to estimate these gains, one has to analyze the difference between the short-run and long-run benefits. In the short-run, some firms might be attracted on the grounds that there is a good investment climate and jobs will be created. When considering these short-run gains, one must first realize that job creation has very little to do with economic efficiency and long-run benefits are not guaranteed. Yet there are increased costs due to higher prices, royalty payments, and administrative costs. Nevertheless, the fact is that if developing countries want to "play the game" with developed countries, they have to play by the same rules.

XI. CANADIAN SITUATION

To get an idea of the manner in which the transfer of technology process works in Canada, and the impact of Canadian IP policies in this area, a survey of IP use in Canada performed by Price Waterhouse for CCAC will be reviewed.

In 1988, CCAC piloted an extensive and comprehensive research and study program on the use and significance of intellectual property rights for a number of industries, trade in general, and the economic objectives of the country. One of the fundamental tools in this program was a survey of various firms (over 700) by Price-Waterhouse. The survey was designed to obtain information on the impact of intellectual property rights (IPRs) on the performance of Canadian firms and their trade and investment decisions. The study has involved asking the companies about many aspects of their business which involve IPRs, including their use of licensing agreements as vendors or purchasers. The firms have been grouped into four categories in order to distinguish the major trends that characterize them. These categories are:

- R&D firms;
- high technology firms;
- medium or low technology firms; and
- the major users of copyright.

As might be expected, this survey shows some significant variations among the categories referred to above regarding the types of IPRs they use, the degree of satisfaction with the Canadian, and international, IP system, the estimated expertise in this field and the actual use of IPRs by firms. It is important to note that the use, and the general satisfaction with the system, remain relatively significant in each of the four groups. Furthermore, the high response rate (81%) demonstrates a pronounced interest by the companies in the issue of intellectual property. However, the awareness and knowledge of such rights seems rather low outside of the group that is active in R&D, large companies (most of which are in that group), and some associations specializing in IP. For the purposes of this paper only the first three groups will be studied.

A. R&D Firms

This category is distinguished considerably from the others by the size of its firms. For example, few firms (less than 15%) have annual sales of 25 million dollars or less, while the vast majority of the firms in the other groups are below this threshold. A relatively large number of companies in this class (more than 40%) are also more than 50% foreign owned. Therefore, it can be said that a major share of the branch plants of foreign multinationals operating in Canada are among the firms active in R&D.

The firms in this group were asked whether they had granted licences for their IPRs to other firms during the three years preceding the survey. Half of the firms replied in the affirmative with regard to patents, compared with 41.2% for trade secrets, 33.3% for trademarks, 32% for copyright and only 11.1% for industrial designs. If we compare the distribution of the replies with the size of the companies, the largest companies seem much more inclined than the others to grant licences for their patents, trade secrets and trademarks. There do not appear to be any pronounced differences with regard to the other IPRs. As for distribution by nationality, there is little variation between the Canadian or foreign controlled firms with regard to any of the IPRs that were examined.

Another point of interest in this area is the use of licensing agreements by the companies when they are the purchasers of technology. Three quarters of the firms in this group which completed the survey had made such agreements within the three years preceding the survey. Of the 21 remaining firms, one third had attempted unsuccessfully to make such agreements during the

same period. The major companies have a greater tendency to enter into these alliances. On the other hand, the lesser sized firms had attempted the most, without success, to conclude such deals, as had foreign firms as opposed to Canadian. Two thirds of the firms are satisfied with the terms of their agreements, and here again the large firms tend to be the happiest in this respect. Few firms (15.2%) say they have experienced restrictions with these alliances, and only one of them thought that these problems had affected its profitability to a large degree.

A large majority of firms said they had great expertise in the IPR field. However, one may be surprised to learn that most of them (60.3%) think the intellectual property system has no effect on the level of research and development they perform. Some people believe that this may be due to the fact that firms view patents as unimportant because they only weakly disrupt the imitation process, forcing reliance on other protective mechanisms. In turn, this may mean that greater international patent protection would encourage considerably more R&D or, equivalently, that the current system generates too little global R&D. However, this conclusion does not seem to follow directly from the empirical results presented in the previous section.

B. High Technology Firms

Although there are some similarities between the companies belonging to this group and those belonging to the preceding one (twenty of the firms that were questioned belong to both categories), the difference in the size of the firms in the two groups means that there may be some differences between them with regard to their knowledge of IPRs and their general behaviour in relation to intellectual property.

It appears that, compared with the top R&D sector, fewer high technology firms sign contracts for the sale of licences. These firms account for about 20% of each of the IPRs. The small companies (fewer than one million dollars in annual sales) tend to grant more licences for their copyright, while the larger firms make more agreements than the others involving patents, trade secrets and trademarks. None of the foreign-controlled respondents granted licences for their copyright and industrial designs. For the other IPRs, the difference between the domestic and foreign corporations seems too small to be able to draw any conclusions.

As is the case for the general use of IPRs, the firms examined within this sample make less use of licensing agreements than those in the group of top R&D firms. The degree of use of

these agreements tends to increase with the size of the firm. Moreover, there does not seem to be any relationship between the nationality of the firms and their involvement in such agreements.

Of those corporations that did not have any licensing agreements (55% of the 250 respondents to this question), only 21.6% had attempted unsuccessfully to sign them. Here again, the largest companies and the foreign firms seem to have a greater tendency to make such attempts. However, it is unclear whether these variations are significant, given the low number of firms in these two subdivisions.

Most of those firms that are involved in such agreements, i.e., close to 65% of the firms, feel that they are satisfied with the prevailing terms of the contracts. Almost all of the other firms (29.7% of the respondents) said they were neither satisfied nor dissatisfied with their situation. The percentage variations by size and origin of the firms are more or less minimal, although it may be noted that there is a slightly higher than average satisfaction rate among the large companies.

Fewer than 10% of these firms (8 out of 110) have had to put up with significant restrictions or difficulties in the framework of their agreements. Half of them think that their profits decreased as a result of these restrictions. It should be noted, however, that six of the eight firms reported revenues of less than five million dollars annually and that seven of them are Canadian-owned.

More than one half of the firms (54.9%) consider their knowledge about IPRs to be very good, and this proportion tends to increase with the size of the firm. Interestingly, foreign corporations seem to consider themselves more expert than Canadian firms in this area. Finally, the vast majority of the firms, regardless of size and nationality, think that IPRs have no effect on R&D. This result runs counter to some accepted arguments which state that IP protection promotes R&D. One must assume that the value of the IP system is overrated and/or that the protection being provided does not meet the rapidly changing needs of the high technology sector. Given the fundamental importance of this question further analysis of this issue is definitely warranted.

C. Medium and Low Technology Firms

The percentage of firms granting licences for their IPRs in this group is lower, and trademarks (11.6%) are the only form of IPR to break through the ten percent barrier. However, there does not seem to be any significant relationship here between the rate of use and the size or ownership of the firm.

A little less than one quarter of the firms had been granted one or more licences during the three years preceding the survey. Here again, this proportion tends to increase with the size of the firm, although the origin of firms does not appear to be related to the use of licences. A small percentage (15%) of firms that did not have such agreements had attempted unsuccessfully to arrange one. These firms are found mainly among those with annual sales of between five and twenty-five million dollars. However, only 22.6% of the companies that had failed in their attempts had encountered problems in the process.

More than three quarters of the corporations felt that they were satisfied with the terms of their agreements. Neither the size nor the origin of the firm seems to exert any influence on this point. Nevertheless, 12.1% of the companies think they have been the victims of difficulties and restrictions, and five out of eight companies stated that their profitability was affected to a large degree.

Within the context of this survey the companies in all four sub-groups were asked to define some of the specific problems they might have had in connection with the various items examined earlier (use of IPRs, licensing, etc.). However, because of the way in which the data were compiled it is impossible to classify the various concerns of the companies in accordance with the four categories of firms. Moreover, the extent and variation of these concerns make it very difficult and tedious to do an exhaustive study on the matter. It would be interesting, however, to look at some examples of the replies, to provide some idea of the concerns that firms might have on some of these issues.

For the analysis of licensing agreements, the firms were asked to list the reasons why they might be discontented with these alliances. In the case of patent licences, the major irritant is the conduct of vendors after the transaction. In some cases they reject any form of cooperation with the purchasers, and the latter have sometimes been confronted with false representations. Some criticisms were also noted concerning the exclusivity of licences, especially when firms are working with the government.

As to the nationality of companies, it does not seem to exercise any direct impact on the intellectual property activities of firms, except perhaps in cases where foreign-controlled firms are, for the main part, big corporations involved in activities in which advanced technology plays an essential role.

Perhaps the most interesting, and seemingly controversial, result which came to light in this study is the limited consideration firms give to IP when contemplating their R&D activities. This may have something to do with the number of biotechnology and computer software firms involved in the survey

(two areas where IP protection, at the time of the survey, was uncertain), as well as the rapid pace of technological innovation many high technology and R&D intensive companies face at this point in time. One must realize that some forms of IP protection, namely patents, are not always well suited to this type of environment and firms are finding it necessary to rely on other forms of IPRs (trade secrets). This evidence definitely seems to support the conclusions reached by both Mansfield and Taylor and Silbertson: IP protection is not vitally important in some industries, but they are used because they are available.

When considering the policy implications of such results it becomes evident that Canada should proceed cautiously in the Uruguay Round of the GATT negotiations. The limited value of improved IP protection in some sectors of the economy seems to indicate that the MTN negotiating team should encourage other countries to support a TRIPs agreement which allows individual countries to set their level of IP protection at, or above, an agreed upon minimum level that is deemed necessary.

XII. CONCLUSION

It is readily apparent that the process of technology transfer is a complex matter. This paper has been an initial attempt at the analysis of this subject matter. We have seen that technology plays an important role in the economic growth of both developed and developing countries. Given that most technologies are developed in industrialized countries, the import of technology by developing countries can play a crucial role in the growth of their economies.

The two main methods used to transfer technology are licensing agreements and transfers to a wholly owned subsidiary. Many factors affect the decision to transfer the technology, as well as its mode of transfer. The monopoly power given to owners of technology has prompted many developing countries who use this material to complain about the abusive behaviour of those firms who licence their technology. To counteract such behaviour, numerous restrictions on the import of technology have been put in place by the governments of some of these countries. However, this can only be seen as a sub-optimal solution to the problem.

One must understand that there are many alternatives for developing countries to consider when planning their socio-economic growth. To illustrate two of these approaches, we have provided evidence on the experiences of India and South Korea. In the case of India, priority was given to the appropriation of foreign technology in order to render the country more self-sufficient. This policy goal has, to a certain extent, been

attained. In the case of Korea, the government has successfully adopted an open approach to the acquisition of foreign technology in order to improve their export capacity, thereby stimulating their economic growth.

In Canada, the technology transfer process suffers from few of the problems that plague transfers from developed to developing countries. On the whole, Canadian firms find it easy to acquire, adapt and utilize the technology they receive from outside the country. This is, of course, due to the advanced stage of development of the Canadian economy and the associated business skills which are present in each sector of the economy.

From the authors' point of view, it would seem inappropriate to assess the policies put in place by developing countries solely on the basis of criteria put forward by developed countries. By looking at the results of developing country policies and comparing them to the original objectives, we can then assess their effectiveness. As stated by Lall (1976), "it is not enough to discuss policies to promote transfers of technology... We must also specify:

- which products are conducive to national welfare;
- what technologies are available to produce these products, and of them, which one is the most appropriate;
- how can these technologies be acquired at the lowest social cost, bearing in mind the necessity of developing local scientific/technological expertise; and
- if they are purchased abroad, is it better to buy them outright or to have them transferred by means of direct investment."

Our analysis of this topic has brought to light little economic evidence which supports the developed countries argument that the existence of a patent protection system in developing countries would stimulate innovations and foster the transfer of technology. Nevertheless, one must realize that the international IP system has significant political and psychological benefits for developing countries, which could result in economic gains. By adhering to this system these countries will be able to obtain the cooperation of firms from developed countries in introducing and developing new technology (Penrose,1973). However, we believe that bargaining which is based solely on the purported economic value of the patent protection system may lead to confrontation and the failure of any set of negotiations. It is only by understanding the real problems faced by these countries that we will eventually be able to come to an agreement in the interest of all parties involved.

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APPENDIX I: GUIDELINES ON THE ACQUISITION OF TECHNOLOGY AS SET OUT BY THE GOV'T OF INDIA.

1.) Entrepreneurs should, to the fullest extent possible, explore alternative sources of technology, evaluate them from a techno-economic point of view and furnish the reasons for preferring the particular technology and the source of imports;

2.) the Indian party should be free to sub-licence the technical know-how/product/design engineering on terms to be mutually agreed to by all the parties concerned including the foreign collaborator and subject to approval of the government;

3.) the royalty wherever allowed will be calculated on the basis of the net ex-factory sale price on the product exclusive of excise duties, minus the cost of the imported components, irrespective of the source of procurement including ocean freight, insurance, custom duties, etc.;

4.) there should be no requirement for the payment of a minimum guaranteed royalty regardless of the quantum and value of production;

5.) arrangement of clauses which in any manner bind the Indian party with regard to the procurement of capital goods, components, spares, raw materials, pricing policy, selling arrangements, etc. should be permitted for internal sales;

6.) to the fullest extent possible, there should be no restrictions on free export to all countries;

7.) the use of foreign brand names will not be permitted for internal sales;

8.) the Government does not favour requests for extension to the duration of collaboration agreements. All efforts should, therefore, be made by the Indian party to assimilate the technology within the initial duration of the agreement;

9.) Suitable provisions should be made for the training of Indians in the fields of production and management. There should also be adequate arrangements for R&D engineering design, training of technological personnel and other measures for the absorption, adaptation and development of the imported technology. Such measures can be undertaken through in-house facilities of the entrepreneur or in collaboration with recognized engineering design, consultancy, R&D organizations in the public or private sectors and recognized scientific and educational institutions, where the necessary facilities exist;

10) Consultancy services required to execute the project should be obtained from Indian consultancy firms. If foreign consultancy is also considered necessary, an Indian consultancy firm should be the prime consultant;

11) If the proposed item of manufacture is covered by a patent in India, it should be ensured that the payment of royalty/lumpsum payment for the duration of the agreement would also constitute compensation for the use of patent rights till the expiry of the life of the patent and that the Indian party would have the freedom to produce the item, even after the expiry of the collaboration agreement without any additional payments;

12) Collaboration agreements will be subject to Indian laws;

13) It is desirable that approved/registered Indian engineering, design and consultancy organizations should be associated right from the start in any evaluation, selection and negotiation conducted for the purchase of overseas technology; and

14) It is desirable that enquiries to overseas parties should be made on the basis of separate quotations for technology (licence fees, know-how, royalties, R&D assistance, etc.) and design and consultancy services not available in the country.

APPENDIX II: INDICATORS OF TECHNOLOGY INFLOWS, HUMAN CAPITAL, AND R&D*.

ITEM	YEAR/PERIOD	INDIA	KOREA
DFI as a percentage of GDP	1967	3.0	1.7
	1977-79	2.1	3.2
Import of capital goods as a percentage of GDP	1965	10.3	13.0
	1977-79	5.6	27.2
Postsecondary students abroad as % of total	1970	1.0	2.0
	1975-77	0.3	1.7
Postsecondary students as a percentage of total	1965	4.0	5.0
	1978	9.0	9.0
Secondary students as a % of possible total	1965	29.0	29.0
	1978	30.0	68.0
Scientists/Engineers (000's) per million pop'n	late 60's	1.9	6.9
	late 70's	3.0	22.0
Scientists/Engineers in R&D per million pop'n	1974	58	NA
	1976	46	325
	1978	NA	398
R&D Expenditure as a percentage of GNP	1973	0.4	0.3
	1978	0.6	0.7

* Source: World Bank Research Project Ref. No. 672-48.