INNOVATION, TECHNOLOGICAL TRANSFER AND COMPETITIVINESS
A TERRITORIAL APPROACH

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Abstract: The aim of this paper is to discuss the innovation and the technological transfer in what concerns their impact on the competitiveness of the performance of lagging regions. The distinction between the concept of innovation and technological transfer seems to be relativised, since it is assumed that the conditions for the operationalisation of the process of technological endogeneisation require contextual conditions similar to the regions that export technology.

Some conclusions about the role of some factors must be taken from studies carried out and from our empirical research, concerning Beira Interior, such as the industrial structure, the quality of entrepreneurial activity and networks and cooperation for innovation, which might appear as a struggle to the process of innovation and to the technological accumulation. We also stress some of the implications on the regional policy.

1. INTRODUCTION

During the 80s it was believed that the technological progress started to take the main role in the process of economic growth and development.

This context explains the reinforcement of the centrality of the technological and innovation policy in the design of the economic policy and researchers agenda, specially in what concerns the regional economics in which the attention paid to the determinants of the innovation and their relationships to the regional performances. Both technology and innovation have being increase their role in conception of the regional policy.

Considering the trends previously referred conceptual tools became more important. Concepts like innovative environment, local and regional system of innovation, technopolos, science park, transfer centres of technology and incubator centres may be seen as a support to the firm in the innovation and technological diffusion. This dynamic is organised according to an institutional model of local partnership between the public and the private sectors (see M. Silva and I. Mota, 1996).

However, there seems to be a tendency to consider the innovative process as phenomena of special relevance in promoting a dynamic efficiency. Paying, therefore, less importance to the contribution of the technological transfer process for the competitive performance. In our opinion, there is a lack on research of the adequate conditions for the creation of a capacity of absorption. This capacity as an essential factor to take an efficient profit and also to the develop the experience require for the valorisation of exogenous technological flows.

Innovation is supposed to be the first commercially successful usage of any new idea (products, operational processes, new organisational models, new markets or new inputs). Diffusion is understood as a subsequent phenomenon, which concerns to imitation processes or incremental change of an innovation. At the very beginning of the process technological diffusion involves deep alterations to the primitive innovation and this generates some considerable effects on the structure of any economic activity. We observe changes in the

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composition and needs of capital, in the quality and types of the raw materials, in the structures of qualifications or skills, in the institutional infrastructures and so on (see M. Godinho and J. Caraça, 1988).

Nevertheless, there is a problem connected to the fact that the market is not able to assure spontaneously the diffusion processes. The imperfect competition of the market is related to a group of technological assets, which are not transferable through the purchase of equipment or patents from abroad. This knowledge is disembodied of the trade technologies of a contextual nature. Then we think that it is essential that the lagging economies can rationally assure their adaptation/valorisation to the new imported technologies and provide adequate responses to the evolution of the market technological conditions.

According to M. Silva and I. Mota (op. cit.), the economic and extra-economic prerequisites necessary to the functioning of technological endogeneisation phenomena gain similar features to the ones that favour the innovative dynamics. This way, the distinction between the two processes becomes less relevant and highlights not only the systemic character of the innovative process but also the technological transfer phenomena.

This means that if the process of convergence and interregional cohesion supported by innovation occur, then they will require similar contextual conditions between the importing or exporting of technology from one region to another.

The aim of this paper is to discuss the role of some aspects in the process of innovation and technological transfer for the competitive performance of lagging regions.

We will start with an approach of the theoretical trends of the innovative process. Then we will refer briefly to some of the methodological aspects related to the representation of the systemic innovation phenomena. At last we will analyse, centred in our case study, the role of some elements that might interfere in the relationship between the technological transfer and territorial competitiveness.

2. TRENDS IN THEORETICAL APPROACHES OF INNOVATION

The representation models of the innovative processes and of the mechanisms of technological diffusion have been developing a lot since the pioneering research studies of Schumpeter (1934), Posner (1961) and Vernon (1966).[2]

The present perspective of the innovation phenomenon differs a lot from the previous one. The linear approaches, *technologic-push* and *demand-pull*, have been suffering a loss of their explanation power for the representations that stress the interactive features of the innovative processes.

According to Klin and Rosenberg (1986), the innovative process is identified by recurrent and strong interactions that show the cross effects grounded on the technological opportunities made available by the activities of I&D and by the market opportunities which were a consequence of a change in the demand. The issue here lies on the fact that the research is not a *sine qua non* condition in the dynamics of innovation. However, it shows off as an activity which makes part interactively of the process of innovation.

Klin's and Rosenberg's model was a relevant step forward for the understanding of the innovative process but it is, however, very conditioning. This model highlights the importance of the interaction between activities. Nevertheless it does not explain either the systemic complexity of the actors or of the other components that act over the dynamics of innovation. Moreover, they do not explain the importance of the technological transfer mechanisms towards a competitive performance.

From this point of view, we realise that the approach proposed by Freeman (1987), Lundvall (1992) and Nelson and Rosenberg (1993) is much more comprehensive and fertile for the phenomenon in analysis. These authors do not reject the role of the interactions between the market and the technological opportunities, however, they put the *National System of*

[2] The contributions of Posner and Vernon were important for the explanation of the convergence process of the national economies supported through the international diffusion of technology.

Innovation as an important element of the ability to innovate any economy. According to Lundvall the National System of Innovation *is constituted by elements and relationships which interact in production, diffusion and use of new, and economically useful, knowledge,..., either located within or rooted inside the borders of a nation state* (1992:2).

The previous authors' approach lead us to some considerations of a methodological and theoretical nature which we consider of the at most importance.

To start with, the firm is no longer the only regulation agent of the innovative process, which starts being led by a complex network of institutional relationships, grounded either on the financial and productive system or on the educational and training system and on the scientific and technological system.

The performance of the system measured considering the total amount, the type and the economic value of the generated innovations and its diffusion pace is strongly conditioned by the organisational and effective quality shown by the management of the exchange of scientifical and technical information among the different components of the network.

The main culture either in community or in the firms seen as the most important environmental element. This idea gives a social feature to the innovative activities. If the technological and innovative aspects are important for the process of socialisation than the stronger the absorption capacity and manipulation of the knowledge will be. This will also provide new practices and attitudes which are favoured to the process of change.

What seems to be particularly relevant in this evolution, as F. Marques Reigado (1996) refers, is the de-materialisation to which the modelling of the innovative process has seen exposed, specially throughout the 80s. This path has led to the consideration of the variables conventionally considered as being extra-economical, namely the valorisation of the conceptual framework of network, the informal sociability relationship, the institutional infrastructure and the organisation and territorial dynamics. The analysis overlook the traditional models, whose functional specification accepts the technological variable as being exogenous to the process.

This theoretical endogeneisation of the innovation and widening of the universe of comprehensive variables is greatly due to some tendencies from the regional analysis. We can refer, amongst others, the approaches developed by Malecki (1983), Ph. Aydalot (1986), Cappelin (1991), Perrin (1991, Camagni (1992), Maillat and Lecoq (1992), Costa and Silva (1994) and F. Marques Reigado (1996).[3]

Concepts such as *innovative milieu* and *regional and local innovation system* drawn the experts attention onto them. These experts have been studying the frames, nature, grounds and evolution of the process in analysis. The interest shown by the researchers on this issues does not mean that the firms should have a minor role as actors in the innovative and diffusion technological process. The methodological reorientation is based on the conviction that the regional and local units have more strength in the explanation and comprehension of the factors that enable the adoption, on the side of the firms, of competitive strategies supported by innovation and technological transfer.

Therefore, the innovative and technological development of the performance of the firms does not depend only on their own actions but they are more or less conditioned by elements of a territorial matrix. We stress the quality of the location factors, public policies of the different levels of the government, historical, cultural and social context. Particular relevance has the socialising dynamics in which science and technology as well as the receptivity to innovation act as one of the structural elements.

F. Marques Reigado suggest a model of an interactive approach for the innovative process, based on concept of innovative milieu (Fig. 1). The innovative milieu is a social system which is involved in dynamics of collective learning with a mainly endogenous nature. These dynamics have elements which structure themselves around a complex territorial system of formal and informal networks. This complex system promotes economic, technological,

[3] Nelson and Winter (1990) and P. Romer (1992) have contributed a lot from the neoclassic point of view to the endogeneisation of the knowledge and of innovation in the explanation of the economic growth.

political and cultural interdependent relationships with capacity for generating links and innovative processes.

However the modelling of innovative process based on territory also recognises the importance of outer stimulus which have eventually some weaknesses, namely when they appear as a result of movements with few or none ability to create externalities in the learning processes as well as strengthening of technological experience.

Nevertheless, introducing the exogenous component in our analysis is what concerns us the most. It is therefore relevant to highlight the fact that innovative milieu has a high level of openness and of integration in a global economy. This means that its ability to get structured and performance are not only related to the coherence and the level of internal integration but also to the mechanisms of an external relationship on a formal as well as on an informal basis on the side of the elements with the most strategic importance: that is to say, firms, chambers of commerce and industry, I&D infrastructures and other structures of scientific and technical exchange. This is important either for the processes or for the products, the markets, organisational and pre-competitive research

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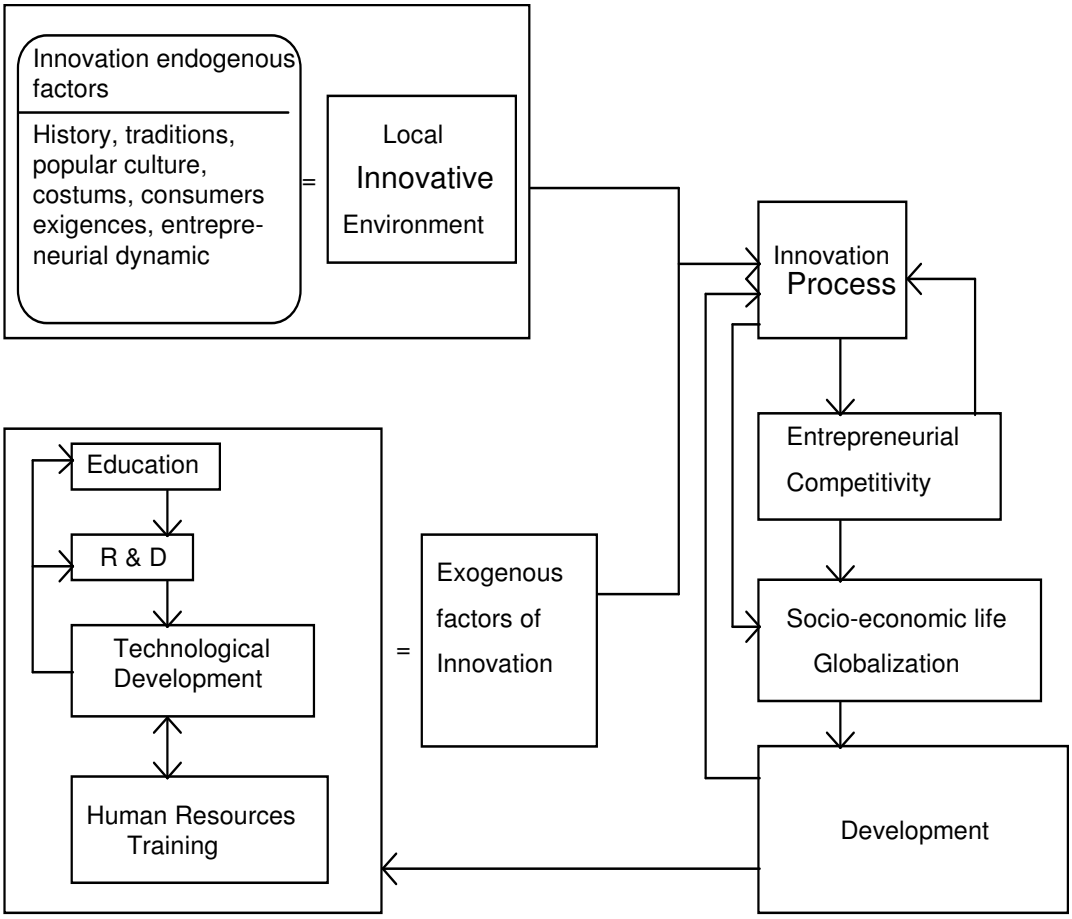

Fig. 1 Innovation factors interaction (F. Marques Reigado, 1996)

The open economic system is so much important that it must be recognised that the most technological developed and competitive economies keep a great part of their budgets to the R&D for the research about the evolution and trends of the globalisation scientific and technological tendencies as well as to the creation of mechanisms aiming at absorbing new technologies. The existence of infrastructures with the ability to make the endogeneisation and diffusion of new technologies is important to guarantee the growth of the technological capacity

of local and regional economies. The innovation do not depend only on the activity of the R&D. The process innovative can have their own starting point in the structural changes in the demand or being stimulated by innovative phenomena which are just starting to appear.

It is therefore understandable that the cooperative institutional capacity is, according to Stöhr (1986), one of the most valuable elements to get positively different performances. This fact gives the technological transfer processes a strategic importance in the valorisation of the performance of the economies, which haven't reached the state-of-the arts yet.

3. EVALUATION OF REGIONAL INNOVATION PERFORMANCE. SOME METHODOLOGICAL ASPECTS

The theoretical trends give a stimulus to the research of new methodologies and indicators with the ability of translating a closer, straighter and more comprehensive innovative paths. This means to develop evaluation methodologies which are progressively oriented towards a systemic approach, able to attract the quality interactions and relationships established between the actors and the several components of the regional and local dynamics of innovation.

Considering approaching models which are based on either the exploitation of flows of input, infrastructure, human resources, expenses in R&D and so on, or the output, inventions, patents, publishing and so on connected to a pipeline type perspective is very limited for many different reasons.

he regional and local reality specially in the lagging areas is emphasised by emergent systems, with a relatively short term. In this context the analysis of the dynamic externalities, to which the empirical evidence seems to give a relevant role, are hardly able to be dealt with the classical approaches.

In general the research searches for evaluation and recognises to the interactive dynamics and to the formulation of policies and measures an important role. Perspectives of "learning by interacting", "learning by using" and "learning doing" become of a great value.[4]

From the point of view of the operationalisation of the research tools, the relevant issues refer to the fact that the different evaluation methodologies and measurement of innovative potential include several dimensions of the analysis. We point out the supply and demand of technological services, the efforts of R&D from the firms, the inter-firms cooperation for the innovation. This effort to improve efficiently operationalisation mechanisms show, in a higher or lower level, insufficiencies in what concerns the determination of the variables, aim and conception of the indicator to be used.

The approaches must be thought according to the level of development of the local system of innovation. The present indicators of input and output traditionally used seem not to satisfy the evaluation of systems in a period of structuration and which aren't near the state-of-the art yet. They also seem to be inadequate because they aim at evaluating results and not processes, at showing phenomena of dynamic efficiency as well as hidden factors, which are important for the accumulation of technology.

We are now facing a theoretical and methodological challenge which is limited in what concerns the production of output on the short run.

As it is referred in the report of the European Commission (op. cit.: 49) the *process indicators developed in the study are not robust in a quantitative sense, in fact, it proved difficult to find quantitative measures to assess process impacts. (...). It was not possible to quantify issues like technology transfer, critical mass, RTD system performance and efficiency, spatial impacts, utilisation of learning opportunities and other such complex variables. The analysis and commentary on these is therefore rather qualitative, which makes interregional and inter-country comparisons difficult and at best, approximate*.

[4] About the relevance of these concepts to the innovative process see e.g. A. Figueiredo (1990).

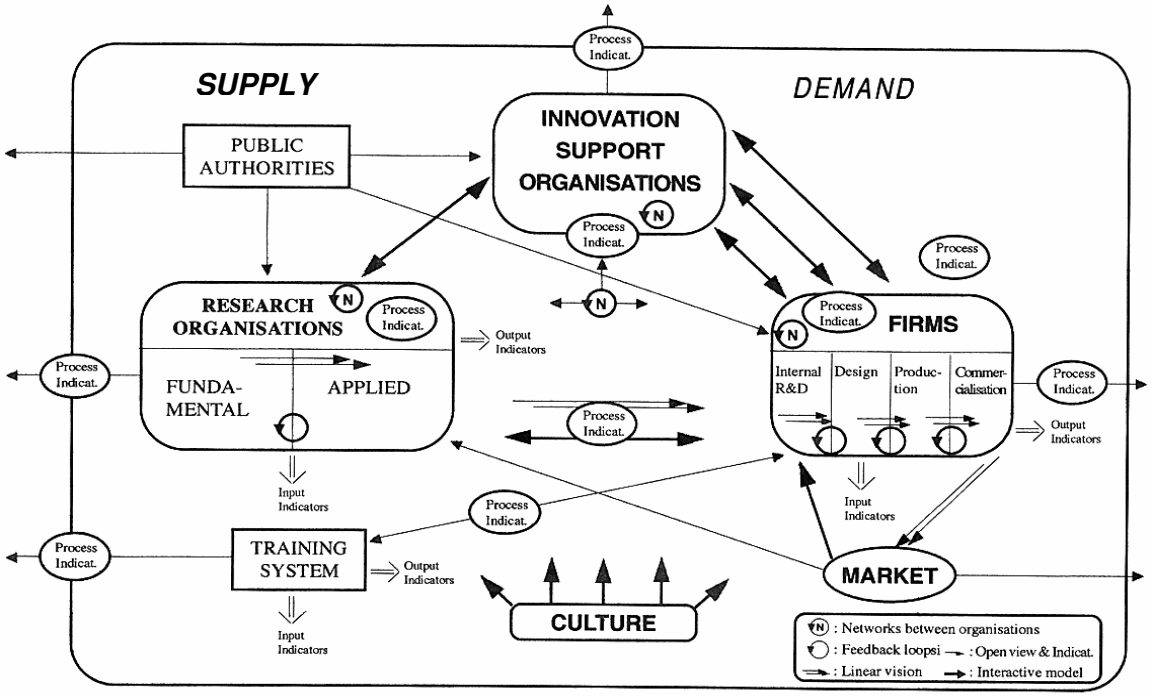

Fig. 2 - Regional system of innovation: input-output and process indicators
(European Commission, 1995)

4. TECHNOLOGICAL TRANSFER AND COMPETITIVENESS: MAIN FINDINGS OF A STUDY CASE — BEIRA INTERIOR

This section is based on a research work study integrated in the Programme STRIDE (Research and Technological Development in the Less Favoured Regions of the Community), that aim at evaluating the scientific and technological potential of Beira Interior.[5]

4.1 General View on the Socio-Economics of Beira Interior

Beira Interior is an area located in the central interiors of the Portuguese Continent and an important part of its geographical area is a cross-border one.

The social and productive aspects suffer from problems of a multidimensional nature: we might identify problems connected with lagging regions as well as problems of industrial decline. With the process of the European integration the revitalisation of the socio-productive structure started to be dependent on the ability to generate processes of restructuring, reconversion and diversification of the productive structures. In the industrial sector centred in wool and textiles, the area has one of the largest and most important industrial poles of the central interiors of the Portuguese Continent with an ancient industrial culture and a great experience in the foreign market.

However, the 80s brought about sectorial recomposition movements, which were connected with the sectors concerning the local markets, namely the real estate sector, the furniture sector, , the food sector, the hotel sector, the retail trade, the very large outlets with a mainly exogenous origin should be mentioned as well as non trade services. The foreign industrial investment is somehow a phenomenon with consequences for the generation of employment, income and sectorial reorientation. However this contribution is more accurate in

[5] See F. Marques Reigado *et al*. (1995).

the increasing of the productive capacity and not so important in the technological one. It is somehow irrelevant concerning a dynamic efficiency.[6]

The political, economic, social and cultural situation has been suffering deep changes, anyway they are not enough to show a better standard of the relative performance. We may also see a certain stability in what concerns the position of this area in the regional hierarchy.[7] This means that the demographic, restructuring and economic reconversion process as well as the investment effort is not yet enough to guarantee a change forward of the development process. In this case, the efficiency and effectiveness of many of the assets located in a recent past in region, still need additional action which aim at a better stimulation and valorisation of the area.

There are however locational elements able to reduce the deficit of strategic resources. There are also some institutional tools that enable the creation of forward factors of a competitive advantage. The institutional structure has a group of actors that may increase the emergence of a regional system of innovation. To the higher education (either in universities or polytechnic schools) we may add other structures that make an interface for the activities of the SME in an international competition framework. The region is provided with technological centres, training centres, chambers of commerce and industry, with large and important physical infrastructures and of a less importance human resources, and innovation support organisations. All these structures provide services to the firms.

All this arises a question: if the region has elements that might enable innovation and technological endogeneisation, why then is the performance of the technological and innovative processes still far away from its potential ?

The determinants of the situation of Beira Interior seem to be based on four essential elements.

4.1.1 Industrial Structure

In the regional productive structure the most important activities are the industrial ones - the textiles, clothing and timber - whose path of technological accumulation is stressed essentially by the innovation of processes, which can be seen in the increase and adoption of new equipments and in the improvement of new inputs easily available in the technological international markets.

What is there to notice is that the industrial structure is built by the sectors supplier dominated, according to Pavitt's taxonomy. Under these circumstances the opportunities of technological learning process and their effects onto the creation of structural competitive advantages are very limited. The firms may accede the general technological resources. So the opportunities for the technological diversification become limited to the logistics and commercialisation.

Considering that the industrial structure depends on activities which are suffering deep restructuring movements imposed by the weak growth potential of the markets and by an increasing international competition, the competitive answer has been centred in an increment of the concentration, vertical integration and the increasing in the efforts to invest in modernisation and rationalisation of the costs.

Another important aspect is that the intersectorial mobility, which is one of the sources of a more efficient dynamics, does not exist, in fact. This might be explained by the barriers to exit. However, there are many research work studies which stress the fact that the industrial structures composed by sectors considered as specialised suppliers show a higher level of elasticity in the change and adjustment as a consequence of a greater control over specific

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[6] See Bell and Pavitt (1993) and M. Silva and I. Mota (1996).

[7] The position of this region related to the national average (100) is 80. The indicator used was built on proxies representing the economic performance and structural conditions (MPAT, 1993)

technological asset.[8] This kind of performance is also felt in regions which are near the technological frontiers.

We believe that the adoption of a competitive strategy based on the increase and on the differentiation of the product seems to be more accurate and eager to promote regional solutions with a more greater impact in the technological accumulation, because they ask for some competencies of a higher specification and that might eventually be extensive to the productive process.

This involves very close contacts between producers and users of technologies, depending partly on the success of the innovation of the proximity effects. This path seems to favour the creation of clusters of activities of a greater technological contents and the stimulation of the profits of the strengths linked to them, as we believe it to be.

4.1.2 Quality of Entrepreneurial Activity

The supply of entrepreneurs and training of the firm resources is an essential component of the vitality of an economy. A great part of the decisions related to the employment, investment, wealth , markets, technological progress, etc. is grounded on the firm and its results are conditioned by the acceptance of risks, by the training levels and by the regional environment.[9]

The research study about Beira Interior shows that the quality of the entrepreneurs is related not only to social and psychological features - risky attitudes and profiles of technical training - but also with the territorial conditions, agglomeration economies and the existence of more demanding markets - with a high level of public demand - access to the financial markets and the relevant information which is important to decide on the competitive performance.

It is also interesting to remark that the firms are mainly small and micro ones and they show an important demographic vitality, particularly in the tertiary sector. The major part of the entrepreneur has a training of a very practical kind and the firms are not organised in a very complex way. Another interesting aspect is that this kind of firms are usually of a familiar basis. The amount of functions is very narrow and mainly centred on factory components, in most cases managed by the same person.

The bigger firms usually have a large experience with foreign markets and they may take benefits from a vertical integration of functions. They also have a more technical qualified/skilled personnel. However these latter ones have, in what concerns determined functions, a very slight perception of their strategical importance, and this, of course, conditions their capacity of technological accumulation.

4..1.3 Networks and Cooperation for Innovation

The density of the relational network between the different actors, firms, higher education institutions, technological and training centres, financial institutions and other institutions of support to innovation are the most important features of a regional system of innovation.

All these are organised on a territorial basis and have a certain capacity of provide a high level of diffusion of information and its usage. Furthermore, its also assuring the development and the diffusion of technological capabilities and knowledge as well as processes of innovation. This way, the central point is the capacity of a regional system of innovation which has to generate a collective learning process, whatever the means to reach them are: the market relationships, cooperation or informal mechanisms.

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[8] The Swiss Jura ARC offers an interesting illustration of transformation of a system based on precision engineering and watchmaking into a production system centred on microtechnologies D. Maillat *et al* (1995)

[9] We find two broad explanatory theories about conditions of firm formation and quality of entrepreneurs: the structural hypothesis, stresses the supply of entrepreneurs, characteristic, motivation and managerial and technical skill, and environmental hypothesis places emphasis on agglomeration economies, quality of information flows, and so on (see R. Barkham, 1992).

Many of these systems have a spontaneous genesis rooted on a culture that has lasted for decades[10]. Others result from the public intervention justified when there is a deficit of positive externalities. In this case, the response have been adopting the strategy of creating regional and local institutions such as universities, technological centres, science park among other tools. This way, intervention aims at assuring the public or semi-public supply of technological services. This stimulation intends to handle the internal low levels of qualifications and technological contents of the SME located in lagging regions.

What many research studies show is that in many volunteering projects, there is a great difficulty in regulating the public availability of technological services with the private demand through the market or through the cooperation relationships.

We believe that this problem refers to the endogeneisation conditions of the exogenous stimuli11 In general cases, the actors act according to a sectorial logic. In particular the actors that emerge from of vertical intervention of the Central Administration. A logic territorial or horizontal it is not relevant yet. The result is that we face badly structured networks with a poor amount of relationships, neglecting the positive benefits of issues such as learning by interacting.

4.1.4 Policy Implications

The implications of the economic policy are no doubt complex. Obviously each of the previous three elements could justify *de per si* an accurate reflection over the options in what concerns the measures to adopt. The first issue we face refers to the effectiveness of the standard instruments since the contextual conditions differ a lot from one another.

The second issue which seems to be of the major importance in the Portuguese case, since very little importance is paid to the knowledge of the local and regional realities towards the technological and innovation point of view by the Central Administration. This one is connected to the necessity of creating technological and innovative policies regionally oriented and sectorially articulated. This means that the technological accumulation policy must integrate a much larger intervention framework in which it should be the main important strategical guideline.

As a larger intervention framework we consider the following of measures that aim at creating material and immaterial logistics able to provide a favourable environment for the development of innovation and the technological activities as well as to the spreading of the effects on the social, economic and cultural issues.

In order to accomplish these objectives, it is necessary that the regionalisation of higher education may be paced by the regionalisation of the sectorial complementary policies, such as industrial, infrastructural, urban and training policies and also their organisation on a territorial basis.

5.CONCLUING REMARKS

In spite of the effort to decentralise higher education and some innovation support organisations, the process of technological accumulation seem to show a limited effectiveness as a cohesion instrument. The short living cycle and consequently the poor maturation of the collective learning process may explain, at least partially, the obtained performances.

However, it is important to recognise that the regions with a low demographic density, in a context in which the relationship ability and the usage of knowledge decrease the role of the scale economies, demand a different type of solutions and of policies. The policy responses must be based in their integration in national and international networks. We think that this process should assure that the imported acquisition of capabilities, technology transfer flows and experience can be reoriented to an endogenous interest basis.

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[10] It's the case of industrial district, see e.g. G. Becattini (1992).

11 .See Marques Reigado (1996).

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