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NORTH SOUTH TECHNOLOGY TRANSFER REVISITED: RESEARCH ISSUES FOR THE 1990S

Daniel Chudnovsky*

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1.Introduction

Technology transfer has been generally referred to in the economic literature to the process by which different elements of production knowledge which are not directly embodied in machinery and equipment are transferred to another entity (generally a business firm) through a contractual arrangement. Elements like patents, copyrights and trade marks, technical services, formulae, designs, product and process engineering, training of personnel are generally included in a technology transfer contract, though in different forms and proportions. While some times these technical assets and/or services can be directly sold, as is the case with turn key projects, in most agreements the disembodied technology is licensed not sold to the recipient firm (i.e. there is no sale of property rights from the seller to the buyer).

In addition to the technology transferred through contractual arrangements either between independent firms or between parent and subsidiaries within transnational corporations (TNCs), technology transfer can also take place through non commercial means as in the form of technical journals, migration of skilled people, training of students, etc. In the present report, our concern is with technology transferred through contractual arrangements by firms in industrialized countries to enterprises in developing countries, either within TNCs or through joint ventures and/or licensing agreements with independent recipients.

While technology issues in general and specially those related to the characteristics and consequences of the new and emerging technologies like microelectronics, biotechnology and new materials have been receiving increasing attention by scholars and policy makers, relatively little has apparently been written and policy makers are paying scarce attention to transfer of technology from industrialized to developing countries in recent years, in contrast with the lively scholarly production and the relatively high policy attention in the 1970s and early 1980s.

Although technology transfer from the North to the South is an important issue in the Asian context and may become more important if other developing countries resume their growth process and specially if the industrialization process is redirected towards the creation of dynamic comparative advantages, the declining interest in the topic under consideration is, in our view, a result of three main developments.

First, it is partially a reflection of what has happened with technology flows in the 1980s, period that has witnessed a dramatic slow down in most of the proxies for the international transfer of technology. As shown in a recent report of one of the UN agencies that was most involved in research, policy advice and international negotiations on this topic, technology flows to developing countries have been dramatically reduced since the debt crisis and with the poor economic performance of these countries (UNCTAD, 1987).

This new development has been however very uneven. As shown in Table 1, while technology flows to Latin America and Africa have been reduced, this is not the case with

flows to Asia, specially South East Asia. At the same time, technology flows between industrialized countries continue to be as or more important than in the past and have taken new forms like those of technical alliances or strategic partnering, that are beginning to be carefully followed and studied(e.g.Chesnais,1988).

Second, while the case in favour of government intervention in the imported technology market and the regulations implemented by a number of countries in the 1970s and their consequences accounted for a significant part of the scholarly production in those years, the trend towards liberalization in technology regulations which is visible in many developing countries in the 1980s has obviously reduced the direct government role in this question.

However, the new policy environment deserves close consideration. Imports of technology are to be assessed in a policy framework in which developing countries are protecting less than in the past their domestic markets and trade and macroeconomic policies are generally favouring manufacturing exports based on low real wages and high exchange rates rather than on technology development, at least in Latin America.

Finally, the narrow way in which technology transfer was approached in the relevant literature, while still valid when referred to the complex relationship between licensor and licensee, has led to diminishing returns to research on it. In contrast, technology transfer seems to be more alive when discussed in a more comprehensive approach specially in connection with domestic generation and mastery of technology and more generally when trade and foreign investment flows are taken into account.

In this connection, while technology transfer to Asian countries is an important topic to be studied not only because technology flows have become more significant but also because the question of access to the more advanced technologies is a crucial issue for the Asian NICs and some other Asian countries in their strategies of technological catching up, the topic under consideration is not only relevant for Asian developing countries.

In Latin America although productive investment has been dramatically reduced in the 1980s and hence imports of technology, embodied or not in capital goods, manufactured exports have grown and domestic markets and production are becoming less protected due to the opening up of the economies and modifications in State procurement and ownership policies. How domestic and foreign enterprises operating in these countries have adjusted to the new conditions and what have the implications of this adjustment been for technology transfer and generally for technological innovation are very relevant issues on which very little is known.

A closer look to these three developments may shed some light not only on the factors accounting for the declining interest on technology transfer in the recent past but also provide some clues on emerging research issues for the near future.

To deal with these questions, the report is organized as follows. In the next section, some of the main issues discussed in the literature on technology transfer in the last decade are reviewed. Section 3 deals with the conditions in which technology transfer have taken place in the 1980s. The main features of the macroeconomic environment are pointed out, to examine then the evidence available on technology flows to developing countries. The relevant policy modifications regarding direct foreign investment, technology transfer and trade are examined and references are made to the growing heterogeneity of enterprises operating in developing countries. In the light of the previous discussion, the most important research questions and possible ways of answering them through firm and country studies are pointed out in the final section.

In what follows and due to time limitations, technology transfer is mostly referred in relation to the manufacturing sector although some of the observations are of relevance to some high tech services. At the same time, the focus is mainly on the demand side, i.e. recipients of technology in developing countries and only references are made to the deep changes taking place in the supply side. Within developing countries, the discussion is on the countries where technological development (and imports of technology) in the manufacturing sector was considerable before the crisis of the 1980s. Hence attention is mostly paid to Latin America, though some references are made to Asia. It is likely that some of the issues under discussion are also valid for some African countries but our knowledge of their situation is very limited to be able to include them.

2. The main issues in the received literature

a) The rationale for transferring technological assets

In contrast to the neoclassical theory in which technology is assumed to be a free good instantaneously transferred across national boundaries, technology is generally treated as an intermediate product. It is both the output of an asset, namely technological capacity and an input into further value added creating activities (Dunning, 1987).

The quasi rents generated by the technological assets a business firm is in possession of, can be obtained directly manufacturing the product in which the technology is incorporated either in the product itself or in its production process and exporting it. If the conditions in the importing country prevent the use of the exporting route to exploit the technological asset due to tariff or non tariff trade restrictions, other government policies, etc, the technology owner has the possibility of transferring the technology to a wholly owned subsidiary (i.e. internalizing the technology transfer) or to license it to an independent firm.

The reasons accounting for one or other way to exploit the technological assets have been extensively discussed in the literature. In his influential eclectic theory of international production, Dunning (1981) points out the ownership, internalization and locational advantages that may favour exports, direct foreign investment or contractual resource transfer (i.e. licensing, technical assistance agreements, management contracts, etc) as alternative routes for servicing a foreign market. Casson (1986) provides a framework for

examining the factors that may influence different forms of contractual arrangements including licensing and Caves(1982) discusses in more detail the advantages of licensing vis a vis direct foreign investment(mostly relying on Telesio, 1979).

Licensing is encouraged where entry barriers deter the firm from undertaking a direct foreign investment or when the licensor lacks some assets needed for establishing a subsidiary. At the same time, the lead time in licensing is lower than in building a subsidiary. Furthermore, licensing is preferred when possibilities of reciprocity may exist.

On the other hand, licensing is discouraged when the risk of facilitating the emergence of a competitor exists, when the technology cannot be easily codified or when the quality of the product(eg. when trade marks are involved) cannot be guaranteed,etc(Caves,1982).

Although the choice among these three routes for servicing a foreign market depends on a variety of conditions in home and host markets and on the nature of the technology and its transaction costs, it is important to point out that pure licensing is generally considered a second best alternative for international expansion, except for small firms or newcomers to this field. Technology transfer through direct foreign investment is clearly the preferred option for exploiting technological assets, specially when TNCs are involved and hence international trade in goods and services is arranged within the firm to accommodate the needs of their global expansion(Teece, 1981). However, the need for reciprocity has enhanced the opportunities for licensing among firms based in industrialized countries, although cross licensing is only one of the means used in these technical alliances.

b)The imported technology market and the licensors' costs for transferring technology

The imperfect nature of the market in which technology is traded(Caves, Crookell & Killing, 1982) and the unequal bargaining position between suppliers and recipients, when the latter were operating in developing countries were the major facts on the basis of which the literature and policy initiatives on technology transfer were developed mainly in the 1970s.

From the pioneer studies of Cooper and Sercovitch(1971), UNCTAD(1972), Cooper (1974) and specially Vaitos(1974) a clear picture from the imported technology market emerged.

The main elements of the picture were:

- i) the international technology market was a very imperfect one where TNCs were the main suppliers;
- ii) in so far as the marginal costs in transferring technology were trivial vis a vis the costs incurred in creating technology, the incomes received by technology owners were mostly profits;

iii) to transfer income from their subsidiaries in developing countries, TNCs used a variety of channels beyond dividends and royalties including the transfer pricing of intermediate products and inputs;

iv) excessive royalty and fees were paid by subsidiaries and licensees to technology suppliers;

v) a variety of restrictive business clauses like tied in imports of intermediate products; grant back provisions by which the acquiring party was required to transfer to the licensor improvements arising from the acquired technology; restrictions on adaptations to the received technology and restrictions operating after the termination of the contract and several export restrictions were used by technology licensors to constrain the operations of their affiliates and specially of independent licensees. These clauses not only increased the costs of importing technology but also inhibited economic and technological development of recipient firms and importing countries;

vi) recipient firms had in most cases a weak bargaining position because of the peculiarities of the technology market and their lack of technological experience.

On the basis of this picture, the unbalanced nature of the technology importing market was pretty clear. Suppliers had an active role and dominated the market while recipients were almost victims of the situation and played a passive role in this very unequal game.

The picture emerged from the findings of a number of studies first based on the evidence of a few developing countries. The evidence was then confirmed in many other countries mainly in Latin America (Argentina, Brazil, Mexico, the Andean Pact members, Costa Rica) and Asia (India, Malaysia, South Korea, Philippines, Indonesia) as reported in several UNCTAD studies (UNCTAD, 1975).

On the basis of these findings, government policies for regulating technology imports were implemented in several developing countries in the 1970s, following the early attempts made in India in the late 1940s and in Brazil and Japan in the late 1950s. These policies mainly attempted to increase the bargaining position of recipient firms and to diminish the social costs of importing technology. They sought to reduce the explicit royalty payments, to eliminate the restrictive clauses and to shorten the duration of contracts. In some cases, these regulations on technology transfer were implemented jointly with policies aimed at

reducing the transfer of resources associated with the operations of TNCs and/or at promoting greater domestic control on foreign firms through joint ventures.

National policies for regulating imports of technology led to an attempt to negotiate within UNCTAD an international Code of Conduct for the Transfer of Technology. Although the attempt was unsuccessful, their negotiation may have played an educational role for other developing countries when the regulatory issue was alive. As discussed below and for a number of different reasons, national government policies on technology transfer have also changed in the 1980s.

The rationale for "government intervention in the market for imported technology in developing countries has been based on the assumption that the monopoly rents enjoyed by technology suppliers could be taxed without affecting the eventual supply. In other words the supply of technology when directed to developing countries was basically supposed to be inelastic to price reductions"(Chudnovsky,1981).

Two main arguments were put forward in the literature to support such an assumption. First, given the fact that once new knowledge has been created it has not only the character of a public good(i.e. its use by one agent does not in principle diminishes its availability to others) but also its transfer costs (if any) are trivial in relation to the development costs, then any income obtained from its transfer can be considered as pure profit(Vaitsos,1974).

Second,although suboptimal from the social welfare viewpoint because the price of knowledge should be zero, it is recognized that a temporary monopoly is required to encourage the production of new knowledge. However,"for most of the countries in the world, and specially the less developed countries, the contribution that the opportunity to earn a profit in their markets makes to the encouragement of investment in the creation of new commercial knowledge is negligible, so that any profit they allow to be earned from the command of advanced technology is for them a short run loss with no compensating long run gain from the encouragement of technical progress"(Johnson,1970,p.40).

While these arguments have certainly given support to the assumption about the inelasticity of technology supply, a number of counter arguments have to be taken into account as well.

Teece(1977) after a detailed investigation of 26 transfer of technology projects(mostly involving intra-firm transactions in developed countries) argued that considerable costs were involved in the transfer of technology and it was therefore "quite inappropriate to regard existing technology as something that can be made available to all at zero social cost"(p.259). However, he pointed out that transfer costs tend to be higher the first time the technology is transferred and higher for newer technologies. They are lower the more prevalent are similar technologies among other companies and the more experienced in manufacturing is the recipient. This finding is very important to qualify how significant transfer costs specially when directed to developing countries are.

Contractor(1981) examined this crucial issue and suggested that the technology supplier's costs should be divided into three categories: transfer costs of effecting the technology transfer, the sunk or development costs and the opportunity costs.

Supporting Teece evidence, Contractor found that transfer costs were significant. These costs included, in addition to legal and marketing expenses, the technical expenditures incurred to bring the licensee firm to a position in which it can produce and sell the licensed product and the travel and training costs . In a more recent study dealing with UK technology suppliers to India, it was found that transfer costs of existing technical knowledge about the products involved in collaboration agreements were of considerable significance(Bell & Scott-Kemmis,1988).

When asked whether R & D expenditures are treated as sunk costs in negotiations with prospective licensees, the responses of the twelve firms interviewed in detail by Contractor clearly supported the argument put forward above,i.e. that licensing income particularly from non affiliated licensees and even more specifically from LDCs, was not used to amortize R & D expenditures of US firms(pp.78-9). A similar approach on the basis of larger sample was found in a study by Lovell(as reported by Root, 1981) and in a study in England(Bell & Scott-Kemmis,1988).

Forgone opportunity costs occur when entering the agreement with the licensee preempts other forms of profit from that market(i.e. from exports or direct investment). In those countries where other routes of serving the market are prevented by the institutional framework, opportunity costs may be nil as Contractor suggests for some developing countries. If opportunity costs also include considerations like in what other markets the same margin can be obtained or what the competitors are doing, they may become more significant(Chudnovsky,1981a), although firms interviewed by Contractor did not apparently consider these costs.

Other opportunity costs may include exports sales that might be lost in third country markets due to the export activity of the licensee, if not prevented by specific clauses. However, in the mentioned study in the UK, 80 per cent of the suppliers firms indicated that they had not expected to loose sales in third country markets as a result of the transfer of technology to India(Bell & Scott-Kemmis,1988).

Although the assumption that the transfer of technology involves no extra costs to the licensor may need to be qualified in the light of the limited evidence presented in the above mentioned studies, it is still clear from the Contractor study that licensing was highly profitable even considering only transfer costs.

In these circumstances and taking into account that development and opportunity costs do not seem to play a significant role, the supply of technology, specially of relatively old and proven technologies, can be considered relatively inelastic to price variations for the types of technologies demanded by developing countries in the 1970s. It is probably for this reason that the reduction in royalty payments and the practice of unpackaging the

technology transfer did not apparently reduce the inflow of technologies to some developing countries where regulatory policies were implemented.

However, as suggested by Ernst and O'Connor (1989) access to high technology is becoming increasingly difficult. Technology has become more elastic to price variations in the 1980s, specially in the case of new and emerging technologies. In this type of technologies, development costs are higher and opportunity costs more significant and hence companies may be less willing to enter into licensing agreements.

c) The degree of competition in the supply of technology

In the standard picture of the imported technology market, the supply was considered monopolistic and mainly in the hands of TNCs. While this may be true in a limited number of cases, further research has indicated that the supply is far bigger and more heterogeneous than originally expected.

First, the US firms that clearly dominated the international technology market until the 1970s have been increasingly challenged by the Japanese and some European corporations in the high tech business. Growing expenditures on R & D mostly financed by the private sector, reduced life cycle of new products and processes, the irruption of new comers to stable oligopolies and higher globalisation in TNCs activities are current features of the technology supply. While growing competition is clearly visible in the supply of technology, attempts to protect technological assets mainly through a reinforcement of intellectual property rights have also altered the picture of the market in the 1980s as compared with the situation in the 1970s.

Second, non equity forms of technology transfer have apparently become more significant even before the current overall decline in North-South technology trade had been perceived. These "new forms" that include not only licensing agreements but also joint ventures (in which foreign held equity does not exceed 50 per cent), management contracts, franchising, international subcontracting, leasing and countertrade arrangement involving technology transfer have enlarged both the supply and the forms of international technology transfer (Oman, 1984).

Third, suppliers of machinery from both industrialized and developing countries have apparently become more important in the technology supply, although as shown below imports of machinery and equipment by developing countries (except in Asia) have been reduced in the 1980s. Despite the fact that machinery makers supply embodied technology, the trend towards customizing and providing after sales services to buyers that is visible in the higher end of the machinery market has probably augmented the disembodied portion of their supply.

Fourth, the growing exports of technology by firms in the most industrially advanced developing countries has created a new source of supply specially for some unsophisticated technologies (see issue of World Development edited by Lall, 1984).

Fifth, small and medium size firms have been increasingly active in supplying technology to developing countries(see Ozawa 1985 and White and Campos, 1986) some times on their own and in other instances following the lead of the big companies to which they are linked as subcontractors.

Finally, engineering firms and specialized process developers have become an important source of technology in process industries like petrochemicals(Cortez & Boccock,1984) but also and generally in the provision of construction and engineering design services(Sapir,1989).

The different actors and channels to transfer technology clearly give a picture of the technology supply that is far less monopolistic than that assumed in the literature of the 1970s. Although some of the actors and factors have emerged in the 1980s, it is probably fair to say that even in the 1970s the monopolistic nature of the technology supply was exaggerated, although it was certainly true in a limited range of sophisticated technologies.

In addition to point out the various alternative available in technology supply and to show that in their sample a significant proportion of the suppliers were remarkably small and non multinationals, Bell & Scott-Kemm found that in the majority of cases the initiative had been taken by Indian firms and not by the British firms.

A similar finding was reported in a study on technology transfer and joint ventures from Italian firms in India (Balcet, 1984) and this is probably also the case in other developing countries(eg in Korea,Enos & Park,1988).

The passive role taken by the suppliers goes against the early thinking on the subject and led to Bell & Scott-Kemmis to suggest that only when major TNCs are involved there is a well defined strategy towards technology transfer to developing countries. Even more important is the active role taken by the recipient, a subject to which we now turn.

d)The position of domestic recipient firms

In the standard picture of the imported technology market, the recipient independent firm(the case of foreign affiliates is discussed separately) was considered with weak technological capability and hence a victim of the monopolistic practices prevailing in that market. From that consideration it was deduced that it would welcome the government intervention as a means of reducing costs and improving the conditions of importation to be able to strengthen her technological capabilities.

This position of the recipient firm does not seem to reflect the reality of developing countries, except in exceptional cases. The most obvious reason for which the licensee cannot be expected to have such an underdeveloped technical capacity lies in the whole business of licensing. Licensors of technology have an immediate interest in ensuring that the licensee is in possession of some technological capabilities, since their earning are

normally related to the sales of the product made under license and these sales depend to some extent on the quality of the product.

However, from having some technological capabilities for manufacturing the product under licence to be able to generate and manage technical change, a significant improvement in the firm capabilities is required.

In this connection and although the elements contained in the agreements are dealt below, it is important to keep in mind that if new production capacity in the importing firm is involved the main elements that are considered are: engineering and managerial services and capital goods and skills and know how for operation and maintenance.

However, if the importing firm is building up a technological capacity the crucial elements to be obtained from the licensor is knowledge expertise and experience for generating and managing technical change(the know-why instead of the mere know-what)(Scott-Kemmis and Bell,1988).

The motive for a firm in a developing country to seek a technical licence from a foreign supplier may be either commercial or technological or both.

First, where the recipient firm operates in a concentrated product market in which oligopolistic competition prevails, a transfer of technology agreement-often including the licensing of a foreign trade mark- becomes an important marketing tool. Such a tool is even more important when the recipient firm has to compete with foreign subsidiaries - which have direct access to the technological and marketing assets of their parents- in their product markets. In so far as they are able to pass the costs of importing the technology to their customers, the payments reduction is not their main concern, although they may try to diminish them.

Recipient firms mostly concerned with acquiring marketing tools, are generally engaged in some technological activities and are mostly concerned in receiving from the licensor product specifications and quality control(i.e. the know what). While this is typically the case in firms producing consumer goods, it is not only restricted to that segment. For instance in the course of the research carried out in the Andean Pact countries it was found that more than half of the firms gave brand name considerations as one of the reasons for licensing(Mytelka, 1979). For capital goods producers studied in Tunisia "licensing basically means a trade mark(the brand fo which they were the exclusive representatives) and technical assistance in designing, setting up and launching the enterprise.By these means, the acquirer of technology seeks mainly to dominate a market and not a technology"(as quoted in Chudnovsky and Nagao,1983,p.63).

Something similar was found in a more advanced developing country,Brazil. In a study on the subject it was found that recipient firms manufacturing capital goods also considered extremely important to have a license agreement to be able to satisfy the requirements of the customer(Erber,1982). In another research on the computer industry, sixty per cent of the firms entered into licensing because they faced direct competition from licensed products which were already proven and enjoyed goodwill in the local market(Tigre,1983).

Beyond the relative importance of marketing with respect to technological considerations in the motives of recipients firms to look for a licensing agreement, what seems to be crucial to pay attention to is to the domestic market conditions in which the licensed technology is exploited, an aspect that started to be considered only recently in the literature(see Desai,1988).

Second, recipient firms that are actually concerned with developing a capacity for implementing technical change may use transfer of technology agreements to take advantage of certain assets that they do not have or that will require excessive efforts or time to develop themselves.

Although firms engaged in this kind of technological development existed when the standard picture on the technology import market was drawn, research on them is largely a phenomenon of the late 1970s and early 1980s.

As mentioned in the introduction of one of the books dealing with technological development:

"From the latter 1970s, however, the assumption about extremely weak technological capabilities in the Third World began to be challenged, as the focus of attention shifted to an examination of technological processes and change in these countries. Increasingly researchers became interested in what happened to technology as it was imported and assimilated. Accordingly rather than focusing research primarily around issues relating to the costs of importing technology, a greater amount of attention began to be given to the processes involved in the mastering and adaptation of this technology"(Fransman,1984,p.5)

On the basis of the studies made on technological development individual firms in some Latin American countries by Katz and his collaborators, in India by Lall and other researchers and in Korea by Westphal and his collaborators and by Enos & Park,a new picture started to emerge.

The main features of this new picture can be summarized as follows:

- i) in so far as the macro and microeconomic environment in which firms operating in developing countries is vastly different from that of the industrialized countries, imported technologies have to be adapted to lower scales of production, to different factor costs, to scarcities of intermediate inputs,etc. The process of adaptation involved specific technological changes in both product engineering and process engineering for which technical efforts(not necessarily accounted as R & D) were required. The assimilation and reproduction of technology involved a process of technological change however minor
- ii) the technological trajectory followed by firms in developing countries involves an important learning process which has a cumulative sequence that led to significant rates of

productivity growth and to the emergence of different products from the previously imported ones.

iii) the aim of these firms is to achieve technological mastery as defined by the operational command over technological knowledge and manifested in the ability to use this knowledge effectively and achieved by the application of the technological efforts(Dahlman & Westphal,1981)

iv) in contrast to the simplistic view in which technology was conceived in the technology transfer literature, a more complex and realistic view of the technology itself started to emerge and was latter developed in the literature. In this connection,"manufacturing technology is characterized by a considerable element of tacitness, difficulties in imitation and teaching and uncertainty regarding what modifications will work and what will not"(Nelson as quoted in Dahlman & Westphal,1981).

v) to be able to take advantage of technology imports, significant efforts are needed in the recipient firms to adapt existing technological knowledge.

This type of technical change in developing countries was mostly studied at firm level and in countries following an import substitution industrialization process(as India and Latin America and even South Korea). An important part of the changes at product and at process levels were undertaken to face the problems of an economic environment which was highly protected from international competition and where exports were generally receiving significant subsidies.

Despite the fact recipient firms were mostly private enterprises, some studies analyzed interesting experiences among public enterprises mostly in Brazil(Fleury, 1985), Korea(Park, 1981 and Enos & Park,1988) and in some Indian firms(like HMT).

As suggested in recent review paper the innovations made by the firms under study were assessed only taking into account the private returns. The emphasis on the firm rather than on the industry makes it difficult to evaluate the social returns of the reported innovative activity.

In the same review is pointed out that, in contrast to the intensive study of innovation in some countries following import substitution industrialization policies, there is less documentation of what happened in the export oriented East Asian countries. The availability at international prices of traded inputs and the need of fabricating products to meeting world demand created a different environment and hence different inducements to technical change than that prevailing in the protected internal markets of Latin America and India(Pack,1988).

Although some studies are available to document the process of absorption and adaptation followed by East Asian firms(in addition to those already mentioned see reports contained in IDRC(1981), Komoda,1986 for a survey of Japanese

studies; Jacobsson and Edquist(1988) and Fransman(1986) for the machinery industries) this is an area that requires further research.

In any case, firms in developing countries doing this type of technological efforts are clearly a different kind of animal than that depicted in the technology transfer literature. They may have a capacity to search and negotiate for the imported technology vastly different from that originally assumed.

Given the focus of the research above mentioned, in most studies unfortunately little attention was paid to the evolving negotiating capacity of the recipient firms engaged in these technological efforts.

However, in a study made on industrial machinery producers in Brazil it was pointed out that a process of learning how to negotiate a licensing agreement was taking place as part of the process of technical learning. This process of learning how to negotiate was manifested in the better terms that the recipients were able to obtain as compared with previous negotiations, although it was not clear to what extent this was due to the government regulations in this field, a question to be discussed below (Erber, 1982).

A similar process has taken place in Indian firms as documented in the important search of technology suppliers that these firms made to be able to import the technology they needed (Alam, 1988).

In the Korean case, the government played a crucial role in negotiating with foreign suppliers the technology required for establishing new plants aimed at producing key products such as petrochemicals, synthetic fibers, diesel engines and iron and steel, despite the fact that only steel is actually made by a public undertaking. While the private firms devoted significant efforts to absorb foreign technologies with uneven results according to each case, the government role was described as follows:

"When we began our enquiry, we did not realize how dependent the success of the absorption of the foreign technology was upon precise terms obtained by the Korean government in its negotiations with the foreign suppliers. The Korean government could have behaved in different ways, as do governments of other developing countries: it could have been passive, accepting whatever terms of the foreign supplier offered; or it could have negotiated just as firmly but for different terms, terms which might have enriched a small fraction of its citizens while leaving the remainder not better off. We believe that in either of these cases the absorption of the imported technology would have been less successful and the benefits to the entire economy less substantial" (Enos & Park, 1988, p.248).

This unusual role played by the government in the negotiating process is not only very different from that exercised in other developing countries but also not so clearly mentioned in other studies on Korea. In this connection, the ability of local firms to negotiate different forms of technology transfer have been pointed out in several studies by Westphal and his collaborators and by Ernst & O Connor. One of the interesting points

made in the Westphal study is the importance of foreign buyers of the products as a source of relevant knowledge, specially regarding quality standards and design specifications(Westphal,Rhee and Pursell 1984).

Despite this fragmented evidence, far more research is needed to assess the negotiating capacity of recipient firms that are at the same time seriously engaged in technological development. A major issue is to learn the extent to which imports and local development are complementary activities and what are the problems recipient firms have in obtaining the more advanced technologies specially in relation to the know why(eg basic design).

e)The position of foreign affiliates

Intrafirm technology transfer is far more significant than that taking place between independent parties as indicated in the high proportion of payments coming from affiliates in the cases of US and German firms (UNCTC,1987). This is a reflection of the preferences of technology suppliers towards fully controlling the assets transferred to overseas establishments.

In the technology transfer literature the technological behaviour of affiliates was mostly focused on the questions of payments. In addition to the explicit payments for the use of technological assets, other channels to transfer funds like the manipulation of the prices in which intrafirm trade took place, intrafirm loans and interest payments, dividends and the capitalization of technological assets or second hand machinery, etc were found in several developing countries following the pioneer studies of Vaitsos in Colombia(Vaitsos, 1974, Chudnovsky 1974).

Regarding the pricing of intrafirm technological transactions, the main issue was how subsidiaries in developing countries were considered when undertaking centralized R & D activities. The pricing could be done either by paying the marginal cost of the ex ante R & D planned for that developing country or as an ex post pro rata contribution to the financing of centralized R & D(Chudnovsky, 1981b). Of course, in addition to the contribution to the R & D costs, the transfer costs as such should be taken into account, though considering Teece observations about the age of the technology transferred.

As it was assumed that subsidiaries do not have any degree of freedom in negotiating the price of the technology transferred by the parent company, the technology payment was directly negotiated with the government. In that connection, some policies were implemented in developing countries to deal with intrafirm technology transactions, as shown below.

Beyond the pricing issue, the technological activities of the subsidiary itself are important to be analyzed and what are the contribution if any of these activities to the development of indigenous technological capabilities.

The starting point to consider this issue is that, within TNCs, R & D is one of the activities that is most concentrated in parent companies (or eventually in subsidiaries operating in other industrialized countries). Therefore, affiliates operating in developing countries basically receive the fruits of the R & D done in industrialized countries.

In the case of US TNCs, R & D expenditures undertaken abroad by all manufacturing subsidiaries as proportion of R & D outlays made by parent companies increased from less than 5 in 1966 to 10.7 in 1977 and declined to 10.4% in 1982 (Vickery 1986). However there are some indications that foreign firms account for significant percentage of the R & D expenditures in countries like Ireland, Canada and Australia (Vickery, 1986). Furthermore, it has been argued that the growing costs of undertaking R & D are forcing leading firms to decentralize this crucial activity to countries with lower wages for scientific personnel and to take eventual advantage of the available fiscal and other incentives (Mytelka 1983).

While R & D of the type done in industrialized countries is apparently absent in subsidiaries operating in developing countries, in some of the studies on technological activities it was found that some subsidiaries have been active in adapting and modifying the products imported from their parent companies to the conditions of the host country. Local facilities have been established for testing products, adapting them to local conditions and controlling quality (UNCTC, 1987).

In the Brazilian case, subsidiaries making standardized series built engineering products like automobiles, auto parts trucks and buses, tractors, construction and mining machinery, etc have been laying the role of technology intermediaries (i.e. adapting technology originally imported from their parent companies to the conditions of developing countries, Chudnovsky, 1989). Firms like Pirelli, GM, Rhodia and IBM are reported to have certain R & D activities but on the whole foreign firms accounted for only 8% of the expenditures in R & D made in Brazil in the period 1978-82 (Ferraz, 1989).

In Argentina, it was found that local R & D and engineering efforts were extensively used in a subsidiary of a US firm producing rayon, resulting in new product varieties permitting the use of different raw materials, product quality improvements and increases in productivity. In a subsidiary of a US TNCs making telecommunications equipment, as a result of "buy national", significant efforts of adaptation to domestic materials and to increase productivity were also reported (Teitel, 1981).

A similar picture emerged from the studies made by Katz and his collaborators. However, to adapt the original production process and blueprints to the local environment the subsidiaries develop domestic technological capabilities in process engineering matters as well as in production planning and organization rather than in aspects of new product design where they mostly rely on their parents. As compared with domestic firms they do not need to develop "in house" engineering as do the local firms and certainly enjoy less freedom and flexibility (Katz, 1987).

In this connection, R & D by foreign affiliates were reported to be less significant than that of domestic firms in India in 1980-81 and, in an econometric exercise, it was found that direct foreign investment had a negative association with R & D intensity(Kumar,1987).

More recent surveys in Argentina in the mid 1980s suggest that efforts on R & D by foreign firms were not discontinued despite the difficult macroeconomic environment. In a study on 341 leading exporters of manufacturers where 81 foreign affiliates were included,it was reported that 73 % of them had R & D activities(in contrast to 53% among the 217 surveyed domestic firms). Half of the foreign firms had technology transfer contracts while only 8% of the domestic firms had such contracts(INDEC/CEPAL,1987).

While the firms studied in Argentina and Brazil were basically adapting the technology received for operating in the domestic market and generating exports of the adapted products to other developing countries, some subsidiaries operating in developing countries are making sophisticated goods to be mainly exported to the industrialized countries markets. This is the case with very modern plants built in Mexico and Brazil to make engines and motor cars and IBM subsidiaries in Argentina, Brazil and Mexico that are exporting computers parts or peripherals to IBM main markets. A similar though probably more significant phenomenon is taking place in a number of Asian developing countries where Japanese TNcs are establishing subsidiaries or joint ventures to make components or final products for export markets.

In some recent studies on the automotive plants installed in the North of Mexico, it was found that not only the plants had very sophisticated production equipment but also that some key organizational concepts like quality control and productivity circles among workers and just in time methods were apparently implemented more or less at the same time than in the United States to be able to face the Japanese challenge(Minian et al, 1988).

Although these studies have started to shed light on this new reality, it is not clear how the process of transferring these organizational and production process technologies has been taking place within the subsidiary. Neither is clear to what extent subcontractors are involved in this technology transfer process, taking into account that the relatively low local content of production.

f)The elements contained in technology transfer agreements

As mentioned at the beginning of this report in technology transfer agreements a variety of elements are included. While in intrafirm technology transfer agreements tend to cover all elements, in contracts celebrated between independent parties technical elements are often more specific, specially after government regulations were implemented and a process of learning to unpack the agreements materialized.

In agreements related to turn key projects almost everything is included. For instance in a petrochemical project, technology transfer may include:

- i) preinvestment, feasibility and marketing studies;
- ii) detailed preproject studies of alternative technologies which be used in the project;
- iii) basic engineering-the embodiment of the central process chosen for the project into project-specific flow-sheets,layouts and designs;
- iv) detailed engineering-architectural and construction plans for the plant, precise specifications of equipment and materials;
- v) procurement and construction;
- vi)training of project staff;
- vii) start-up and initial troubleshooting services(Cortez & Bibcock,1984).

The main issues in this sort of comprehensive agreement are training of personnel to achieve a gradual replacement of foreign experts by domestic engineers and degree of unpackaging of the project to offer opportunities for participation to local suppliers of goods and services.

While in some countries the experience with these sort of agreements seems to be rather disappointing not only in terms of technology transfer and development of indigenous technical capabilities but also in relation to the actual operation of some of the plants installed(see on Algeria Yachir,1988 and on Tanzania,Wangbe,1986), in countries like Korea and Brazil not only the process of training and unpackaging gone further but also it led to the creation of a significant technological capacity to increase productivity.

In relatively mature technologies(eg in process industries) it seems that the possibilities of obtaining as much as required in terms of training and local unpackaging depends very much on the degree of industrial development of the host country, on the strategy of the importing entity and the intervention of the government in the negotiations as clearly suggested by Enos & Park (1988).

In some of these industries, the growing bargaining position of the transferee is also helped by the variety of suppliers including engineering consultants. However, the growing bargaining position of the recipient may be affected by the serious slump in investment conditions in many parts of the developing world and the serious difficulties in obtaining domestic funds to finance the local participation.

In technology transfer agreement for introducing a new product or a new process of production, the main elements are:

- i) basic design, design methodology of the product and formulae when appropriate;
- ii) detailed design for the manufacture of parts and components;
- iii) technical assistance for manufacturing processes including quality control systems, procurement, organizational methods, etc;
- iv) training of personnel and technical services;
- v) patents;
- vi) trade marks

The relative weight of these elements in different technology transfer agreement, according to the type of recipient firms and sectors of activity were examined in several studies(eg Unger & Saldaña, 1984).

In relation to the elements transferred in licensing agreements two issues have been pointed out in the literature. First, given the fact that suppliers often included in the contracts elements that were not actually transferred but charged for, a crucial issue was the capacity of the recipient party to select the elements actually needed and to pay a reasonable price for them. Second, the possibilities of learning through the agreement not only the technical elements required to operate and maintain the facility but also to eventually generate new products and processes. In other words, to obtain not only the know what but also the know why.

In a study of machinery firms that entered into the manufacture of complex capital goods mostly relying on licensing agreements in India, Korea and Brazil, a more selective approach was visible in Indian and Brazilian firms while surprisingly Korean companies tended to import everything. At the same time, recipient companies considered basic design and design methodology as key elements in technology transfer. However, it seems that technology suppliers were only prepared to provide designs of an older vintage and were reluctant to transfer design methodology, except to their subsidiaries(Chudnovsky & Nagao,1983).

In a study of technology absorption by a Korean firm producing diesel engines, it was pointed that the basic design of engines and of the facilities within which they can be produced has yet to be mastered. Although this may be a consequence of the various problems faced by the recipient firm, it was also mentioned that the technology supplier did not allow to learn the design of new engines to the Korean engineers sent to his plant(Enos & Park,1988).

The difficulties in obtaining basic design methodology were also serious for Brazilian domestic firms producing equipment for process industries. In contrast producers of mechanical equipment seemed to find easier to develop basic design capability, although it also required further domestic expenditures by the recipient firms(Erber,1982).

In a study dealing with technology transfer to India, few instances of suppliers reluctant to provide deeper technical knowledge(including basic designs) were found. In general, recipient firms were apparently concerned with obtaining certain specific knowledge and the content of collaboration was "narrow and shallow", leaving the impression that recipient firms were missing opportunities. To some extent,government regulations restricting payments did not help to obtain more knowledge from licensors (Scott-Kemmis and Bell,1988).

Although what recipient and suppliers firms have actually bargained in technology transfer contracts as compared with what they were prepared to transfer or willing to receive are definitely relevant issues on which further research is required, it is obvious that the picture

emerging from this study on Indian agreements gives exactly the opposite impression to that conveyed from the early studies on the subject.

Since technical assistance for manufacturing is a crucial element in the contract to be able to make and deliver the product and/or to implement the process in question, this is not a frequent issue in the received literature, except perhaps the adaptation of the process for making greater use of local inputs. This is precisely the area in which efforts by recipient firms were most successful and where the assistance of technology suppliers is more limited.

When the technology is protected by patents, technology suppliers are very careful about licensing this industrial property right. Patents are generally granted to the parent companies and licensed to affiliates or third parties for use in the country where the contract takes place.

The lack of use of the patents granted in developing countries for industrial production and as a way of protecting import monopolies led to a widespread criticism of the patent system in relation to developing countries(UNCTAD,1973),a subject that is beyond the scope of this report. Nonetheless is pertinent to point out that, in contrast to the debate in the 1970s in which developing countries had the lead, in the 1980s the United States has taken a strong position towards stricter protection of industrial property rights in bilateral and multilateral instances, making the patent issue probably more significant for technology suppliers in licensing agreements than it was in the 1970s(Correa,1988).

Licensing of foreign trade marks was probably a more significant element in technology transfer agreements than patents, specially when consumer goods were involved. While foreign subsidiaries directly use the trade marks from their parent companies, domestic firms competing with them try to obtain these assets through licensing agreements.

Although the short term benefits for domestic firms of this kind of licensing are clear, the long run costs of this business behaviour are some times not perceived. For the licensor, the benefit of this agreement goes beyond the royalty received for the sales of the trademarked product or the income received for selling some intermediate products to the licensee. The crucial benefit is the goodwill that the licensor is receiving out of the licence of the mark which is generated by the efforts of the licensee in keeping the market value of the trademark(Chudnovsky, 1979).

g) The effects on and attitudes of firms towards government regulations

The three areas in which government regulations produced particularly visible effects in technology transfer transactions were those of the duration of contracts, payments for technology transfer and restrictive clauses.

In contrast to the situation prior to the government intervention where contracts of 10 to 15 years and even of undetermined duration were frequent, a maximum of five years was

normally allowed by the governments. This restriction did not preclude the possibility of renewals, but they were subject to government evaluation and approval.

In most countries, the competent bodies fixed maximum royalty rates, according to the kind of technology and/or to the sector in which the recipient party operated. A ceiling of five per cent was often fixed for the most complex technologies and much lower rates were permitted for the licensing of less sophisticated technologies and of trade marks.

The clauses in technology transfer contracts that may negatively affect the economic and technological development of the importing country were often listed in the legislation and some of them declared per se illegal. Clauses most frequently imposed such as export limitations, tied in purchases of inputs, grant back provisions and those which restricted the use of the technology after the expiration of the agreement were subject to government review.

Although competent bodies made some exceptions, the restrictive clauses previously so common in the agreements under study were largely eliminated in the countries in question. Despite the fact that the monitoring systems were generally weak, legislative reform rendered these clauses unenforceable in law. This implied that any attempt by the technology supplier to enforce such practices would either involve coercion or be based on their tacit acceptance by the recipient firms(Chudnovsky, 1981a).

Using some proxy indicators, it was possible to observe that royalty payments as a proportion of the manufacturing output were reduced in some Latin American countries. The reduction achieved in royalty payments did not apparently affect the flow of technology, if measured by the number of contracts as an indirect indicator. Furthermore, intrafirm royalty payments by US manufacturing firms operating in Latin America were reduced in absolute terms since 1975 and the total record of repatriated dividends and interest payments did not suggest a shift from technology payments to other normal types of remittances until 1979(Chudnovsky, 1981a and 1982).

Despite the fact that these indicators lent some support to the suggestion that monopoly rents enjoyed by technology suppliers might had been taxed without serious prejudice to the inflow of technology, other arguments might also be valid.

On the one hand, the lack of effective control of the regulations left with some room to the suppliers to exert their market power by passing the regulations. This behaviour could be facilitated by recipient firms that did not welcome government intervention in this market. On the other hand, the effects just described could be mainly attributed to the growing bargaining position of recipient firms, may be helped by government regulations.

Since technology suppliers did not obviously see any benefit for them in the host government intervention, to judge the effectiveness of government policies in the market for imported technology, the key issue was the behaviour of recipient firms.

Although some pieces of evidence were found in some developing countries favouring government intervention and recipient firms used the government rules to increase their bargaining position with suppliers, most firms seemed to prefer a passive role to be played by the government in those matters and suggested that regulations should be flexible and exceptions should be contemplated(Mytelka,1979; Mortimore,1978).

In a more recent study on Indian recipient firms, the majority of them remained largely unaffected by the government policy. Only a minority of firms were either benefitted from government regulations in their negotiations with suppliers or found those regulations too restrictive. In the same study it was found that one of the main clause,i.e. export restrictions was often irrelevant to the actual export performance of the recipient firms since most the surveyed firms did not export and did not foresee exporting in the near future(Alam,1988).

Ways of by passing the government regulations were certainly used though is difficult to find direct evidence. For instance, in a study on licensing agreements in Brazil , most domestically controlled firms "indicated implicit gentlemen agreement's between them and the suppliers as necessary conditions in getting the technology"(Fung & Cassiolato,1976). In a study of the computer industry in Brazil, it was pointed out that despite government regulations against it,most licensed products faced export restrictions (Tigre,1983).

In other studies made in India and Brazil, it was mentioned that domestic firms were prepared to pay more than what the government regulations allowed(Erber, 1982, Bell and Scott-Kemmis,1988). It is not clear however whether such payments were made any way or the recipient firms used the regulations to their advantage as is mentioned in the same studies in a number of instances.

In addition to these pieces of evidence, it seems that recipient firms were not particularly disappointed when several of the governments that implemented the technology transfer regulations in the 1970s liberalized them in the 1980s, though this is a subject that needs to be investigated. In any case the apparent lack of complaints by the supposed beneficiaries of the government regulations is certainly a strong indication that the convergence between private and social interests on which the regulations were based was not as strong as originally assumed.

It could be argued however that a process of learning to license not only took place in recipient firms but also in the government. As pointed out in a study "through a decade of experience in these countries, administration of the laws and guidelines has improved substantially; and a considerable degree of flexibility and pragmatism is now a common feature in most of these countries. The regulatory pressure has also eased, with increased capability on the part of domestic companies to negotiate effectively with foreign technology suppliers"(Marston,1986,pp.418-9). A similar view was expressed regarding the changes introduced in Korea:"by 1979 the government had recognized that most large Korean firms had accumulated experience in screening the proposals of prospective suppliers and conducting negotiations with them"(Enos & Parks, 1988, p.37).

If domestic firms were not supporting the government regulations that, in principle, were aimed at favouring not only the importing country but also the recipient firms, it seems that the basic push for government intervention came from some sections of the government bureaucracy.

While the influence of the government officials was crucial in the Japanese and Korean cases and the Indian experience was shaped in the whole self-reliant tradition of the civil service, in the Latin American case an interesting interpretation was put forward by a political scientist.

In a very documented study of the experiences of Argentina and Brazil not only in regulating technology transfer but also in implementing science and technology policies and more particularly sectorial experiences in computers and nuclear energy, it has been suggested that ideological factors played a key role in the formulation and implementation of these policies. These ideas were put in motion by the Latin American pragmatic antidependency guerrillas that were basically intellectuals able to influence policy making in key areas of economic activity as technology transfer institutions. While in the Argentine case these intellectuals had some importance in technology transfer regulations and specially in the nuclear technology policy, in Brazil and due to the convergence with military officers and some industrialists, they had a long-lasting influence in the shaping and implementation of technology policies (Adler, 1987).

3. The environment for technology transfer in the 1980s

a) The macroeconomic picture

Most of the issues discussed in the literature on technology transfer have been raised in relation to an economic environment that was largely modified in the 1980s.

In the 1960s and 1970s developing countries were growing faster than developed countries and their industrialization process required an increasing flow of technologies to set up new plants and introduce new and more complex products and production processes in existing undertakings.

In addition to the demand for embodied and disembodied technologies brought by the industrialization of the oil-producing countries that, since the 1973 oil shock became a significant market for industrialized countries' firms, a number of oil-importing developing countries in Latin America, Asia and Africa, continued their industrialization process, requiring imported technologies to build up or modernize their intermediate products and engineering industries.

In a context of growth and of deepening the industrialization process, although affiliates of TNCs had a significant participation in a number of branches, the main actors in the search of imported technologies were public enterprises and domestic firms.

Given the fact that, as pointed out in UNCTAD(1987), in the period from 1973 until the early 1980s technology related flows continued to grow globally in nominal terms -though their rates of growth in real terms were substantially lower than during the 1960s-technology flows as such were not an issue. The issues as pointed out in the previous discussion were related to the conditions that surrounded the imported technology market and to the need to increase the bargaining position of the recipient parties.

This context in the developing countries was helped by the situation in industrialized countries. Developed market economy countries ended their golden age period in the 1970s and reduced growth rates, high inflation and growing unemployment were clear manifestations of the crisis. Furthermore, industrialized countries had a significant stock of proven technologies to be eventually transferred and technological progress was not seriously affected by the macroeconomic changes. Although the technical frontier started to accelerate due to the production and diffusion of new and emerging technologies, mostly those based in microelectronics, this new trend just materialized in the 1980s.

With the emergence of the debt crisis at the beginning of the 1980s, the economic performance of the developing countries in Africa, Latin America and several Asian countries deteriorated enormously.

While developed market economy countries after the recession in the early 80s, started a new growth process, although at rates far lower than in the golden age period and with significant differences between the US and Japan and Western Europe, developing countries with the exception of some Asian countries entered into the most serious crisis since the 1930s.

The crisis in the external sector was a result of a pervasive combination of factors such as dramatic reduction in external capital flows and growing capital flight; increasing interest payments due to the significant augmentation of interest rates in industrialized countries ;higher remittances; a deterioration in the terms of trade and slow growth in industrialized countries.

Domestic production stagnated and production per capita was generally lower in the 1980s than in the 1970s. Investment rates, that had a sustained growth in the 1960s and 1970s, led by the public sector but with significant participation of private entrepreneurs collapsed in the 1980s and in many countries net productive investment was hardly existing. The fall in the living standards of large sections of the population combined with a growing inequality in income distribution aggravated the social problems and contributed to the political instability that undermined the power of some new civilian government that took office after years of military dictatorship in some key countries of the developing world.

Macroeconomic imbalances contributed to high inflation rates and to wide fluctuations in the economic activity. The burden of servicing the external debt with the growing difficulties in taxing incomes due to capital flights and other factors led to a continuous fiscal crisis. Such a crisis not only seriously affected public investments but also crucial

expenditures in health, education and science and technology as well as the level of remuneration and of efficiency of public firms and of the administration.

The reduced level of economic activity and the investment slump contributed to a major reduction in imports. In the Latin American case, the volume of imports was 37% lower in 1983 than in 1981. Since 1984 imports started to grow again but in 1987 they were still 17 % lower than in 1981. In this way the reduction of imports was the main instrument used in the region to face the crisis in the external sector(BID,1988).

Despite the fall in commodity prices that seriously affected a number of developing countries, exports augmented in a significant way. Exports volume augmented at an annual rate of 4.4% in the 1980s(higher than the 2.6% of growth rate in world trade) and exports contributed with 90-95% of the hard currencies incomes in 1983-87(as compared with about 70% in 1978-81)(BID,1988).

While most Latin American countries increased the ratio of exports in GDP(if 1985-87 is compared with 1979-81), they had, at the same time decreased even more the ratio of imports in GDP, suggesting that the developmental impact of the growing export ratios has been very weak.

This issue becomes more clear when exports of manufactures are taken into account. Although some Latin American countries like Mexico and Venezuela had very high rates of growth of such exports in 1980-87, in sharp contrast to moderate growth in Brazil, Chile and Costa Rica and no or negative growth in Colombia,Bolivia, Argentina, Peru and Ecuador, the performance in the export front was not accompanied by the creation of new capacity. As mentioned above not only gross domestic investment in GDP decreased in all Latin American countries but value added in manufacturing grew very little if something in 1980-87.

Export growth of manufactures was not only due to the recessive conditions in domestic markets that led to spare capacities. It was also a result of the continuous process of devaluation of domestic currencies and reduced costs of labour. High exchange rates and extremely low wages gave international competitiveness to a number of branches that were built in the import substitution stage and that due to the new conditions in domestic markets had substantial idle capacity.

However, it was pointed out that although currency devaluations in real terms were very significant, in a number of countries they have been unnecessarily large and they may have contributed to a perpetuation of exchange rate instability, since a reversal of the movement(a real appreciation) could be expected to take place, if and when balance of payments stringencies eased. Although a simple correlation between real exchange devaluation or exchange rate stability and growth of exports is difficult to expect, it was found that a poor export growth of manufacturers was associated with exchange rate instability and/or with very large real depreciation of their domestic currencies in the cases of Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador and Uruguay , Ghana, Kenya and Nigeria.

Furthermore, in the same study is shown that real wages in manufacturing decreased between 30 and more than 50 % in the period 1980-87 in selected developing countries. Though no inverse correlation is found between export growth and the fall in real wages, it is interesting to point out that, while in countries like Mexico, Venezuela and Morocco, export growth was associated with reduction in real wages, this association was not visible in Nigeria, Ghana, Uruguay and Argentina where real wages fell a lot and manufactured exports grew little if something(UNCTAD 1989).

In contrast with the crisis faced by developing countries in Latin America, Africa and West Asia, a number of countries in East and South Asia managed to have a good performance in the 1980s. In the case of the Asian NICs and in some ASEAN countries, a process of exports of manufactures led growth continued in the 1980s, specially after the recovery in world demand since 1983. The sharp expansion of exports from these countries was accompanied by continued increases in investment and by stronger domestic consumption. The growth in exports and in investment, induced buoyant import growth in 1987. In addition to the these Asian countries, the economic performance of China was also quite remarkable in terms of production and investment growth(UNCTAD,1988a).

It is very striking to find that in countries like Indonesia, Malaysia, Mauritius, Pakistan, South Korea,Sri Lanka and Taiwan strong growth in manufactures exports was generally accompanied by high rates of growth in investment, manufacturing output and/or GDP in 1980-87. Furthermore, in South Korea,Thailand and Malaysia, real wages in manufacturing augmented near 50%(and in Indonesia 20%) in the same period(UNCTAD,1989). Thus in a number of Asian countries, exports of manufactures were clearly accompanied by significant structural changes in the economy and better living conditions, in sharp contrast to the African and Latin American experiences.

Though data are very scanty, the contrast between Asia and Latin America in R & D expenditures in the 1980s is also sharp. While Brazil and Mexico were devoting 0.6 and 0.7% of their GDP to R & D, Argentina, Chile and Venezuela 0.4-0.5%, India allocated 0.9% and South Korea 1.9% (UNESCO,1988)

b) Technology flows

Since 1981 and 1982, a dramatic slow down in most of the proxies for the international transfer of technology to developing countries is apparent.

As shown in table 1, imports of capital goods, that are a proxy indicator for embodied technology, were reduced from near 130 billion dollars in 1981 to less than 100 billions in 1985. While in Latin America and Africa such imports remained at low levels-but with significant fluctuations in Latin America-the growing imports in China since 1984 and the recovery in Asia in 1987 are remarkable.

The reduction in capital goods imports in Latin America and Africa is a direct consequence of the fall in productive investment and the difficulties found by the importing countries in obtaining external funds to finance their investment requirements. In this connection, it is important to keep in mind that, in Latin America, gross internal investment as a proportion of the GDP was reduced from 22,9% in the 1970s to 14,9% in 1986 and to 15,7% in 1987(BID,1988).

Direct foreign investment flows to developing countries were reduced since 1982 both in absolute terms and as a proportion to other destinations, specially the United States (UNCTC,1988). As shown in Table 1, the reduction in the flows of investment was significant in Latin America and Asia while Africa kept receiving a limited amount of direct foreign investment. The growing flows of direct foreign investment to China were the exception to the general rule.

Since 1986 and specially in 1987, direct foreign investment flows started to gain momentum in several Asian countries. Significant increases in foreign direct investment in Thailand, Malaysia and Singapore were reported in both years while in 1987 there was an important growth of foreign investment flows in South Korea, the Philippines and Indonesia as well(UNIDO,1988).

The growth in foreign direct investment to these countries was not only due to the good performance of these economies but also to the increasing flow of investments by Japanese TNCs and firms. The buoyant import growth that started in Japan since the yen revaluation is apparently pushing Japanese firms to establish subsidiaries in Asian developing countries to be able to export not only to the United States as was the traditional case but also back to Japan(Kohama & Urata, 1988).

The reduced foreign investment flows to Latin America have an obvious explanation in the economic situation of the region and the uncertainty created by the continuous debt renegotiations. Within the general trend of reduced direct foreign investment flows, it is important to take into account the implementation of debt to equity conversion plans in a number of Latin American and Asian countries.

In Brazil where net inflows decreased from an annual average of 1,682 millions in 1978-82 to 990 millions dollars in 1983-86, half of them were made through debt conversion. A more restrictive stance by the Central Bank and the political and economic uncertainties reduced the volumes converted in 1986 and 1987 to one third of total inflows. A new and more liberal system was approved at the end of 1987 and put into operation in February 1988. With the new system the value of operations rose to 793 millions dollars in the first semester of 1988, accounting for 83% of the total inflow(Fritsch & Franco, 1988).

In Mexico, in addition to the policy changes to be discussed below, debt-equity conversion also played a crucial role in reversing the sharp fall in direct foreign investment that took place since 1981. Debt conversion accounted for almost half of the direct foreign investment authorized or registered in 1986 and 1987. In this last year the inflow was 3

billions(in 1985 dollars) as compared with 2.1 billion as an annual average in 1978-82(Perez Nuñez, 1988).

In Argentina, where foreign direct investment flows were not very significant since 1981(from 841 millions in that year, they were reduced to an average of 222 millions dollars per year in 1982-84) and mostly accounted by profit reinvestment rather than new investments, there was a program to convert private external debt with exchange insurance into equity in 1985-86. The amount involved (512 millions dollars) represented half of the direct foreign investment flows made in those years. At the end of 1987, a program to convert external public debt into equity was launched. In this new program, the investment projects by foreign firms that were approved amounted to 516 millions dollars (Basualdo & Fuchs,1989).

From the experiences of these three leading countries in Latin America it is obvious that in a context reduced flows of direct foreign investment, subsidized schemes like debt-equity swaps seem to have a strong influence in attracting direct foreign investment.

Technical assistance flows that constitute a minor channel for technology transfer were not at least reduced in the 1970s and as shown in Table 1 had somewhat augmented.

Regarding payments made by developing countries for the use of imported technology, the information collected by the leading technological exporters^y indicates a significant growth in receipts in the case of the Federal Republic of Germany and a growing trend in the case of Japan until 1983. With respect to the largest technology exporter,i.e. the United States, technology receipts remained constant in nominal dollars(UNCTC,1987).

It is important to take into account that in both the United States and Germany, technology payments are dominated by intrafirm transactions. Therefore, although receipts that are based on passed investment may grow, the reduction in direct investment flows will certainly affect the future receipts to be received from developing countries.

Some information is available about technology payments and the flow of new technology transfer contracts in selected Latin American countries in the 1980s.

In the Andean Pact member countries, the number of registered contracts was rather low in the period 1982-86 and no clear trend emerges from the data shown in Table 2.

As shown in the same table, a declining trend is visible in the number of technology transfer contracts in both Argentina and Brazil. The fall was more pronounced in the Brazilian case(almost half between the late 1970s and mid 1980s) than in the Argentine case(one third between the late 1970s and late 1980s) but a growing trend is visible again in Brazil in recent years.

A similar picture is visible regarding payments at least in Brazil and Mexico. Technology transfer payments in current dollars decreased in both Brazil and Mexico since the early 1980s while in Peru they fluctuated and in Argentina augmented (table 3). Except in the

Argentine case where the liberalization of the technology import control system started in 1977, in Mexico and Peru this new trend started in the mid 1980s and in Brazil changes were made very recently.

It is important to take into account that Argentina was one of the first countries in liberalizing the control system, first in 1977 and then in 1981. Only contracts between linked companies are subject to some government scrutiny while technology transfer agreements between independent parties including those of trade marks are only registered. As a result of this liberalization from 1977 to 1983, payments for the use of foreign technologies and trade marks augmented more than 1,100 % while manufacturing GDP fell 20%(INTI-SECYT,1985).

While only scattered information is available on Asia, it seems that the trend is quite different than in Latin America. In India, with greater liberalization of foreign technology inflows the number of contracts reached 526 in 1980 and 673 in 1983. By 1983-84 technology payments were about 400 million from about 150 million dollars in 1980-81. In South Korea a growing trend in the number of technology contracts approved by the government is visible not immediately after the control policy was relaxed in 1979 but later on(from 288 contracts in 1979, the annual figure fell to 222 in 1980 and gradually increased to 432 in 1984)(Enos & Park,1988).

Despite the use of very proxy indicators, it is clear that whereas technology flows towards developing countries have decreased in the 1980s, sharp differences can be appreciated between some Asian countries, on the one hand, and Latin American and African countries, on the other. What has happened in the technology transfer front is to a large extent a reflection of the behaviour of the main macroeconomic variables in those regions.

However, although this broad picture is certainly true at a very general level, detailed analysis of the changes taking place in different countries and within each country at industry and at firm level is required to understand the behaviour of domestic and foreign firms with respect to technological variables.

c) The changed policy environment regarding foreign investment and technology transfer

Significant changes in the policies regarding direct foreign investment and technology transfer have taken place in developing countries in recent years. Although some of these changes were made in the 1970s, most of them have been a phenomenon of the 1980s.

On the basis of the examination made in a number of UN reports (UNCTAD,1987 and 1988b, UNCTC,1989), the picture can be summarized as follows.

Although many developing countries have always had liberal policies towards direct foreign investment, several countries in the late 1960s and in the 1970s attempted to regulate and control foreign investment flows and the activities of TNCs.

In this connection, policies limiting the field of activity and share of ownership by non residents in the country were pursued. Some countries took steps to promote joint ventures with a view to securing greater benefits from foreign collaboration agreements. It was also frequent to find policies -so called "performance requirements"- which established schemes to be followed by foreign firms regarding exports, training of personnel and absorption and diffusion of imported technologies. Furthermore, limits to profit repatriation and capital amortization were often established.

From the early provisions in India and the comprehensive policies of the Andean Pact countries (Decision 24), legal instruments dealing specifically with transfer of technology transactions were adopted in a significant number of developing countries. These regulations attempted to control technology payments, avoid restrictive practices in the contracts and their excessive duration. Furthermore, rules were fixed for limiting payments of royalties between a subsidiary and a parent company and the requirement that technological know how could not be capitalized as an investment contribution.

Jointly with the regulations on technology transfer, a number of countries in Latin America, India and Yugoslavia introduced changes in the patent system to reinforce provisions governing the actual exploitation of patents, since most of the patents registered in developing countries only served for protecting import monopolies or to impose restrictions in licensing agreements.

These policies towards regulation and control of direct foreign investment and technology transfer were implemented in the environment of the 1970s when direct foreign investment and technology were flowing towards the more advanced developing countries (though not as much as in the 1960s) to take advantage of their growth process. In these circumstances, a number of developing countries were preoccupied by the growing control of leading manufacturing branches that foreign firms exercised and hence about the likely denationalization of key areas of their economies. Furthermore, the effects of foreign firms on the balance of payments and their controversial role as agents for technology transfer were also factors accounting for policies mostly aimed at controlling the entry and the activities of foreign firms.

However, even in the context of the 1970s some countries like Argentina, Chile and Uruguay completely reversed the previous control system and liberalized foreign investment and technology flows as part of a package of policies aimed at opening up the economy. In Argentina trade policies were then modified again while leaving the opening stance regarding foreign investment and technology while Chile continued her policy of opening up the economy to imports of goods and services.

These liberalization policies were followed by several other countries in the completely different environment of the 1980s, specially since the initiation of the debt crisis in 1982.

The policy balance has shifted more towards promotion than control of the flows, no doubt as a result of the sharp decline in these flows, increased debt burden and poor performance in many developing countries.

The new foreign investment policies have reduced the limitations on the field of activity and ownership requirements and the restrictions on profit and other channels to remit funds. At the same time, guarantees against nationalization and other forms of taking of foreign property were enacted and a number of bilateral agreements and multilateral initiatives (like the Multilateral Investment Guarantee Agency) have been established in this connection.

In addition to facilitating the entry and operations of foreign firms, the new policy regulations have eliminated one of the factors for which technology owners may have chosen joint ventures or even technology transfer agreements as means for doing business in the countries in question. As a result, a growing participation of fully or majority controlled forms of technology transfer is to be expected.

Regarding transfer of technology transactions, the changes were aimed at easing the control of transactions by the government agencies, in some cases through a substantive modification in the legislation (like the Decision 220 of 1987 that replaced the Decision 24 in the Andean Pact).

While in a number of developing countries, the previous control system was transformed in a mere registration of technology contracts, in a few countries like India or Brazil, the control system still is in force, though certainly relaxed as compared with the 1970s. In Brazil, for instance, the agency dealing with technology transfer will no longer examine the different clauses of the agreements because it is assumed that parties know the legislation in force (INPI, 1988).

Industrial property legislation was also modified in a number of countries (like South Korea, Mexico and Taiwan) to ensure more protection to technology owners.

While in the case of technology transfer transactions, the growing bargaining power of recipient firms and the attitude of these firms towards government regulations may have been important explanatory factors in the policy changes, the reversal in direct foreign investment policies is a more complex phenomenon.

Although direct foreign investment was never an important factor for bringing external finance and, in any case, direct foreign investment was rather a complement than a substitute to bank loans (Lichtensztejn & Trajtenberg, 1987), the debt situation and the ideological offensive of certain industrialized countries and multilateral agencies have led to a growing interest in direct foreign investment as a potential supplier of funds for highly indebted countries. This renewed interest and the privatization trends that are becoming significant in a number of developing countries probably explain this policy reversal.

It is too early to learn to what extent these policy changes have affected technology and direct investment flows. Nonetheless, and as mentioned above, the proxies used for measuring technology transfer flows indicate a declining trend, except in some Asian

countries suggesting that these policy changes were not the main variable taken into account by prospective investors or transferors(Helleiner, 1989).

In addition to these policy changes regarding foreign investment and technology, the trade policies implemented at the same time in several countries, as to be discussed below, may revive the traditional route for serving developing countries' markets: exports from their home countries and, therefore, discouraging direct foreign investment and technology transfer.

However, even if there is no or little global economic growth, specific factors such as TNCs strategies in certain branches like automobiles and locational advantages have certainly played a role in shaping direct foreign investment flows as the Mexican case seems to indicate(Perez Nuñez,1988).

Far more significant that the liberalization trends in direct investment flows seem to be the debt to equity conversion plans that, as mentioned above, accounted for an important share of the investments flows going to several Latin American countries. Although the subject deserves to be investigated, this method of attracting direct foreign investment seems to be very expensive, create macroeconomic problems and what is more important redistribute existing rather than bringing new assets into the importing country.

Within this general trend towards liberalizing foreign investment and technology regulations, it is important to bear in mind that this liberalization was taking place in some cases jointly with policies aimed at promoting technological development at sectorial level and/or with new approaches towards foreign investment and technology transfer.

In the Mexican case, the liberalization policy was implemented jointly with growing commitments for manufacturing firms receiving technology from abroad in two areas:exports and contributions to indigenous R & D activities(eg the Mexico Program by which more than 50 foreign firms have contributed with funds for research and for training human resources) and promotion of technological development of suppliers. Although it is not clear how significant are these commitments, they may indicate some bargaining position from the side of the government in the negotiations with foreign firms(Perez Nuñez, 1988).

Far more significant than these general rules seem to be certain sectorial plans, as for example that to develop the computer industry in Mexico. This policy that started in 1981 and was modified in 1985 aimed at fostering the domestic production of computers, with the provision that in the microcomputers segment of the industry foreign firms could only have 49% of the undertakings, a decision that was accepted by some important US firms but not by IBM that wanted to establish a fully owned subsidiary.

In 1985 and when the whole program was reoriented from import substitution as main priority towards increasing exports, even at the expense of domestic integration, the IBM proposal for a fully owned subsidiary was finally accepted changing the previous

ownership policy in the area of microcomputers. In the negotiation IBM accepted to increase the value of the investment from 6.6 millions to 91.1 millions dollars (in which a significant commitment to R & D, development of local suppliers and technical assistance to a technological centre for semiconductors was included), augmenting the direct and indirect jobs to be created and both the local content and the export ratio of the production (Lichtentjzn & Trajtenberg, 1987). However, two years after the controversial agreement was made, the US company had not started the project (Soifer, 1988).

Besides the policy changes towards foreign investment, the Mexican electronic program is quite interesting to be analyzed in the context of the new trade policy that the country launched in recent years and that has certainly affected the way in which domestic firms, joint ventures and even foreign subsidiaries have been doing business. Although the general assessment of the experience is controversial (see Soifer 1988), it was reported that a number of firms have apparently been able to successfully face the new conditions, by relying among other things on imported manufacturing technologies and on some domestic technical developments (Warman & Miller, 1989).

The policy towards developing the informatics sector in Brazil is probably the most articulated attempt to foster the participation of domestic firms in certain branches of the electronics industry. The policy, that was reinforced by the adoption of an Informatics Law in 1984, was structured around the concept of "market reserve" for national companies, coupled with control of foreign investment. Such investments were limited to 30% participation in joint ventures.

Although foreign firms continue dominating the market for large computers, there was a significant growth of domestic firms in the reserved segments of the industry and a building up of local technological capacity on the basis of licensing agreements and own efforts (Tigre, 1983; Soifer, 1988). The Brazilian policy in this area has been very much against the main stream in developing countries in the 1980s, but it is not very inconsistent with policies followed by this country in other areas specially merchandise imports, direct foreign investment and technology transfer.

d) The changes in trade policies

The success achieved by some Asian developing countries with export oriented industrialization strategies and the increasing disenchantment with the import substitution policies coupled with the pressures from multilateral agencies towards opening up their economies have led a number of developing countries to reform their trade policies and limit the role to be played by industrial policies. At the same time, the fiscal crisis of the State and the privatization trends have not only fostered privatization programs in some developing countries but also contributed to reduce the funds available for implementing traditional industrial policies including State procurement in favour of domestic suppliers.

Replacing quantitative restrictions with tariffs, reducing tariff protection and the direct promotion of exports have been the main areas in which trade policy reforms have been

focused on. As recognized by the World Bank, which is one of the leading promoters of these reforms, few of the developing countries which adopted such reforms sustained them for any length of time(eg South Korea and Chile) and several attempts made in the 1960s and 1970s(eg Pakistan, Yugoslavia, Brazil, Argentina) have since been reversed(World Bank, 1987).

Most developing countries reacted to the balance of payments crisis in the early 1980s in a defensive way by adjusting imports to foreign exchange availabilities, through tariff increases, quantitative restrictions and to multiple exchange rates. Later on and generally as part of the adjustment programs, more comprehensive approaches were tried aimed at improving the efficiency of the export and import competing sectors.

At the end of the 1980s most developing countries had adopted or were edging toward more liberal trade policies than before the crisis. A variety of approaches have been followed, combining tariff and non tariff measures with foreign exchange policies. Only a few countries have reduced significantly and at the same time both tariffs and non tariffs measures, among which are Ghana, Mexico and Morocco(UNCTAD,1989).

While the effects of these policy changes in the import competing sectors have not yet been assessed , some information is available in the same UNCTAD report on export performance by those countries. In a representative sample of 32 developing countries, it was pointed out that the ranking of countries according to their rate of growth of exports of manufactures in 1980-87 bore little relation to their ranking according to the extent to which they liberalized their imports.

In examining the export performance of three outward oriented economies(South Korea, Turkey and to some extent Indonesia) it was observed that "all had successful export growth with continued import restrictions and heavy government involvement in managing trade.The key instruments in stimulating exports was not import liberalization per se but rather 1) a realistic and unified exchange rate; 2) heavy investments in the exporting sector, often spurred by government subsidies and direct credit allocations; and 3) an array of additional financial incentives for exporters"(Sachs,1989,p.16).

Hence export performance was mostly related to export incentives, to adequate but not unstable exchange rates and to heavy investments in the export oriented sector . As mentioned above, while in certain Asian countries the growth of export of manufactures was associated with growing investments and growth in total and manufacturing GDP, this was not the case in most Latin American countries where growing exports were made at the expense of domestic growth and with significant reduction in real wages.

In the same UNCTAD study, it is pointed out that the general reduction of tariffs and non tariff barriers did not lead to an abandonment of past policies of selective trade intervention in support of industrialization. This was particularly the case in the very successful Asian developing countries. Something similar is probably taking place in Latin America but with important differences among countries.

In this connection, it is important to bear in mind that countries like Brazil with an impressive record of manufacturing exports has important non tariff measures to protect domestic production. At the same time, Brazil launched in 1988 a new industrial policy in which trade, technology and industrial policies instruments were combined in an ingenious way to modernize the manufacturing sector and increase its competitiveness(see Fritsch & Franco,1988 for the background and a critical view).

While in other Latin American countries, some forms of selective State intervention exist at the level of specific sectors, industrial policies are becoming generally less relevant than in Brazil.

The modifications in trade policies are not only the factor contributing to the diminishing role that industrial policies is playing in many developing countries. Privatization trends and changes in State procurement policies may have also reduced the importance of this factor for fostering domestic production of goods basically demanded by the State(like custom made capital goods).Furthermore, the reduced public investments and the scarcity of funds for local finance may increasingly constrain the use of these traditional instruments for fostering industrial development.

In contrast to the modifications in foreign investment and technology transfer policies, changes in trade policies may have profound direct effects on the behaviour of technology suppliers

Instead of using direct foreign investment or licensing agreements to supply the market in question, technology suppliers may directly export to that market, specially when the industrial property legislation can assure an adequate protection for the product embodying the technology. As suggested in a recent report, one of the main reasons behind the offensive of the US to enforce intellectual property legislation at world level is to use international trade as a means to exploit technological assets(Correa,1988).

If despite trade liberalization the country in question is implementing sectorial policies or has specific locational advantages that may justify exporting the technology rather than the good embodying it, it is likely that fully or majority controlled ventures are going to be preferred by technology suppliers, specially when they are allowed by the current policy changes in this respect.

These new options for technology suppliers will certainly reduce the possibilities for domestic firms to obtain disembodied technology through non equity means. However, research is needed to shed light on the strategies followed by domestic enterprises to face the modified trade policy environment and what role technology imports may play in these strategies.

In this connection,it is important to bear in mind that as pointed out by the World Bank "little is known about technological innovation in relation to trade policy. Nonetheless, there is increasing evidence that adoption of new technology has been faster in outward

oriented than in inward oriented developing economies. It is worth noting that exporting firms often benefit from a considerable transfer of technology from abroad, including advice on production engineering and aid in product design and marketing. Exposure to foreign know-how may help to speed innovations"(World Bank,1987,p.91).

Although this observation on the positive relation between export performance and technology transfer may certainly be true, a good export performance is not necessarily correlated with import liberalization as mentioned in the quoted UNCTAD report.

As thoroughly discussed in a recent paper, it is difficult to sustain the case that liberalization, as a general rule, must have a positive impact on technical efficiency, as is often assumed by the supporters of trade liberalization. Scale economies for instance usually go hand in hand with imperfect competition and the Schumpeterian perspective would disagree strongly with the view that competition is conducive to either innovation or cost reducing investments. To shed light on this crucial question it is then important to undertake empirical studies in countries that have experimented with trade reform, though trying to differentiate as far as possible between the effects of such reform from those resulting from macro stabilization programs(Rodrik, 1988).

e)The growing heterogeneity of enterprises

The serious crisis that is facing Latin America in the 1980s has not affected all enterprises in the same way and not all firms have reacted to the new conditions in the same manner.

Although Latin American manufacturing sectors were never homogeneous, it seems that the new conditions have increased the structural heterogeneity of enterprises regarding branches, size, ownership, market orientation and technology.

The growing heterogeneity is, to some extent, a consequence of the different strategies followed by the firms as a response to the new conditions. As suggested in a recent study, some firms behaved in an "offensive" way trying to incorporate process and product technologies and organizational changes while many others reacted in a "defensive" way trying basically to survive in a low profile manner(Katz,1989). A third category was of course those who did not survive at all and became distributors of imported goods or directly disappear.

The most relevant actors to be studied are then the domestic and foreign firms that have reacted to the new conditions in an offensive manner. Before suggesting in the next section, which are the questions that should be answered regarding those firms, it is important to point out some of the structural changes in the manufacturing sector and some elements showing the growing heterogeneity of enterprises.

Despite the lack of data and studies comparing the situation at the end of the 1980s with that prevailing before the crisis, it is likely that some of the following changes have happened with different intensity in each country:

i) manufacturing branches producing intermediate and consumer products may have augmented their participation in the reduced output while engineering branches declined their share. In other words, branches based on low wages and natural resources and/or producing industrial commodities on the basis of subsidised fixed assets have increased their relative share at the expense of branches based on skilled labor.

ii) small and medium size firms may have reduced their participation in total output and, in some cases, in total employment, though they may have increased their significance in certain branches.

iii) manufacturing output is not only smaller but also more concentrated. However, in some countries and branches is becoming more open to the competition of imported goods.

iv) the share of exports in manufacturing output is higher while the degree of local integration of production is probably lower.

v) within a global picture of low productive investment and higher technological gaps vis a vis industrialized countries, productivity levels, technological and organizational efforts, reliance on imported technologies and modernity of the physical and technological stock(including the incorporation of microelectronics based machinery and equipment) are widely different not only between branches but also inside branches and apparently disregarding size and ownership of the firms(see Ferraz, 1989 for an attempt to assess the technological heterogeneity of Brazilian industry and Fleury, 1988 for different firm strategies in adopting electronics based equipment).

vi) the participation of foreign affiliates in production is probably lower due to the reduced foreign investment flows, although is very significant in key branches of the manufacturing sector and probably higher in total exports.

vii) in contrast, nationally owned firms and, specially those belonging to the big private groups, have increased their importance in the economic life of the region. These groups, that in some cases were originated in the 19th century, have quickly grown in recent years and participated both in extractive and agricultural activities and in manufacturing and services(mainly financial).

In some way or another these changes may have taken place in a number of countries, although studies covering them in detail do not seem to be available. They took certainly place in the case of Argentina where significant policy changes were made since the mid 1970s and the situation of the manufacturing sector was aggravated with the crisis in the 1980s.

In the Argentine case, for instance, the global participation of foreign firms in industrial production was reduced from 30.4% in 1973 to 26.8% in 1984(Azpiazu, 1988). However, this global reduction did not mean that all foreign firms have followed a defensive strategy or even left the country(as it happened in some cases like General Motors and Olivetti).

Despite the bad performance of the economy, a number of TNCs have been active in the Argentine manufacturing sector launching new products both for the domestic and the foreign market, increasing and modernizing their production capacity and even establishing new enterprises fully owned or in joint ventures with domestic firms(Basualdo & Fuchs,1989).

Domestic firms operating in Argentina, specially those belonging to the big groups have increased their global participation, in contrast to what happened with foreign firms. In a study examining the participation of different types of firms in production and sales within the 250 largest industrial enterprises, it is shown that firms belonging to the big groups have increased their share from 13.4 to 16.8% in production and from 12.9 to 17.4% in sales, between 1973 and 1983(Basualdo,1987). In another study (Khavisse,Basualdo, Acevedo, 1989) it is shown that, within the 200 largest industrial firms of the country, the big economic groups have augmented the number of their enterprises from 34 in 1976 to 56 in 1983, while state, foreign and domestic firms not belonging to the groups have all reduced their share in such a ranking.

This situation is presumably not peculiar of Argentina. In countries like Brazil, Mexico and Venezuela, the big domestic groups have probably increased their economic significance in recent years, also at the expense of foreign affiliates in some cases, and in other instances, at the expense of the State and independent domestic firms. This trend does not mean, of course, that a number of TNCs have not been very active in those countries, as the high share of foreign firms in the manufactured exports of Mexico and Brazil and the very advanced manufacturing facilities that in some cases they have, clearly indicate.

In addition to pay attention to the way in which some key foreign affiliates operating in Latin America have adapted and assimilated the technologies received from their parent companies , it is important to pay attention as well to domestic firms and specially those belonging to the big economic groups as well.

Although these groups have very diversified activities, with a growth path highly influenced by the need of augmenting the value of their financial assets, in some cases they have well equipped factories with highly qualified personnel making high value added goods or delivering sophisticated services not only for the internal market but also for export. At the same time, these groups have had joint ventures or technological agreements with partners from industrialized countries to strengthen their productive and marketing skills and to obtain relatively modern product and process technologies(Basualdo & Fuchs, 1989).

Within the poor Latin American picture in productive investment and technological development, some of these groups have entered, with a strong State support into high tech activities as is the case with informatics in Brazil and to a lower extent in Argentina, and heavy mechanical engineering in Brazil and Argentina, etc. While in the past, many of these activities were undertaken through State purchases, the fiscal crisis and current privatization trends will probably lead to a reorientation of the groups' strategies. It is likely

that the big domestic groups will channel their investments towards areas to be privatized like telecommunications in Argentina and/or increase their commitments to activities with high export coefficients where the access to markets and/or productive or marketing technologies are very relevant.

Given the importance of these economic groups, whose capital is mostly domestically owned, in the economic life of some Latin American countries, their dynamism and their needs of international links and technological updating, it is plausible to expect that, in the same way as they have received a significant share of the reduced investment flows and transfer of technology agreements in the 1980s, these groups are the best placed to receive important investment and technology flows in the 1990s.

However, to be able to capture the growing heterogeneity of the manufacturing sectors, it would be important not only to focus on the large domestic firms and key foreign affiliates but also in some selected medium and small firms . While in certain branches small and medium size firms have acted in an offensive manner and have been actively engaged in technological development(eg in the Argentine machinery industry), in other branches such an attitude could be expected in case of subcontractors of large foreign and domestic firms.

Although subcontracting is not very advanced in developing countries, it is possible that some large firms are relying more on such a device to reduce costs, specially when exports are concerned. In this case, it is likely that some subcontractors have entered into a number of technological activities to be able to meet quality control requirements from the parent companies.

4. Research issues for the 1990s

a)Introduction

Given the different performance of countries in Latin America, Africa and West Asia from that of East and to some extent South Asia, it is important to keep in mind their differences while, at the same time, suggest common issues. In what follows the research issues are discussed with the Latin American picture in mind. However, at the end, some suggestions about more specific Asian research issues are made.

Despite the fact that manufacturing production and exports in Latin America have not only fallen but also evolved towards static comparative advantages on the basis of natural resources and low labor costs, the possibilities of reorienting the production process towards the creation of dynamic comparative advantages on the basis of assimilating, adapting and generating technologies certainly exist.

In this perspective a very important issue that is receiving increasing attention is that of international competitiveness, in which technological activities should play a crucial role. In contrast to the traditional approach to competitiveness that related performance in external

markets almost exclusively to variations in real exchange rates and labour costs, a new approach based on "structural competitiveness" was developed, very much linked to technology issues at firm and at country level(Chesnais, 1986).

In the Latin American case, it has been argued that instead of the current trend towards currency devaluation and reduced real wages to increase competitiveness, a different approach should be followed,i.e. that of genuine competitiveness based on the incorporation of technical progress(that includes a good deal of technology transfer) to be able to augment productivity and upgrade quality (Fajnzylber,1988). Despite the problems involved in conceptualizing and measuring genuine competitiveness, this view is inspiring interesting research projects and gaining support in the debate, though not yet at policy level.

To be able to search different modalities for increasing the genuine competitiveness of certain manufacturing activities in Latin America, a diagnosis of the experiences and strategies of the firms operating in this complex environment to gain competitiveness is required. For this purpose, it is indispensable to provide fresh evidence through detailed interviews at firm level.

Although the firm should be a major actor to be studied, it is extremely important to place the firm in the industry in which it firm is operating and both the firm and the industry should be analyzed as much as possible in the macro economic environment in which they are doing business.

b)Issues related to the influences of the policy framework

While in technology transfer studies made in the 1970s it was possible to focus almost exclusively on the firm because the environment was not changing so quickly, this is no longer possible in the 1990s. Of course this is a major challenge and add complications to the already difficult technology studies. However, it is the only form in which their findings could be then integrated into the general picture and hopefully give to the emerging policy recommendations a more realistic stance than in the past.

From the previous discussion on the policy framework it is clear that regulations on foreign direct investment and technology transfer are not the most important issue to be analysed. However, it would be useful to learn how significant these changes were for the firms to be interviewed and, more specifically, to pay some attention to the effects of certain changes in industrial property regulations that may be of concern for specific sectors.

What is crucial to learn is to what extent the contradictory signals emerging from the evolution of the macroeconomic variables and the modifications in trade and industrial policies in a context of stagnation or low growth, may have affected the investment and technological decisions taken or planned to take by the firms in question.

While the behaviour of macroeconomic variables like inflation rates, real interest rates and level of activity may have negatively affected investment and technological decisions with a long term perspective in mind, it is likely that the key relationship between real wages and real exchange rate may have favoured export oriented strategies, provided the firm is able to get good financial conditions for this kind of endeavour. At the same time, the way the firm is predicting the future evolution of the relationship between real wages and exchange rate and the experience it is gaining in export markets may have a strong influence in the decision to allocate efforts to upgrade the quality of its products and to modify its product and process mix to be able to compete in the future on the basis of technological efforts and a not so favourable relationship between real wages and exchange rates.

Changes in trade policies may have reduced the degree of effective protection the products in question are receiving in the domestic markets, depending on the precise way trade policies are modified and on the evolution of real exchange rates. The reduced protection in the domestic market and the possibilities of exports given by the favourable exchange rates may or not favour technological efforts to reduce costs, increased product quality, change product mix, etc. It is likely but not obvious that firms engaged in technological development (and with a good experience in licensing technology) in protected internal markets were in a better position to face the new conditions in the trade front than firms without such an experience. The contradictory effects of trade policies upon technological imports and development is a key issue on which only empirical research on different firms operating in different policy contexts can shed light.

If changes in the trade regime are taking place with modifications in traditional instruments of industrial policy like State procurement or fiscal incentives to favour investment in fixed assets, firms may react to the new conditions either increasing their technological efforts to be able to compete with lower costs or better products or concentrating their activities in making products with lower value added, taking advantage of low labour costs and favourable exchange rates.

At the same time, certain sectorial policies like those followed in motor cars or computers, the search for new subsidies like debt equity swaps and/or the eventual entry into areas to be privatized may counteract the impact of the changes in traditional industrial policies with a not clear influence on technological activities.

Despite the fact that rather similar approaches are followed in a number of developing countries in their macroeconomic, trade and industrial policies, many differences exist in the precise way these policies are implemented and in the impact they may have on different firms.

The whole question of the influence of changes in macroeconomic, trade and industrial policies upon technological performance is then a major issue on which research is urgently needed. It is in this specific context, that research on technology imports should be focused.

c)Issues at firm and at industry level

Regarding the type of firms to be studied, in addition to learn the way in which some key foreign affiliates operating in Latin America(included those operating in in-bond industries like the Mexican maquila) have received and assimilated the technologies imported from their parent companies and the impact of this technology transfer process upon the host economy, in studies to be focused on technology transfer and directed to assess the bargaining position of recipient parties, it is very relevant to pay attention to domestic firms that followed offensive strategies as seems to be the case with some enterprises of the big economic groups.

However, although enterprises belonging to big groups should be certainly included, within domestic firms to be studied priority should be given to those enterprises that made significant efforts in adapting and assimilating new technologies and generated a flow of product and process innovations however minor. Some of these enterprises belong to the big groups but many are independent firms of different size and operating in different branches.

Despite the fact that comprehensive studies and information on the structural changes in the manufacturing sector since the beginning of the debt crisis are not available and, therefore, the proposed studies on firm behaviour have a considerable handicap, a review of the available sectorial studies will give a preliminary industry dimension to the survey to be made at firm level. The availability of these previous sectorial studies should be a major consideration in the choice of branches to be examined.

Within technologies and as far as possible, special attention should be paid to those firms that have incorporated automation technologies and new techniques of production technology like total quality control and just-in-time techniques, to be able to learn what was the effect of this incorporation in their modernization strategies(see Fleury,1988 for an interesting study in this respect).

The main questions to be answered at firm level are as follows:

- i) what were the specific strategies used to face the new conditions derived from the changed policy framework? which were the most relevant policy changes that favoured the strategies followed ? what these specific strategies meant in terms of product mix, product and process innovation and investments in physical and technological assets?
- ii) to what extent debt equity swaps and other subsidies were used for investment in physical assets and how dependent on them were the investments made(or, in other words, would the investments in question have taken place without these subsidies)?
- iii) to what extent domestic(both within and outside the firm) and imported technological inputs were used and for what specific purposes? what was the relative weight of marketing with respect to technological factors behind the decision to import technologies ?

iv) under what conditions domestic and foreign inputs held a complementary relationship and when were they substitutes? In this respect, how did an individual firm's attributes, such as size and nationality influence that relationship? and how did the speed with which the technology frontier moved influence the extent to which foreign technologies become essential to indigenous technical development?(Rosenberg & Frischtak, 1984,p.xv)

v) how important were organizational tools(i.e.total quality control, just in time system,etc)in the strategies followed? to what extent have they implied more or different reliance on domestic subcontracting? What was the economic and technological profile of the main subcontractors and how technology was transferred to them?

vi) what were the main results of their strategies in terms of competitiveness in both domestic and foreign markets? What were the crucial factors explaining the level of competitiveness achieved and to what extent they depend on foreign exchange and wage levels?

vii) how the search of potential technology suppliers was made? what were the difficulties recipient firms faced to obtain these inputs from suppliers in industrialized countries in terms of age of the technology, explicit and implicit costs, ownership requirements, effective transfer of know how and know why,etc? how important the protection of industrial property rights was for potential suppliers and for the recipient firm?

viii) what were the main elements in the negotiation strategy with foreign suppliers? what was the relative importance of factors like previous licensing experience, accumulation of technical capabilities, size and international connections, access to specific markets or suppliers, government intervention, etc?

Although these are very general questions they give an indication of the major research issues on the topic under discussion in the demand side. In suggesting these questions, we have taken advantage of what we considered remain in force of the conventional literature on technology transfer and of some of the significant advances made in the literature on technology creation in developing countries. However, in contrast to previous approaches to the subject matter, far more attention is paid to the changed policy environment(i.e. macroeconomic, trade and industrial policies) and the way firms have reacted to this new environment.

A more comprehensive study should include not only recipients but also suppliers, as was done in the interesting studies contained in Desai(1988). Issues related to the different types of costs incurred by suppliers when transferring technology to developing countries that were mentioned in section 2 b), the question of increasing protectionism and unwillingness to provide advanced technology to firms in developing countries as suggested by Ernst & O'Connor(1989)and generally the way suppliers have reacted to the new conditions in both developed and developing countries need serious consideration and should be included in a research agenda for the 1990s.

d)Methodological questions

Depending on the way the particular research project is focused, there are various possibilities for selecting the firms to be eventually surveyed.

First, to choose a number of relevant firms from a list of enterprises that have been significant investors in recent years.

In the Argentine case for example this list is available from a survey in progress by the CEPAL office in Buenos Aires. On the basis of that list is possible to prepare a small but representative sample, in which a number of key branches and different types of firms are included. With the same approach, firms to be surveyed may be selected from those enterprises that participated in debt equity swaps or had a significant number of technology transfer agreements or are known to have had significant technological activities.

Second, to select a small number of key branches on which previous studies may be available and that are relevant for the subject matter. Once these sectors are chosen, then it is possible to prepare a small sample of firms in which the different types of enterprises are included.

Motor car including auto parts, electronics including telecommunication equipment, some segments of non electrical machinery, food processing, textiles and clothing, petrochemicals and fine chemicals including pharmaceuticals and perhaps biotechnology firms are some of the interesting branches to be studied in terms of significant technological and organizational changes that are taking place . However, the choice of the few specific branches to be eventually examined will depend on the peculiarities of each country study and the possibilities of intercountry comparisons.

Finally, to focus more on specific issues like debt equity swaps or subcontracting arrangements and select a number of different firms that have participated in these arrangements. In that case, specific branches have less importance though it would be useful to have different types of recipient firms.

Despite the growing heterogeneity of enterprises, priority given to big firms rather than to small and medium size firms is due to the fact that they have become less significant in the demand side than in the past. Furthermore, some major research efforts have already been made in that area(eg the project coordinated by CEDREI and supported by IDRC). However, it would be important to include some small and medium size firms, specially subcontractors to learn about their technological experience.

The very general questions mentioned above would require a lot of work to define in precise terms their concrete meaning and the way to assess the different issues to be studied. To enter into these details is beyond the scope of this report but will certainly require an extensive preparatory work.

The preparatory work will include not only the detailed questionnaire to be used in interviews and the selection of the firms to be surveyed. It will also require to study in detail the main policy modifications that have taken place in the country and their effects on the performance of the industries to be studied.

To be able to have a good number of contrasting cases, firms to be finally surveyed should be no less than twenty in each country. This means a lot of work not only for doing meaningful interviews but also for interpreting them in a coherent manner.

Although interviews are going to be mainly directed to firms that followed an offensive strategy, it would be very important to keep whenever possible the industry dimension of the problem. This is important not only because firms(although belonging in some cases to conglomerates) develop their technological strategies and compete at the level of an industry. It would also avoid some of the criticisms made to the early studies of technological activities at plant level in which scarce attention to the social returns of the innovations studied was paid.

e) Countries to be studied in Latin America

Key countries to be studied in Latin America are Argentina, Brazil and Mexico in which the development of indigenous technical capabilities and technology transfer were significant in the past and where the effects of the crisis and the changed policy environment need to be carefully assessed.

The inclusion of these three countries will permit to assess quite different government policies. While Brazil has followed a more protectionist policy regarding imports and at sectorial level regarding direct foreign investment(eg in informatics), Mexico has seriously advanced in trade and direct foreign investment liberalization measures and has an impressive experience in the maquila. Argentina had an early attempt in trade liberalization and has followed more erratic macroeconomic policies in a context of low productive investments but certainly have a significant number of firm engaged in technological development.

In addition to these countries, it would be very interesting to study the Chilean experience to learn how firms have managed to acquire technologies in a very open and export oriented economy and perhaps Venezuela where recent major macroeconomic changes including trade policies may certainly affect some interesting examples of technology acquisition in certain branches like professional electronics and other capital goods(Perez,1989).

Among the smaller countries in Latin America, it would be interesting to study the cases of Costa Rica and Uruguay. In Costa Rica because an unusual experience of combining

trade and industrial and technological policies is in progress and in Uruguay because it is a relatively open economy with a modest manufacturing sector.

The selection of countries to be included will not only depend on the financial resources allocated to the project but also on the availability of local researchers and previous sectorial and technological studies.

f) Countries and further issues to be studied in Asia

Many of the issues mentioned above are also relevant to be studied in the Asian context and a comparison between the Latin American and the Asian experiences would be very interesting.

India seems to be an obvious case to be examined in view of the policy changes taking place in recent years towards industrial policy deregulation and greater reliance on technology imports in a country that has many years of technological development in a closed environment.

Countries like Philippines, Indonesia and Thailand as well as South Korea and some other NICs should be also studied. However, their recent performance and the international and domestic policy environment would probably lead to different priorities and add new issues.

Some of the specific issues to be dealt with in the Asian case studies should be as follows.

First, the new wave of Japanese direct foreign investment is extremely important to be analyzed in depth. The strategies followed by Japanese companies in their regional sourcing and marketing networks have to be examined to verify what is the real meaning in terms of technology transfer and development of indigenous technical capabilities of this horizontal division of labour that is emerging (Imai, 1988).

Second, the catching up process followed by the Asian NICs has apparently been facing with growing problems of access to the latest technologies by the leading companies in industrialized countries. In this way, these countries are not only facing growing market but also technology protectionism by their traditional suppliers (Ernst & O'Connor, 1989). In this context, the problems in negotiating technology transfer agreements or joint ventures have to be assessed and the possibilities of establishing strategic partnering between the leading Asian companies and partners in industrialized countries have to be studied.

Third, the different forms of international subcontracting followed in Asian countries need to be assessed in terms of technology transfer as compared with traditional licensing agreements and joint ventures. In this issue a comparison with the Latin American cases is particularly relevant.

Finally, few studies have apparently been made in the Asian context regarding the accumulation of technological capabilities in domestic firms, specially those operating in

export oriented economies in the context of the 1980s. Within these studies the special cases of the large Korean conglomerates and the Indian big private houses should be specifically examined to analyze to what extent their technological behaviour differs from that of other domestic companies.

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Table 1
 Capital Goods Imports, Foreign Direct Investment Flows, and Technical co-operation grants to Developing Countries and Territories
 (Billions of current dollars)

	Total (1)	America	Am. exc. Tax Havens	Africa	Asia	China (2)
A. Capital Goods (3) imports						
1980	114,3	31,6		24,5	54,0	3,7
1981	127,9	36,1		26,8	61,7	3,3
1982	120,6	29,2		23,0	65,6	2,1
1983	104,4	20,6		18,7	62,7	2,8
1984	102,8	24,1		18,1	58,3	4,3
1985	97,8	25,5		17,0	52,6	10,1
1986	107,7	28,8		16,8	58,4	11,0
1987	123,4	23,8		16,5	74,3	9,0
1988	144,0	36,0		17,0	87,0	9,0
B. Foreign Direct Investment						
1980	10,8	7,1	6,2	0,3	3,2	0,1
1981	14,8	7,5	8,0	1,6	5,5	0,3
1982	13,8	7,4	6,3	1,4	4,9	0,4
1983	9,7	4,0	3,6	1,2	4,4	0,6
1984	10,8	4,7	3,2	1,4	4,6	1,3
1985	11,6	5,6	4,3	2,6	3,3	1,7
1986	12,3	5,4	3,6	1,7	5,1	1,9
1987	22,7	10,8	5,6	2,1	9,6	2,3
1988	25,5	11,4	8,1	2,1	11,7	3,2
1989	26,4	8,6	7,4	4,3	13,3	3,4
c. Technical co-operation grants						
1980	7,3	1,2		3,2	1,8	0,1
1981	7,4	1,2		3,0	1,8	0,1
1982	7,4	1,0		3,0	1,9	0,1
1983	7,7	1,0		3,2	1,8	0,1
1984	7,7	1,0		3,2	1,7	0,1
1985	8,2	1,2		3,5	1,8	0,1
1986	9,6	1,5		4,1	2,1	0,2
1987	11,5	1,8		4,7	2,5	0,3
1988	12,6	2,0		4,9	2,9	0,3

Notes 1- Total includes developing countries and territories of Europe and Oceania.
 2- Memo item. Figures not included in totals.

3- Includes SITC Rev. 1, Section 7, machinery and transport equipment except 7194 domestic appliances, non-electrical, 7241 television receivers, 7242 radio broadcast receivers, 7250 domestical electrical equipment, 7321 passenger motor cars, 7326 chassis set passenger motor cars, 7329 motor cycles, and 7331 bicycles.

Source: UNCTAD secretariat computations based on data from (i) UN, for capital goods imports, (ii) IMF & UNCTC adjustments (retrieved on 20 May 1991), for foreign direct investment and (iii) OECD, for technical co-operation grants.

Table 2
Technology Transfer Agreements in Latin America

	Argentina		Brazil	Bolivia	Colombia	Ecuador	Peru	Venezuela
	(1)	(2)	(3)	(4)	(5)	(5)	(5)	(5)
1979	510	n.a	1562	1345	n.a	n.a	n.a	n.a
1980	495	n.a	1572	1268	n.a	n.a	n.a	n.a
1981	488	55	1526	1148	17a	216a	90a	417a
1982	392	66	1527	1122	6	45	39	132
1983	377	48	1417	873	2	72	37	92
1984	367	51	1281	704	14	51	28	104
1985	436	77	1381	663	0	70	28	100
1986	351	58	1368	786	5	49	33	112
1987	339	37	2016	963	n.a	n.a	n.a	n.a
1988	320	56	1882	1082	n.a	n.a	n.a	n.a

Notes:

(1) Total number of contracts approved.

(2) Number of contracts between linked firms

(3) Total number of processed contracts (averbados)

(4) Total number of processed contracts excluding trademarks licences

(5) Number of registered contracts

a: Accumulated until 1981

Source: INTI for Argentina, INPI for Brazil, Secretaría del Sistema Andino de Información Tecnológica for Andean countries.

Table 3
Payments for Technology Imports
(in millions of current dollars)

Year	Argentina	Brazil	Mexico	Peru
1973	81	139	139	5,8
1974	99	194	154	n.a
1975	64	223	164	n.a
1976	38	263	186	n.a
1977	51	n.a	180	n.a
1978	148	n.a	134	n.a
1979	157	313	206	n.a
1980	239	321	305	7,5
1981	247	276	605	4,0
1982	361	240	280	7,9
1983	484	218	132	4,3
1985	n.a	175	160	4,1
1986	420	184	134	3,6
1987	n.a	174	n.a	7,8
1988	n.a	135	n.a	n.a

Sources: Argentina INTI, Brazil INPI; Mexico Rendiz Nuñez 1987, peru Valdivieso Trillo 1989