Trade Policy in 1980s with Special Reference to the Technoloqy Import Policy for Export Promotion

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Last Year Korea has achieved the target of $10 billion exports. According to the Long-term Economic and Social Development Plan, Korea's exports will be increased to $115 billion by 1991. It is obvious that, in order to achieve this target, Korea cannot rely on the traditional labor-intensive products.

Thus, Korea is placing a great emphasis on developing technology-and skill-intensive industries, including electronics, machinery, shipbuilding, and petrochemicals. The relative importance of these exports is expected to account for more than 70 percent by 1991. Development of such industries necessitates domestic R&D activities and importation of foreign technology on a large scale. In other words, Korea's sustained export promotion in 1980s will crucially depend on the ability of business firms and government institutions to organize and adopt modern technology.

The purpose of this paper is to examine the various aspects of the role of technological change in economic growth and international trade, with

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special emphasis on the technology import policy for Korea's export promotion.

I. TECHNOLOGY, ECONOMIC GROWTH, AND INTERNATIONAL TRADE

Although it was evident that the rapid advances in technology must have been an important cause of growth, it was not until 1950s that economists began to pay systematic attention to the role of technology in economic growth. The interest originated from empirical works which seemed to show that increases in factor inputs could not explain even the major part of increases in output.

Traditionally economists tried to explain the economic growth by the two important factors of production, namely capital and labor. But it was Robert Solow who first called attention to the importance of technological change in economic growth. In a seminal article published in 1957, Solow attempted to estimate the rate of technological change for the nonfarm U.S. economy during 1909~1949.[1]

Solow uses a function of the following form:

$$Q=A(t)\ f(K,\ L) \qquad (1)$$

where Q is total output, K is capital input, L is labor input, and $A(t)$ is shift factor to allow disembodied and neutral technical progress. Assuming that there is constant returns to scale and that capital and labor are paid their marginal product, the rate of technical change, $\dot{A}/A$, can be computed using the following equation, which is derived from equation (1):

$$\frac{\dot{Q}}{Q}=\frac{\dot{A}}{A}+W_K\frac{\dot{K}}{K}+W_L\frac{\dot{L}}{L} \qquad (2)$$

where $\dot{Q}/Q$=the growth rate of total output

$\dot{K}/K$=the growth rate of capital input

(1) Solow, R., "Technical Change and the Aggregate Production Function," ***Review of Economics and Statistics***, August 1957.

$\dot{L}/L$=the growth rate of labor input

W_k=the capital's share in total output

W_l=the labor's share in total output

Equation (2) states that the rate of growth of total output is equal to the rate of technical progress plus the rate of increase of inputs being weighted by its share in national income. This equation can be reduced future by utilizing the fact that $W_l=1-W_k$ and denoting Q/L by q and K/L by k. Then, as $\dot{q}/q=\dot{Q}/Q-\dot{L}/L$, equation (2) can be rewritten as:

$$\frac{\dot{q}}{q}=\frac{\dot{A}}{A}+W_k\frac{\dot{K}}{K} \qquad (3)$$

Technical progress, thus, emerges as a residual, being the rate of growth of output per head less the rate of growth of the capital stock per man weighted by the capital's share in total output. Solow fitted equation (3) to U.S. data for the period 1909~49. Based on this research, he concluded that 87.5 percent of increases in output per capita during this period was attributable to technological change, where only a minor percentage of the increase, 12.5 percent, was due to increases in the amount of capital employed per worker.

Kick Hayashi also tried to estimate equation (2) to Japanese data for the period 1910~67 and yielded the following results[(2)]:

Period	$\dot{Q}/Q$	$\dot{K}/K$	$\dot{L}/L$	W_k	W_l	$\dot{A}/A$
1910~40	0.0435	0.0070	0.0427	0.75	0.25	0.0276
1947~67	0.1026	0.0207	0.0741	0.75	0.25	0.0686

Although, in Japan, the postwar technical change was more than double the prewar rate, the relative contribution of technical change to the gorwth of output is about the same in both prewar and postwar years; 63.4% for the prewar period and 66.8% for the postwar period.

It is widely known that Solow's method had limitations in that he omitted

(2) Hayashi, K., "Technical Change in Japan, 1610-1967," in G. Wilson (ed.), ***Technological Development and Economic Growth,*** Indiana University, 1971.

many other factors such as economies of scale, improved allocation of resources, changes in product mix, increases in education, or age-sex composition of workers. To improve the measurement, Edward Denison attempted to include many factors--for example, changes in labor quality associated with increases in schooling--that had been omitted by Solow.(3) Since it was relatively comprehensive, Denison's study resulted in a relatively low residual increase in output unexplained by the inputs he included. Specifically, he concluded that the "advance of knowledge"--his term for the residual--was responsible for about 40 percent of the total increase in national income per person employed during 1929～57 in the United states.

In order to account for the improvement in education, age-sex composition and interindustry shifts, Kich Hayashi also applied Denison's method to Japanese data.(4) After substracing all these contributions to Japanese growth, Hayashi obtained a residual average annual growth rate of 2. 21 percent and 3. 79 percent for the prewar and postwar periods, respectively. This means that 50. 8 percent of the prewar growth and 36. 9 percent of the postwar growth remain unexplained.

It must be emphasized, that the contribution of technical progress or advances of knowledge comes out as a residual in both Solow's and Denison's estimation, and that there is no independent measure of this contribution. Denison arrived at a smaller residual than Solow because of the various adjustments he made, most notably to labor inputs. It is possible to follow this approach future by attempting quality adjustments to capital inputs. This is what has been done by Jorgenson and Griliches.(5) They start from the proposition that real product is equal to real factor input, hence, the growth of real product should be accounted for by the growth of real factor

(3) Denison, E., *The Source of Economic Growth inthe United States*, Committee for Economic Development, 1962.
(4) Hayashi, K., Ibid.
(5) Jorgenson, D. and Z. Griliches, "The Explanation of Productivity Change," *Review of Economic Studies*, July 1967.

inputs. Thus the residual, which is the excess of the former over the latter, should be negligible if all measurement are correct. Indeed, by correcting many statistical errors in the measurement of capital and labor services, they showed that the the rate of growth of inputs accounts for 96.7 percent of the growth of output in U.S. economic growth over the period 1945~65.

This is not to say, however, that advance in knowledge does not occur, but simply that benefit accures to those who incur the cost in bringing it about. In a sense, it is matter of classification. If productivity increases, Jorgenson and Griliches impute this as an increase in factor inputs, while Solow and Denison treated it as a residual.

As an alternative approach to measurement of the contribution of technical progress in economic growth, Zvi Griliches attempted to include the growth of research capital as a source of growth.(6) He uses a Cobb-Douglas production function of the following form:

$$A = Ae^{\lambda t} R^{\alpha} K^{\beta} L^{1-\beta} \qquad (4)$$

where A is constant, λ is the rate of disembodied technical change, R is the stock of R&D capital, and constant returns to scale have been assumed with respect to conventional inputs (K and L). The following equation can be derived from equation (4):

$$f = \lambda + \rho(I_R \backslash Q) \qquad (5)$$

where f is $\dot{A}/A$, ρ is the rate of return to research expenditures (i.e., the marginal product of the stock of R & D capital), and I_R/Q is the net investment in R&D divided by total output. Based on very rough estimates of ρ and I_R/Q, he concluded that about 2/10 of one percentage point of the rate of growth of U.S. output was due to R&D expenditures.

Although measurements of the contribution of technological change in economic growth have thrown up somewhat confusing results, there seems to be abundant evidence that technological progress has been "the engine

(6) Griliches, Z., "Research Expenditure and Growth Accounting," in B. Williams (ed.), ***Science and Technology in Economic Growth,*** John Wiley & Sons, 1973.

of growth" for the past two centuries. This is especially ture in that the availability of unexploited investment opportunities largely due to the creation of new technological opportunities. The improvements in the quality of capital are themselves probably in good part the result of new technology. If the pace of technical change had been slower, we would have experienced neither the observed high increases in capital quality nor the maintenance of high returns to education.

Technological factor also played very important role in the so-called new theories of international trade. Ecoeomists have long been perplexed by the apparent inability of traditional Heckscher-Ohlin model to explain what has been observed in real world trade. It was found that changes in the structure of trade are often due to technological innovations that displace old products and introduce new ones.

The "technology gap" model tries to explain why certain countries should be prolific source of innovations, the production of which eventually diffused to other countries. First of all, the model stresses the advantages to the innovating country which come from the possession of the newest product as opposed to advantages accuring from lower costs. Next, the model assumes that technology is not a free good and that a time period would elapse before technology eventually diffuse to other countries.

However, the technology gap model is somewhat unsatisfactory in that it cannot explain why the gap persist for so many years. The "product life cycle" model was developed to provide an answer to this question.(7) According to this theory, the comparative advantage for manufacturing a particular product is a dynamic characteristic which moves from developed to developing countries as the product in question progresses from its introduction to obsolescence. Technology plays the decisive role in this process.

In phase I of the product life cycle, when the product is first introduced into the market, production takes place in pilot form and R&D costs ac-

(7) Wells, L. (ed.), *The Product Life Cycle and International Trade*, Harvard University, 1972.

count for a substantial part of total manufacturing costs. There is already a market demand for the product, however, with little price elasticity, and this is an incentive to bring the product to the market immediately. In phase II, demand grows fast as the market expands, and this creates an incentive for other firms to begin production. In phase III the product matures, sales level off, and eventually decline, competition becomes keen, price elasticity is high and, therefore, cost becomes the competitive factor.

According to the product life cycle theory of international trade, a product is first introduced in a developed country with a large market which has the necessary technological knowledge and initial market demand to develop the product. Early in phase I and during phase II, the developed country enjoyes a comparative advantage for the production of the new product because it is better endowed with the necessary technology, and that gives it a monopolistic position in the international market. The developed country will thus be an exporter of the product during these two phases. But as the product becomes more standardized, the technological knowledge involved in its manufacturing spreads and cost begins to play a more relevant role. In other words, low-cost labor or cheap natural resources will become more important and developing country can be better endowed for the manufacturing of the product in phase III, first in order to avoid imports, later with the possibility of becoming an exporter in world markets.

While the technology gap and product life cycle theories emphasizes different effects of a nation's level of technology in shaping international trade, both are based on the assumption that at a given time, some technology is not universially shared by all countries, and conclude that the dynamic comparative advantage of a nation crucially depend on the level of technology it encompasses. It is also consistent with the technical change view of economic growth process outlines earlier.

Empirical studies of U.S. trade in synthestic materials, electronic products, office machinery, and consumer durables have demonstrated that these products actually .followed a trade cycle which could be devided into four stages: (a) U.S. export strength, (b) foreign production starts, (c) foreign productions becomes competitive in export markets, and (d) import competition begins(8). An investigation by Gruber and others(9) also have shown that there is a strong positive correlation between "research effort" and "export performance." The research effort is measured by the total R&D expenditures as percentage of sales and the number of scientists and engineers as a percentage of total employment.

The importance of technically more advanced industries in Japanese trade can be seen from Table 1. Organized around a classification of industries into groups--A,B, and C, according to their research intensity and the technological complexity of their products--those in group A have expanded their share in manufacturing trade at the expense of less technologically

Table. 1. Japanese Exports by Research and Technological Intensity of Industry Groups

Industry Group	Share of total Japanese exports		Share of Japanese exports in total OECD exports		
	1963	1970	1963	1966	1970
Group A Chemical elements and products, pharmaceuticals, plastics, machinery, aircraft, road motor vehicles, ships and boats, instruments, synthetic fibers, and petroleum products(including some unrefined petroleum products)	34.3	50.1	4.6	7.3	9.4
Group B Rubber, ferrous metal, nonferrous metal, metal products, stone, clay, glass, and paper	23.6	23.7	8.2	10.0	12.1
Group C Food, lumber, textile fibers, iron ores and scrap, coal, textiles, clothing, furniture, and fixtures	28.3	15.3	6.0	6.6	6.7
Other	13.8	10.9	—	—	—
Total	100.0	100.0	5.6	7.4	9.0

Source: Hugh patrick and Henry Rosovsky (eds), *Asia's New Giant*, The Brookings Institution, 1976, p. 528.

(8) Wells, L., "A Product Life Cycle for International Trade?" *Journal of Marketing*, July 1968.
(9) Gruber, W., D. Metha, and R. Vernon, "The R & D Factor in International Trade and International Investment of U.S. Industries," *Journal of Political Economy*, February 1967.

intensive industries, those in group C.

The export growth of A industries in Japan has also increased its share in the total world trade in these products. Japan's share of all OECD exports of A industries rose from 4.6 percent in 1963 to 9.4 percent in 1970, mostly at the expense of the shares of U.S. and U.K.

The association of research intensity and exports in Japan is futher indicated by the statistatistically significant positive rank correlation between Japanese industries ranked by research spending as a percent of sales and by the increse in export share for products of these industries from 1963 to 1970. Therefore, it is very clear that technology intensive industries in Japan have accounted for a major part of the country's trade success and rapid economic growth during the 1960s.[(10)]

In 1976, the share of heavy and chemical products in the total korean exports of manufactured goods was 34 percent, which is rather low compared to other trade-oriented countries (See Table 2). The share is expected to increase to 72.5 percent by 1991, when Korea's total exports is targeted to reach $115 billion in current prices or $54.3 billion in 1975 prices. It is obvious that, in order to achieve this target, the role of technology will become crucially important.

Table. 2. Composition of Exports: An International Comparison

	Primary products	Light Manufacturing Products	Heavy and Chemical Products
Korea(1976)	4.6	61.4	34.0
Japan(1975)	0.4	12.1	87.6
W. Germany(1967)	3.2	14.8	82.0
France(1975)	8.0	23.4	68.7
Netherland(1975)	10.2	25.0	64.8
Sweden(1975)	5.7	12.5	81.8

Source: KDI, *Long-term Economic and Social Development*, 1978 p. 78.

(10) Peck, M., "Technology," Chapter 8 in H. Patrick and H. Rosovsky (eds), *Asia's New Giant, How the Japanese Economy Works*, the Brookings Institution, 1976.

II. INVESTMENT IN TECHNOLOGY DEVELOPMENT

In principle, technology must be developed domestically or imported from abroad. Although the work of private inventors and improvements that are discovered as a by-product in the process of production could be sources of technological change, most of technology developments come about from organized R&D (research and development) activities. In this section, we will first review the results of empirical estimation of rates of return from R&D investments and then discuss the problems associated with the organization of R&D activities.

1. Rates of Return from R&D Investments(11)

From the point of view of public policy, economists have been interested in the social rates of return from past and prospective invesments in new technology. In response to the need for such information, a variety of microeconomic studies have been carried out in the past 20 years.

To estimate the social benefits from an innovation, economists generally have used the conventional supply-demand model. If the innovation results in a downward shift in the supply curve for a product such as from S_1 to S_2 in Figure 1, they have used the area under the product's demand curve (DD_1) between the two supply curves (ABCE) as a measure of the social benefit during the relevant time period from the innovation. This area is equal to the social value of the additional quantity of the product plus the social value of the resources saved as a consequence of the innovation.

Thus, if one compares the stream of R&D expenditures with the stream of social benefits measured in this way, it is possible to estimate the social rate of return from the R&D investment.

An early investigation that used this approach was Griliche's study of

(11) This review is largely drawn from E. Mansfied, "Role of Technological Change in U.S. Economic Growth," an published paper, 1977.

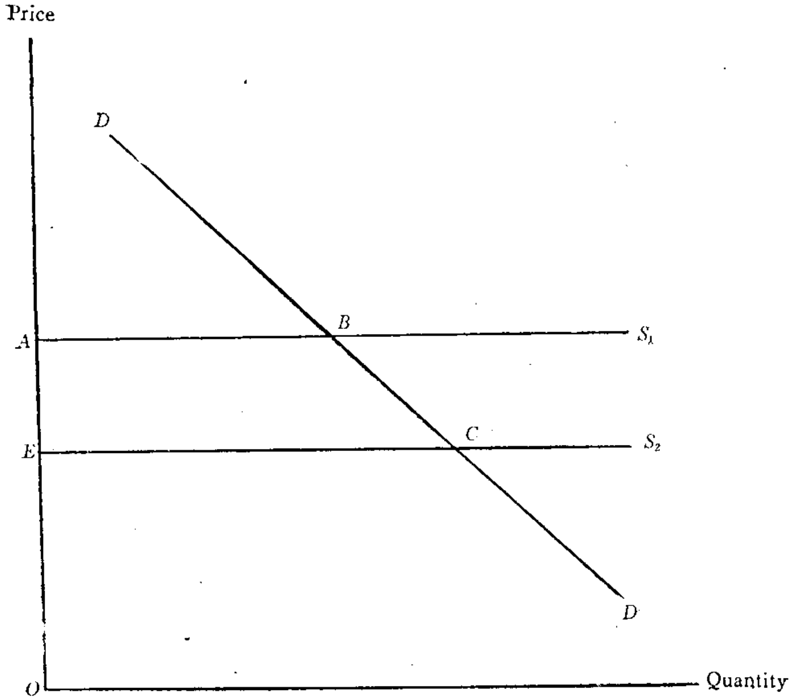

Fig. 1. Measurement of Social Benefits from Technological Innovation

U.S. hybrid corn in 1958.[12] According to his research, the rate of return from investment in hybrid corn research was 37 percent, which is not surprising in view of the fact that the investment was known in advance to have been very successful. A later study by Peterson for poultry research reported the rate of return of 18 percent, which is a rather high figure since he included the failures with the successes.[13] A futher study by Schmitz and Seckler for tomato harvester resulted in more than 100 percent of the rate of raturn.[14]

To sum up, every study carried out to date seems to indicate that the average social rate of return from U.S. agricultural R & D tends to be very high. Also the marginal social rate of return from agricultural R & D--the rate of return from an additional money spent on research--was reported to

(12) Griliches, Z., "Research Costs and Social Returns: Hybrid Corn and Related Innovations," *Journal of Political Economy*, October 1958.
(13) Peterson, W., "Returns to Poultry Research in the United States," *Journal of Farm Economics*, March 1967.
(14) Schmitz, A., and D. Seckler, "Mechanized Agriculture and Social Welfare: The Case of Tomato Harvester," *American Journal of Agricultural Economics*, March 1970.

Table 3. Social and Private Rates of Return from Investment in 17 U.S. Innovations

Innovation	Rate of Return(percent)	
	Social	Private
Primary metal innovation	17	18
Machine tool innovation	83	35
Component for control system	29	7
Construction material	96	9
Drilling material	54	16
Drafting innovation	92	47
Paper innovation	82	42
Thread innovation	307	27
Door control innovation	27	37
New electronic device	Negative	Negative
Chemical product innovation	71	9
Chemical process innovation	32	25
Chemical process innovation	13	4
Major chemical process innovation	56	31
Household cleaning device	209	214
Stain remover	116	4
Dishwashing liquid	45	46
Median	56	25

Source: Mansfield and others, "Social and Private Rates of Return from Industrial Innovations," *Quarterly Journal of Economics*, May, 1977

be very high, generally in the nighborhood of 40 to 50 percent.

On the other hand, many studies have been conducted to estimate the rate of return from industrial R&D activities. In earlier investigations based on econometric estimation of production functions, Mansfleld[15)] and Minasian[16)] estimated the private marginal rate of return from R & D in the chemical and petroleum industries. Mansfield's results indicated that the marginal rate of return was about 40 percent or more in the petroleum industry and about 30 percent in the chemical industry if technical change was capital embodied. Minasian's results indicated about a 50 percent marginal rate of return on investment in R & D in the chemical industry. Terlecky has also used econometric techniques to analyze the effects of R & D expenditures on

(15) Mainsfield, E., ***Industrial Research and Technological Innovation***, W.W. Norton, 1968.
(16) Minasian, J., "Research and Development, Production Functions, and Rate of Return," ***American Economic Review***, May 1969.

productivity change in 33 manufacturing and nonmanufacturing industries during 1978~66.[17] In manufacturing, the results seem to indicate about a 30 percent rate of return from an industty's R & D based only on the effects of an industry's R & D on its own productivity. In addition, his findings show a very substantial effect of an industry's R & D on productivity growth in other industries, resulting in a social rate of return greatly exceeding that of 30 percent.

More recently Mansfield and others estimated the returns from 17 specific innovations from a variety of industries, using a model somewhat like that described in Figure 1.[18] The results, shown in Table 1, indicate that the median social rate of return from these innovations was 56 percent, a very high figure. On the other hand the median private rate of return was 25 percent.

In sum, practically all of the studies carried out to date indicate that the average social raturn from industrial R & D tends to be very high. Moreover, the marginal return also seems high, generally in the neighborhood of 30~50 percent. Needless to say, there are a variety of very important problems and limitations inherent in each of these studies. Recognizing this fact, it nontheless is remarkable that so many independent studies based on so many types of data result in so consistent a set of conclusions.

2. Organization of R & D Activities

Research and development effort of a country is commonly measured by the proportion of GNP devoted to R & D expenditures. As can be seen is Table 2, the ratio is the highest for U.S., followed by U.K., West Germany, Japan, and France. All of these countries devote more than 2 percent of their GNP to R & D activities. On the other hand, the ratio for Korea re-

(17) Terleckly, N., *Effects of R and D on Productivity Growth of Industries*, National Planning Association, 1974.

(18) Mansfield, E., J. Rapoport, A. Romeo, S. Wagner, and G. Beardsley, "Social and Private Rates of Return from Industrial Innovation," *Quarterly Journal of Economics*, May 1977.

Table 4. R&D Expenditure and Researchers

	R&D expenditure as a percentage of national income	Researcher per 1,000 population
Japan(1976)	2.04	2.3
U.S.A.(1976)	2.47	2.5
U.K.(1972)	2.26	1.4
France(1975)	2.00	1.1
West Germany(1976)	2.61	1.8
Korea(1974)	0.38	0.5

Source: *Indicators of Science and Technology*, Science and Technology Agency of Japan, 1978 and *Handbook of Korean Economy*, EPB, 1977.

mains at 0.38 percent, a very small proportion compared to advanced countries.

The percentage of GNP spent on research and development in only one measure of research effort. Another is the number of researchers per unit of population, by which measure Japan ranks with U.S. and ahead of Western European countries (see Table 2). On the other hand, the number of researchers per 1,000 population for Korea is less than one fourth of that of Japan.

Judging from these indicators of research intensity, it seems obvious that Korea's domestic R&D activities is much to be desired. Another characteristic of Korean R&D activities is that private industry pays for a very smaller share of the nation's research effort than other major industrialized countries, as the data in Table 5 indicate. In 1974, Korean business firms financed only 20 percent of the total R&D expenditures while government contributed about 80 percent. In the maj or industrialized countries, private industry is paying for at least 40 percent of the nation's research effort.

In order for Korean business enterprise to survive internationalization and severe international competition, the private corporations must increase R&D expenditures substantially in the near future. However, it has been pointed out that because it is often very difficult for private firms to appropriate the benefits that society receives from technology, there is a tendency for too few resources to be devoted to the development of new tecnhology. Moreover, R&D is a relatively risky activity and involves significant indivisibilities. These factors prevent the private sector from undertaking R&D activities efficiently.

Tabl. 5. Source of Funds for R&D Expenditures

	Business	Government	Others
Japan(1976)	66.9	26.5	6.6
U.S.(1975)	43.4	54.0	2.6
U.K.(1972)	43.6	48.7	7.7
France(1975)	40.0	41.0	19.0
W. Germany(1975)	53.0	45.0	2.0
Korea(1974)	19.3	80.7	—

Source: *Indicators of Science and Technology*, Science and Technology Agency of Japan, 1978 and *Handbook of Korean Economy*, EPB, 1977.

Therefore, it can be suggested that the government provide tax incentives for R&D activities, that the government initiate and expand work of relevant kinds in its own laboratories, that the government insure a portion of private credit to firms for R&D and other innovation costs, that the government use its own purchasing procedures to encourage technological change in the private sector, and that the government use its regulatory policies to try to encourage R&D in the private sector.

On the other hand, since the developing countries generally lack the necessary resources to develop their own R&D activities, importation of technology from the developed countries has become an important factor in the econmic growth. This is especially ture in viewof the emphasis these countries place on rapid industrization, and more recently upon their need to develop exports of manufactured goods.

It is widely known that postwar Japanese successful economic growth was to great extent due to the massive importation of foreign technology and the ardoit and extensive use of management, investment, and domestic R&D to capitalize upon imported technology. As can be seen in Table 6, between 1965 and 1976, Japan has introduced foreign technology in a total of

Table. 6. Importation of Foreign Technology: Japan and Korea

Year	Japan	Korea	Year	Japan	Korea
1975	460	3	1972	1,916	50
1966	601	17	1973	1,931	69
1967	638	35	1974	1,572	86
1968	1,061	50	1975	1,403	98
1969	1,154	60	1976	1,461	130
1970	1,330	84	1977	n.a.	170
1971	1,546	45	Total	15,073	897

Source: Science and Technology Agency of Japan and EPB.

15,073 cases.

On the other hand, Korea has imported only 771 cases of foreign technology between 1962 and 1977. Royalty payments on these have amounted to $132 million. This amount is too small in comparison to the nation's ever-expanding economic scale and increasing demand for new technology. In view of the weight in terms of technology in heavey and chemical fields, Korea should liberalize the importation of foreign technology on a mass scale.

There are many mechanisms for the developing countries to import technology.

a) licensing agreements

b) management contracts(including technical aid agreements)

c) turnkey contracts

d) joint ventures

e) direct investments

Each of these methods has its advantages and disadvantages to the country that seeks to import technology, depending on a wide variety of circumstances. The objectives of sharing the gain and of asserting of control by the host country are among the major considerations, but these are seen to be broad and somewhat difficult concepts to define in reality. These difficulties are the subject of later sections of this paper.

III. TECHNOLOGY:IMPORT AND THE COST OF FOREIGN TECHNOLOGY

As noted earlier, between 1962 and 1977, Korea imported foreign technology for a total of only 771 projects, paying royalties totaling U.S. $132 million. However, as Korea's industrial base expands and becomes increasingly diversified, more complex and varied foreign technologies are needed for her continuous economic growth. Recently, the Korean Ministry of Science and Technology estimated that foreign technology for at least 9,000 different projects need to be introduced and utilized for the coming decade in the Korean heavy industry and chemical industry alone if they are to develop as planned. It is also estimated that the costs of importing foreign technology for such projects will be substantial. Accordingly, it is important for Korea to consider how such foreign technology can best be acquired.

1. Costs of Technology

Technology often is provided in a package with other resources or goods, such as equity capital, key personnel to be hired, equipment and intermediate goods to be purchased, etc., making it difficult to evaluate the price of the technological component, and leading to hidden costs. And the 'price' as expressed in the direct costs may be a small part of the whole cost as the sale is often conditioned on the acceptance by the buyer of restrictive clauses which may alter substantially the true costs.(19) Therefore, acceptance of all such conditions imply that the control of ownership or management of the technology recipient firm by sellers of technology may be possible through technology transfer, another that the true costs involved in a given technology import may exceed its benefits in some cases.

The composite nature of the technology package makes it extremely diffi-

(19) Moxon, Richard W., *The Cost, Conditions, and Adaptation of MNC Technology in Developing Countries*, Mimeograph, (University of Washington, 1976), p. 35.

cult to assess the reasonableness of the cost of one part of the package, as meaningful comparison with the cost of similar technology to other parties is often difficult.(20) In fact, it has been pointed out that the packaging of resources is a major source of monopoly power of multinational companies.(21) Hence, it is important that the buyer should have a clear idea of what he buys and how much he pays for it not only in direct costs but also in indirecct costs.

Since any combination of contractual rights and equity participation may be demanded by the technology supplier in offering a given package of technological elements(with or without tying non-technological elements) the various costs can be divided into two groups: (1) the costs implicit in the contract of technology transfer and (2) additional costs to be noted in equity participation by the technology supplier. Therefore, we will discuss them under two separate headings.

(1) The Costs Implicit in Technology Transfer Contract

The careful analysis of the nature and content of a given technology transfer contract is important for proper identification of the costs involved in it, since charges for technology can be made in many difierent ways. In addition to straight-forward payments for technology, there may also be indirect charges for the same technology which are often difficult to identify and estimate. Such indirect charges are more likely in case of the technology which is provided in a package with other resources or goods, since the more packaged transfer gives the supplier of technology greater scope for making charges either from one category or from another.

Furthermore, as pointed out earlier, the sale of technology is often conditioned on the acceptance by the buyer of various restrictive clauses. Therefore, the costs implicit in the contract of technology transfer will be disc-

(20) United Nations Industrial Development Organization, ***Guidelines for the Aquisition of Foreign Technology in Developing Countries***, (New York, 1963), p. 12.

(21) For example, see Vaitsos, Constantine V., ***Intercountry Income Distribution and Transnational Enterprises***(Oxford: Clarendon Press, 1974).

ussed under three different classifications: direct charges, tie-in clauses and restrictive clauses.

(a) Direct Charges

The direct charges are those costs which are specifically stated to be payments for a given technology import in clauses of the contract. These include charges for the right to use patents, technical knowledge, know-how and trade-marks needed both in the pre-investment, in the investment and in the operational stages.

Royalties are usually the major direct expenses, and the most common form of royalty payment is that of a percentage based on sales. Royaties being recurring payments, the percentage rate, the base on which the payment is calculated, and the period for which payment to be made are important elements in estimating the costs.

In an empirical study on technology transfer cost, Teece concluded that royalties are a very real component of the cost of technology, at least from the point of view of the recipient firm.[22] Furthermore, he found that

$$\bar{R}_i = 14.02 - .85N_i - 6884184/I_i, \qquad r^2 = .63, \qquad n = 14.$$
$$(5.29)(-3.13)(2.03)$$

where $\bar{R}_i$ is the royalty payment expressed as a percentage of the total cost of the technology transfer project; N_i is the number of firms identified as possessing a technology that is "similar and competitive" to the technology underlying the *ith* transfer; I_i is the pland and equipment cost of the *ith* technology transfer project. The number of competitors variable is found to be highly significant, pointing to the fact that the availability of other sources of technology supply is an important variable in explaining the variations of royalty payments. Furthermore, technology transfer projects with larger investments in plant and equipment have lower royalty paymesnt than smaller projects.

The above empirical findings have important implications for licensees in

(22) Teece, David J., *The Multinational Corporation and the Resource Cost of International Technology Transfer*, (Cambridge, Mass.: Ballinger, 1976), pp. 85-89.

less-industrialized countries. Assuming that the number of firms variable defined above is an acceptable surrogate for the number of firms willing to license their technology, royalty payments, representing the price for the right to utilize industrial knowledge, will, like any other price, be determined by supply and demand. From the point of view of product life cycle theory originally developed by vernon,[23] in the time period which technology is sold to developing countries there usually are many firms possessing similar and competitive technology. As technology becomes mature, there will be more successful imitation by latecomers. For example, a study of technology transfer to developing countries undertaken by Stobaugh[24] in the petrochemical industry indicated that, in the life cycle of certain products, the original producers accounted for only 1 per cent of the total licensing while the remaining 99 per cent was divided between followers of commercial producers(52 per cent) and engineering firms (47 per cent) Since alternative sources of technology supply are usually available for the prospective licensees in less-industrialized countries mainly due to the kinds of technology typically demanded by those countries, they might reduce royalty payments by actively searching for such alternatives or through negotiation.

The empirical finding that technology transfer projects with larger investments in plant and equipment have lower royalty payments than smaller projects might be interpreted as indicating that technology transfer with larger investments gives the supplier of technology greater scope for collecting profits from indirect charges other than royalty. Since it is important that the technology recipient firm should have a clear idea of what it buys and how much it pays for the technology not only in direct costs but also in indirect costs, indirect costs arising from the overpricing of the

(23) Vernon, Raymond, "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*, Vol. 80 (May 1966) pp. 190-207.

(24) Stobaugh, R. "Utilizing Technical Know-how in a Foreign Investment and Licensing Program," paper presented in the National Meeting, Chemical Marketing Research Association, New York City, Feb. 1970, p. 5. Also cited by Vaitsos, ibid, p. 13.

intermediate goods and equipment purchased frm the technology supplier should be fully understood.

Royalty payments also depend on the mechanism of technology transfer. There is some empirical evidence that joint ventures pay larger royalties than do wholly owned subsidiaries. According to Stopford and Wells, in addition to capitalization of technology royalty payments have served as another way for the multinational enterprise to capture some of the monopoly rents from a technological lead. In subsidiaries in which the enterprise holds all the equity, royalty payments are not needed to provide a return on technology. All the profits accrue to the multinational enterprise in any case though in this case royalties may play a role in reducing taxes or in moving profits through foreign exchange controls. However, in joint venture, royalties play the additional role of distributing to one of the partners a partnersa share of the profits over and above the profits associated with his share of equity.[25]

Other direct costs can be classified further into two groups: (1) Costs in the preparation stage for reaching agreement such as costs incurred in finding appropriate licensors, appraisal of prospective licensors, negotiation of license contract, etc. (2) Technical assistance fees and other costs to be incurred during the post-contract period. These costs may include salaries for licensor staff, fees for technical manuals and drawings, etc. and legal inquiries, entertainment of visiting licensor representatives, legal expenses to maintain patents, arbitration of disputed and renegotiation of contracts, R&D activities to modify technology to fit specifications required by licensor and/or local conditions, etc. Whichever way the payment is actually specified. the point is that the contractual clause itself gives a clear indication of what the payments are or how they can be estimated. Wherever there are clear indications of a cost element in the contract, it should be included in the

(25) Stopford, John M. and Wells, Louis T., Jr., *Managing the Multinational Enterprise*(New York: Basic Books, 1972), pp. 121-122.

calculasion of the cost of a particular transfer of technology.

(b) Indirect Costs

Various tie-in clauses, such as a requirement that the licensee purchase intermediates and capital goods from sources approved by licensor, are often found in a proposed technology transfer contract. In a sense, this may be regarded as the transfer of embodied technology(technology transfer through tangible goods although technology itself is an intangible good) forced by licensor. However, some indirect costs may arise from the overpricing of goods purchased from the technology supplier since he may have considerable latitude regarding the prices to be charged for these goods. Such ever-pricing can can be considered as a cost associated with tie-in clauses in contractual transfers of technology.

The excess cost imposed on the technology recipient firm can be measured by considering the difference between the price of these inputs from the technology supplier, as against the prices of these inputs from the best supplying source available to the recipient firm or the open market prices. Since the rate of overpricing should be measured in terms of effective cost to the recipient firm including freight and insurance cost, the effective rate of overpricing can be measured as $(CIF_T\text{-}CIF_B)/CIF_B$ where CIF_T is a CIF price to be paid by the licensee for tied-in inputs from sources specified by the technology supplier and CIF_B is a CIF price of such inputs from the best supplying sources available or CIF price quoted in the open market. For each tie-in input the quantity to be purchased should be multiplied by the effective rate of overpricing in order to obtain the effective excess cost of the tie-in input. Such estimates need to be made for as many different inputs as are involved in the particular contract concerned.

The quantitative importance of the excess costs due to various tie-in clauses has been found to be considerable. In the study made by Vaitsos in various Latin American countries,[26] he found that tie-in arragements are

(26) Vaitsos (1974), ibid, pp. 42-54.

very popular in technology transfer to developing countries. 67 per cent of the contracts with relevant information has been found to have tie-in clauses in Bolivia, and Peru while in Columbia, 100 per cent of the contracts of foreign-owned subsidiaries and above 95 percent of nationally owned firms in the pharmaceutical industry included tie-in clauses. He also reported that in all sectors and countries that were evaluated significant returns to foreign factors of production appeared to accrue through the profit margins of products tied into the importation of capital and/or technology.

(c) Restrictive Clauses

There are also certain opportunity costs due to various restrictions in a proposed technology transfer contract which do not enter into the monetary transactions and cannot easily be measured. Such restrictions may include export restriction, prohibiting production or sale of similar products, restrictive quality control, controlling the volume of sales, controlling the volume of production, prohibition of the sale of similar or the same products after the termination of the technology transfer contract, etc.

For example, when a licensee agrees not to export, or not to expand beyond certain market, he agrees in effect to lose all benefits to be derived from export or an expansion of his business. These, and all other restictive clauses, should be interpreted as a cost borne by the licensee and the society in which he is operating. Hence, the cost is the sum of the advantages the purchaser accepts to sacrifice as a result of the particular restrictive clause.[27]

Restrictions on exports are often found in contractual arrangements for the transefr of technology. Some contracts may include complete prohibition of export, but there may be other limitations on exports, such as provisions specifying the markets to which exports can or can not be made, limitations on the quantity of exports, the requirement of prior approval of the licensor for exports, price control on exports and restrictions on the use of trademarks in the export trade.

(27) Cilingiriglu, A., *Transfer of Technology for Pharmaceutical Chemicals*, (OECD, 1975), p. 79.

Export restriction imposed by licensor may be perceived as a real cost or may not, depending upon the market horizon of management of the licensee concerned. As long as the management perceives no possibility in exporting during the contract period or has no interest in export markets, export restriction may not be regarded as having cost to the licensee. Likewise, prohibition of the sale of similar or the same products after the end of the contract period may or may not be perceived as cost to the firm, depending upon management's time horizon for decision-making as well as management's perception of the life cycle of the product concerned.

Similar arguments can be made to other restrictive clauses since what is important at the time of decision-making for a proposed technology transfer is management perception and evaluation on various restrictions at that time, although management perception may also change through time and is dependent on information available, etc.

(2) Equity Ownership by Technology Supplier

In some technology transactions, the technology supplying company tries to obtain an equity holding in the technology recipient company in exchange for technology. Technology transfer with equity participation by a foreign licensor usually represents the most complete package of resources which can be offered to a prospective licensee.

Evaluation of benefit and cost involved in a proposed technology import becomes much more difficult when a package of resources or collective inputs are offered by a prospective licensor. As we can infer from the argument that the packaging of resources is a major source of monopoly power of multinational companies, acquiring only those technological elements needed by unbundling the package, may not be possible especially in the case of proprietary technology. Even in this case, however, unbundling of package is conceptually useful for a prospective licensee to understand, analyze and evaluate the benefit and cost involved in a given package. By so doing, the prospective licensee can improve the understanding of the of ten implicit and indirect cost of a proposed technology transfer.

Various components of the collective inputs and their implications on costs to a prospective licensee can be presented as follows:

Major Category of Component	Possible Benefits to Licensee	Possible Costs to Licensee
(Technology)[28]		
Materials transfer	Access to source of supply.	Cost of various tie-in clauses.
Design transfer	Capacity to manufacture products covered, or in the case of process technology, to utilize the process. Quality control techniques.	Royalties, technical assistance fees, various restrictions and their implicit costs.
Capacity transfer	New scientific and technical knowledge, ideas and innovations, capacions, capacity to modify imported technology and to develop indigenous technology.	R&D expenses including investment in research facilities and salaries for scientists and engineers.
(Equity capital)	Risk sharing by initial capital contribution.	Dividend, and implicit costs due to loss of control.
(General management)	Business know-how and managment techniques.	Rembursements in the form of salaries and other personal expenses. Implicit costs of inappropriate management methods.
(Finance)	Availability of funds Access to international money market.	Interest and other service charges.
(Marketing)	Know-how and management skills of marketing and selling. Access to foreign markets.	Fees, loss of direct access to foreign markets, and cost due to lower transfer prices.

A number of alternatives may be available for acquiring all or some of these foreign resources even with the above major categories of components. With further breakdown of the major category of component, however, the possible combinations of alternatives will be numerous. For example, in the major category of technology, turnkeys provide a complete package of technology while only one element of technological know-how of project planning, product design, plant design, systems design, plant construction, and production start-up may be acquired.

Equity participation by foreign licensor can be valuable to a prospective

(28) Three phases of horizontal technology transfer were distinguished by Hayami and Rutten as materials transfer, design transfer and capacity transfer. See Hayami Y. and Rutten V., ***Agricultural Development and International Perspective***, (Baltimore: Johns Hopkins, 1971), p. 175.

licensee in the sense that the foreign partner will share risks, common interests and responsibilities. Hence, the licensee may expect to receive assistance in general management, marketing, finance and sourcing form the licensor in addition to technology. Although the benefits may be substantial, the costs involved which are usually difficult to measure may also be substantial, sometimes incurring almost all costs listed in the previous table.

A necessary ingredient in the framework for evaluating the self-perceived profit factor is a comprehensive measurement of the value of projected relevant marginal costs and benefits associated with a given technology import,[(29)] including all of the potentially significant benefits and costs involved in a given package of technological elements with any tied non-technological elements to be contributed by the technology supplier. The self-perceived profit factor will also be influenced by the licensee's ability to measure cost and benefit involved. Such an ability is a function of experiences in joint venture with foreign firms and/or technology imports, technical sophistication in forecasting, knowledge of environment and market potential(domestic as well as international markets), stability of environment, etc.

Equity sharing with the technology supplying company can be done by establishing a separate new entity or by allowing the technology supplying company to obtain an equity holding in the existing recipient company in exchange for technology. In the case of establishing a new entity, the self-perceived resource cost to licensee is the perceived marginal value of resources contributed to the new joint venture by the licensee, including initial capital contribution, personnel, production site, etc. In the case of sale of licensee equity or issuance of new shares in the existing licensee firm for the technology supplier the cost to licensee is much more difficult to measure since the existing firm can have value as a going-concern. The self-

(29) Zenoff David B., "Licensing As a Means of Penetrating Foreign Markets," *Idea,* Vol. 14, No. 2 (Summer, 1970) pp. 293-308.

perceived value of a firm as a whole may be much bigger than the mere summation marginal values of different resources contributed. Hence, in this sense, the cost of equity-sharing to licensee will depend on how the licensee concerned perceives the value of his own firm. Since sale of equity is equivalent to sharing an unpredictable but unending flow of dividends because of the rigidity implicit in the idea that ownership runs forever so long as certain conditions are met, an important proportion of the profits of recipient enterprises would constitute payment for the technology. This may result in particularly high additional payments for technology compared with royalties or lump sum payment allowed in technology contracts. Thus it is important to distinguish between a one-time contribution or transfer and one that continues over time in evaluating contributions to be made by a prospective technology supplier.

In addition to the resource cost mentioned above, there may be the cost to licensee implicit in loss of control in the licensee firm by equity-sharing with the technology supplying firm, depending upon the distribution of equity ownership ratio. Perceived cost to licensee due to loss of control can be measured in terms of possible restraints through ownership rights by the technology supplier. Hence, it is necessary for the technology recipient firm to maintain needed controls to secure a tolerable cost and benefit relationship, considering such possible conflict areas as dividend policy, method of financing, plant expansion, R&D, production process, source of supply, management selection and renumeration, etc.

When the technology supplying company tries to obtain an equity holding in the technology recipient company in exchange for technology, evaluation of benefit and cost involved in a proposed technology import becomes much more difficult. Costs and benefits involved in a given technology transfer are a function of the conditions under which a project involving a transfer of technology is carried out. Size of equity holding by the technology supplier in the licensee firm influence the size and form which costs and benefits may take.

It the ownership ratio of the technology supplier is so immaterial that there is no substantial loss of control in the licensee firm on the part of the licensee, the cost of equity sharing to the licensee would be limited to the sharing of an flow of future dividends. However, when the technology supplier has the controlling interest in the technology recipient firm, there may be considerable scope for the licensor to vary the ways of taking benefits out of the licensee firm. Hence, the evaluation of costs and benefits to the licensee must attempt to take into account as many of these ways as possible in order to arrive at reasonably accurate assment of the benefits and costs involved.

When some combination of equity ownership and contractual rights is demanded by technology supplier in offering a given package of technological elements with or without tying non-technological elements, the costs involved in acception such offer to licensee will be equal to the costs due to equity participation by the technology supplier *plus* the costs implicit in the technology import contract. In deciding whether a proposed technology import is sufficiently profitable to warrant its conduct, all relevant costs should be considered.

2. The Mechanism for Determining the Cost of Technology

As is true of other fotms of economic specialization and exchange, the transfer of technology is a positive sum game which can benefit both licensee and licensor. In other words, benefits can accrue to one of the participants which do not necessarily imply costs for the other. Within this fundamental harmony of interests, however, thever, there is likely to be a conflict of interests as the prospective licensee and the prospective licensor strive to maximize their respective shares of the net economic benefits of a given technology transfer. In his sense, the specific details of eacth technology transfer project take place basically within a bargaining framework.

There is widespread agreement that prospective licensees in less-industrialized countries are weak in negotiating a given technology import. Determination of a fair price for technology is very difficult, as it is sold in a market that is often characterized by oligopolistic sellers and poorly informed buyers, with the technology 'products' for sale being difficult to compare.(30) Hence, the crucial problem in technology imports by less-industrialized countries will continue to derive from the fact that oligopolistically organized multinational firms are the owners and sellers of industrial technology, on markets in which many of the purchasers, especially those in less-industrialized countries, are extremely badly informed and thus possess a minimum bargaining strength.(31) With poor negotiation on the part of a prospective licensee, not only can the gains from international transfer of technology be fully appropriated by a technology supplier but it is also quite possible for the supplier's gains to be realized at the absolute expense of the technology recipient firm.

Although the international techology market is complex and imperfect, there is much room for negotistion open to prospective licensees in less-industrialized countries mainly due to kinds of technologies to be imported to those countries. According to the product life cycle theory for international factor movement originally developed by Vernon,(32) the less-developed countries need to acquire the relevant technologies only late in the product cycle when current scientific capability is no longer much required. While a new technology tends to be held by a small number of firms, it generally spreads to other firms as the technology matures. Fortunately, less-developed countries rarely need technology at the forefront of current research and

(30) Moxon, ibid, p. 35.

(31) Helleiner, G.K., "The Role of Multinational Corporations in the Less-Developed Countries's Trade in Technology," *World Development*, (April, 1975), p. 162.

(32) Vernon, Raymond, "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*, Vol. 80, (May 1966) pp. 190-207. See also Wells, Louis T., Jr. (editor), *The Product Life Cycle and International Trade*, (Boston: Harvard University, 1972).

development, and thus rarely depend on obtaining technology from sources for which the options sre most limited.(33) Hence, foreign technology can be acquired on better terms by licensees in those countries with a proper exercise of bargaining power.

It has sometimes been argued that the prospective licensees in less-industrialized countries are well adviced to accept a given proposal of technology import if the net benefits exceed some minimum returns. On the basis of one-sided benefit/cost analysis, if the net benefits exceed some minimum returns, the conclusion is often reached that proposal for technology import should be accepted rather than it should be acceptable. The former implies that the 'alternstive situation' is the absence of the proposed technology import, disregarding a multiplicity of negotiable situations where foreign technology could still be acquired.(34) Therefore, it is more desirable for the licensees to evaluate technology imports within a bargaining framework as an alternative to analyses based on one-sided cost-benefit estimates.

Because of the unnecessary complexities and difficuties to be encountered in carrying out general studies on technology imports to less-industrialized countries, in the literature of international transfer of technology there have been some recommendations that the study should be confined to a selected industrial sector level.(35) Since there has been no systematic study on negotiation framework for technology importers in less-industrialized countries on a well-defined industrial sub-sector level, the pharmaceutical industry of Korea was selected for an in-depth study. The pharmaceutical industry was chosen since it belongs to the 'fine chemicals' sector which, although not large, has wide-reaching techological implications and is of

(33) United Nations (Walter A. Chudson and Louis T. Wells, Jr.), *The Acquisition of Technology from Multinational Corporations by Developing Countries* (New York, 1974), p. 26.

(34) Vaitsos, Constantine V., *Intercountry Income Distribution and Transnational Enterprises*(Oxford: Clarendon Press, 1974), p. 7 & p. 120.

(35) See for example, UNCTAD, *Guidelines for the Study of the Transfer of Technology to Developing Countries*, (New York), 1972), Hawthorne, E.P., *The Transfer of Technology*, (OECD: Paris, 1971), and Department of Scientific Affairs, General Secretariat of the Organization of American States, *The Transfer of Technology to Latin America*,(Washington D.C., 1972.)

great importance to the growth of many industries. In fact, primary manufacture or 'fine chemicals' manufacture was selected as one of the most strategic industrial sectors for development under the ourth five-year economic developmefnt plan of Korea currently being implemented. Considering the economic infrastructure of the country, the choice was appropriate in the sense that the 'fine chemicals' sector is neither capital-intensive nor resource-based.

The pharmaceutical industry was also selected since international transfer of technology in that industry has been very active. This is so since a main characteristic of the industry in many industrializing countries is its continuing dependence on foreign sources for technology and active ingredients. It was pointed out that the many patents available, the recognition of certain brand names by the medical profession, and the control some companies have over certain active ingredients all contributed to making license agreements a distinguishing feature of the industry.(36)

Hence, an analysis of negotiable elements which effect negotiation scheme for technology importers in Korea in general, and those in the pharmaceutical industry in particular, has been attempted.

Therefore, in order to obtain foreign technology on as favorable terms and conditions as possible it is necessary for prospective licensees to strengthen their bargaining position and to exercise their negotiation power in a more rational manner. The literature on negotiation frameworks for technology imports is not only sparse; most studies are concerned with exercise of bargaining power among host countries and foreign technology suppliers, especially multinational firms rather than the point of view of licensee. Since private licensees are direct and ultimate recipients and users of foreign technology in most cases, strengthening the bargaining position of licensees in industrializing countries is a key element to effective import of foreign technology.

(36) Cilingiroğlu, A., *Transfer of Technology fcr Pharmaceutical Chemicals*, (OECD, 1975), p. 93.

IV. ELEMENTS OF TECHNOLOGY AND AN INDUSTRIAL CASE STUDY

1. Elements of Technology

International technology transfer can be defined as a spatial movement of 'technology' beyond national boundaries from a supplier to a recipient so as to enable the latter to perform certain functions which the former has the capacity to perform. Therefore, the central point in any technology import discussion is what is to be imported, namely technology. Since technology means different things to different observers it is necessary to specify what kind of technology import will be analyzed in this study in order to describe the research problem more precisely.

Like all words that refer to a wide variety of phenomena, technology has no standard definition. Different definitions of technology can be noted in the context of international transfer of technology. Root defines technology as the body of knowledge that is applicable to the production of goods and the creation of new goods.(37) He further argues that the distinction between technology as knowledge and its embodiment in capital equipment, industrial processes, and products should be clearly made since technology consists of ideas about products and how to make them rather than the products themselvesor production facilities.

Teece, by focusing on unembodied technology in defining resource cost of international technology transfer, identified several categories of unembodied technology: system-specific knowledge, firm-specific knowledge, industry-specific knowledge and basic knowledge.(38) He argues that transfer of embodied technology in physical goods is a relatively straight-forward operation since it involves nothing more than the physical relocation of objects, while tra-

(37) Root, Franklin R., "The Role of International Business in the Diffusion of Technological Innovations," *Economic and Business Bulletin*, (Fall, 1968), pp. 17-24.

(38) Teece, David J., *The Multinational Corporation and the Resource cost of International Technology Transfer*, (Cambridge, Mass: Ballinger, 1976), pp. 34-38.

nsfer of unembodied technology is a much more complex process.

In order to identify the technology 'products' which are being traded in international technology market, Helleiner noted the following components of technology transfers:(39) (a) Technology, in the legally recognized form of patents or trademarks; (b) Technology in the form of unpatentable or unpatented know-how; (c) Technology embodied in skilled labour; (d) Technology embodied in physical goods. Chudson disaggregated technology into product design, design of production process and facilities, and management techniques which is a broad concept, ranging from the scheduling of production and control of financial management and marketing.(40)

A variety of additional definitions on technology are noted in the literature and they vary from simple dictionary explanations to elaborate disaggregations.(41) Whichever of these different definitions one chooses to adopt, it is important to note that there are certain key elements of technology, depending on industry classifications such as pharmaceuticals, food, electronics, construction, automotives, etc. According to Hawthorne,(42) the command of such key elements of technology, or 'kernels' is a prerequisite to the successful growth of firms in a given industry. For example, a key element of technology to a wholesaler is marketing while the key element of technology to a firm in electronics industry which sells high precision and high quality products may be its production and quality control techniques.

In this sense, identification of key elements of technology in the pharmaceutical industry(43) is necessary in order to specify major kinds of techn-

(39) Helleiner, ibid. p. 163.

(40) Chudson, Walter, "The International Transfer of Commercial Technology to Developing Countries," *UNITAR Research Report* No. 13, (New York: United Nations, 1971), pp. 3-4.

(41) Perlmutter, Howard V. and Tagi Sagafi-nejad, *Muffled Quadrilogue: Codes of Conduct for Technology Transfer and Development*, (forthcoming, 1978), p. 2.

(42) Hawthorne, ibid, p. 21.

(43) The following paragraphes on elements of technology in the pharmaceutical industry are summarized from Cilingiroglu, ibid, pp. 59-65.

ology to be analyzed in this study. Drug-making involves the superposition of various stages of technological requirements. Firstly, the active ingredient(s) must be made available by recourse to natural substances, chemical synthesis or other processes. Secondly, active ingredients must be purified and made suitable for application to human beings and/or animals without risk of unacceptable harzards. Thirdly, the drug must be given the physical form most suited to the purpose for which it is intended. The control of quality(efficacy, stability, etc.) is an another stage which has to be considered. Drug-making, in the final analysis, is to give to active ingredients a form which makes possible their absorption by the human or animal body, so ensuring the desired action is achieved in the most safe and rapid manner.

Therefore, the main technology element in drug-marking is the active ingredients—the so-called 'raw materials'. The second important technology is to realize the desired mixture of the various ingredients, and to achieve the composition and form required by the medical profession in carrying out treatments. This technology concerns analysis of all materials intended to form part of the final medicine and also quality control.

Two more or less separate applications of technology can be distinguished in the pharmaceutical sector: the discovery and introduction of new medicines; efficient production of existing medicines. The two are clearly related, but a country using advanced production methods does not necessarily engage in attempts to discover products, and vice versa. Thus, a country with only few manufacturing facilities would be capable of innovating certain products.

The technology for efficient production of existing medicines is not considered as a key element of technology in the pharmaceutical industry since it is known that large and medium sized companies in many less-industrialized countries all apply modern techniques of production shortly after they have been developed. Such technique is usually embodied in the equipment used and the cost of the equipment required, although certainly expensive, is not prohibitive in most cases. Furthermore, some experts claim this technology should be considered as mechanical technology rather than pharmaceutical technology.[44]

According to Mansfield,[45] technological change or a change in technology results in a shift in the production function, or in the availability of new products or both, resulting from an advance in knowledge. In this sense, technology import will result in a shift in the production function of the licensee firm, or will enable the firm to produce entirely new products. Since technology for developing new products is a key to the successful growth of firms in the pharmaceutical industry and thus can be considered as the main element of technology in pharmaceuticals, we will be mainly concerned with imports of new product technology.

2. The Survey Method

A critical issus faced from the start was the utility of published information for the type of analysis undertaken for this study. All officially published information in Korea with respect to technology imports only involves such basic data as names of licensees and licensors, nationalities of licensors, payments of royalties, duration of technology transfer contracts, date of government authorization, etc., and is usually aggregated. Hence, it was concluded that published information was minimal value for this study and information has to be collected directly from the origin of data, i. e., from the licensees themselves in the pharmaceutical industry. Individual firms were surveyed by means of interviews with managers.

3. The Industry

This section of the study briefly describes the pharmaceutical industry in Korea. The pharmaceutical industry is a major industrial sector, representing

(44) *Proceedings of Istanbul Meeting*, Mr. Krasovac, OECD, CT/AC/TT/23, Mimeograph.
(45) Mansfield, Edwin, *Industrial Research and Technological Innovation: An Econometric Analysis* (New York: W.W. Norton & Co., 1968) p. 2.

2.22 per cent of Korea's GNP and 7.56 per cent of total production in the industrial sector as a whole in 1975. The Altogether, there are 26 cases of technology transfer contracts (19 cases by the number of technology recipient firms) authorized by the government in the pharmaceutical industry of Korea for the years 1966～1976, including two cases revoked subsequent to the authorization. When any firm had engaged in different license agreements, they were treated as separate cases.

Of these 24 cases of materialized technology transfer to the industry, the transfer of technology through pure licensing agreements accounts for 19 cases while that transfered through subsidiaries of foreign firms accounts for the remaining five cases. Since proper exercise of bargaining power can only be expected in technology transfer between independent parties, the survey findings presented in the following sections are based on available information from 18 cases of technology transfer to the industry through pure licensing agreements. Although attempts have been made to obtain in-depth information on all these cases, only rough findings are available in some cases. Total output of the industry in the year was about U.S. $ 300 million. The pharmaceutical industry has grown at a faster rate than the manufacturing industry as a whole. Annual growth rate percentages were as follows: 39 per cent for the period of 1957～1960; 29 per cent for 1971～1965; 27 per cent for 1966～1970; 21 per cent for 1971～1975.

The manufacture of a pharmaceutical can be divided into two stages: (1) the chemical production of the active ingredients; (2) their combination into a finished product form.[46] There are obvious differences between the two. The manufacture of final products which includes formulating, labelling and packaging activities is labor intensive, and its skill requirements are not high. Active ingredient production, on the contrary, has many requirements which are opposite to those of final product manufacture, and it re-

(46) Cooper, M.H. and Culyer, A.J., *The Pharmaceutical Industry* published by Economists Advisory Group and Dun and Bradstreet, Ltd., 1973.

quires a high technological input. In this sense, the start of domestic production of active ingredients in 1965 can be regarded as an important step forward in the growth of the pharmaceutical industry of Korea. Such production of active ingredients increased significantly during the following decade, comprising 11.9 per cent of total pharmaceutical production in 1975.

Despite the significant growth of active ingredient production, only certain ingredients are locally produced. Therefore, the pharmaceutical industry in Korea is heavily dependent on imports for raw materials. The export and import performance of the industry is shown in the following table.

Export and Import of Pharmaceuticals Unit: Us thousand dollars

Year	Active Ingredients	Finished Drugs	Oriental Medicines	Tools & Equipment	Total
1950					
Export	none	28	130	none	158
Import	none	718	93	none	811
1955					
Export	22	15	92	none	134
Import	none	3,014	349	none	3,363
1960					
Export	341	294	407	none	1,042
Import	2,478	2,783	932	337	6,503
1965					
Export	58	99	1,219	none	1,376
Import	3,936	522	224	397	5,079
1970					
Export	745	1,363	2,674	none	4,782
Import	14,691	2,995	1,538	408	19,632
1975					
Export	10,063	1,270	6,553	4,868	22,754
Import	40,005	3,194	3,666	2,061	48,926

Although exports from Korea of pharmaceuticals has increased substantially, the main chemical material still has to be imported. It has been pointed out that the export performance of a country is a good measure of the success of its pharmaceutical industry.[47] If this is in fact true, the pharmaceutical industry of Korea could not be considered very successful.

(47) OECD, *Gaps in Technology*, 1969, p. 41.

Some research and development on pharmaceuticals have been undertaken in large companies. Usually, a small firm producing a multitude of products in competition with others has neither the resources nor the interest to carry out its own research and will profer to depend for technology on others. The pharmaceutical industry is composed of numberous companies, many of which are small in terms of output and sales. As of 1975, there were 303 pharmaceutical producers in Korea. Despite the large number of producers, about 47% of overall production is accounted for by seven large companies. Only 4.5 per cent of the total production is accounted for by 216 small firms. In addition to the problems posed by the proliferation of companies, many of these companies produce a multitude of products. As of 1975, the number of official permits for drugs in circulation was 8,788 while that of drugs actually marketed was 5,382. It was found that on the average 5 items produced by other competitors were regarded as being competitive to any firm's one major item on the market.

Under these conditions the industry has to be dependent on foreign sources for technology and active ingredients since the funds each has available for research and development are less with the number of firms and the number of produced increased. Furthermore, activities for sales promotion by pharmaceutical producers have been excessive since trade-name promotion has a special significance for the drug market in Korea. About 7 per cent of total sales is spent for advertising expenses, which is ten times as high as the average in the whole manufacturing industry. It also should be pointed out that the distribution margin for pharmaceuticals is high. On the basis of 274 items surveyed on August, 1976, the average margin of wholesaler was 12 per cent while that of retailer was over 25 per cent. Therefore, the average margin rate for the entire distribution process is estimated as about 40 per cent.

In short, it can be concluded that the Korean pharmaceutical industry is at present mainly engaged in formulating and packaging activities and manufacture of active ingredients is insufficient in terms of their variety. For the industry to continue to expand, therefore, it will have to engage more extensively in primary manufacture of pharmaceuticals. Since the primary manufacture requires big technological inputs and indigenous R&D work in the industry is little, the industry will have to be heavily dependent on foreign sources for technolgoy. In this sense, effective technology imports by the pharmaceutical firms in Korea will be necessary for the industry to grow successfully in the future.

4. Findings on Technology Imports to the Industry

Since the Foreign Capital Inducement Law of Korea was promulgated in 1966, a total of 581projects of technology import had been approved by the government as of December, 1975. During the same period, 26 projects of technology transfer to the pharmaceutical industry were authorized: one project in the year of 1966, two in 1968, six in 1969 and 1970 respectively, three in 1971, five in 1972, two in 1973, and one in 1974 by the year of the government authorization.

Major technology suppliers have been the pharmaceutical firms in the U. S. and Japan, accounting for nine projects and eight projects, respectively. The other technology supplying countries were Germany, England, France, Italy and Switzerland.

The kind of technology transfered to the pharmaceutical industry of Korea has mainly been new product technology for the manufacture of specific pharmaceutical ingredients or finished drugs since such technology is generally considered as a key to the successful growth of firms in the pharmaceutical industry. However, it is interesting to note that a right to use a trademark was granted in almost all cases of technology transfer to the industry. In some cases, it would not be wrong to speculate that the licensee is more interested in acquiring the trademark than the techology. This may be especially true for a licensee who has imported a drug under a certain trademark which has already established customers in the drug market, prior to engaging a license contract.

The duration of technology transfer agreements is usually three to five years. However, there are seven cases of agreements whose duration is over 5 years. One of the agreements has indefinite duration. Short duration agreements generally apply to the larger experienced licensee firms.

All of the agreements include terms of royalty payment which in most cases is by a percentage rate on the sale of specific products incorporating the respective technology to be imported. Except five cases, percentage rates of royalties were three to five per cent of sales or net sales value. There is one case of technology transfer agreement which stipulates 15 per cent of net sales as the terms of royalty payment. There is each of the following cases of more favorable terms of royalty: 3 per cent of production value; 3 per cent of domestic inputs value; 1.12 per cent of net sales of raw materials; 2.5 per cent of invoice price of raw materials and intermediates imported. The first three cases of more favorable terms of royalty apply exclusively to the largest pharmaceutical company in Korea which is also the most experienced licensee in the industry. Total royalties actually paid by the industry amount to U.S. $ 1,153,500 by 1976.

Among the most prominent limiting clauses in technology transfer agreements were prohibition to export, obligation to buy the raw materials from a specific source, and requirement for quality control. Most contracts contain an export restriction clase which completely prohibits export or allows export to specified countries. As an example, a license agreement made between one of the largest five pharmaceutical firms in Korea and a licensor in Germany contained an export restriction clause as follows:

> The licensor whall grant the licensee the right to export PRODUCTS to the countries listed herein; 1) Hong Kong, 2) Malaysia, 3) Singapore, 4) Thailand. The right to export to the above mentioned countries will be valid until the expiry date of this Agreement.... An enlargement of the above-mentioned countries shall have to be appr-

oved of by the licensor.

Since scale of operations is an important factor of economic production in the pharmaceutical industry espeically for the production of active ingredients and the size of local market is generally limited, it may be difficult for a licensee in the industry to produce pharmaceuticals efficiently without exports.

An export restriction clause which prohibits exports after the termination of a technology transfer contract in fact can be regarded as a complete export ban since it usually takes many years for a licensee in the industry to be able to export. The difficulties of export operations, the varied rules in each country for the import and distribution of drugs, and the non-tariff protection of the drug industry in the major countries, mean that a licensee in the industry would need to make tremendous efforts to enter the export market.[48] Unless license agreements also cover export sales techniques, therefore, licensees in the industry can never be able to export licensed products by accepting such a restrictive clause. In a sense, the proliferation of pharmaceutical products in the industry can partly be explained by the limited capability of export by the pharmaceutical firms since they have to compete in a limited home market by means of product diversification.

The absence of an export restiction clause does not necessarily mean that the licensee can export. It all depends upon the productive and marketing capacities of the firms, their relative competitive position in external markets, their export horizon, etcetera. Yet contractually assumed export possibilities, even if they do not constitute a sufficient condition, represent a necessary one for such export capabilities. Moreover, they can create a critical prohibitive element in the long process necessary for firms to develop export orientation and capacities.[49]

(48) Cilingiroglu, A., *Transfer of Technology for Pharmaceutical Chemicals,*(OECD, 1975), p. 73.
(49) Vaitsos, Constantine V., *Intercountry Income Distribution and Transnational Enterprise*(Oxford: Clarendon Press, 1974), p. 58.

Most of the contracts in the pharmaceutical industry also include obligatory terms which designate the purchase of raw materials from the source specified by licensor. The overpricing of pharmaceutical ingredients has for long been a recognized issue throughout the world. To obtain a technology or the use of a trademark by purchasing such ingredients at a higher than world market price is a practice which has been noted in many countries. According to the Ministry of Health and Social Welfare of Turkey, price differences for active ingredients were as high as 300 per cent.(50) In all sectors and countries that Vaitsos studied, it was found that significant returns to foreign factors of production appeared to accrue through the profit margins of products tied into the importation of technology. He further reports that by far the highest rates of overpricing were noted in the pharmaceutical industry.(51)

It is necessary to check the prices of imported materials against prevailing international prices in order to measure the rates of over-pricing by checking the prices of imported materials against prevailing international prices. Because of the measurement difficulty involved, we did not try to estimate average rate of overpricing. However, we found there is general agreement that substantial overpricing in such materials has also been noted in technology transfer to the industry.

Although the majority of contracts explicitly require the purchase of materials from the source specified by the licensor, some contracts can achieve similar results indirectly through quality control clauses and/or tradmark licensing. By claiming that if the licensor does not control the supply of raw materials he is unable to guarantee the quality of the pharmaceuticals produced by the licensee or to grant trademark, it can be much easier for the licensee to specify the sources of such materials.

There are various other types of limiting clauses encountered in contracts

(50) Cilingiroglu, ibid, pp. 81-82.
(51) Vaitsos, ibid, p. 50.

of the industry. Some contracts prohibit production of similar products. Others prohibit the sale of similar or the same products after the end of the contract—so-called "termination clause." If technology were truly transferred, a licensee would be able to produce similar products or the same products after the end of the contract. Acceptance of all such restrictive clauses by licensee may increase substantially the true costs of technology import. Appearance of various restrictive clauses in most technology transfer contracts of the pharmaceutical industry can be regarded as evidence that the licensees in the industry are not successful negotiators. In fact, according to the survey, it was found that the licensees themselves in the industry, frequently quoted negotiation with licensors as the most difficult task to be performed in the entire process of technology import.

It is known that in negotiating licensing arrangements, licensors in the U.S. usually seek a total "compensation package" although later, in measuring their licensing income, they lose sight of trading profits and indirect returns. In other words, in conducting their foreign licensing negotiations, licensors typically consider the periodic royalty payment as just one component of a total compensation package they are bargaining for, and the compensation package is consciously built up with a view to maximizing the combined returns from royalty payments, technical service fees, export earnings, purchase commissions, and other monetary and nonmonetary gains attainable under the proposed licensing tie.[52]

It appears that sellers of technology bargain very hard on small differences of royalty rates as a strategic choice that leaves other much more important negotiable aspects outside the negotiating process. The licensee negotiator concentrates his attention and negotiable trade-offs on elements that are perhaps completely marginal.[53] By perceiving explicit costs as the only costs, the licensees in the industry tend to overlook the more important

(52) Lovell, Enid B., *Appraising Foreign Licensing Performance*(New York: National Industrial Conference Board, 1969).

(53) Vaitsos, ibid, p. 135.

implicit costs such as imtermediate product overpricing.

In addition to the inappropriate perception of the costs involved in a given technology import, there is an apparent lack of knowledge of other agreements concluded in other countries on the part of the licensees. The technology market is so imperfect, and negotiations are carried out in such a seretive manner, that such information is not freely avaiable. Because of this apparent lack of knowledge of other agreements, almost all drafts of technology transfer contracts in the pharmaceutical industry of Korea were prepared by the licensors. Accordingly, the licensees in the industry had to negotiate on unfavorable grounds from the beginning.

Inexperience and incompetence of negotiating managers are another reason for poor exercise of bargaining power on the part of the licensees in the industry. It was also found that in many cases technological experts in the licensee firms were excluded from the negotiation process. Furthermore, expert opinions were not fully communicated to negotiating managers mainly because of lack of effective internal commnnication. In this regard, it should be also pointed out that assistance from professional institutions in negotiating technology transfer contracts is minimal because of the lack of effective communication between the industrial community and professional institutions.

The most critical reason for the poor bargaining results in the industry stems from the defensive negotiation position usually taken by the licensees. This defensive position of the licensee arised partly from the threat that the licensor will go to some other firms if the terms of the contract are too hard. It also partly arises from the fact that the risks of failure and the uncertainties of development costs for new products and technologies are generally high. Since a precondition for the private development of new products and techniques is probably a large and attractive market for the firm,[54] internal development of new products and techniques by the phar-

(54) United Nations (Walter A. Chudson and Louis T. Wells, J4.), *The Acquisition of Technology*

maceutical firms will be difficult because of the limited domestic market. By assuming the alternative situation is the absence of the proposed technology import when bargaining with a particular prospective licensor, the conclusion is often reached that a proposal for technology import by the licensor should be accepted if the perceived net benefits exceed some minimum raturns.

There is almost universal agreement that foreign investors, or foreign technology suppliers say that concessions alone play only an insignificant part in bringing them to a specified country.(55) Furthermore, alternative sources of technology are usually available to the licensees in the industry since only 11.4% of all technologies transferred to Korea by the end of 1974 is patented technology. In this regard, the most important distinction is between proprietary and nonproprietary technology, as the markets for these two types are quite different. Proprietary technology is that which is unique to a given enterprise, while non-proprietary technology is available on a competitive market, or may even be freely available.(56)

Therefore, it should be clearly distinguished that a given technology import under certain forms and terms should be accepted from it as acceptable. Therefore, it is important to consider the possider the possibiltiy of achieving more favorable terms of contracts which can bring greater net benefits.

As mentioned earlier, the transfer of techology to the pharmaceutical industry of Korea through pure licensing agreements has been greater than that transferred through subsidiaries of foreign firms. Since the industry usually imports technology by means of pure licensing agreements for the manufacture of specific drugs, proper exercise of bargaining power is necessary for prospective licensees in the industry to be able to acquire foreign

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from Multinational Corporations by Developing Countries(New York, 1974), p. 21.

(55) Streeten, Paul, "The Theory of Development Policy," in J. Dunning (editor), *Economic Analysis and the Multinational Enterprise*, (New York: Praeger, 1974), p. 271.

(56) Moxon, Richard W., *The Cost, Conditions, and Adaptation of MNC Technology in Developing Countries*, Mimeograph(University of Washington, 1976), p. 36.

technology on as favorable terms and conditions as possible.

However, there seems to be an apparent lack of systematic bargaining framework used by them. By rushing into signing technology transfer contracts based on partial analsis of explicit costs such as royalty, no systematic attempts have been made to consider the range of possible exercise of bargaining power on the part of licensees in the industry. In fact, survey of technology importers in the industry failed to turn up a case in which the licensee firm appeared to have made a careful cost/benefit analysis of the possible relationships so as to determine which would be most profitable since no management seems to have undertaken systematically to determine inputs and time horizons, without which a systematic analysis of cost/benefitis obviously impossible.

5. A Suggested Negotiation Framework for the Licensees(57)

Although there is widespread agreement that the licensees in less-industrialized countries are in a particlarly weak negotiation position vis-a-vis licensors, no systematic negotiation framework for the technology importers has been suggested in the literature. Therefore, we developed a negotiation scheme for technology import which could be of use for prospective licensees. We limit ourselves here to presenting the summary of the model.

In developing the negotiation scheme, a one-sided prescriptive point of view is taken. In terms of the various factors influencing benefits and costs involved in a given proposed agreement of technology transfer, this is equivalent to the analysis that will determine how the licensee *should* evaluate and perceive them in the light of his understanding of how the licensor *might* in fact perceive.

Among other things, the exercise of bargaining power depends on the awareness of the size of the distributable returns from a proposed technology

(57) For detailed discussions of the negotiation framework, please refer Yong Hee Chee, "A Negotiation Model for Technology Importers in Less-Industrialized Countries," ***Korean Management Review***, Korean Association of Business Administration, forthcoming.

transfer since it represents the conceptual boundary of the range of bargaining. Accordingly, we analyze how the licensee should identify the size of the distributable returns.

The most appropriate concession pattern which the licensee should adhere is as follows: he starts by making a bid that implies a high pay-off. Before making a bid leading to a lower pay-off than before, he should attempt to make all bids or at least a great many different bids, implying the same pay-off. In order to do this, the licensee should be able to undertake rational substitutions among the various terms which the licensor might demand. We must therefore have some means of relating preferences to payoffs, and for this reason the measuring device of certainty monetary equivalent is suggested.

Although we have mainly been limited to establishing the solution of the efficiency problem of the negotiation which will lead to a Pareto-optimal outcome, the bargaining scheme developed here can help the licensee better understand the complex bargaining problem of technology import.

V. NATIONAL POLICIES CONCERNING TRANSFERS OF TECHNOLOGY

In order to carry out the sophisticated negotiation required to obtain foreign technology on more favourable terms, it is necessary for Korea to formulate and implement appropriate public policies on transfers of technology. It seems appropriate therefore, that this study should conclude with an examination of the possible directions for implementing policies concerning such transfers.

Governments in less-industrialized countries must play a regulatory role to certain extent because indiscriminate and unrestricted import of foreign technology without reference to costs and neecs can create economic pressures and distortions.[58] In some countries(e.g. India) the importance of this

(58) United Nations Industrial Development Organization, *Guidelines for Acquisition of Foreign Technology in Developing Countries* (New York, 1973), p. 33.

regulatory role has been recognized from the outset but the appropriate techniques of control have not always been used, and where these techniques were used they were often smothered by excessive bureaucracy.[59]

Since the interests of a particular licensee and that of the country may not be the same, corrective actions by the governments in certain aspects of technclogy transfer are justified. Accordingly, the government should evaluate whether the bargaining results reached by the private parties are acceptable or not for the country by assessing the impact on the economy and society. However, it is also important to eliminate unnecessary government obstructions since red tape itself can be regarded as another overwhelming obstacle to effective imports of technology.

Therefore, unnecessary interferences with private contracting should be avoided. One of usual forms of the governments' regulatory action in some less-industrialized countries is control of terms and conditions of technology import. Although such a control may increase the cenefits and decrease the costs of foreign technology in some cases, there is apparent limitation to its beneficial effects.

Control of terms and conditions of technology import is in fact price control of technology to be imported. Any price control restricts the income terms of private contracts, and one of general propositions for price control analysis can be stated as the following:

> When the right to receive income is partly or fully taken away from a contracting party, the diverted income will tend to dissipate unless the right to it is exclusively assigned to another individual. The dissipation of non-exclusive income will occur either through a change in the form of using or producing the good, resulting in a decline in its value, or through a change in contractual behavior, resulting in a rise in a rise in the cost of forming and enforcing contracts, or through a combination of the two.[60]

The above proposition should be considered in evaluating a proposed control

(59) United Nations Conference on Trade and Development, ***Guidelines for Study of the Transfer of Technology to Developing Countries*** (New York, 1972), p. 48.
(60) Cheung, Steven N.S., "A Theory of Price Control," ***The Journal of Law and Economics***, p. 58.

of terms and conditions of technology import.

A ceiling rate in royalty, for example, may appear to contribute to reducing direct cost of technology but may result in increases of indirect costs in various forms through a change in contractual behavior. Some may argue that a ceilling rate in royalty provides licensees with negotiation edge, but the basis of the argument is not much convincing once we recognize various substitutes avaiable to licensor for royalty. The net effect of such restrictive policy would be the dissipation of non-exclusive income through a change on contractual behavior and a corresponding rise in transaction costs.

The transaction costs of reaching agreement will be higher, the more restrictions are imposed on these arrangements; they will be lower with competing offers than without. Hence, transaction costs or costs of settling negotiation for technology import is generally high. The transaction costs will be higher where government tries to renegotiate terms and conditions of technology imports. In evaluating appropriateness of price control policy of technology imports, the transaction costs involved should be considered.

Furthermore, one of the major components of transaction cost is measurement cost involved. Since a ceiling rate of royalty may eventually result in decrease in more directly measurable cost (royalty) in the expense of increase of increase of increase in indirect costs which are more difficult to measure, the net effect of such restrictive policy may further cause a rise in the transaction costs.

It may often be difficult for a regulatory agency to determine the reasonability of the total payments for any technology when comparable figures for similar technology are not available.[61] While restrictive clauses should, in general, be eliminated, no set rule can be laid down. This is because there are the possibilities for trading off restrictions or costs in one area against benefits in another in the course of the negotiations between the licensor and the licensee.

(61) UNIDO, ibid, p. 38.

Therefore, good guidelines, rather than absolute prohibitions are needed to make such a policy effective. As countries gain more experience, flexible guidelines hold the promise of obtaining for less-industrialized countrialized countrialized countries the benefits of foreign technology at reasonable cost.[62]

With the presumption that Korea is determined to seek active introduction of foreign technology, inducing private industrial firms to voluntarily introduce foreign technology as effectively as possible is desirable in the sense that such an approach is a method for implementing technology development plans within a free enterprise concept. This may avoid the extremes of rigid governmental control, on the hand, and of unrestrained capitalism, on the other by focusing on inducement.[63] Accordingly, stimulating and acertaining positive climate for effective technology transfar is much more important than any predetermined restrictive policy.

Likewise, inducement policies aimed at strengthening bargain power of licensees in dealing with the sellers of technology are more desirable than direct interferences with private contracting by governments in less-industrialized countries, since licensee firms are direct and ultimate recipients and users of foreign technology. In order to be effective, such an inducement policy for private industrial firms should be baseed on clear understanding of managerial bargaining framework for technology import and perceived obstacles that they may have.

Because the licensees in Korea are in a particularly weak negotiation position vis-à-vis the licensors, the government may help the licensees in improving their bargaining power at the national level. Hence, we present some possible programs for strengthening bargaining power of licensees.

1. Information Dissemination

Lack of information probably may be as important cause of ineffective

(62) Moxon, Richard W., *The Cost, Conditions, and Adaptation of MNC Technology in Developing Countries*, Mimeograph, (University of Washington, 1976), pp. 58-59.

(63) Bilkey, Warren J., *Industrial Stimulation* (Lexington, Mass.: Health Lexington Books, 1970), p. 1.

technology import as are environmental deficiencies. Although the structure of the industry and the requirements of the particular firm set boundaries on the kind of agreement that can be concluded, the information available to each side and the negotiating skills and strategies of the parties are nevertheless significant determinants of the kind of bargain that is struck within those boundaries.(64)

Availability of information cannot be assumed as given but needs to be introduced as one of the policy variables in a country's confrontation with foreign licensors since the possibilities and limits of exercising certain bargaining pressures depend on information available. As Vaitsos pointed out:

> Acceptable competitive market conditions assum a priori sufficient and equitably available information. Yet in a which the whole system of relative power is based since the latter (i.e. bargaining power) is among other things, a function of the knowledge of what the counterpart is gaining from different configurations of policies and situations.(65)

It is generally known that licensees in less-industrialized countries as "buyers" of technologies are very imperfectly informed about many features of the technologies that they buy. The common assumption about an informed buyer choosing what suits to the need of licensecs is even less justified in technology market than is usual.(66) As a result, the licensee firms are in a weak position vis-à-vis the licensor firms in settling terms and conditions of technology transfers.

Therefore, the prospective licensees often require considerable assistance in obtaining basic information on alternative technology available in various fields and the sources of such technology. The search for information is likely to be expensive and difficult for any single firm which may wish to import technology only very infrequently. A specialized organization, how-

(64) Smith, David N. and Wells, Louis T. Jr., *Negotiating Third-World Mineral Agreements,* p.153.
(65) Vaitsos, Constantine V., *Intercountry Income Distribution and Transnational Enterprises*(Oxford: Clarendon Press, 1974), p. 135.
(66) Streenten, Paul. "The Theory of Devèlopment Policy," in J. Dunning(editor) *Economic Analysis and the Multinational Enterprise,* (New York: Praeger, 1974), p. 274.

ever, could provide information service for all prospective licensees.

Availability of information on technological alternatives is a prerequisite for obtaining technology on the best possible terms and conditions. This extension of the enterprise's option is valuable not only because each possible supplier may make a more favourable initial offer to the importer, but also because each supplier may be more willing to concede better terms during the course of negotiation if he is aware of strong competition from other suppliers.(67)

In fact, more alternative sources of technology can be made available to the prospective licensees by making prospective foreign licensors be aware of the sectors for which Korea particularly wishes to obtain foreign technology. It would be desirable for the government to draw up a list of the principal sectors in which foreign technology could be used advantageously to promote industrial growth. Such a list would also have to be reviewed periodically in the context of new developments. Information on prospects for technology transfer can best be compiled and disseminated by the goverment through various agencies in the industrialized countries.(68) While the prospective licensees may still have to approach foreign licensors to obtain technology, it will be easier for the licensees to contact the informed licensors and discuss possible terms and conditions of technology transfer.

The crucial problems with the information dissemination programs are to be interesting, to be credible, and to get relevant information into the hands of decision makers. In order to be effective, such programs for prospective licensees should be based on clear understanding of managerial decision-making framework for technology import and their information needs.

2. Advisory Services

The government can also provide various advices to the prospective lice-

(67) UNCTAD, ibid, p. 51.
(68) UNIDO, ibid, p. 34.

nsees. For example, it can help the licensees to prepare the initial drafting of technology transfer agreements. The drafting is a complex and difficult undertaking. Many large, multinational firms attempt to use more or less standard agreements, and these agreements often represent their initial bargaining posture.[69]

In the bargaining process the terms of the starting offer have usually proved important in determining the outcome of negotiations. Inevitably a draft agreement incorporates needs of the party who prepared the draft. Where the licensee allowed the licensee allowed the licensor to present the initial draft agreement, the licensee usually find it difficult to negotiate away from the general framework and from a large number of specific provisions that reflect the licenor's point of view. Starting from a favorable first draft is often makes a party reluctant to oppose a series of provisions presented by the other side.[70] Therefore, it is important for the licensees to consider their own needs and to present them by drafting technology transfer agreements. Model draft agreements to be used in various key industrial sectors can be provided for the prospective licensees.

3. Structure Changing Programs

Firms with a special structure, such as a R&D department, for analyzing technology import will be more likely to consider alternative sources of technology and to bargain systematically than will firms without such a structure. The principle involved is that each department has its particular subgoals and responsibilities, and tends to act accordingly.

Various programs could be instituted to encourage firms to establish a structure such as a R&D deparment. Tax incentives and informational campaign to convince managements that such a structure would be good for their firms can be utilized. In all cases, the departments established should

(69) United Nations Industrial Development Organization, *Manual on the Establishment of Industrial Joint-Venture Agreements in Developing Countries*, (Vienna, 1971), p. 2.

(70) Smith and Wells, ibid, pp. 156-157.

be truly functional; mere "paper" departments are useless for inducement purposes.[71]

In conclusion the inducement programs must be undertaken systematically if they are to be successful. This requires careful planning-not in the sense of superseding the market mechanism, but of complementing it. Essentially, benefit-cost analysis will be needed. The benefit is the inducement achieved; costs are the economic opportunity costs of the programs instituted.[72] Careful coordination of government efforts with industry needs is also important.

(71) Bilkey, ibid, p. 130.
(72) Bilkey, ibid, pp. 131-132.