

University of Montana

## ScholarWorks at University of Montana

---

Graduate Student Theses, Dissertations, &  
Professional Papers

Graduate School

---

1987

### Transfer of technology and its effects on LDCs

Morten Leergaard

*The University of Montana*

Follow this and additional works at: <https://scholarworks.umt.edu/etd>

**Let us know how access to this document benefits you.**

---

#### Recommended Citation

Leergaard, Morten, "Transfer of technology and its effects on LDCs" (1987). *Graduate Student Theses, Dissertations, & Professional Papers*. 8774.

<https://scholarworks.umt.edu/etd/8774>

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact [scholarworks@mso.umt.edu](mailto:scholarworks@mso.umt.edu).

COPYRIGHT ACT OF 1976

THIS IS AN UNPUBLISHED MANUSCRIPT IN WHICH COPYRIGHT  
SUBSISTS. ANY FURTHER REPRINTING OF ITS CONTENTS MUST BE  
APPROVED BY THE AUTHOR.

MANSFIELD LIBRARY  
UNIVERSITY OF MONTANA  
DATE: 1987



TRANSFER OF TECHNOLOGY AND ITS EFFECTS ON LDCs

by

Morten Leergaard

Examen Artium, Vinstra Videregående Skole, Norway, 1977

B.A. - Extended, Eastern Montana College, 1983

Bedriftslederskolen, NKS, Norway, 1986

Presented in partial fulfillment of the requirements


for the degree of


Master of Business Administration

University of Montana

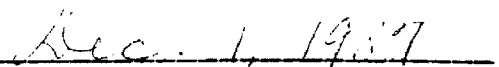
1987

Approved by

  
Chairman, Board of Examiners

  
Dean, Graduate School

Date



UMI Number: EP39575

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



UMI EP39575

Published by ProQuest LLC (2013). Copyright in the Dissertation held by the Author.

Microform Edition © ProQuest LLC.

All rights reserved. This work is protected against unauthorized copying under Title 17, United States Code



ProQuest LLC.  
789 East Eisenhower Parkway  
P.O. Box 1346  
Ann Arbor, MI 48106 - 1346

## TABLE OF CONTENTS

### Chapter

I.	OVERVIEW	
	Objectives of the Paper.....	1
	Justification.....	1
	Research Methods.....	2
	Contribution of the Paper.....	2
	Reasons why Transfer of Technology is Considered Important.....	3
II.	PROBLEMS IN TRANSFERRING TECHNOLOGY TO LDCs	
	What is Technology and what Problems does it bring?.....	8
	How is Technology Transferred?.....	10
	Alternative ways to Transfer Technology...	12
	Why Different Patterns are Used in the Transfer of Technology.....	13
	Development Strategies.....	17
	The Effect on the Local Populations's Skills and the Effect on the Community....	19
	Foreign vs. Local Technical Capabilities..	23
	Political Aspects / Military and Defense Implications.....	25
	Problem Areas - Unresolved Issues.....	28
III.	SOURCES OF TECHNOLOGY AND THE CHOICE OF APPROPRIATE TECHNOLOGY FOR LDCS	
	Major Current Sources.....	31

Availability of the Technologies.....	33
Features of the Major Transfer Mechanisms.....	36
Competition and Choice of Technology.....	42
Capital vs. Non-Capital Intensity.....	45
New vs. Second-Hand Technology.....	49
The Effect of the Different Policies and Regulations on Host Countries.....	51
IV. SUMMARY.....	58
CONCLUSIONS.....	61
REFERENCES.....	64

## LIST OF TABLES

1. Distribution of Ownership Patterns of 1276 Manufacturing Affiliates of 391 Transnational Corporations Established in Developing Countries 1951 - 1975.....	32
2. Types of International Cooperation in Five Dimensions.....	43



## Chapter I

### Objectives of the Paper

The rapid rate of economic growth and change in the social structure of Less Developed Countries (LDCs) has led to an increasing awareness of the effect of the transfer of technology in these countries.

Specifically, this paper will address the following questions:

1. Why is transfer of technology from developed countries (DCs) to LDCs considered important?
2. What are the mechanisms for transfer of technology to LDCs?
3. Will the transfer of technology to LDCs make them dependent upon DCs? If yes, how?
4. What barriers exist in relation to transfer of technology from DCs to LDCs.
5. How does the transfer of technology influence the social, political and economic environments in LDCs?

### Justification

The majority of the world population live in some 100 Less Developed Countries. These countries represent enormous human and natural resources. Large international companies have previously dominated the trade with these countries, but there is also a growing number of small and

medium companies that take part in this trade.

This increase in economic growth and the rapid improvement in the LDCs social structure, has recently led to a growing concern in regards to the transfer of technology. Another concern is based on the fact that if left uncontrolled, the particular LDC would increase its external dependence.

To understand these concerns, one must examine what it is that technology does for LDCs, whether technology can make LDCs dependent upon developed countries, what barriers exist to such transfer, and the influence this technology has on the social, political, and economic environments in developing countries.

### Research Methods

This study is based on the use of secondary data. The secondary data to be used include editorials and articles on the issue of international transfer of technology, and monographs dealing with this topic. Case studies done by different committees within the United Nations also represent a major source of information.

### Contributions of the Paper

This paper will shed some light on the problems that

LDCs face in regards to transfer of technology. It should also give the reader some understanding of the social responsibilities that rest upon industrialized countries. The paper will also provide an understanding of the benefits from the transfer of technology, and the different choices for international transfer of technology.

### Reasons why Transfer of Technology is Considered Important

A common belief is that technology and technical innovations of DCs offer the LDCs an easy entry or a short cut into financially successful circumstances (UNCTAD 1975-a; UNCTAD 1979). LDCs have the advantage of having technical and scientific "know-how" already tested out by DCs available for their use (UNCTAD 1972). In other words, the technology exists and the only problem is to find an appropriate way to transfer it to the LDCs. The LDCs don't have to go through all the R & D that countries in the past had to do.

LDCs are characterized by high unemployment or under-employment in occupations where productivity and earnings are low. In addition, the labor force is expanding very rapidly, opening up the need for new productive facilities. Due to the lack of appropriate data and the complexity of the channels in which technology is transferred, it becomes difficult to measure the effect of international transfer

of technology (DECA 1974).

International transfer of technology has always existed and therefore has been discussed for quite some time. Governments, policy makers, business executives (DECA 1974), as well as academic researchers, are becoming more and more interested in the technology transfer topic (UNCTAD 1972; Lipsey, Steiner, and Purvis 1984). Public officials from all over the world are expressing concern about the effects and causes of both import and export of technology. These concerns have led to discussions regarding whether or not governments should control technology transfer to maximize positive effects and minimize negative effects.

Many argue that the world itself has become more interdependent and more integrated in the last two decades due to the fact that more and more countries are entering into the world trading system (Lipsey, Steiner, and Purvis 1984). This change has caused transfer of technology to become a higher percentage of the GNP, which especially is true for DCs (Lipsey, Steiner, and Purvis 1984). Communication and transportation improvements have further made technology transfer easier and this has caused "know-how" to spread out faster all over the world (UNCTAD 1978-a).

Through aid and programs from both local and international organizations, the technical capabilities and

higher education in LDCs have made them more able to absorb new technology (Marton 1986). This has further led to a decrease in the cost of transferring technology. Along with the growing influence of multinational corporations (MNCs), cooperative research arrangements, co-production agreements and the increase in direct foreign investment in general, the process of technological development has become more international (UNCTAD 1972). As stated earlier, there is however a problem in measuring and identifying the diversified process that constitutes the international transfer of technology.

Public officials at all levels are mostly interested in this trade's effect on international competitiveness, domestic economic development, national security, and the need for the officials to be in control (Lipsey, Steiner, and Purvis). Many organizations on the international level have also started to study the effects of international transfer of technology. These include the United Nations (UN), General Agreement on Tariffs and Trade (GATT), the Organization for Economic Development (OECD), and the United Nations Conference on Trade and Development (UNCTAD) (Lipsey, Steiner, and Purvis). Private firms and individuals who are directly involved in technology transfer would also like to have a better understanding of the subject (Kaynak 1985; Sirgy 1985). Among their concerns are the choice of transfer channels, what technologies to

transfer, the cost involved and how to pay (Kaynak 1985). Finally there are the possible implications from increased control of transfer of technologies by national governments.

Most LDCs are overpopulated and have a limited amount of resources. There is also a lack of motivation to change for part of the population in that many appear to be satisfied with life the way it is. Economic development may call for a specific technology but the local population may object very strongly to this new technology as stated by Samli (1985). Part of this may be explained by the high illiteracy level that exists in many LDCs, but also because many people believe that "tradition is the most important guiding factor of the society" (Samli 1985, p. 6). From a development and industrialization point of view it can therefor be said that many of the LDCs are in a vicious economic circle (Samli, 1985).

Successful transfer of appropriate technology can break the vicious cycle and help the LDC develop. There are three distinct ways to transfer technology for this purpose, as stated by Samli (1985, p.24)

- a) Export promotion. This means bringing in the technology that would help the country increase its exports. Good examples are countries like Korea, Singapore and Taiwan.
- b) Import substitution. This means bringing in

technologies to produce goods and services to replace imports, which can result in substantial economic gains.

c) The neutral approach. Meaning that the imported technology is used to start new industries that previously did not exist or "provide balanced growth within the country by providing opportunities to increase overall efficiency." Scarce resources can now be used more effectively, leading to increased economic output.

## Chapter II

### PROBLEMS IN TRANSFERRING TECHNOLOGY TO LDCs

LDCs are experiencing increasing economic growth. Because they don't want to become too dependent upon DCs and MNCs, the LDCs must find ways to manage this growth and still be able to fulfill their social, political, and economical goals. There is, however, no one solution and each country will be faced with difficult choices.

#### What is Technology and what Problems does it bring?

Transfer of technology is the information and services needed to produce something in addition to the legal rights to use the received information (UNCTAD 1972). It can be said that technology is an important part of production and that it is sold all over the world just as any other commodity. Rosenberg and Frischtak (1985) stated that transfer of technology is the practical application of technological knowledge where technological capacity is the ability to make an effective use of that knowledge. There are different forms of technology, which include sale or trade of highly skilled labor (Ranis 1985). These people will take care of the complicated machinery, organizational techniques and management, training of technical and managerial personnel, etc. Another form is through sale or trade of information (UNCTAD 1978-b). This information is



usually sold under restrictive conditions: The more restrictive the conditions, the less available the information. This information could involve things like marketing and improvements to processes and product designs.

The DCs have the knowledge and the experts, making them able to be in charge of the technology trade (Rosenberg, Frischtak 1985). The LDCs, with the exception of a few countries, have little "capital goods" to offer. Also, because the LDCs' school systems are limited and that there does not appear to be any systematic scientific policy, the DCs have the advantage of having a concentration of higher education and thereby a larger supply of technical skilled labor. That does not mean that the LDCs do not have any skilled labor, but of the ones that they do have, many will go to work for international companies operated in or from DCs. This form of scarce resource loss is what is called "brain drain."

Suppliers of technology often use monopolistic practices, which then lead to information barriers for the LDCs, and will in many cases make LDCs dependent upon technology suppliers (UNCTAD 1975-c). The LDCs may not be aware of the different components involved in the transaction, making the impact and cost of the transaction hard to measure (UNCTAD 1975-c). This can further be understood since transfer of technology very seldom is an

isolated transaction. Finally, there is the problem of adapting the technology to the local conditions, because there is no unique type of technology for DCs and for LDCs (Cavasgil 1985; Graham 1979).

### How is Technology Transferred?

There are eight main sources for acquiring technology from external sources, as stated by UNCTAD (1972, p. 8):

- a) The flow of books, journals and other published information;
- b) The movements of persons from country to country;
- c) Education and training;
- d) Exchange of information and personnel through technical co-operation programmes;
- e) Employment of foreign experts and consultancy arrangements;
- f) Import of machinery and equipment and related literature;
- g) License agreements for production processes, use of trade marks and patents, etc.;
- h) Direct foreign investment;

License agreements and direct foreign investment constitutes the highest level of attention. The reason is that MNCs, who possess a high degree of modern product specialization and technologies, have patented their knowledge (UNCTAD 1972). In other words, the older technologies are not that difficult to obtain, because they have become common knowledge, more or less.

How technology is transferred internationally varies significantly from case to case (Rosenberg and Frischtak 1985). Where the firms are supplier-dominated, the technology will already be existing in the production machines, and it can be said that technology is included in products, processes and people (Buckley 1983). Social values and cultures thereby become an integral part of the technology and its transfer. Technology transfer, will for instance, be influenced by the geography, (sugar beets cannot be grown in the Sahara) (Samli 1985, pp. 3-5). Some cultures may be more tradition oriented and be more closed to new technologies, since they may resist the development and adaptation of these technologies.

In former colonies and to a degree, in some independent countries, direct foreign investment used to be the universal way to acquire technology (UNCTAD 1975-b). MNCs are especially interested in having full control over the operation of their new production facilities in a LDC. Packaged technology transfers through a license agreement, and very often through direct investment, is therefore preferred by MNCs, since the local participation will be limited (Dunning 1983). From the LDCs' point of view, especially if they have limited knowledge, they may also wish to receive a packaged transfer (Dunning 1983).

The opposite is to acquire the most advanced and modern technologies from different sources, but that will

again require substantial financial sources. Unpackaged technology transfers are easily available and mostly involve a lump sum payment, with no more strings attached (UNCTAD 1978-a). These technologies are called process technologies, which often are standardized and available from equipment and machinery manufacturers (UNCTAD 1978-a). In the middle, between these two sources, are various forms of joint ventures (Cavusgil 1985).

### Alternative Ways to Transfer Technology

It is becoming clear that transfer of technology is often in the form of a packaged deal, and these transactions give the suppliers a monopolistic advantage (UNCTAD 1972). In many cases, it is not that the technology or the product is that special, but rather the fact that the supplier has the right connections or the foreign exchange advantage. The suppliers maintain more control since almost all moves are done from their headquarters, and because a supplier offering a packaged deal most likely will not be using local technical skilled employees, materials, or management (UNCTAD 1972, p. 10). Therefore, very little learning or adaptation of imported technology is going on between the LDCs and the DCs.

When it comes to choosing the way technology is transferred, there are often few alternatives besides a

monopolized technology (UNCTAD 1972). Many times it comes down to a matter of deciding whether or not to produce a particular product or not. One method is to simply change the product that is to be produced with other products that require other technologies. This does, however, depend upon the availability of alternative products and technologies.

What worries many LDC governments is the consequences and the high cost they have to pay in the form of exchange rates, royalties, exclusive rights, export restrictions, etc., for the technology transfer (UNCTAD 1972, p. 11). Therefore many LDC's, and specifically the more advanced ones, are trying to improve their bargaining positions by moving towards joint ventures (Graham 1979). The LDCs should focus on expanding their own economies instead of focusing on foreign technologies and expenses (Graham 1979). This can be done by eliminating contractual clauses and making sure that the imported technologies have positive effects on the different national aspects (Graham 1979).

#### Why Different Patterns are Used in the Transfer of Technology

The reason why different patterns are used in the transfer of technology comes from such factors as the age of the technology, the specific nature of the particular technology, what impact the name or trademarks have, where

the technology originated, the type of market where the technology is going to be used, and the size of the firms involved (UNCTAD 1972, p. 15). For newly developed technologies and products that require managerial and technical skills beyond the level of the local population or enterprises, the tendency is towards a license agreement with some sort of equity financing (UNCTAD 1972-a). More established technologies are still transferred through a license agreement, but without any sort of equity financing (UNCTAD 1972; UNCTAD 1975-a). The exception to this is when we are talking about a transfer of pharmaceutical or chemical technologies.

A brand new technology, will most likely be transferred to a LDC as a packaged deal, even if the technology is noncomplicated (Chudnovsky and Nagao 1983). It may also function as a monopolistic tool for the supplier, who most likely will be wanting to have as much control as possible on a worldwide basis. This does not encourage the local scientists to work on the development problems in their own country, which is the reason many LDCs are now turning towards an export oriented strategy.

Smaller suppliers of technology seem to go with a standard license agreement, while the larger suppliers prefer wholly-owned subsidiaries, but there are several other cases where large supplying firms favor a minority holding in a joint venture (UNCTAD 1972). There is also no

apparent system in the way packaged technology is transferred. It is more a matter of where the technology originated and what is customary in that particular country. For all the above patterns, it can be said that they are only possible explanations for the different patterns. In the literature reviewed, many suppliers seemed to prefer unpackaged technology transfers, but it is not an easy matter to choose between the two (DESA 1974; UNCTAD 1972; UNCTAD 1975-a; UNCTAD 1978-a). In the end, it comes down to weighing the short-term costs with the long-term gains for both the suppliers and the LDCs.

To get a better understanding of the situation, the existing barriers to economic development need to be considered. Despite the fact that many policies in LDCs are encouraging national growth, when the population growth is taken into effect, the gains will disappear (Lipsey, Steiner, and Purvis 1984). Years ago, nature took care of the population growth in the way of drought and plague etc. Today, however, medicine and other support programs have led to a decrease in death rates. DCs have improved the health of the population in LDCs, but with adverse effect to their economy.

The speed of technical change has increased the need for more R & D, and the finances needed for this have created an important barrier to entry (Chudnovsky and Nagao 1983, pp. 196-197). The manufacturing that exists in the

LDCs, is most likely of a low standard and locally owned, making it dependent upon technical assistance from outside machine suppliers. The growth of a community depends a great deal on the communication and transportation network (Lipsey, Steiner, and Purvis 1984). Further, sufficient and reasonable water systems, sanitation, postal service and phone lines are needed to create economic development. Lack of these creates a strong barrier to economic development.

With respect to the financial aspect of economic development, investments are necessary in order to grow, and one of the sources of funds for investment is through savings. Many people in LDCs do not trust the banks, and will either not deposit their savings or, if they do, withdraw their money periodically in panic due to mistrust (Lipsey, Steiner, and Purvis 1984). A high inflation has also made the situation worse by threatening the value of the money holdings. When this happens, the banks cannot take part in the long-term loans that are needed to finance investments, because they cannot depend on the deposits that are left in their banking systems.

Before looking at the development strategies, it is necessary to also mention the commercial restrictions that often are found in contracts regarding transfer of technologies (UNCTAD 1972, pp. 23-24). These restrictions could specify, for example, that : "Country A agrees to sell technologies to country B, but country B under no



circumstances must transfer the technology or finished products, of that technology to country C." A good example of this is Airbus Industry, who could not use a Rolls engine for sale to Libya since parts of the engine was made in the U.S., who had restrictions on sale to Libya (Barton, p. 96). These restrictions can have a significant economic impact. Caterpillar Tractor's sales of pipelaying machinery to the U.S.S.R. were suspended by President Jimmy Carter, costing Caterpillar \$400 million in damages (Paliwoda, Liebreuz, p. 57). There are, however, ways to get around this. Rank-Xerox, for instance, has set up an assembly plant in India to supply the Russian market (Barton 1984, p. 95). Other restrictions take the form of price control on the products, that sales on the finished products must meet the approval of the country where the technology originated, and that raw materials must be obtained from approved suppliers (UNCTAD 1972). These restrictions play a significant role in the issue of transfer of technology from DCs to LDCs.

### Development Strategies

Opinions in regards to government control varies from full government control to no government control at all, and there is evidence of success in both of these styles or a combination of such approaches. Examples are the U.S.S.R.

and Austria where there is a high degree of government control as opposed to Singapore and Hong Kong where there is hardly any government control.

Education is important, but very expensive, and if a new program is initiated, it will take several years before we will notice any change (UNCTAD 1978-a). Many LDCs are sending a few people abroad, but the drawback here is that those who go come from well established families, and after their education, many emigrate due to higher wages. During the training period there will not be much improvement in the level of production, but it becomes necessary in order to prepare the next generation for a more competitive economic development.

A common trend among the LDCs is that they all seem to have a certain specialty product or what can be called common commodities like bananas, coffee, cotton, sugar, tea, and oil (Gray 1986). Throughout history, many countries have tried to create a cartel, but without any success until the creation of OPEC (Lipsey, Steiner, and Purvis 1984). The success of OPEC as a cartel combined with worldwide demand for oil has made some OPEC members among the wealthiest countries in the world.

The world has been faced with inflation, monetary and exchange instability, and rising unemployment, making the DCs more concerned and worried about their own economies (Graham 1979; Lipsey, Steiner, and Purvis 1984). It is

therefore natural that they have become more restrictive in transferring technologies (Graham 1979). The leading goals for the LDCs are increased employment and an improvement in the distribution of income (Ghoshal 1982, p. 27). The MNCs role is analyzed by the LDCs in terms of providing jobs and producing articles which can be used by poorer sections of the population, because the only resource that is not limited is labor hours (Ghoshal 1982, p. 27).

#### The Effect on the Local Population's Skills and the Effect on the Community

Transfer of technologies from a DC to a LDC can lead to better productivity and performance in the LDC because the transferred technologies may make the people more technically aware. Other domestic industries may adapt or imitate some or part of the imported technology and thereby increase the level of efficiency. However, this view may lead people to think this is an easy way to develop, and their own efforts to create local technologies may diminish. Without skilled labor, the range of productive activities open to the LDCs are limited and the possibility of growth is thereby also restricted.

In a direct transfer of technology, the LDCs may use consultant companies or individual experts to either help or carry out market research, management advice, or engineering designs, while local personnel are being

trained (UNCTAD 1972). The scientists and technologists that are being trained at the suppliers' headquarter will upon return from training in a DC, tend to become isolated from the international scientific community, which becomes a main reason why many migrate from the LDC (Cunningham 1976, p. 65). A packaged technology transfer organized through foreign subsidiaries or foreign operated joint ventures will very often involve a limited amount of domestic skill training. These MNCs are more interested in profitability of their enterprise, and will continue to use their own skilled workers unless a higher net return could be expected by using local skilled workers.

Technology transfers through license agreements will in many cases involve a higher degree of skill training, even though the cost in the beginning may be high due to unskilled workers (UNCTAD 1972). The technology supplier may however supply some learning and training, because in a license agreement, the licensor often collects payments or royalties on sales, making it in the licensor's interest to have workers as skilled as possible. Due to all the expenses, the licensor may demand that they use their own personnel for certain key positions (UNCTAD 1978-b). This will lead to an under-utilization of the local people's skills.

The private, locally-owned enterprises appear to be favoring packaged technology transfers, which mostly

involve the use of foreign skilled workers, even though there are equally skilled local workers (UNCTAD 1972, p. 18). Research shows that technologies developed in local laboratories in LDCs are put aside in favor of licensed technologies from DCs despite the fact that the technologies are more or less the same (Malhota 1986). Companies like IBM, Hewlett Packard, Corning Glass, National Cash Registers and Kodak, are starting to look at R & D abroad as a necessity if they are to have good public relations (Cavusgil 1985, pp. 226-227). A policy that encourages the local importers to use domestic technology may lead to an increase in the social costs, because it is highly likely that foreign workers will have different social values, which again undermines the social values in the LDC.

Previous discussion emphasized the chance of LDCs becoming too dependent upon the DCs and their technology, which further led to underdevelopment in the LDCs. The transferred technologies also often lead to the production of products that are inappropriate in the LDC itself (Wells 1982). The use of foreign skilled workers may reduce the employment opportunities for the local workers, both skilled and unskilled. This again leads to an unequal distribution of income. Finally, it can be said that by becoming too dependent upon the technology suppliers, the LDCs lose some of their bargaining power.

Certain types of technology may affect the environment in many ways that still are not understood. Increasing numbers of man-made chemicals are being introduced into the biosphere, interfering in the natural ecological cycles (UNESCO 1978, p. 20 and 22). The greater the man-induced processes, the higher the possibility of a breakdown somewhere in the system, resulting in direct or indirect harmful effects on human beings. "In the Cañete Valley of Peru, the use of organochlorine and organophosphorous pesticides gave rise to highly resistant super-pests whose ravages made cotton production uncommercial until the pesticides were abandoned and equilibrium was restored" (UNCTAD 1978-a, p. 21). In Malaysia, the use of pesticides brought on heavy attacks by pests on oil palm, rubber and other crops (UNCTAD 1978-a, p. 21).

The prices of the goods introduced to the LDCs as a result of a technology transfer, are often too high for the poor to afford and therefore the requirements of nutrition, health, clothing and shelter for the majority of the population are not satisfied (UNESCO 1978, p. 22 and pp. 33-34). Although the gains to society from having products shaped to its needs would be high, profitability is low because of the limiting purchasing power of the income group that would consume the products (Graham 1979). New jobs bring people to the city. Urbanization in itself is no cause for alarm, but the speed at which this is taking

place is too big for the local governments to handle, resulting in the creation of enormous slum districts where congestion and pollution are much worse than in many of the DCs (Cavusgil 1985; Sirgy, Samli, and Bahn 1985; UNESCO 1978-a). The transferred technology does not take into account these social costs. Many, therefore, accuse foreign technology as the reason for pollution, urbanization, creation of slum districts, and the breakdown of the family patterns (Sirgy, Samli, and Bahn 1985).

#### Foreign vs. Local Technical Capabilities

The problem in using local technical capabilities is that the locals will most likely be less experienced and therefore less efficient than the foreign workers. The cost of using the local workers will then be higher during the initiating/training period, and the problem is whether or not these short-term costs will outweigh the gains from increasing the skill level in the economy. There is also evidence from the literature, that on many occasions, it is the foreign workers' unfamiliarity with the local conditions, that leads to the highest increase in cost (UNCTAD 1972, p. 18; UNCTAD 1975-a; DESA 1974). Policy makers in LDCs must therefore try to recognize the limitations that exist for their own workers for them to get an understanding of when they should focus on packaged

technology transfers, which puts less demand on the local skill-level.

The choice is not just dependent upon what costs less in the form of money, it is also a matter of social policies and goals. What are each country's main objectives? It also becomes important to set up guidelines for how much weight one should put on reduction of dependence versus decrease in unemployment. One way is to look at the benefits and the costs of the different transfer mechanisms in light of the social objectives.

As long as foreign workers are used, a large amount of foreign exchange will leave the country, and there may be a higher amount of foreign goods imported to the country to supply the foreign workers' consumption habits (UNCTAD 1972). The wages paid to foreign workers are often considerably higher than those paid to local workers. It then becomes the responsibility of the local government to decide to what extent it is willing to hire foreign workers at a higher wage level, requiring a larger foreign exchange level but with a faster growth rate, or hire local workers, requiring lower wage rates and a lower foreign exchange level, but with a slower growth rate due to skill level of local workers.

Some governments may deliberately limit the use of foreign workers because they are concerned with the effect that they may have on the social values of the country.



Governments are also concerned that foreign workers may undermine their social objectives, because foreign workers come from a different culture and do not support other countries' social values and customs.

### Political Aspects / Military and Defense Implications

An increasing number of LDCs are assigning a high percentage of their economic resources to the build-up of their defense systems (Landgren-Bäckström 1977, p. 110). National security is one of the major reasons for this. Many LDCs have been victims of arms embargoes from their suppliers, which has led to their decision to protect their independence (Landgren-Bäckström 1977, p. 111). The danger of being dependent in a military conflict is that there is a possibility of being cut off by suppliers. Another reason in favor of local arms production is budget saving resulting from not buying from another country (Landgren-Bäckström 1977, p. 111; Katz 1986). It also creates employment, and by producing large quantities, the unit cost is also lowered. Supporters of local arms production point to the fact that military technology will have spin-off effects on the economic development in the country (Katz 1986; Neuman 1980).

As the development of weapons becomes more and more sophisticated, LDCs in particular, become more and more

dependent upon foreign expertise, because an educated and skilled work force is a vital part of the foundation needed for a local production capacity. The problem is that the more that is spent on modern weapons, the shorter the lifetime of the equipment and the machines (Deger and Sen 1985, p. 1). In other words, older machines become obsolete more quickly.

It is also worth noting that while in the last 10 years the military expenditure has increased by 14% in DCs, the increase has been 63% in LDCs (Katz 1986, p. xv). At the same time, the World Bank states that spending on social programs, including medicine, housing, education, food and clean water, in third world countries, has stopped growing or decreased (Katz 1986).

There is no direct proof that local manufacturing of weapons rather than importing weapons has reduced the LDCs' dependence upon DCs (Landgren-Bäckström 1977). It has been stated that "self-sufficiency in weapons production is beyond the reach of less developed countries, because domestic production creates other dependencies" (Neuman 1980). What has happened is that the LDCs have gotten rid of the need to import finished weapons, but in return, they have also created the need for the technologies to manufacture the weapons. Many countries have therefore signed licensee agreements with advanced weapon producers. South Africa's air defense system "Cactus" was developed by

"Dassault" in France and 85% was financed by South Africa. Both Iran and Saudi Arabia have financed certain weapons development in the U.S.A. (Landgren-Bäckström 1977, p. 110).

The LDCs have been exposed to modern warfare for quite some time, and now that they are able to support themselves with modern weapons and warfare, they, as opposed to DCs, apparently do not hesitate to use them. A war between two superpowers is less likely than one between two LDCs. LDCs were involved in 89% (14 out of 16) of the cross-country wars, and 98% (42 out of 43) of the civil wars during the period between WWII and 1980 (Katz 1986, p. 281). Those countries that are not able to produce their own weapons but are able to import, tend to resolve their disputes on the battlefield (Katz 1986). Had they not been able to import, small issues may have been solved in a peaceful manner. The number of militarily powerful nations is expanding however, and if one technology supplier decides to terminate its delivery of technology, there are too many countries willing to sell the needed technology for the termination to have any significant effects.

Military technology is, by nature, secret, and the different research projects require advanced technologies. A problem here, especially for researchers in LDCs, is that they very seldom have any control over funding for the different projects. Changing political policies can, in

other words, have a significant impact on the funding for research. If the scientists, due to the secretness of the research, are isolated, this may make it very hard for them to get any feedback from any other scientists regarding their ideas and experiences (Katz 1986).

### Problem Areas - Unresolved Issues

Many governments in LDCs are looking at converting their economies within the next generation (Lipsey, Steiner, and Purvis 1984). It is understandable that they want to make the transition as fast as possible, but one should not be too optimistic. With respect to the previously discussed population problem, many critics state that once an urban society has developed, family size will be reduced voluntarily (Lipsey, Steiner, and Purvis 1984). They further point out that since this has happened to the western industrialized countries, why could it not happen to the LDCs (Fortner 1977).

In the early 70's, the debt of the LDCs increased significantly (Lipsey, Steiner, and Purvis). A good part of this increase was due to rising oil prices. When OPEC raised the oil price, it created enormous surpluses in the OPEC countries, but also in the banks where the "OPEC money" finally ended up. These banks faced excess liquidity and had to lend out the money. The LDCs represented most of

the borrowers of these funds because many LDCs were dependent upon imported oil and because of the increase in oil prices, domestic income went down. This, in turn, increased the deficits and created the need to borrow foreign money, and the LDCs found themselves in a vicious circle. The doubling of oil prices in 1979 increased the debt of many countries beyond their capacity to pay back what they owed.

The increase in unemployment rate in DCs has also led to a more protectionistic policy that has discouraged exports from LDCs. Inflation and monetary policies further have increased the interest level, and in many cases, the LDCs have had to borrow more money just to pay the interest (Lipsev, Steiner, and Purvis 1984).

Many of the problems facing the LDCs are caused by the MNCs through agreements and patenting that prevent the sharing of technological information (UNCTAD 1975-b). This has prevented the majority of the countries in the world from replacing their old technologies (UNCTAD 1975-b). Most research is done by the MNCs in DCs, and because LDCs lack financial resources, they have been unable to compete with the technological capabilities of the MNCs (Gray 1986). Many will argue that the MNCs cannot be blamed, and that they have to consider the return on their investment in technology (Samli 1986).

The LDCs are concerned about the cost and availability

of technology, and the appropriateness of the technology being transferred (UNCTAD 1979). A more alarming problem is that for countries where education is lagging and population is growing, the unskilled workers are not employed in modern jobs. Too much technology transfer will virtually eliminate the start up of local industries, and the already scarce local capital may be decreased by the MNCs.

## Chapter III

### SOURCES OF TECHNOLOGY AND THE CHOICE OF APPROPRIATE TECHNOLOGY FOR LDCs

When the different processes for a technology transfer have been identified and its implications analysed, each individual country is faced with making an appropriate choice. Each transfer mechanism involves different positive and negative aspects that must be reconciled with other policies of the country.

#### Major Current Sources

The dominating form for technology transfers has been a direct investment by a MNC in the form of a wholly owned subsidiary, preferred by U.S. companies (Ghoshal 1982, p. 32). Next is the joint venture, with a minimum involvement from the foreign firm, preferred by Japanese companies (Ghoshal 1982, p. 32). A third form, in which a foreign firm provides most of the services of a direct investment but leaves out the equity capital, is called a management contract. Another traditional method is a licensing agreement without any equity participation, but with the design and supply of equipment and technical help and assistance in the initial phase. This method is referred to as a turnkey operation (DESA 1974; Marton 1986). Turnkey customers are usually Governments, who have stated that a given product or service must be produced

Table 1

Distribution of Ownership Patterns of 1276 Manufacturing Affiliates of 391 Transnational Corporations Established in Developing Countries 1951 - 1975

Home Country and Type of Ownership	Number established as percentage of total				
	Before 1951	1951-60	1961-65	1965-70	1971-75
-----					
Affiliates of 190 United States based Corporations					
Total	100.0	100.0	100.0	100.0	100.0
Wholly Owned (95% +)	58.4	44.5	37.4	46.2	43.7
Majority Owned (over 50%)	12.2	21.4	19.2	17.8	17.3
Co-owned (50 : 50)	5.6	7.9	11.4	11.2	10.4
Minority Owned (5 to 50%)	11.2	18.8	21.7	21.5	28.1
Unknown	12.6	7.4	10.3	3.3	0.4
Affiliates of 135 European based Corporations					
Total	100.0	100.0	100.0	100.0	n.a.
Wholly Owned (95% +)	39.1	31.6	20.9	18.9	
Majority Owned (over 50%)	15.4	20.1	15.6	16.4	
Co-owned (50 : 50)	5.3	6.6	11.1	6.6	
Minority Owned (5 to 50%)	9.8	27.9	35.8	42.1	
Unknown	30.5	13.9	16.6	16.0	
Affiliates of 76 other transnationals Corporations					
Total	100.0	100.0	100.0	100.0	n.a.
Wholly Owned (95% +)	27.4	16.7	10.7	6.1	
Majority Owned (over 50%)	8.2	26.2	12.6	8.2	
Co-owned (50 : 50)	12.3	7.1	6.3	7.5	
Minority Owned (5 to 50%)	16.4	42.9	66.7	74.2	
Unknown	35.6	7.1	3.8	3.9	

Source: Peter J. Buckley, "New Forms of International Industrial Cooperation," *Aussenwirtschaft*, Vol. 38, June 1983, p. 198.



locally and under local control (Buckley 1983, p. 205).

There is a strong tendency to move away from wholly owned subsidiaries as means of technology transfer by MNCs. This can be seen in table 1., where the "other" ownership group also includes Japanese firms. Despite the trend toward joint ventures, foreign direct investment in LDCs continued to be wholly owned or majority owned in the late 70's (Buckley 1983, p. 196). There has also been an increasing trend toward technology licensing by MNCs to nonaffiliated companies in LDCs, particularly if the industry is regulated and local entrepreneurship exists (Marton 1986, p. 71).

Many operations involve a combination of two or more of these methods. Direct investments may for instance be subject to a contractual provision, or a co-production may be combined with management contracts or turnkey contracts of various types (Erdilek and Rapoport 1985). Each of these methods has advantages and disadvantages.

#### Availability of the Technologies

A LDC who wants to buy technologies, faces the problem of determining what alternatives are open now and in the future. It could be that the specific technology that the country is looking for may not be available through any of the existing sources. However, as the country develops and

gains more solid economic and technological capabilities, there will be a more extensive range of possibilities available (Dunning 1983).

A problem for the LDCs is that many of the technology sellers only make their technologies available on conditions that are acceptable to them (Dahlman and Westpal 1983). Further, this bargaining position may make certain transferring methods and agreements unacceptable. Firms that believe that they have an alternative of equity participation will usually prefer this instead of entering into any kind of management contracts where it appears that they will be receiving a lower financial return (DESA 1974, p. 25). Firms that have a lesser available technology may further deviate from the "normal policies," and set special clauses on their agreements (DESA 1974). Generally, it can be said that licensing, management contracts, joint venture and purchase from equipment suppliers are not available when only a few firms have the technology. Only a wholly owned subsidiary is good enough for the supplier under such circumstances. Therefore, particularly in the early stage of a specific technology, a technology importer has few options but to go with a wholly owned subsidiary (DESA 1974). As the technology becomes more known, more options will be available.

Some technology suppliers insist on only selling technology through controlled connections (DESA 1974). The

available sources point to the fact that firms who use large advertising budgets, who rely on their marketing skills and on closely organized production in several countries, generally insist on a wholly owned subsidiary or a subsidiary where they are in control.

Sometimes the brand name is so strong that the market will be dissatisfied with any other brands, and a wholly owned subsidiary may be preferred. Some technology suppliers have been willing to license their operations to LDCs as long as they (the suppliers) maintain control over the marketing through a wholly owned subsidiary (DESA 1974). Examples of companies would be manufacturers such as Lever and Callbury, and trading companies like Shaw, Jardine Matheson, Wallace, Butterfield, Sevire and Atkins (Dunning 1983, p. 337). The opportunity cost for the LDC in this particular situation is that it will be drawing on the already scarce equity and loan capital instead of a foreign equity capital.

Normally, management contracts are available when the technology supplier has a strong interest in the project and there are no alternatives (Lasserre 1984, p. 46). A common arrangement is operation of the plant by the supplier for a period of time (DESA 1974, pp. 27-28). This is particularly the case in the sale of machinery, where the supplier operates the plant for a short period.

As sellers, the MNCs will not sell if the returns are

considered too low (Dahlman and Westpal 1983). And if technology were available to all potential users without charge, that may take away the "want" to create. There are always alternatives, but in some cases the local firm has very little choice in selecting a foreign partner. The reason could be that the technology involved is unique, or that the project is included in an intergovernmental agreement (Lasserre 1984).

#### Features of the Major Transfer Mechanisms

When choosing among several alternative ways of obtaining a desired technology, the decision may be left to a local firm if one is involved; but an increasing number of governments in host countries are becoming more involved in these decisions, even if the firm is a private one (DESA 1974). The cost and benefits that the government and the local firm come up with will also normally be different from each other due to their different methods of valuation (DESA 1977-b).

When evaluating the benefits, it is important to determine what elements of the technology the LDC is most likely to receive. In those cases where only a part of the package is needed, the decision-makers must calculate the cost/benefit and forecast the opportunity cost of the domestic resources that must be assigned to supply the

replaced elements such as capital or management (DESA 1974, p. 28).

The most common form of transfer occurs based on full or partial ownership of a subsidiary by a MNC (Buckley 1983). Included here are also joint ventures. Under normal circumstances a more complete and packaged technology transfer will occur (Lasserre 1984). Besides design and know-how, the MNC also usually contributes with marketing and management expertise. One must be aware that it is difficult to isolate the cost of the individual elements from the payment made by the local company to its MNC parent company (DESA 1974).

Great attention, out of both political and economical reasons, has been given to the case where the local firm or government owns a majority share of a joint venture (DESA 1974, p. 29). The main reasons for this attention are that it gives the locals more control, a larger share of the profit, and participation in top management (Kaynak 1985).

The percentage of common shares does not always determine who has control over major decisions. Actually there is a tendency in the contract agreements to specify in detail the powers of the partners. These types of contracts are called contractual joint ventures, and often specify such things as the salaries for the foreign workers, and export/import procedures and policies (DESA 1974, p. 30).

A special form of a contractual joint venture is Tripartite Industrial Cooperation (TIC) where there are at least three firms, representing a centrally planned economy (East), industrialized economy (West) and a LDC (South). These firms join forces to carry out common activities in the host developing country (UNCTAD 1978-a).

A foreign owned or controlled subsidiary is more likely to get access to the international distribution channels than a joint venture would. This difference will still remain regardless of any restrictions on exports in the joint venture or licensing contracts. This has led countries who have great export potential to lower their demands for joint ventures. Another reason is that benefits from exports usually outweigh other economic and political benefits of minority joint ventures (DESA 1977-b).

A wholly owned subsidiary implies that capital, technology skills and different rights to produce are all transferred (UNCTAD 1974). LDC firms must here realize that such a transfer may not adapt the technology to the local conditions in such a way that it will maximize profits of the local affiliates. The big advantage from the MNCs' point of view is that it allows long term planning, avoids market uncertainties, allows discriminatory pricing and may reduce external interference (Buckley 1983).

The third major transfer mechanism is licensing, which is common among the textile, chemical, machinery, and

electrical power equipment industries (Ghoshal 1982, p. 33). Licensing agreements without equity participation by the MNC are often considered to be the ideal procedure for the transfer of technology from the LDCs' point of view, because the price of the technology is fixed in advance (Buckley 1983). Instead of paying unpredictable amounts, the licensee pays fees that often are based on a percentage of sales (DESA 1974).

Licensing agreements seldom provide a complete package of technical skills, marketing, management and training, that often come with direct investment agreements (Marton 1986). The licensing agreements are used most with technology that is fairly common and widely known, and in countries that have an internal market big enough to make it worthwhile for the MNC to provide its technology (DESA 1974). These agreements can be divided into several parts: the first is patent licenses, used for a specific process or method of manufacturing (Kaynak 1985, pp. 166-167). Know-how agreements cover information that may be hard to obtain, and technical assistance agreements involve the supply of scientific assistance, management guidance, and engineering services (Kaynak 1985, p. 167). Copyright licenses cover registered creations, and finally franchising, sales and service representation will be included in a miscellaneous agreements category (Buckley 1983; Kaynak 1985).

Management contracts may look like direct investments, but they eliminate the equity, possibly the loan capital and the basic control that a direct investment offers the LDCs (DESA 1974, pp. 33-35). Often the suppliers are mainly interested in licensing technology or selling equipment and offering to run the plant in order to create more equipment sales. Industrial equipment suppliers seldom have the skills needed for the production processes and many plants run by these have had financial problems in addition to marketing and control problems (DESA 1974).

A management contract gives the LDC solutions for control and ownership problems (DESA 1974), but there is also a price to pay for these benefits. What to produce and how much to export may become part of the international company's image, and that may not be in the best interest of the local firm. In general, management contracts will be more successful when the supplier has an interest in the outcome of the project instead of only the need to sell a machine or technology. An example of this is franchising, where an authorization is given to sell a manufacturer's products within a specific time limit and territory where a privilege or immunity is authorized.

Turnkey projects, on the other hand, do not have the same problems because they are supported by a local managerial group that will take over after the initial training period (DESA 1974, p. 33). Turnkey agreements are



generally entered into in the early stages of a country's industrialization, but the tendency is to replace these contracts with license agreements for manufacturing technology (UNCTAD 1975-b).

In many LDCs, individual equipment suppliers have served as an important source of technology (UNCTAD 1972). However, since a technology often consists of several elements and because the technology that the suppliers provide is "unpackaged," the LDCs must turn to other sources to obtain the other elements of the technology (UNCTAD 1972).

There is no certain way of stating which mechanism will work best. The many unforeseen conditions, such as the effectiveness of the government and that what works well in one particular country may not work well in another make such an assessment very difficult. Whether or not a specific technology transfer mechanism represents the lowest cost will depend upon the suppliers' competition, the availability of the technology and the needs of the LDC.

Besides the equity differences, there are also time limitations included in the different contractual agreements. Often, these limitations are meant as a fade-out where the MNC is liquidating its investments and selling its stakes to locals (DESA 1974, pp. 35-37). From the LDCs' point of view, it is desirable to make the

contract period as short as possible with a possibility to renew the contract. This way, the LDC will be able to renegotiate the existing contract in case there are other interested firms competing with the present supplier. License agreements often include space limitations on where the license is valid (Buckley 1983, p. 206). This provides the licensor with a means of segmenting the market and reducing the competition among other licensees, ensuring that the licensees do not become competitors (Buckley 1983, p. 206). Table 2 gives a better view of the different forms of agreements and their major characteristics.

#### Competition and Choice of Technology

The choice of technology is to a great extent dependent upon the competitive milieu (Lasserre 1984, p. 44). If a MNC is faced with strong price competition, it is more likely to choose a technology that minimizes costs (DESA 1972; Goshal 1982). Some authors state that foreign owned plants operating in a LDC would be more likely to compete using their brand name than a domestically owned plant would (DESA 1974; Fortner 1977; Leff 1979). However, as long as the competing product is held constant, there does not appear to be any significant difference between a foreign and a domestic owned plant (DESA 1974). Once the brand identification has been established among the

Table 2

## Types of International Industrial Cooperation in Five Dimensions

Form of Cooperation	Equity or Non equity	Time Limited or Unlimited	Space Limited	Transfer of Resources and Rights	Mode of Transfer
1. Wholly Owned Subsidiaries	Equity	Unlimited	At discretion of MNC	Whole range	Internal
2. Joint Ventures	Equity	Unlimited	Agreed	Whole range?	Internal
3. Foreign Minority Holdings	Equity	Unlimited	Limited	Whole range?	Internal
4. "Fade Out" Agreements	Equity	Limited	Nature of Agreement	Whole Range? for limited period	Internal changing to Market
5. Licensing	Non Equity	Limited by contract	May include limitation in contract	Limited range	Market
6. (Franchising)	Non Equity	Limited by contract	Yes	Limited + support	Market
7. Management Contracts	Non Equity	Limited by contracts	May be specified	Limited	Market
8. "Turnkey Ventures"	Non Equity	Limited	Not usually	Limited in time	Market
9. "Contractual Joint Ventures"	Non Equity	Limited	May be agreed	Specified by contract	Market
10. International Sub-contracting	Non Equity	Limited	Yes	Small	Market

Source: Peter J. Buckley, "New Forms of International Industrial Cooperation," *Aussenwirtschaft*, Vol. 38, June 1983, p. 208.

consumers, it is often very difficult for a local product to compete, despite the fact that its somewhat lower quality may be offset by its dependence on labor intensive technology (UNESCO 1978-a).

MNCs that have built production factories in LDCs with the purpose of exporting the finished product back to the developed countries have done so because of price competition (Goshal 1982, p. 34). As competition increases and the MNCs face greater competition from other MNCs, the LDCs will start to search for new forms of cooperation and the MNCs will be more willing to compromise on the total ownership (Buckley 1983).

An exception to all of this is Japan. When the Japanese were faced with modernization of their technology, they had: a) a well established political system, b) a strong sense of social responsibility, and c) a very strong cultural tradition. Everybody saw the need to adapt, copy and redesign transferred technologies to make them suitable to the local conditions. They further managed to transfer technologies for the capital goods sector only, thereby leaving their traditional industries untouched. The government discouraged direct foreign investment and managed to protect the economy from excessive importation of modern technology, while at the same time allowing local industry to build up its own technological capacity (Sirgy 1985).

## Capital vs. Non-Capital Intensity

When it comes to the design of a manufacturing plant, the engineers will play a very important role. Today's engineers mostly prefer advanced technology, which makes them able to perform at the level for which they were educated (DESA 1974). High quality products can be made without the use of capital intensive machinery, but to rely on people to control quality is normally not appealing to engineers (DESA 1974, p. 7).

The managers' point of view and their goals will also influence the design of a plant. As long as the operation provides a satisfactory profit, many managers would prefer to avoid the problems associated with large labor forces (DESA 1974; UNCTAD 1972). A capital intensive plant may allow the manager to respond more quickly to unforeseen fluctuations in demand or even production levels that the plant was not intended for. Another major reason is that a capital intensive plant may reduce the risk of facing liquidity crises in the future (DESA 1977-a). If the level of sales is uncertain and most likely will vary, the capital intensive plant will provide the best option, because it allows for an easy adjustment of the output, despite the fact that it may cause a higher production cost. Therefore, a manager who wants to hedge against the risk and uncertainty in business operation may find that a labor intensive design is less appealing compared to a

capital intensive plant (DESA 1974). Off-shore drilling will always be capital intensive whether the location is in the high wage North Sea or in the low wage Indonesia, because the "elasticity of factor substitution is very low" (Ghoshal 1982, p. 31).

So far, most of what has been said points in the direction of a capital intensive firm, but there are also things that favor a labor intensive firm. One of the most important constraints on capital intensity is that of scale (DESA 1974). Few plant designers will, for example, recommend any equipment that will operate at only a fraction of its capacity, so the limitation of small local markets is important to keep in mind (DESA 1974; UNCTAD 1978-a). The problems of maintaining complex equipment in LDCs will also act as a brake on automation and thereby capital intensity. Skilled repairmen are rare in LDCs and those who exist may have to be maintained despite the fact that they are only needed occasionally, thereby adding a high cost to the firm (DESA 1974, p. 10). Also, spare parts may be difficult to obtain, and getting the supplies from other countries may mean expensive transportation and inventory cost.

Labor intensive technologies may save capital and foreign exchange compared to capital intensive technologies, but the labor intensive technologies may not necessarily mean a lesser demand for skilled workers

(UNCTAD 1978-a). If there is a shortage of skilled workers in a LDC, then certain production methods that demand capital intensive technologies may be appropriate, despite their often greater cost per worker (UNCTAD 1978-a). However, labor intensive technology might be preferred if it provides an opportunity to increase the skills of the workers through a "learning by doing" process (UNCTAD 1978-a, p. 37).

It has been suggested that in countries where labor is plentiful and wages are low, firms tend to adapt their technologies to take advantage of the low cost of labor, which contradicts the previous argument (Ghoshal 1982, p. 29). Taiwan for instance continues to rely on labor intensive consumer goods like clothing and textile industries (Ranis 1985, p. 29). By looking at input-output relationship, it is easy to see that while the cost of an automatic sewing machine is higher than the cost of a machine operated by hand, it may require less capital to produce a unit of output than a machine operated by hand. Furthermore, even if a labor intensive technology is less expensive than a capital intensive technology, the labor intensive technology may take a much longer time to complete (Ghoshal 1982). So if the benefits are lost because of the delay, the labor intensive technology may be rejected, despite the fact that its direct cost is lower.

A study done by the World Bank on appropriate

production methods in nine LDC industries - beer, bricks, cornmeal, cotton, cotton yarn, cloth, fertilizers, leather, shoes and sugar - gave an interesting result (Gordon 1979). Appropriate technology was defined as the one providing the highest net present value relative to capital investment. The results showed that the appropriate technology would provide more jobs per unit of capital than the most capital intensive technology presently used in the LDCs. An investment of \$900 million would produce the following results:

	<u>Cap. Intensive Tech.</u>	<u>Appropriate Tech.</u>
Value Added	\$374 Million	\$800 Million
Jobs Created	60,000	300,000

The study concluded that it is essential that the policies favoring capital intensive technologies should be reduced or eliminated. The acceptance of modern technologies has led to an under utilization of local resources, unskilled labor in particular, and an increasingly serious social and economic effect. Therefore, the solution to the underdevelopment problem is not a direct transfer of technologies, but adaptation and development of appropriate technologies (Ghoshal 1982, p. 36).

The labor laws have served as restrictions on the automation of plants, but the labor or capital intensity of



a country's production processes depends on both the industrial composition of its output and on the particular technology that is applied to the individual operations (DESA 1974, pp. 10-11). Firms that compete primarily by emphasizing their brand name are more likely to have a capital intensive technology than the firms that compete on the basis of price. In the long run, if the MNC can earn a satisfactory return by using capital intensive technology, the gain associated with lowering cost by using a labor intensive technology is not enough to make up for the disadvantages.

#### New vs. Second-Hand Technology

Second hand technology saves money because it is cheaper than new equipment in almost every case. The design of these technologies usually reflects the looks of an older technology that, in several incidents, is more labor intensive than what is currently used in DCs (DESA 1974). The machines that are used in LDCs are also associated with more labor intensive technology than the machines that are used in DCs, even though they produce comparable products (Desa 1973; DESA 1974; UNCTAD 1978-b).

This does not mean that all LDCs use second-hand technologies. It varies from country to country, and there appears to be a relationship between the distance between

the production facilities and the end product's final destination (Wells 1973). Some markets such as the oil industry simply require the latest technology. For others, it can be said that the farther the distance is, the more modern technology is required. A businessman who works for a company that is closer to the "modern World" and the market can, for instance, inspect and find new equipment or replacement at a lower cost than a businessman in an isolated country (DESA 1974; Wells 1973).

There is no indication in the available sources as to how much and how often second hand machinery is imported. In many LDCs, about one third of the equipment used is second hand imported from other LDCs (DESA 1974, p. 12). Much of the data examined also appear to point in the direction of an increase in this trade. However, high barriers to buy and sell these technologies exist. The reason is that even though many LDCs have several areas that produce machinery, their marketing abilities are limited (DESA 1974). They seem to have little information about the other LDCs, and what they have to offer and what they have a need for.

Evidence, as previously discussed, shows that MNCs may be influenced to go with labor intensive technologies, but other influential matters may lead them to use more capital intensive technologies. Also, a MNC is more likely to use second-hand technologies than a domestic firm would. Part

of this reasoning may be explained by the fact that MNCs have a better ability to evaluate the different equipment (DESA 1974; UNCTAD 1975).

For a LDC government or firm to make a choice between new and second-hand technology, one must look at the local requirements, the differences in use, the different outputs and inputs, and choose the one that makes the maximum use of all the available resources (Dahlman and Westpal 1983).

#### The Effect of the Different Policies and Regulations on Host Countries.

In many labor surplus LDCs, there is a notable interest to inspire firms to choose or develop labor intensive operations. At the same time it is important to create an atmosphere that makes the local firms aware of the technological possibilities and inspires them to improve their entire appearance, in the sense of how the country is seen from the outside (Dahlman and Westpal 1983, p. 9). If not, the MNCs may redirect their investments to other non-threatening countries.

In many LDCs, the factor prices are twisted, because the governments, through labor legislation, push the wages above their opportunity cost, while subsidizing capital to attract investments (Ghoshal 1982). With the addition of overvalued currency, maintained by exchange controls, it may turn out to actually be very profitable for a local

firm in a LDC to import "ready to sell" products despite the fact that unemployment exists in the country (Ghoshal 1982).

In order to create an environment that favors a more powerful response to factor costs from the firms, there are several policies that the government should consider. One is the competitive climate (DESA 1974). A relatively open economy is more likely to produce such an environment when the competitive pressure is strong (DESA 1974, p. 15). Some degree of protection must obviously be withheld just to attract the preferred investment. However, one must be aware of the fact that a high degree of policy protection is most likely to generate capital intensive technology. The LDCs should try to create policies that utilize the competitive economic forces in their own countries and thereby create conditions that foster economic development.

A host government's clear preference for labor intensive technology will also create a high possibility that the MNC will select its processes in response to the availability of labor (DESA 1974). But what is happening is that in many countries, the investors are faced with ambiguous signals from the host government. The Labor Minister may, for instance, be worried about the employment situation. On the other hand, the Industry Minister may be worried about the importance of having as modern a plant as possible in the country, despite the implications that this

may have on the factor proportions. When the investor is faced with these conflicting signals, he will most likely choose the technology that he feels most comfortable with, which oftentimes means a capital intensive plant (DESA 1974; Tiano 1983; UNCTAD 1978-a).

Although some ambiguities will always exist, the planning process can do a lot to resolve the conflicts. The combined efforts between different ministries that are needed to establish priorities for the plan may sometimes lead to a better understanding of each individual ministry's interests and the total national interest (DESA 1974). The end plan may then call for technologies that reasonably reflect to the foreign investors where the priorities lie.

As previously discussed, many LDC may have a ban on the import of second-hand technologies. The reason for this may be due to previous difficulties (for example spare parts may have been needed but could not be obtained or were no longer available). There are ways to reduce the risk connected with second-hand technology. One example is an independent evaluator or consultant, who will inspect the machinery in other countries for a prospective buyer and then send the intended receiver a description of its condition and the availability of spare parts (DESA 1974). These consultants would most likely come from the outside, because an organized international market for second-hand

technology and machinery hardly exists.

A fourth area concerns the labor laws. For a settled firm, strict labor laws may slow down the replacement of labor by machines (DESA 1974). But for firms that are planning new facilities, labor laws may lead management to prefer not to hire many workers, thereby creating a capital intensive technology. The problem in making these laws is that rules that protect jobs and give such rights to the workers as minimum wage, may actually make it more difficult for the unemployed workers to find jobs (DESA 1974, p. 16).

The market cost of the factors to the firm obviously has some influence on what kind of technology is selected (UNCTAD 1972). It may therefore be necessary to introduce certain procedures that will lead the market price of the productive factors to better reflect the actual scarcities in the economy. The different approaches to influencing the private costs to the firm have different degrees of effectiveness, and the most important element may be the initial cost of the equipment. Machinery from LDCs is commonly associated with a more labor intensive technology rather than machinery from DCs, and if tariffs and sales taxes are used at a higher rate on capital equipment, it may create a preference for machinery from other LDCs.

The least effective tools for influencing the choice of technology are those that involves tax law changes (DESA

1974). The reason is that biases can be built into the tax laws in such a way that they encourage the use of capital instead of labor (DESA 1974). Unless they serve a clear purpose, like a sufficient increase in the local capital formation, they should be removed.

Persuading governments to adopt direct subsidies for labor use is difficult. Tax reductions are easier to introduce than policies that require the distribution of funds from the treasury (Marton 1986). Furthermore, the different subsidies for the different industries are so complex that it is very unlikely that the average businessman, or the tax collector for that matter, will understand the rules sufficiently enough that it will influence the choice of technology used.

The most effective policies for influencing the choice of technology are establishing a competitive environment and using selective tools to influence the private costs of factors of production (DESA 1974). That doesn't mean that there are no other effective tools. In some cases, an excise tax that is imposed on products that are manufactured by capital intensive technologies may have some effect (Marton 1986). These kinds of taxes will most likely not cause new firms to use labor intensive techniques, but might keep alive some labor intensive firms that otherwise would not survive (Marton 1986). What has to be done is to compare the probable effects on employment

with the results of higher prices on the final product. It is important to use a cost-benefit analysis and take into account the opportunity cost of the labor that would be dismissed as a result of the loss of the labor intensive plants.

Many LDCs have recently been establishing what is called export processing zones (EPZs) with the purpose of speeding up the industrialization process, developing exports and creating employment. These zones are particularly used by labor intensive production processes like the textile, garments, and electronic industry (Marton 1986, p. 42). More specific expectations have been an increase in the use of local raw materials, inflow of foreign technology and capital, and the development of export skills (Marton 1986). Economists and representatives from MNCs are the ones that mostly favor these zones, stating that they are a step toward the interdependence between rich and poor countries, and further, that they are a positive sign that MNCs and LDCs can work together for mutual benefits (Moxon 1974). These zones are mainly restricted to foreign companies, and the production consists mainly of textile and garment industries, although the production of electrical and electronic components have increased in the last years (Marton 1986, pp. 41-44). Over 70% of the work force are women and their tasks can be learned in one day to two weeks (Marton 1986, p. 43).



Projects that offer the promise of employing a large labor force may sometimes obtain some extra advantages. The fact of the matter is that there very seldom appears to be a follow-up inspection of the actual performances (DESA 1974). If there had been, the LDC governments would often find less employment than was promised. If on the other hand, a follow-up inspection was expected, the foreign firm might be more honest in its application, thereby allowing for a better evaluation of the available alternatives from the LDCs' point of view. The foreign firm might also in many cases choose a more labor intensive technology than they would have had if there had been evidence that there would not be a follow-up inspection (DESA 1974, p. 8). The same would also be true if the foreign firm could be reasonably certain that if they failed to employ the numbers of workers that they promised, this would not result in the withdrawal of benefits from the government (DESA 1974, p. 8). UNCTAD has been involved and is developing a code of conduct for the transfer of technologies. UNCTAD is also studying the brain drain process that was discussed in chapter II (Graham 1979). As a final conclusion, it can be said that the LDCs have adopted more practical and flexible rules and regulations lately and that we will see clear increases in the technology transfer to these countries in the 80's and into the 90's (UNESCO 1978-a).

## SUMMARY

Joint ventures, where the majority share is owned by the host government or firm, are now starting to dominate the field replacing wholly owned subsidiaries, except for the early stages of a new technology. As seen in Table 1, it is the U.S. based corporations that are the slowest to react to this trend. Capital intensive technologies and processes are often favored by MNCs because of the low levels of skills and productivity in LDCs when confronted with newly developed technologies and products. Engineers and plant managers prefer capital intensive technologies since it leads to a limited liquidity risk, an easy adjustment of outputs, less capital per unit, and an appropriate alternative if a shortage of skilled workers is present. To compete with other products, quality, uniformity, dependability and reduction in cost become important factors, further supporting the MNCs' view.

Adapting the technologies and processes often means a substantial expense increase and limited chances of a good return on the MNCs investments. From the LDCs' point of view, many think that technology should not be transferred directly at all, but adapted to meet the appropriate needs of the particular country or region (UNCTAD 1978-a). Their argument against direct transfer is based on the following:

- It makes the LDC more dependent on technologies from the MNC.

- The high cost will lead to problems in paying their debt.
- Elimination of jobs because of the MNCs' support of capital intensive technology.
- Pollution and a worsening of the working conditions.
- Industrial and regional dislocation (Ravn and Vidal 1986, p. 207).

The LDCs should focus on improving education and finding alternative sources of supply. Many alternatives exist, but most need some adjustments (Buckley 1983; Rosenblatt 1979). Currently, LDCs are increasing their military expenditure at a faster rate than the expenditure on education and other social programs. As weapons becomes more advanced, their lifespan diminishes and the LDCs become more dependent upon foreign expertise to provide the new technologies for both import and production of military equipment. For the technology transfer process to be effective and in order to maximize the learning potential, the receiving country or firm, should be in a position to:

- Define the type of technology wanted.
- Be able to identify potential suppliers and have the ability to find the one(s) that most appropriately meet their needs.
- Be able to collect information from a wide variety of sources and to be prepared to negotiate as best as possible.
- Write a contract for the supply of the core technology only, and subcontract the peripheral technology to local sources, preferably, or to lower priced foreign sources (Rosenberg and Frischtak 1985).

Lack of knowledge, unstable economies, poor health and illiteracy are all sources that represent barriers to transfers of technologies. Combined with lower wages and unequal distribution of income, the difference between rich and poor becomes more and more distinct. Many of the key positions are held by foreigners, resulting in an underutilization of local workers, despite the fact that they may be equally qualified. Training programs in the LDCs through both financial and personnel support by the MNCs, would be in everyone's interest, and it will most likely improve the attitude of the local people towards the MNC. Presently DCs are in control with educated and technically skilled workers, while LDCs have limited resources and face the problem of brain drain. In addition DCs are more familiar with the international distribution channels. Many MNCs produce one specific function at each plant, to take advantage of the economies of scale. Examples of companies utilizing this method are IBM, Phillips, Ford, International Harvester and Honeywell (Dunning 1983, p. 337).

The LDCs should consider innovating on their own, since it is the LDCs' desire to imitate the lifestyles of the West that invites the MNCs' domination of their economies and technologies (Fortner 1977, p. 50). It is also desirable for LDCs to have the contract period with foreign firms as short as possible and to see increasing

competition among the MNCs, which will give the best choice of technology for the particular LDC. Technology that is to be imported to LDCs should be evaluated to assess its cultural, social and economic impact before it is allowed to be transferred. The decision makers should determine what sort of milieu they want and then try to reach that without necessarily following the same pattern that the West has followed.

### CONCLUSIONS

LDCs represent an enormous market potential not only to the DCs, but also to LDCs themselves. It is therefore in everyone's interest to raise the standard of living in the developing countries. MNCs are competing, often unscrupulously, for the biggest share of the market due to a lack of common rules. A 1972 shipment to Iran of 80,000 tons of imported wheat and barley coated with organic mercury fungicide, caused the death of 400 persons and 5000 were hospitalized. The fungicide had already been banned in the exporting country (UNCTAD 1978-a, p. 21). Many seem to think that the LDCs have a shortcut to success, since much of the R & D is already done for them. The problem is that it is a matter of how fast people can adjust to these social changes without too much negative influence. Most noticeable is the creation of slum districts which in

itself creates numerous side effects such as crime, drug, prostitution, and diseases to mention a few. Well thought out government planning may be the only solution, but it will also be dependent upon the willingness of the people, the effectiveness of the government and how selfish the people in power are. They must, in other words, be willing to share the wealth that exists.

Technology transfers between the LDCs themselves will raise their awareness of the problem and further make them aware of older techniques and machinery that are more compatible with their needs at their current stage of development. The school systems in LDCs are limited and many of the educated people go overseas due to higher possibilities for success. This trend leads to import barriers because the speed of technical change creates a need for more R & D. Each country must try to turn this trend around by offering, for example, better paying jobs, providing advancement opportunities, and offering rewards to individuals who make positive contributions. The latter may open up the "need to create" which may further lead to better alternatives. The population in LDCs is increasing faster than their economic prosperity. Many authors argue the significance of this, but when combined with unstable economic conditions and commercial restrictions that gives more power to MNCs, there are reasons for concern.

The major reasons why LDCs are dependent upon

technologies from DCs are:

- High illiteracy rate
- Lack of capital
- Lack of benefits from being innovative
- Lack of skills and few opportunities to acquire them
- Lack of organizational infrastructure (Sirgy 1985, p. 204).

New technologies increase dependency, while older technologies will have more sources and therefore less dependency. Still, the LDCs will have to improve in the areas mentioned above, particularly in education, if they want to become more self-supported and independent. The example of Japan mentioned in the text also points out the necessity to have a thorough strategic management.

One of the main things that can be obtained from this study is the lack of government support or rather lack of rules and regulations. Import of technologies will have some influence on the LDCs' way of living. It will bring some "know how", but it will also lead to underutilization of local technology, particularly for newly developed technologies that are transferred directly. Japan had a stable political system which is not the case for many LDCs and the development of these countries will be more dependent upon DCs. Finally, each country is its own master, and each should develop its own code for technology transfers (Rome 1985), and develop in the direction that it wants, preferably with its own special characteristics.

## SELECTED BIBLIOGRAPHY

---

- Balasubramanyam, V. N., "International Transfer of Technology to India", (Praeger International Studies, New York, New York), 1973,
- Barton, John H., "Coping with Technological Protectionism", Harward Business Review, Nov./Dec. 1984, pg. 91-97.
- Buckley, Peter J., "New Forms of International Industrial Cooperation", Aussenwirtschaft, Vol. 38, #2, June 1983, pp. 195-222.
- Buttel, Frederick H., "From the Green revolution to Biorevolution: Some Observations on the Changing Technological Bases of Economic Transformation in the Third World", Economic Development and Cultural Change, Vol. 34, October 1985, pp. 31-55.
- Cavusgil, S. Tamer, "Multinational Corporations and the Management of Technology Transfers", In: Technology Transfer: Geographic, Economic, Cultural, and Technical Dimentions, by A. Coskun Samli, pp. 217-229.
- Chudnovsky, Daniel and Nagao, Masafumi, "Capital Goods production in the Third World: An Economic Study of Technology Acquisition", (Franches Pinter Publishers, : London, England), 1983.
- Cieslik, Jerzy, "Restrictive Clauses in Licensing Agreements: The Pharmaceutical Industry in Developing Countries", Journal of World Trade Law, Vol. 18, #5, Sept./Oct. 1984, pp. 415-428.
- Cole, W. E., "transfer of Soft technology to LDC", Journal of Economic Issues, Vol. 21, #1, 1987, pp. 309-320.
- Cunningham, Paul, "Technology Transfer and the Gatekeeper Function", PASITAM Design Note, #5, March 1976, Indiana University, pp. 65-67.
- Dahlman, Carl and Westpal, Larry, "The Transfer of Technology", Finance and Development, Vol. 20, #4, December 1983, pp. 6-9.
- Davidson, W. H. and McFetridge, D. G., "Key Characteristics in the Choice of International Technology Transfer Mode", Journal of International Business Studies, Vol. 16, #2, 1983, pp. 5-21.



- Davidson, W. H. and McFetridge, D. G., "International Technology Transactions and the Theory of the Firm", Journal of Industrial Economics, 1984.
- Davies, H., "Technology Transfer Through Commercial Transactions", Journal of Industrial Economics, Vol. 26, December 1977.
- Deger, Saadet and Sen, Sommat, "Technology Transfer and Arms Production in Developing Countries", Industry and Development, #15, 1985, pp. 1-18.
- Department of Economic and Social Affairs (DESA), "Implementation of the International Development Strategy", (United Nations (U.N.), New York (N.Y.)), Vol. II., 1973.
- DESA, "The Acquisition of Technology from Multinational Corporations by Developing Countries", U.N., N.Y., 1974.
- DESA, "Policies and Techniques for Mobilizing Personal Savings in Developing Countries", U.N., N.Y., 1977-a.
- DESA, "Economic and Social Progress in the Second Development Decade", U.N., N.Y., 1977-b.
- Department of International Economic and Social Affairs (DIESA), "Technology Assessment for Development", U.N., N.Y., 1979.
- Dunning, John H., "Market Power of the Firm and International Transfer of Technology", International Journal of Industrial Organization, Vol. 1, #4, December 1983, pp. 333-351.
- El-Kholy, Aziz and Mandil, Salah H., "The relevance of Microcomputers to Health Improvement in Developing Countries", Information and management, Vol. 7, #4, August 1984, pp. 177-182.
- Erdilek, Asim and Rapoport, Alan, "Conceptual and Measurement Problems in International Technology Transfer: A critical Analysis", In: Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, by A. Coskun Samli, pp. 249-261.
- Fortner, Robert S., "Strategies for Self-Immolation: The Third World and the Transfer of Advanced Technologies", Inter-American Economic Affairs, Vol. 31, #1, Summer 1977, pp. 25-50.

- Fransman, Martin, "Conceptualising Technical Changes in the Third World in the 1980s: An Interpretive Survey", Journal of Development Studies, Vol. 21, July 1985, pp. 572-652.
- Ghai, D. P., "The Basic needs Approach to Development", Geneva, Switzerland, 1977.
- Ghoshal, Aminesh, "Multinational Corporations, Technology Transfer and Economic Development", Economica Internazionale, Vol. 35, #1, February 1982, pp. 27-37.
- Gordon, David L., "The Bank and the Development of Small Enterprises", Finance and Development, #16, March 1979, pp. 25-33.
- Graham, Anila, "Transfer of Technology: A Test case in the North-South Dialogue", Journal of International Affairs, Vol. 33, #1, 1979, pp. 1-17.
- Gray, H. Peter, "North-South Technology Transfer: Two Neglected problems", Journal of Economic Development, July 1986, pp. 27-45.
- Harvey, Michael G., "Application of Technology Life Cycles to Technology Transfers", Journal of Business Strategy, Vol. 5, #2, Fall 1984, pp. 51-58.
- Herbolzheimer, Emil and Ouane, Habib, "Transfer of Technology to Developing Countries by Small and Medium-sized Enterprises of Developing Countries", Trade and Development, #6, 1985, pp. 131-148.
- Hope, Kempe R., "Basic Needs and Technology Transfer Issues in the New International Economic Order", American Journal of Economics and Sociology, Vol. 42, #4, October 1983, pp. 393-404.
- Katz, James Everett, "The Implications of Third World Military Industrialization: Sowing the Serpents' Teeth", (Lexington Books, : Lexington, Massachusetts), 1986.
- Kaynak, Erdener, "Transfer of Technology from Developed to Developing Countries: Some Insight from Turkey", In: technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, by A. Coskun Samli, pp. 155-176.

- Kim, Linsu and Kim, Youngbae, "Innovation in a Newly Industrializing Country: A Multiple Discriminant Analysis", Management Science, Vol. 31, #3, March 1985, pp.312-322.
- Landgren-Bäckström, Signe, "The Transfer of Military Technology to Third World Countries", Bulletin of Peace Proposals, Vol. 8, #2, 1977, pp. 110-120.
- Lasserre, Philippe, "Selecting a Foreign Partner for Technology Transfer", Long Range Planning, Vol. 17, #6, December 1984, pp. 43-49.
- Leff, Nathaniel, "International Transfer of technology to Developing Countries; implications for U.S. Policy", In Technology and Economic Development: A Realistic Perspective, by Samuel M. Rosenblatt, pp. 87-108.
- Lipsey, Richard G., Steiner, Peter O. and Purvis, Douglas D., "Economics", 7th. Edition, (Harper & Row Publishers, : New York, New York), 1984.
- Malhotra, Naresh K., "Why Developing Societies need Marketing Technology", International Marketing Review, Vol. 3, #1, Spring 1986, pp. 61-73.
- Marton, Katherin, "Multinationals, Technology and Industrialization - Implications and Impact in Third World Countries", (Lexington Books, : Lexington, Massachusetts), 1986.
- McGregor, Peter, "Management Contracts Overseas; Risks and Opportunities", Industrial Marketing Digest, Third Quarter, 1986, pp. 89-98.
- Moxon, R. W., "Offshore Production in Less Developed Countries: A Case Study of Multinationality in the Electronic Industry", Working Paper, (New York, : New York University), July 1974.
- Neuman, Stephanie G., "Arms Transfers, Indigenous Defence Production and Dependency: The Case of Iran", in Hossein Amirsadeghi, ed., The Security of the Persian Gulf, (London, England, : Croom Helm), 1980
- Pack, Howard, "Technology and Employment: Constraints on Optimal Performance", In: Technology and Economic Development: A Realistic Perspective, by Samuel M. Rosenblatt, pp. 59-85.

- Paliwoda, Stanley J. and Liebrez, Marilyn L., "Technology Transfer to Eastern Europe", In: *Technology Transfer: Geographic, Economic, Cultural and Technical Dimensions*, by A. Coskun Samli, pp.55-67.
- Ranis, Gustav, "Appropriate technology: Obstacles and Opportunities", In: *Technology and Economic Development: A Realistic Perspective*, by Samuel M. Rosenblatt, pp. 23-57.
- Ravn, Hans F. and Vidal, Rene V. V., "Operational Research for Developing Countries - A Case of Transfer of Technology", *Journal of Operational Research Society*, Vol. 37, #2, 1986, pp. 205-210.
- Rodrigues, Carl A., "A Process for Innovators in Developing Countries to Implement New Technology", *Columbia Journal of World Business*, Vol.20, #3, Fall 1985, pp. 61-73.
- Rome, Food and Agriculture Organization of the United Nations, "Choosing Appropriate Channels for Rural Technology Transfer", *Ceres*, Vol. 18, May/June 1985, pp. 33-38.
- Rosenberg, Nathan and Frischtak, Claudio, "International Technology Transfer: Concepts, Measures, and Comparisons", (Praeger International Studies, : New York, New York), 1985.
- Rosenblatt, Samuel M., "Technology and Economic Development: A Realistic perspective", (Westview Press, : Boulder, Colorado), 1979.
- Rosenblatt, Samuel M. and Stanley, Timothy W., "Technology Transfer in Practice: The Role of the Multinational Corporation", In: *Technology and Economic Development: A Realistic Perspective*, by Samuel M. Rosenblatt, pp. 109-131.
- Samli, A. Coskun, "Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions", (Quorum Books, : Westport, Connecticut), 1985.
- Samli, A. Coskun, "Technology Transfer: The General Model", In: *Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions*, by A. Coskun Samli, pp. 3-15.

- Samli, A. Coskun and Yavas, Ugur, "Reverse technology Transfer: Demarketing Lessons from Less Developed Countries", In: Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, by A. Coskun Samli, pp. 133-141.
- Sirgy, M. Joseph, "Achievement Motivation, technology Transfer, National development", In: Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, by A. Coskun Samli, pp. 200-216.
- Sirgy, M. Joseph, Samli, A. Coskun and Bahn, Kenneth D., "Personality, Culture, and Technology Transfer: A Parsonian Social System Perspective", In: Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, by A. Coskun Samli, pp. 177-191.
- Tiano, A., "Transfers of Iron and Steel Technology to the Third World: Effects on Employment in the Developed Countries", International Labour Review, Vol. 122, July/August 1983, pp. 429-442.
- Tisdell, Clem, "Technological Change and Transfer in the Pacific: the Position of Australia and Japan", Australian Outlook, Vol. 39, April 1985, pp. 39-43.
- United Nations Conference on Trade and Development (UNCTAD), "Guidelines for the Study of the Transfer of Technology to Developing Countries", (U.N., New York), 1972.
- UNCTAD, "Major Issues Arising from the Transfer of Technology to Developing Countries", U.N., N.Y., 1975-a.
- UNCTAD, "The Role of the Patent System in the Transfer of Technology to Developing Countries", U.N., N.Y., 1975-b.
- UNCTAD, "An International Code of Conduct on Transfer of Technology", U.N., N.Y., 1975-c.
- UNCTAD, "Debt Problems of Developing Countries", U.N., N.Y., 1975-d.
- UNCTAD, "Transfer of Technology - It's Implications for Development and Environment", U.N., N.Y., 1978-a.
- UNCTAD, "Review of International Trade and Development 1977", U.N., N.Y., 1978-b.

UNCTAD, "Development, Environment and Technology - Towards a Technology for Self-reliance", U.N., N.Y., 1979.

Weiss, Charles and Jequier, Nicolas, "Technology, Finance, and Development: An Analysis of the World Bank as a Technological Institution", (Lexington Books, : Lexington, Massachusetts), 1984.

Wells, Louis T. Jr., "Economic Man and Engineering Man: Choise of technology in a low wage country", Public Policy, Summer, 1973.

Wells, Louis T. Jr., "Technology and Third World Multinationals", (International Labor Office, Geneva, Switcherland), 1982.