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**TECHNOLOGY TRANSFER POLICIES AND INNOVATION
CAPACITY BUILDING:**

THE CASE OF PORTUGAL

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1. INTRODUCTION

Technology has emerged as a strategic issue for both the competitiveness of firms and the process of social and economic development of nations.

The creation and assimilation of knowledge is one of the foundations of global competition. The escalating costs of R&D activities in high-technology industries, the shortening of product life-cycles and the need to compete globally led the large multinational firms to become "global scanners", setting up antennas in the most dynamic and innovative environments, to tap new technological opportunities. Those factors also stimulated the spurring of technology-based inter-firm cooperation: firms understood that they need to "cooperate to compete globally"(1).

This globalisation process generated an increasing oligopolisation of international markets and reduced the freedom of Governments to define their policies, namely on the economic, monetary, trade, technology, investment and information grounds. The strengthening of regional integration movements has been, to a large extent, a response to the globalisation phenomenon. Simultaneously, however, a "new alliance" was developed in many industrialising (and newly industrialising) countries, based on the argument that "the success of the national enterprises on the World scene is a prerequisite for the achievement and preservation of the country's technological and economic autonomy"(2). Governments are acting as purveyors of resources and competencies to enable their home-based companies to win in the global competition arena. Government support includes the following:

(1) Howard Perlmutter and David Heenan, Cooperate to Compete Globally, Harvard Business Review, March-April 1986.

(2) Riccardo Petrella, Technology and the Firm, Technology Analysis & Strategic Management, Vol. 2, n°. 2, 1990.

financing infrastructures; financing the development of capabilities (education, training, dissemination of information, funding of basic research); providing incentives for investment in industrial R&D and technological innovation; defining product, safety and environmental standards; and supporting national firms in the domestic market, through public procurement.

For less industrialised countries, with weak technological infrastructures and lacking their own multinationals, the globalisation process offers some opportunities for entering international trade and investment networks, but also raises severe problems, making the "catching-up" more difficult. In particular it sharpens the need for acquiring, assimilating and diffusing technology (and namely new technologies) throughout the industrial fabric to enable domestic firms to become internationally competitive.

To fulfil this objective defensive technology transfer policies, aimed at just controlling foreign technology inflow, are not the most appropriate. Promotional policies are needed, having in mind the weakness of domestic scientific and technological infrastructures. Domestic firms capabilities to identify, select, negotiate and absorb foreign technologies should be enhanced. In parallel, the infrastructure of services to firms (research and technology organisations, engineering and technological consultancy, standardisation and methodology, strategic management advice) has to be developed. This will, of course, demand a redesign in technology transfer policies and the setting up of stronger links with other relevant policies (industrial, education, training, science and technology...).

In the present paper we will examine the main trends in technology transfer policy in Portugal⁽³⁾. The Portuguese experience

(3) By technology transfer policy we will mean the policy concerning the inflow of foreign technology, and particularly that conveyed in context of technology transfer contracts (trans-border agreements regarding the sale or license of industrial property, of know-how, as well as the supply of technical assistance, training, and engineering services).

seems to be interesting for three main reasons. First, Portugal is a "middle-of-the road" country, with an industrial fabric that has some similarities with those of newly industrialising nations, namely on what concerns the importance of traditional sectors in industrial output and exports, an historical reliance on low wages as a factor of competitiveness (a fading factor, however) and an insufficient innovative capability. Second, Portuguese economy is deeply internationalised and has experienced a recent process of integration with more advanced partners. Finally, Portugal's technology transfer policies underwent significant changes, from a regime of previous evaluation and authorisation of technology transfer agreements to an almost complete liberalisation of technology inflow, together with a strengthening of the technological component in industrial policy.

Following the outline of country surveys defined by UNiDO, this document will include four main parts. The first will provide a brief historical perspective of technology transfer policy in Portugal, stressing in particular the process of evaluating technology transfer contracts and the present situation, where technology transfer policy, in the sense above defined, has no longer a central role, while innovation policy is gaining importance. The second part deals with technology transfer flows, stressing especially the level and the characteristics of technology payments. Then we will turn towards the assessment of the policies followed to enable a brief presentation of policy approaches on technology transfer, in the last chapter.

2. TECHNOLOGY TRANSFER POLICY IN PORTUGAL

2.1. Historical Retrospect

The regulation of technology transfer agreements by Portuguese authorities is a recent phenomenon, where three main phases, characterised by different legal regimes and policy orientations, may be broadly identified:

- (i) Foreign exchange control, from 1973 to 1978;
- (ii) Technology transfer approach, from 1978 to 1985; and
- (iii) From technology transfer to innovation policy, from 1986 onwards.

For many years technology transfer contracts were not subject to any legal framework, on what regards their technological, competition or foreign exchange implications. Some steps were taken since the post-War period to set up some kind (though still incipient) of technological infrastructure: the creation of the Nacional Laboratory for Civil Engineering in the late 40's, of the National Institute for Industrial Research (INII) and of the National Board for Nuclear Power (JEN) in the late 50's and of the National Board for Science and Technology (JNICT) in the late 60's. However, despite the concerns of some of these organisations with technology imports and with the endogeneisation of foreign technologies, only in the late 60's/early 70's, in the context of an OECD - sponsored research project, an assessment of technology transfer patterns in a specific sector (pharmaceutical industry) was carried out.

The first legal initiative to address technology transfer as a concept distinct from industrial property was taken in 1973. The drawing up of technology transfer agreements between residents and non residents was then subject to prior authorization by the Bank of Portugal (Decree-Law 158/73 and Ministerial Order of the Minister of Finance dated 10 April 1973). Such legislation was mainly intended to control foreign exchange outflows and was not

concerned with the overall conditions of technology acquisition. Therefore, the analysis undertaken by the Bank of Portugal was focussed on the financial and foreign exchange implications of contracts, leaving aside their economic and technological aspects.

With the change of political regime in April 1974 conditions were created to adopt a different stance towards the control of technology transfer agreements. Technology was increasingly seen as a key element for national economic development, and it became clear that the impact of technology transfer was much beyond its foreign exchange implications. Furthermore, there was an international trend, where the Andean pact experience played an important role, towards the control of technology flows, having in mind the peculiar features of the technology market and the need to unbundle the so-called "technological package".

The first version of the Foreign Investment Code - encompassing the regulation of both foreign investment and contractual technology inflows-was enacted in 1976 (Decree-Law 239/76, of 6 April). Technology transfer agreements were subject to prior authorization and registration with the Foreign Investment Institute and various restrictive practices were prohibited. However, this law left much to be desired, technology transfer issues being addressed in an inappropriate and uncoherent way. The envisaged enabling legislation was never enacted, so that the real impact of this legal framework on technology inflow was very limited.

A new, more liberal (especially on what foreign investment was concerned) Code was published in 1977 (Decree-Law 348/77 of 24 August), together with five regulatory decrees, one of them specifically concerned with technology transfer contracts (Regulatory Decree 53/77). This body of legislation, with slight changes introduced in 1982, was the legal framework that characterised the period labelled above as "technology transfer approach", which extended until the end of 1985. The policies followed during this phase deserve a closer analysis to be undertaken in the next section.

Portugal's accession to the European Communities was the driving force behind the substantial liberalisation movement that

took place since 1985 and that, to a large extent, emptied the ground for conducting a technology transfer policy. In fact, to comply with E.C. rules, technology transfer legislation underwent a profound change, in several steps.

The first (Decree Law 351-C/85 of 26 August and Normative Order 95/86) consisted in setting up a regime of prior registration of contracts with the Bank of Portugal, where denial of contracts might be possible. Then, registration was considered to be just for statistical reasons, meaning that all contacts transmitted to the Bank of Portugal would be automatically registered (Normative Order 86/89). Finally, to comply with Single European Market requirements, the principle of freedom to undertake current invisibles and capital operations with non residents was defined (Decree Law 176/91, of 14 May). So, in accordance with Bank of Portugal Information 6/91, technology transfer contracts should now be submitted to that Bank, but only for statistical purposes.

These developments mean that there is no longer a specific control of contracts from a technology transfer policy standpoint. The only sources of control stem now from competition policy, both at national (Decree-Law 422/83, of 3 December) and Community levels (E.C. Regulations 2349/84 on patent licences and 586/89 on know-how licences).

Simultaneously, a growing concern with innovation policy emerged, mainly from an industrial policy standpoint, but also from a scientific and technological policy perspective.

The technology transfer approach faded, while two large EC sponsored programmes - one in the industrial field (PEDIP) and the other on the science field (CIÊNCIA) (4) - were launched. Specific technology transfer concerns lost ground, while a wider approach of innovation promotion gained strength (5).

(4) PEDIP stands for Specific Programme for the Development of Portuguese Industry while CIENCIA stands for Creation of National Infrastructures of Science, Research and Development.

(5) The main features of present technological policies will be presented in section 2.3..

2.2. Technology Transfer Approach (1978/1985)

This stage is characterised by a policy specifically addressed towards technology transfer and based on a procedure of prior evaluation and registration of contracts. Started in 1978 when the Foreign Investment Institute launched its activities in the wake of Decree-Law 348/77, this period extended until the end of 1985, on the eve of Portugal's accession to the European Communities. We will briefly review three main topics: the legal framework, the policy and the links established with other relevant policies.

2.2.1. Legal framework

As a mentioned above, Decree-Law 348/77 (and Regulatory Decree 53/77) laid down the basis for the screening of technology transfer contracts. The main features of such legislation were the following:

(i) Setting up of a mechanism of prior evaluation, authorisation and registration of contracts by the Foreign Investment Institute;

(ii) Scope - The law concerned technology import contracts only. These were defined in a broad way, encompassing not only the sale or license of industrial property rights or know-how, but also franchising, training, the provision of engineering services and various forms of technical assistance;

(iii) Mandatory provisions - With an aim to protect technology recipients when drafting their contracts, the law identified some clauses - corresponding to "guarantees" for the licensee - that must be included in the contracts. The most relevant concerned the following: detailed description of the transfer object and of payment terms and conditions; contract duration; transmission of information on improvements; provision of training programmes; and guarantee of supply of inputs under agreed conditions (prices should not exceed international standards);

(iv) Restrictive clauses - To strengthen the bargaining power of technology recipients, several provisions were, as a rule, not permitted. There was, however, a "rule of reason" whereby those clauses might be accepted when the "transfer of technology assumed a special interest for national economy". The clauses concerned were, inter alia, the following: tie-in; restrictions on the volume and structure of recipient's production; export and marketing restrictions; price-fixing by the licensor; and limitations on licensee's post-contract activities, excepting those due to industrial property rights held by the licensor;

(v) Intra-group contracts - The law applied to all technology transfer contracts between residents and non residents, irrespectively of their equity relationships or other links. It was explicitly stated that technology transfers connected with foreign investments were subject to the general provisions on this matter;

(vi) The institutional framework - A new body was created to implement the legislation - the Foreign Investment Institute. Its functions were: coordination, guidance and supervision of direct foreign investment; controlling the drawing up and implementation of technology transfer agreements; and ensuring the proper implementation of direct foreign investment and technology transfer policies.

2.2.2. Policy objectives and implementation

The main objectives pursued by the Foreign Investment Institute in regulating technology transfer were the following (6):

(i) To increase technology market transparency, by providing appropriate support and information to domestic firms;

(ii) To improve the terms and conditions of contractual technology import, including the reduction of royalties to levels consistent with the relevance of the technology transferred and with the patterns of other countries;

(6) Foreign Investment Institute, "Annual Report - 1981", Lisbon, 1982

(iii) To promote the development of Portugal's scientific and technological capacity, by creating conditions for the absorption, assimilation and diffusion of imported technologies.

The Institute, aware of the fact that a hard-lined approach might have adverse effects on the characteristics and volume of technology inflow, followed a "soft", flexible stance. The dialogue with contracting firms (and particularly with the Portuguese partners) prevailed over a strict enforcement of legal orientations. Contracts were subject to several changes and amendments, but sharp rejections of applications only occurred in exceptional cases, for instance when the contract had no technological content or when it concerned widely diffused knowledge.

Contract evaluation guidelines were consistent with the objectives mentioned above, although the improvement of contractual terms and conditions was the dominant concern. Three aspects were particularly scrutinized: level of payments, restrictive clauses and contract duration.

Payments were envisaged as an important issue, but not necessarily as an essential feature of contracts. Conditions of use and absorption of the technology were in general deemed to be more relevant than the amount of payments. In general the Institute discouraged the use of front-end payments and minimum royalties in licensing contracts, since they increase the burden on the licensee and reduce licensor's risk and commitment. With regard to restrictive clauses, the Institute took a flexible approach, assessing in each case the restrictive potential of contractual provisions and the relevance of the technology for the recipient as well as for the upgrading of Portugal's industrial fabric. Emphasis was put on some clauses, considered to be generally more harmful (export restrictions, unbalanced access to improvements, post-expiry restrictions, tie-in and price-fixing). Experience proved, however, that it was very difficult to delete all potentially restrictive clauses from draft contracts without seriously hampering the technology transfer operation or provoking a reaction to evade control. The rationale for contract duration evaluation was the definition of periods long enough to enable the assimilation of technology, but

not so long that might become an undesirable burden. The "rule of thumb" was to allow a 5-year period, that might be renewed by an equal term.

The Institute tried to increase Portuguese firms awareness of the advantages of absorbing imported technologies. The participation of domestic consultancy and engineering firms, as key players in the process of technology endogeneisation, was actively sought. These efforts faced, however, some opposition by both suppliers and recipients. If the former's attitude can be easily understood, the latter's deserves a word of explanation. Recipients often perceived the involvement of Portuguese engineering firms as an additional risk factor; by purchasing a technology package they could deal with just one counterpart and felt that project implementation and the assignment of responsibilities would become easier although the experience has shown that this was not always the case.

2.2.3. Linkages with other policies

The strongest link was obviously with the foreign investment policy, since the implementation of both foreign investment and technology transfer policies was attributed to the same body - the Foreign Investment Institute.

There were, in fact, several reasons to put both policies under the same roof: foreign investment is also a relevant vehicle for technology inflow; knowledge on foreign affiliates strategies enables a better assessment of their technology agreements; and there are synergies between the two fields, namely in the evaluation of the technology transfer content of new foreign investment projects. But the experience has shown that their coexistence is difficult. Foreign investment tends to be more visible and valued, especially when a strong emphasis is put on foreign investment promotion - as happened in Portugal from 1980/81 onwards. Therefore, foreign investment increasingly concentrated management's interest, while technology transfer regulation was seen as a grey, bureaucratic area and even, in some cases, as a hurdle for foreign investors.

Besides this close linkage, two others stemmed directly from the legal framework. One concerned foreign exchange, the Institute periodically informing the Bank of Portugal about registered contracts and getting in turn detailed data on technology payments; it should be acknowledged, however, that this exchange took place at the operational level, and not so much at the policy formulation level, technology payments not being an issue in the definition of foreign exchange policies. The other regarded the compatibility of technology imports with the strengthening of domestic scientific and technological capacity. To achieve this objective, the National Board for Scientific and Technological Research was supposed to keep the Institute informed about the activities and potential of Portuguese research centers. In practice, however, such an exchange of information never worked. Despite some good intentions and nice words, the links between technology transfer and scientific and technological policies remained very slack.

The linkages with other economic policies were not strong either, largely as a result of an insufficient coordination at governmental level. Therefore, despite the provision that evaluation of contracts should take into account economic and industrial development priorities, links were more a consequence of personal relationships and ad-hoc efforts than the outcome of policy coordination at the top.

Two issues deserve a mention in the articulation between technology transfer and industrial policies. The first was the development of specific guidelines for some sectors - namely pharmaceuticals, cosmetics and automotive industries - where there was a close cooperation between the Institute and the Ministry of Industry. The second concerned the preparation of a Technological Development Plan (concluded in 1983), led by the National Laboratory of Industrial Technology and Engineering (LNETI), and where the Foreign Investment Institute played a minor role. Such Plan, which was never implemented, was basically concerned with technology generation and diffusion, and only incidentally with technology transfer as we defined it.

Finally, a reference should be made to the linkages established with fiscal policy. These led to a common definition of the royalty levels accepted as costs for tax purposes, making clear for firms the general guidelines on technology payments.

2.3. From technology transfer to innovation policy (1986 onwards)

As remarked above, Portugal's accession to the European Communities in 1986 entailed a steady liberalising trend which emptied the scope for carrying out a technology transfer policy as such. In fact, there is no longer a mechanism for evaluating technology transfer contracts, and the celebration of such contracts (especially those of license) is now much more influenced by competition policy than by specific considerations of technology transfer nature. While this liberalisation movement was gaining strength, a growing concern with innovation emerged, leading to the identification of technology as a key feature of industrial policy in the context of PEDIP. Simultaneously, in the field of scientific policy, a new programme was launched (CIÊNCIA), mainly aimed at creating and strengthening infrastructures and developing the human resource base.

In the following pages a brief picture of the headlines of these developments will be provided. The legal framework for technology transfer contracts will be presented first, turning then to policy objectives and instruments.

2.3.1. Legal framework

From the legal standpoint (and leaving aside industrial property and tax considerations) technology transfer contracts are subject to two main types of regulations: foreign exchange operations and competition.

a) Foreign Exchange Operations

With the publication of Decree-Law 351-C/85, of 26 August, a significant change was introduced: technology transfer agreements were not considered on its own right, but just as transactions that might give origin to foreign exchange (current invisibles) operations. This, by and large, corresponded to wiping out the specific dimension of technology transfer contracts, coming back to the situation prevailing between 1973 and 1976. The registration of such contracts was again a task committed to the foreign exchange authority, that is, to the Bank of Portugal.

At first (Normative Order 95/86), a régime "prior registration" of contracts was set up. Technology import agreements should include the following elements: description of technology transfer content; identification of types and amounts of payments to be made; and contract duration. Contracts should be submitted to the Bank of Portugal and if no objections were raised in a 30 day period they were considered as automatically registered.

In 1989, the procedures for contract registration were significantly eased, by the Normative Order 86/89, of 24 July. Such registration had just a statistical objective, and the Bank of Portugal could no longer deny it. Simultaneously, the scope of the definition of technology transfer contracts was changed, mainly to disregard technical assistance contracts of minor importance.

A new liberalisation drive, to comply with the Single European Market requirements, took place in 1991 (Decree-Law 176/91, of 14 May). The principle of freedom to undertake current invisibles and capital operations with non residents was defined. Therefore, technology transfer contracts are to be forwarded to the Bank of Portugal "in a delay of 15 days after they are entered into and always before generating foreign exchange operations", but only for statistical purposes (Bank of Portugal Information 6/91).

To sum up, there is no longer a screening of the terms and conditions of technology transfer contracts, not even in the framework of foreign exchange regulations. Contract recording turned out to be just a statistical issue.

b) Competition Rules

The potential anti-competitive effects of technology transfer contracts led the authorities responsible for competition policy to define rules that the parties should bear in mind when negotiating and drafting such contracts. Those rules are aimed at setting up a balance between the safeguarding of competition, on the one hand, and the upgrading of production and distribution as well as technological and economic development, on the other.

Portuguese Competition Law (Decree-Law 422/83, of 3 December) is largely based on Articles 85 and 86 of the Treaty of Rome. It states that contracts should not include inter alia the following clauses: price-fixing; controls on production, marketing, technological development or investments; the sharing of markets; and making contracts conditional upon the acceptance of additional obligations, without any relation with contract object. Those clauses or practices can, however, be accepted when they contribute for economic or technological development, provided that they do not entail harmful effects on competition.

While the Portuguese law is rather general, technology transfer contracts being mixed with a host of other types of inter-firm agreements, the European Communities laid down two very specific regulations, aimed at tackling particular kinds of technology transfer arrangements, on the basis of Article 85 of the Treaty of Rome. These are the following:

- Regulation (EEC) 2349/84, concerning patent licensing; and
- Regulation (EEC) 556/89, on know-how licensing

Both regulations have a very similar structure, defining three types of clauses (and practices) having in mind its restrictive potential and its likely contribution towards the amelioration of production and marketing or the promotion of technological development:

(i) Clauses acceptable due to their positive effects, in spite of potencial harmful impact on competition, including inter alia exclusivity clauses and export restrictions (only for a limited period or when there are patents granted in the territory concerned) and limitations on the volume of production;

(ii) Clauses acceptable because they have not, as a rule, negative impact on competition, such as tie-in clauses (under specific conditions), confidentiality provisions, field-of-use restrictions and the payment of minimum royalties; and

(iii) Clauses forbidden, due to harmful competitive effects, including the following: grant-back clauses; unreasonable tie-in provisions; no contest clauses; price-fixing; and payment of royalties for products which are not manufactured with the licensed technology or for know-how that is already in public domain.

This brief presentation shows that EC Regulations, though providing an insufficient safeguard of licensee's interests, are a very relevant framework to guide firms when negotiating and drafting licensing contracts.

2.3.2. The Policies

The liberalisation of technology transfer contracts amounted to putting an end on a technology transfer policy as such. It might not have been necessarily so: the screening of contracts might have been turned into the promotion and advice to firms on what concerns licensing issues. For instance, in Irland, the main body responsible for science and technology - EOLAS - set up a service aimed at providing advice to domestic firms on the identification of new business opportunities, and on searching, approaching and negotiating with would-be licensors. Unfortunately, nothing similar has been done in Portugal, and technology transfer concerns, as defined in this paper, are almost absent from present policy guidelines.

This said, we may now turn to a closer analysis of the policies generally addressed towards the development of Scientific and Technological (S&T) infrastructure, on the one hand, and on industrial technological innovation, on the other.

(a) The development of S&T infrastructures: the CIÊNCIA and STRIDE Programmes

The CIÊNCIA programme, which enjoys a significant financial support from the European Communities, has three main objectives: (i) strengthening the country's S&T potential; (ii) enhance the institutional infrastructures of Portuguese scientific and technological system; and (iii) correct S&T regional imbalances. It is thus mainly addressed at the creation and/or the development of research and development infrastructures and the upgrading of human resources (namely through the granting of support for masters and doctoral courses in Portugal and abroad). CIÊNCIA will also support the basic infrastructures of I&D "campuses" on the two Science and Technology Parks now being launched in the areas of Lisbon and Oporto.

Mostly concerned with overall scientific and technological capabilities, its impact will be mostly felt in the medium term. Its likely contribution towards firm's technological development is only indirect, by impacting on supply factors (organisations capable to provide better R&D services and increased availability of highly qualified people). To summarise, this programme is closer to basic research than to development and more concerned with University and non profit organisation laboratories than with technology development at firm level.

The STRIDE (Science and Technology for Innovation and Regional Development in Europe) is also an E.C. sponsored programme, chiefly aimed at: reducing regional imbalances in S&T capabilities in the European Community; stimulating the participation of organizations from less developed regions in E.C. technology programmes; and strengthening cooperative links between research and development centres and firms. Although still very much concerned with science and technology in general, STRIDE is

downstream with regard to CIÊNCIA and more turned towards the creation of linkages with the industrial fabric. Three points are particularly worth mention:

- Creation of an Innovation Agency, aimed at strengthening the links between the financial system, the scientific and technological system and firms, at enhancing the industrial exploitation of R&D activities and at promoting innovation. This Agency has just been launched;

- Support to Science and Technology Parks;

- Financial support to cooperative R&D programmes, undertaken by firms and research centers together, with the objective of promoting the capabilities for technology endogeneisation, especially those technologies that may have a more significant impact on the modernisation of industries or on the development of new competitive branches.

A criticism often raised to these programmes concerns an excessive focus on infrastructures and on technology supply, providing insufficient attention to demand factors and namely to the development of in-house R&D activities in industrial enterprises - one of the weakest links in the Portuguese S&T system. Furthermore, one may wonder whether the launching of so many new infrastructures will not create serious problems of survival in the medium term if a steady demand does not arise. It should be noted, however, that there are signs that the Innovation Agency will pay attention to the promotion of firm's technological capabilities, although it is still too early to make a sound judgement.

(b) Innovation concerns in industrial policy: the PEDIP Programme

Portugal's industrial policy in the last years has been developed with two main objectives in mind: (i) modernisation and diversification of the manufacturing fabric, namely through the restructuring of traditional industries, the industrial exploitation of natural resources, the development of electronics and information technologies industries, and the promotion of capital goods

industries; and (ii) strengthening of policies concerning industrial design and quality, environmental protection, energetic efficiency, and innovation and technological development.

It was acknowledged that Portuguese firms competitiveness can no longer just rely on low prices. Firms increasingly need to achieve dynamic competitive advantages, based on design capabilities, trademarks, market knowledge, and technology learning and development skills. Technology was, therefore, considered as a "strategic vector for firm's development" and a priority issue in Portugal's industrial policy.

The main instrument for pursuing such a policy has been PEDIP (Strategic Programme for the Development of the Portuguese Industry), an E.C. sponsored programme with a budget of around 2500 million ECUs, running from 1988 to 1992. The renewal of this programme, still with a significant technology component, is being negotiated at the time of writing this document.

Technological innovation concerns rank high in PEDIP, recognising that the modernisation of Portuguese industry demands a committed investment in technological development, and namely in strengthening the links between firms and research centers and in developing in-house R&D activities by manufacturing firms. Measures and actions aimed at promoting technological innovation are spread through the various axes of PEDIP, the following deserving particular reference:

(i) Support to the launching and development of technological infrastructures, including inter-alia the development of technological centers (aimed at providing technological advice and standardisation and certification activities in specific sectors, such as textiles and clothing, wood and cork, shoe industries, glass, and metalworking industries), centers for the development of new technologies with immediate industrial interest and centers for the transfer of new technologies aimed at diffusing these technologies especially in traditional sectors;

(ii) Training in new technologies for engineers and highly qualified technicians, particularly in the areas of electronics and information technologies and in capital goods industries;

(iii) Creation and strengthening of human R&D capacities in firms, through the Researchers for Industry Project;

(iv) Financial support to investment projects in technology acquisition and development, concerning research and development projects and development of new products and processes including the building up of prototypes and pilot plants; if these activities were carried out with the support of domestic research centres financial incentives would be increased; in the period 1988-92, about 130 projects were granted support under this scheme;

(v) Financial support to investment projects on innovation and modernisation; this programme was, however, widely used for promoting investment projects, not necessarily innovative ones, although innovative potential were one of the issues considered in project appraisal;

(vi) Promotion of demonstration actions, aimed at diffusing the application of new technologies and new technical solutions throughout the industrial fabric;

(vii) Financial support to the legal protection of inventions by Portuguese entities;

(viii) Financial support to the introduction of computer integrated manufacturing (CIM);

(ix) Promotion of industrial quality and certification of firms, as well as of industrial design (including the creation of a design institute);

(x) Launching of two specific programmes, aimed at strengthening the capabilities of Portuguese firms and at attracting new projects in two key areas - electronics and information technologies, and capital goods;

(xi) Launching of two risk capital enterprises, to support innovative, high risk projects; it should be recognised however that the activity of such enterprises left much to be desired, due to both lack of innovative projects applying for sponsoring and difficulty to break with traditional banking philosophy and behaviour.

In this vast array of measures it is surprising not to find any action specifically aimed at helping firms in their efforts for searching, negotiating, acquiring and absorbing foreign technologies. The only programme that to some extent tackled this problem (just on searching, negotiating and acquiring issues) was not a national one, but rather a Community programme, aimed at promoting innovation and technology transfer (SPRINT). Three actions deserve mention in the context of SPRINT: (i) creation of transnational networks on technology transfer, involving technology brokers and technology transfer agencies; through the activities of these intermediaries it is expected that companies will be put in contact and technology transfer agreements, especially licences, will be entered into⁽⁷⁾; (ii) setting up of networks of research and technology organisations (technological centers, contract research organisations, engineering consultants); and (iii) promotion of transnational specific projects, concerning the application in E.C. countries of technologies already developed in other areas of the Community.

(7) Experience has, however, shown that commercial arrangements are much easier to arrive than real technology transfer agreements.

3. TECHNOLOGY TRANSFER FLOWS

It is widely acknowledged that international technology flows take place through a variety of channels, such as the circulation of people, the purchase of machinery, equipment, scientific instrumentation and high-tech products (usually referred to as embodied technology transfer), subcontracting, direct foreign investment, cooperative R&D agreements and contractual technology transfer. Some of these flows, however, are very difficult to assess statistically, as the circulation of people or subcontracting. Even when statistics do exist, the evaluation of the relative magnitude of each channel is very problematic.

Having these problems in mind, we will provide a brief picture of technology inflow in the last years, examining first each channel and trying then to make a global assessment. Particular focus will, of course, be put on contractual technology transfer.

3.1. Contractual Technology Transfer

The changes introduced in the legal framework of technology transfer contracts led to a disturbance in statistical series. There are very reliable and detailed statistics on technological payments until 1985, but these were discontinued and for some years the only information available stemmed from general balance of payments statistics and left much to be desired. Fortunately, since 1990 the Bank of Portugal started again to collect information on payment flows from technology transfer agreements.

Although there were changes in the scope of technology transactions covered, it will be interesting to compare both series (1980-1985 and 1990-92) to identify the main trends in technology payments.

(a) General Perspective

It may be seen, from table I, a strong growth in technology payments in the early nineties, at an average rate of around 65% per year. This means that after moderate increases in the first half

of the eighties (except for 1982, with a growth of 75%), there was an upsurge in technology payments in 1991-92. A closer analysis shows, however, this was not due to licensing contracts, but rather to engineering services: as a matter of fact, engineering services accounted for 43% of overall technology payments in 1992, from shares below 10% in 1980-85 and 14% in 1990. This finding should deserve further investigation, but available data do not allow it.

TABLE I
PORTUGAL : TECHNOLOGY PAYMENTS

	PAYMENTS (TOTAL)		PAYMENTS (LICENSE AGREEMENTS)		
	AMOUNT (10 ⁶ esc)	INDEX (1980 = 100)	AMOUNT (10 ⁶ esc)	INDEX (1980 = 100)	<u>PAYMENTS</u> _n X 1000 GDP _{n-1}
1980	4204	100	2697	100	2.72
1981	5796	138	2913	108	2.32
1982	10129	241	4273	158	2.92
1983	13769	328	5269	195	2.85
1984	14572	347	6636	246	2.91
1985	16165	385	8551	317	3.05
-	-	-	-	-	-
1990	19525	464	11415	423	1.60
1991	33504	797	13854	514	1.63
1992	52954	1260	17533	650	1.78

Sources: Foreign Investment Institute and Bank of Portugal

Turning now to payments from licensing agreements, the first impression is of steady growth, annual averages reaching 26%, for 1980-85, and 24%, for 1990-92. However, when comparing payments for 1990 and 1985, it is clear that growth during that period has been very slow, of just 6% per annum. It seems, therefore, that with EC integration there was a decline in the recourse to licensing, confirming the slower growth in the number of contracts registered since 1984. Empirical evidence collected shows, in fact, that licensing lost ground as a consequence of European integration. We will return to this later.

The relative importance of licensing in the Portuguese economy may be assessed through the comparison between licensing payments remitted in the year n with GDP in the year $n-1$, since royalty payments in a given year are the consequence of sales made in the previous year. This comparison would be much more enlightening if we could restrict it to manufacturing industries and contrast the behaviour of domestic and foreign-owned firms, since these usually account for a large share of licensing payments in Portugal (more than 70%). This was not possible, however, due to lack of appropriate data.

Be as it may, the figures provided in Table I show that there was a sharp decline in the ratio of licensing payments to GDP. It fell from around 2.9%., for 1982-85, to less than 1.8%., for 1990-92. Despite a slight recovery in 1992, this brings confirmation to the examination of payment trends developed above: the role of licensing in the Portuguese economy declined since the mid-eighties.

(b) Destinations of technology payments

Unfortunately, available data do not enable an analysis of the sources of technology by type of contract. We are, therefore, constrained to rely on data for all kinds of technology transfer agreements.

Taking the period 1990-92 as a whole, it is interesting to find that the 7 main destinations of payments (France, United States, Germany, Switzerland, the Netherlands, United Kingdom and Spain) are the same than for 1980-85, accounting for more than 91% of total payments (87% for 1980-85). However, ranking within this group experienced significant changes. Almost one third of total payments went to France. This country has traditionally been one of the main sources of technology for Portugal (20% of payments for 1980-85), but its outstanding position seems to be linked with exceptionally high payments undertaken for engineering services in 1992. The United States rank second (20% of total), with a share similar to that exhibited in the early eighties, mostly due to payments undertaken by American affiliates in Portugal. Germany accounted for 11%, strengthening its position, together with

Switzerland (fourth, with 9%). The most significant declines, as against the early eighties, were those of the United Kingdom (8% as against 11%, confirming the erosion of U. Kingdom's place as an international technology supplier), and of Spain, whose share fell from 9 to 4%.

(c) Industrial breakdown

As expected, manufacturing industries were, by far, the leading sector, concentrating 60% of Portugal's technology payments for the 1990-92 period (as against 66% for 1980-85). Unfortunately, available data do not allow to identify, within manufacturing, the most relevant branches. On the basis of previous experience and sketchy information, it seems plausible to suggest that metal products, machinery and transportation material (ISIC 38) together with chemicals (ISIC 35) were responsible for the majority of payments.

Two other sectors with significant payments were trade, restaurants and hotels (ISIC 6), which accounted for 19% of total, and financial services, real estate and business services (ISIC 8), with 11%. The share held by this sector is in line with a trend identified since 1983 and with the growth of transborder data flows and of software and information processing activities; it may also be partially explained by payments to engineering firms. More puzzling is the high position of ISIC 6. The most probable explanation is the change in the methodology of ascribing payments to industrial sectors. The Bank of Portugal considers the main sector of activity of the firm, what means that all payments undertaken by firms with simultaneous manufacturing and commercial activities, but classified as commercial, will be reckoned under ISIC 6. Furthermore, the boom in franchising activities may have also contributed to inflate the amount of payments under that item.

3.2. Other technology flows

Having in mind the problems associated with the measurement of most technology flows referred to above, this section will concentrate on embodied technology flows (purchase of machinery and equipment) and on direct foreign investment. A brief reference will be made to inter-firm cooperative agreements other than licensing.

a) Embodied technology flows

Portugal's industrial fabric is particularly weak in the area of machinery and equipment. A significant part of the capital goods used in Portugal is imported. Since 1987, the share of machinery in Portugal's total imports has remained remarkably stable, around 23%.

Periods of buoyant investments are immediately translated into increased imports of machinery and equipment, as it happened in the early post-accession years. In fact, between 1987 and 1990, those imports almost doubled, reaching 834 billion escudos in 1990, from 438 in 1987. From 1990 onwards there was a slow-down, expressed in average annual growth rates below 5%.

The purchase of machinery and equipment has undoubtedly been the main device for technology upgrading of Portuguese firms, especially in traditional industries. The importance ascribed by Portuguese entrepreneurs to machinery and equipment as a factor of innovation is well shown by a recent survey undertaken by CISEP in cooperation with the Planning Department of the Ministry of Industry(8). The purchase of new equipment was ranked first among the sources of innovation with a score of 1136 points, followed by the need to improve products (1023 points) and the need to adapt products to clients requirements (931 points), while research and development activities and licensing ranked 13rd and 18th, respectively (with 192 and 95 points).

(8) CISEP/GEPME, Inovação Indústria Portuguesa-Observatório M.I.E. Lisboa, GEPME, 1992

It should be recognised, however, that Portuguese firms have made a scarce use of reverse engineering by comparison to their Japanese or Korean counterparts. If in a few more mature areas of metal-mechanics and electrical machinery Portugal has generated some endogenous technological capacity, the country lacks internationally competitive firms in the industrial machinery industry. User-producer linkages are generally weak, and high demanding customers go abroad to fulfil their needs.

As the statistics show there was in the last years an important modernisation in terms of machinery and equipment, partly with the support of PEDIP. However, Portuguese firms are now discovering, at their own cost, that equipment modernisation per se is not enough to achieve competitiveness. In fact, the key for competitiveness rests much more in the "soft", in intangible technology and management competencies, than in the "hard", in the access to machinery and equipment.

(b) Direct Foreign Investment

In the wake of EC's accession direct foreign investment in Portugal experienced a remarkable boom, increasing around 11-fold between 1987 and 1991, to reach 799 billion escudos. Investment growth was particularly strong in 1987-89, always with annual growth rates above 120%. In 1990 and 1991 there was a slow-down, despite the significant contribution of the Ford-Volkswagen project which ranks as the largest foreign investment ever undertaken in Portugal. Data for 1992 indicate a sharp decline, foreign investment amounting to 591 billion escudos (25% less than for the previous year) (9).

Taking the pre-accession period as a reference, foreign investment pattern during the post-accession period may be briefly characterised as follows:

(9) It should be noted that data for 1991 are inflated by the Ford-Volkswagen project. However, even discounting for this huge project, foreign investment fell by around 4%.

- strengthening of the European Community as the main source of investments, reaching 71% for 1986-91 and 72% for 1992;

- acquisitions gained ground, accounting for 20% of overall foreign investment in 1986-92, a share very close to that of the creation of new firms (21%); this means, of course, that investments by firms already established in the country continued to account for the majority of foreign investment;

- services took the lead as the main destination of foreign investment, especially financial services and real estate;

- manufacturing industries share declined to less than one third of overall foreign investment, despite the large Ford-Volkswagen undertaking (30% for 1986-91 and 22% only for 1992);

- foreign investments in manufacturing, for the period 1986-91, were led by metal products, machinery and transportation material (ISIC 38), with 54% of total, followed by chemicals (13%), food industry (9%) and non metallic minerals (8%). Such a sectoral distribution underwent an upheaval in 1992, when chemicals took the lead (41% of total), followed by non metallic minerals (21%), while metal products, machinery and transportation material fell sharply to rank third (19%).

With regard to the characteristics of foreign investment in manufacturing, a detailed analysis conducted on the biggest projects declared 1986 and 1990 shows that export-oriented investments accounted for around 60% of total. Portugal appears to be chiefly envisaged as a manufacturing location in the context of Europe-wide (or even World-wide) production rationalisation strategies (10).

(10) For details on this topic, see Vitor Corado Simões, European Integration and the Pattern of FDI Inflow in Portugal in John Cantwell, ed., Multinational Investment in Modern Europe: Strategic Interaction in the Integrated Community, Chichester, E. Elgar, 1992; and Vitor Corado Simões at alii, Impacto do Investimento Directo Estrangeiro na Estrutura Industrial Portuguesa, Lisboa, CESO I&D, 1993.

The technology transfer effects of many of these investments remain to be seen and will very much depend on the density and the strength of the linkages to be established with domestic suppliers as well as on the technological and human resource requirements of the activities to be performed in Portugal and their diffusion throughout the domestic industrial fabric.

(C) Non-equity inter-firm cooperation arrangements

The growing importance that technology based inter-firm cooperation is gaining led us to examine the relevance of such arrangements (excluding licensing and other technology transfer contracts, already analysed above) as vehicles for technology inflow.

A press survey undertaken by our team for the period 1988-91 identified only 10 technology-based agreements, 8 of them concerning licensing and technical assistance. This means that Portuguese firms have largely remained absent from the wave of technology -based cooperation that spread throughout Europe and the whole Triad. As we noted elsewhere (11), this may be interpreted as indicating, on the one hand, that Portuguese companies are still technologically too weak to be regarded as interesting partners (for a two-way technology exchange) by foreign corporations and confirms, on the other, the low concern of those companies with disembodied technology transfer.

Turning now to E.C. cooperative research programmes the overall picture is not very different. As a rule, the participation of Portuguese enterprises is low, BRITE/EURAM being the only noticeable exception. Furthermore, Portuguese contractors seldom have leadership positions - thereby hindering their capacity to better profit of such projects. Despite these shortcomings, the Portuguese experience in E.C. programmes may be assessed as positive, since it opened some new opportunities for technology learning and transfer and helped the development and consolidation of some research teams, capable of further networking with domestic firms.

(11) Vítor Corado Simões, Globalisation and the Small Less Advanced Countries - The Case of Portugal, Brussels, FAST/MONITOR, FOP 24, 1991

3.3. Towards a synthesis

This brief overview of technology transfer flows suggests four main conclusions, that may be presented as follows:

(i) The purchase of machinery and equipment is still envisaged as the first source of technology upgrading by Portuguese firms, although a concern with the need to invest more in tacit knowledge is emerging;

(ii) The boom of foreign investment is over: in 1992, for the first time since 1987, foreign investment inflow declined vis à vis the previous years; foreign investment has nevertheless an important role to play as a purveyor of technology, although the full materialisation of its potential very much depends on the kind of activities undertaken locally and on the linkages established with domestic manufacturing fabric, namely with networks of domestic suppliers;

(iii) The use of inter-firm technology-based cooperation by Portuguese firms has been very limited, partly as a consequence of the limited innovation capabilities of those firms;

(iv) Last but not least, since EC accession there was a decline in the relative use of technology transfer agreements, and particularly of license contracts, as a vehicle for technology inflow. Available evidence suggests that licensing lost ground to other types of inter-firm relationship, namely equity investments and agency contracts. In fact, several arm's-length licensing arrangements were discontinued and substituted by other links:

- some former licensees were taken over by their licensors in industries such as food processing, beverages, chemicals, pharmaceuticals and machinery; in some cases, reduced risk perception, market growth prospects and the easing of trade flows (enabling to supply the Portuguese market from abroad) led the former licensors to take an equity share, often a majority one, in their licensees; in others (fewer), it was the licensee that, fearing increased competition, tried to forge a stronger link with its

licensor, as it happened in metalo-mechanics and machinery industries (12); all in all, the freedom of licensees appears to have been curtailed by E.C. accession;

- in sectors where licensing agreements had been entered into mostly as a means to circumvent tariff barriers, such as in cosmetics, market integration led to the discontinuation of licensing (as well as of domestic packaging) and license contracts were changed into agency arrangements.

(12) An interesting case happened with a firm of domestic water-boilers that sought to increase the commitment of its large German licensor (one of the biggest German multinationals). As a consequence of German firm's participation in Portuguese firm's equity, the manufacturing of domestic water-boilers for the whole Europe was transferred to Portugal and the technological content of the Portuguese firm significantly increased. This process led the German partner to held a majority share, but Portuguese partners are still involved in the management.

4. TECHNOLOGY TRANSFER AND DOMESTIC TECHNOLOGY CAPACITY-BUILDING: AN ASSESSMENT OF POLICIES

This chapter is aimed at providing a brief assessment of the policies followed, especially on what regards their contribution towards the technological performance of the Portuguese industry and the accumulation of technological capabilities, with a view of make some suggestions concerning the future.

A caveat should be made. Given the different characteristics of the policies review above (technology transfer policies between 1978 and 1985, and more wide ranging policies from 1986 onwards) it is not correct to compare them and their perceived results. Our main task will be, on the basis of the experience of "mild" control over technology transfer contracts, to see how technology transfer policies might harmoniously merge with innovation policies.

4.1. The experience of contract evaluation (1978/1985)

A first level of assessment regards the impact of contract evaluation on the magnitude of foreign technology inflow. We think that, in general terms, regulation did not seriously hindered technology inflow through licensing and technical assistance contracts. As mentioned above the Foreign Investment Institute adopted a "soft" approach, which was not regarded as a significant obstacle by technology suppliers. This is not to say, however, that in some instances the Institute's intervention would not have unvoluntarily led to undermining one or another contract due to the time factor: the opportunity for marketing the product was lost as meanwhile another firm preempted the domestic market and raised barriers to the entry of new competitors.

Payment statistics strongly confirm that technology inflow was not reduced. Technology payments increased 6-fold between 1979 and 1985. Payments stemming from license contracts have shown a steady growth, while the weight of these payments in GDP also exhibited a (slight) increasing trend. It is interesting to remark

that such weight declined in the late eighties and in the nineties, mostly due to market liberalisation: licensing lost ground to direct foreign investment and to exports as a market-servicing mode.

Evaluation procedures had a positive effect on contractual terms and conditions, especially in reducing unduly contract durations, in curbing payment levels and in eliminating some of the most restrictive clauses (particular focus was put on export restrictions, unbalanced grant-back provisions, price-fixing clauses and tie-in). It should be borne in mind, however, that the deletion of restrictive provisions from contracts does not ensure that the corresponding practices do not take place: in some cases there are parallel gentleman's agreements; in others, the bargaining power of licensors increased over time and restrictive practices might have gradually emerged.

Another field where the Foreign Investment Institute tried to play a role concerned the establishment of linkages between technology acquisition, and technology mastering and diffusion. It should be pointed out that diffusion is difficult in the case of licensing contracts, since it is the very possession of secret know-how that provides an edge over competitors; diffusion will only happen through indirect forms: demonstration effects, leave of skilled personnel and use of sub-contractors. The case is different for engineering agreements, where domestic engineering firms may play an important role in assimilating and diffusing technologies. The Institute endeavoured at increasing the participation of domestic firms in large engineering projects, but this proved not to be an easy task. With regard to linkages with domestic R&D centers, achievements were even weaker, due to the lack of adequate incentives for firms to develop projects of mastering and further development of imported technologies and also to the short-minded approach followed by most firms in acquiring foreign technologies. These were clearly issues where the lack of connection between technology transfer policy, on the one hand, and science and technology and industrial policies, on the other, undermined the possibilities to enhance the absorption of foreign technologies. It also shows that pursuing policies mostly focused on "defensive" issues (control of contracts) does not grant success in technology endogeneisation: the latter requires positive incentives and a

committed policy to foster strategic approaches by firms when acquiring foreign technologies (to use the technology as an investment device and not just as a consumption good) and to promote linkages between firms and domestic R&D centres (in our view, a demand-driven approach is more effective than a supply-oriented one).

As we said elsewhere, "the pedagogic activity of the Foreign Investment Institute has probably been the most important and long lasting outcome of 8 years of technology regulation"⁽¹³⁾ - and also the most difficult to measure. The dialogue with Portuguese licensees increased the entrepreneurs awareness of the opportunities and problems of technology transfer agreements and of the negotiation of their terms and conditions.

The Portuguese experience shows that a "dynamic" and wider perspective of technology transfer has to be adopted. Registries should not be confined to a defensive, and reactive, attitude of checking contractual terms and conditions. Strict control is not the most appropriate way to enhance technological capabilities in an increasingly globalised World where international competition is fierce. More pro-active policies should be followed to strengthen domestic technological infrastructures and to upgrade the technological level of domestic firms. Technology transfer policy has an important role to play, especially in two axes: first, by promoting the import, in adequate conditions, of technologies needed to further domestic firms competitiveness; and second, by fostering the mastering and endogeneisation of such technologies, through the establishment of positive incentives that may lead firms to invest in effective absorption of foreign technologies.

(13) Vitor Corado Simões, Impact of Regulatory Functions Related to the Transfer of Technology: Portugal, Vienna, UNIDO, 1989, pg. 30.

4.2. From technology transfer to innovation policies (1986 onwards)

It was already pointed out that, following EC accession, the Portuguese economy experienced a swift internationalisation process, with a strong increase in embodied technology imports and in the inflow of foreign investment (together with a decline in disembodied technology payments). Such a process resulted into an increased Europeanisation of the economy and has been, to a large extent, led by foreign firms. These actively profited from the opportunities opened by regional integration, while Portuguese firms took a more reactive stance.

The scientific and technological system exhibited a growth trend, R&D expenditures reaching 0,6% of GDP for 1990 - a figure that is, however, much below EC average. The last few years witnessed the emergence of a significant number of private non profit organisations (some of them aiming at bridging the gap between University and Industry), the development of politechnical education, and a substantial growth of financial support for R&D activities. The S&T system remains, however, weak, lacking human resources and links between research centers and industrial firms. Furthermore, technological effort by industrial firms is very low, not only on what concerns in-house R&D expenditures but also on resources committed to other scientific and technological activities (quality control, certification, design, small product improvement), which lays the basic ground over which R&D activities may achieve minimum productivity levels.

The CIENCIA programme has played a positive role in the creation and strengthening of R&D infrastructures and in the training of skilled human resources. There was, however, an insufficient attention paid to the current activities of those infrastructures (working costs are not supported) and, last but not least, to the setting up of linkages with the industrial sector. It was implicitly assumed that such linkages could not develop without the existence of infrastructures, but it should be borne in mind that the very existence of research centers is not enough to generate a demand for their services - and CIENCIA, by its very nature, is supply and not demand - orientated.

Technology and innovation were granted a central place in the new industrial policy discourse behind PEDIP. Innovative capabilities and dynamic competitiveness factors were considered as a new base for firm's competitiveness, instead of just relying on low cost.

It is still too early to fully evaluate PEDIP from the technological standpoint. Technology upgrading takes time and behavioural and structural change are slow processes. Available evidence suggest several positive aspects to be credited to PEDIP: a growing concern with innovation policy and with domestic firms technological skills ; the launching of new technological infrastructures and the strengthening of existing ones, to provide technology services to firms; the stimulus to technological upgrading of domestic firms (especially on what concerns machinery and equipment); the attempt to develop domestic capabilities in the two key areas of electronics and information technologies and capital goods (not translated in very significant results, however); the launching of demonstration projects, an interesting instrument for technological diffusion; and the promotion of quality, certification and industrial design.

PEDIP also aimed at changing economic agents attitudes, namely through increasing domestic firms awareness of the importance of dynamic competitiveness factors (design, quality, trademarks, fashion, product differentiation and learning capabilities). It seems, however, that this discourse was not fully interiorised by the entrepreneurs, notwithstanding some success cases.

In fact, investments in machinery and equipment significantly expanded, largely with the support of PEDIP; it may be said that, in general, Portuguese manufacturing firms have now machinery of recent vintages and are failure, if not well, equipped in terms of hardware. There was also an upgrading in the technological content of some foreign investments, especially in the automotive industry - although it should be acknowledged that the attraction of these investments, such as the huge Ford/Volkswagen project mentioned above, entailed the granting of substantial incentives. A few new technology based firms, often with close links with Universities and research centres, were created. However, for the majority of

domestic owned firms the modernisation in terms of machinery and equipment was not paralleled by a similar drive in investment in intangible assets. Management capabilities remained weak and strategic thinking rested largely absent.

The weakness of strategic capabilities is a structural problem, due to the interweaving of several factors, from the resistance to change and the family-owned nature of many businesses (meaning that familiar succession in management posts prevails over the separation between ownership and management) to the lack of industrial groups that might act as "rationality centers" and the insufficiencies of entrepreneurs on what technical and management knowledge are concerned.

Portuguese firms are too much focussed on production strategies, paying low attention to market signals and to the need to develop new products to respond market needs. Associated with this problem is the weakness of user-producer inter-action in Portugal.

Furthermore, as a recent report on Portugal's industrial policy remarked(14), "it is particularly worrying the low capacity of Portuguese firms to correctly identify their technological needs." This is, in fact, a key point that conditions the possibilities of further development of firms, the linkages to be established with research and technology organisations providing technology support services and the searching and import of foreign technologies.

International technology transfer has been a missing link in recent industrial policy in Portugal. In fact technology transfer has often been seen in the perspective of vertical transfer between research centers and Industry, but less often as the process of acquisition and endogeneisation of foreign technologies. Having in mind the weaknesses of Portuguese S&T system, the lack of in-house development capabilities of most firms and the need to bet on product differentiation, the acquisition of foreign technologies is needed.

(14) "Relatório sobre Política Industrial em Portugal nos Anos 90", commissioned by the Commission of the European Communities and led by Professor Ernani Lopes.

Unfortunately, measures aimed at supporting firms in the definition of their needs, in the searching of alternative technologies and suppliers, in negotiating contracts and in technology absorption were lacking. The implementation of such measures might have helped firms to develop new business opportunities, to upgrade current technologies and to learn about new technological approaches.

The research undertaken on domestic firms licensing-in experience shows that they assess it as largely positive. Licensing has been a suitable device for launching new products and/or for modernising the existing range of products. More than one third of firms indicated that they had achieved a good mastering of licensed technologies and were now able to design and/or develop new products or process based on them (15). However, opportunities for licensing within the European Communities appear to be shrinking due to the withdrawal of tariff and non-tariff barriers. In contrast, medium-sized American and Japanese companies seem eager to license-out as a means to penetrate European markets. This might be an avenue to exploit, but again it demands support measures to induce and advice firms in identifying and approaching so distant licensors.

To sum up, innovation emerged as an important reference in industrial policy and efforts were undertaken to upgrade the technological level of Portugal's manufacturing fabric and firms technological capabilities. The inflow of foreign technology was remarkable on what concerns machinery and equipment and inward investment, but the role of technology transfer agreements as vehicles for technology acquisition was disregarded and the opportunities offered by licensing-in underated.

(15) Vitor Corado Simões, Oportunidades de Desenvolvimento Tecnológico das Empresas Portuguesas através de Contratos de Licença, AIP, Lisbon, 1992

5. CONCLUSIONS: THE WAY AHEAD

The analysis of Portuguese technology transfer and industrial policies presented above suggests, in our opinion, four main conclusions:

(i) Technological (and organisational) know-how and learning capabilities are key assets for firms to compete in markets increasingly globalised, where product life cycles are shrinking;

(ii) Supply-driven approaches (development of technological infrastructure, namely research and technological centers) are helpful but not enough; demand led approaches, stemming from firm's needs and willingness are needed. This means that committed efforts should be undertaken to strengthen firm's technological base (especially on "soft" areas) and to promote their technological accumulation and mastering capabilities. Technology transfer contracts may be an essential ingredient in this process of technological accumulation, insofar as they contribute to the upgrading and the development of firm's technological base;

(iii) Defensive technology transfer policies do not respond to those needs, since the key issues do not lay in contractual terms and conditions only, but rather in domestic firms capabilities to use technology imports as a learning device and as a leverage for further innovation;

(iv) International technology transfer policies have an important role to play in national innovation policies, especially in less industrialised countries, and appropriate linkages should be established between them.

For countries like Portugal, heavily internationalised and with a weak S&T system, joint-venturing and licensing-in should be actively promoted as instruments for enhancing domestic firm's capabilities. A programme aimed at encouraging licensing-in should include the following actions:

(i) Strengthening firm's capabilities to define their own needs, namely through the launching of a technology audit programme, which might partially finance the costs of technology audits carried

by independent consultants to assess and identify firm's technological strengths and weaknesses;

(ii) Diffusion of information on technologies available for licensing, in order to reduce search costs (obviously, the more firm specific information requirements are, the more difficult it becomes for general information dissemination to substitute for firm-level search activities);

(iii) Fostering contacts between domestic firms and would-be foreign technology suppliers: the use of international organisations networks might prove helpful in this regard; in the case of Portugal, two avenues might be exploited having in mind the fact that European large firms are less prone to licensing: smaller European firms and medium-sized firms in the United States and Japan;

(iv) Identifying the opportunities for licensing-in relationships with foreign R&D centres, as a means to have access to exclusive technologies (this involves higher risks, however, since licensed products may raise marketing, or even technology development, problems);

(v) Educating firms in technology transfer management: providing advice to firms (through Government agencies, Industrialists Associations support services or private consultants) on technology transfer matters might lead to ameliorate contractual terms and conditions and to foster technology absorption. Areas to be tackled include: technology and licensor search, evaluation and selection; negotiating licensing agreements; building up profitable licensing relationships; and assimilating, mastering and developing imported technologies;

(vi) Promote "investment strategies" in licensing: firms should be encouraged to invest in technology acquisition, through the building up of "in-house" technical capacities to assimilate, adapt, master and further develop imported technologies, so that they may really contribute to a sustained path of technological development.