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"Firms and Territories in Innovation:

Lessons from the Italian Case"

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Firms and Territories in Innovation: Lessons from the Italian Case

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Abstract

This paper describes the theoretical framework and results of the first systematic survey carried out in Italy on firms patenting at the European level. The goal is to present the Italian geography of innovation and the social logics that govern it. The paper focuses on the role of territory, organizations and networks in the processes of innovation. The key assumption of the study is that firms' and territories' "potential for patenting depends on their skill in the "social construction" of innovation. In other words, it depends on the effective integration – through social networks – of firms' human and social capital on the one hand, and of collective goods and resources from the local (and non-local) context on the other.

Research results confirm the importance of the territory and external economies (material and immaterial) for the growth of innovative firms. In fact, the study of socio-spatial contexts shows the importance of infrastructure and local collective goods for the leading systems in high tech and machinery sectors. This characteristic distinguishes them clearly from the weakest areas in terms of capacity for patenting.

Another important result of the study concerns the relational dimension of innovation. In this respect, the survey on the leading firms supports two important theoretical conclusions. First, it confirms the importance of contextual resources and social networks that innervated the processes of innovation. However, it also brings to light the importance of organizational assets and business strategies that support these relationships.

1. Introduction

What is the role of territory in the processes of innovation? How do firms' internal resources combine with those of the territories in which they operate? In order to acquire external resources, do firms rely more on short-range networks - mostly involving local contacts - or on long-range networks? In this contribution we try to answer these questions on the basis of an extensive study on the Italian firms that applied for European patents in the decade 1995-2004.

In recent years, the topic of innovation has taken a central role in studies on economic growth (Nelson 2007; Verspagen 2005). A much debated issue concerns the role of territories and enterprises[1]. The picture that emerges shows ambivalent traits. On the one hand, there are those who note that globalization exposes enterprises and regions of advanced economies to strong competitive pressures that reduce the territorial embeddedness and the economic rents inherited from the past. On the other hand, there are those who instead stress the cumulative effects of the learning processes and the territorial agglomeration of innovation, which tend to confirm the existing positions of strength. At the micro level, in fact, the use of new technological and market opportunities depends very much on the "absorptive capacity" of the firms, which is linked to the skills gained in previous experiences (Cohen and Levinthal 1989, 1990). The same is true at the territorial level, where tacit knowledge - accumulated over time - generates path-dependent models of development that tend to reproduce the competitive advantages of the most developed areas (Maskell and Malmberg 1999).

In reality, the outcomes of the innovation processes vary greatly depending on the industries and technological trajectories analyzed, which in some cases reinforce and in other cases destroy pre-existing competences[2]. In both scenarios, however, the innovative activities benefit from a strong component of "tacit" and "person-embodied" knowledge (Pavitt 2002) whose circulation is facilitated by the spatial and social proximity of the people involved. The production of new knowledge, or the creative recombination of existing knowledge, can be seen as a process of "learning through interacting" (Lundvall and Johnson 1994) that is rooted

[1] For an overview of the debate on these issues see Cantwell (2005) and Fagerberger Godinho (2005).

[2] For the distinction between "competence enhancing" and "competence destroying" processes of innovation see Tushman and Anderson (1986) and Henderson and Clark (1990). On the sectoral systems of innovation see Malerba (2004).

in social networks and local systems of innovation[3]. In the literature, in fact, the structural and systemic dimensions of innovation are often emphasized.

Although the role of territory as an important resource for innovation is generally recognized, the specific relationship with firms is not as clear. Of course, the latter can take advantage of a range of *local collective goods* that represent tangible and intangible external economies (Crouch et al 2001; Trigilia 2005) (e.g., the presence of universities and research facilities, high skilled workers and specialized suppliers); however, not all firms are able to adequately exploit these resources and not all territories are able to use the research and training facilities at their disposal to encourage innovation. There is a yet little studied "black box" which concerns the specific links between enterprises and local areas. These links call into question the organization of firms and the social networks that support their innovative activities. It is on this issue that we will focus our attention.

The paper is organized as follows: in the second and third paragraph we illustrate the theoretical framework of our study and the design of research; in the following paragraphs – from the fourth to the sixth - we discuss the main findings; finally, in the last paragraph we present some conclusions of the study.

2. The social construction of innovation

We know that the most innovative firms tend to cluster in specific areas where they can take advantage of external economies of particular value. The literature on high tech districts and innovation systems has provided convincing explanations of these phenomena of territorial agglomeration, highlighting two aspects.

a) The first is that technological innovation is based on processes of interaction involving multiple actors and institutions, including non-economic ones. The dynamics of innovation, in fact, make use of a complex web of relationships among firms, as well as between firms and universities, research centers, institutions specialized in funding innovation, local governments, and foundations, among others.

[3] The territorial embeddedness of innovation has been studied mainly at the regional and national levels. On national and regional systems of innovation and on the so-called "learning regions" see Asheim and Gertler (2005), Cooke *et al.* (2004), Cooke and Schwartz (2007), Edquist (1997), Freeman (1987, 2002), Lundvall (1992), Lundvall *et al.* (2007), Nelson (1993). On social networks see Smith-Doerr and Powell (2005) and Van Wijk *et al.* (2003).

b) The second aspect is the spatial dimension of these processes, which links the performance of firms to a vital economy and public goods at the local level. In other words, the activities related to high technology are greatly concentrated from a territorial point of view.

Why are these phenomena of agglomeration - which have already shown their importance in traditional manufacturing sectors, and particularly in industrial districts - equally important for high tech sectors and for the most innovative firms? The reason is to be connected to the evolution of the production models and competitive scenarios. In the contemporary economy the social and relational dimensions of innovation tend to become increasingly more important vis-à-vis the firm dimension. This means that the local roots of the innovative processes also increase. Innovation is not just about the most effective solution to a problem but regards the discovery of new problems. It does not concern the best way of travelling along a well-known road, but it rather involves the capacity of discovering new roads. In this sense innovation has a fundamentally interpretive and dialogical component which concerns effective interactions or "conversations" - as they were recently called by Lester and Piore (2004) - between several actors with different experiences. This process fosters learning and promotes new discoveries. However, effective conversations need informal and direct interactions and this fact calls the territory into question.

Even in the past, in the social and productive structures dominated by Fordism, there was a social construction of innovation, but it was linked more to the world of big enterprises than to territories precisely because the vertically integrated firm was by its very nature more autonomous from the social and local context. Fordist innovations had time. They could rely on long periods of introduction and diffusion. The post-Fordist world is different. The timing of innovation has become shorter, whereas costs and risks associated therewith grow as the technological trajectories and the markets become more open and uncertain. The enterprises that follow the road of innovation cannot assume these increasing costs and risks alone. They have to share them with other specialized enterprises and have to open themselves more to external cooperation.

The architectures may be different: the large or medium enterprises are organized in networks with external collaborators or networks of small firms and districts. In any case, the economy that aims at innovation becomes more relational. Learning and discovering new roads is based, then, on formal and informal relations between actors operating in enterprises rooted in specific regions. In this way local systems of innovation or high tech districts are formed where small and medium firms collaborate with each other. However, large enterprises - that operate in

oligopolistic sectors, with high volumes of production and economies of scale – also tend to put their innovation antennas in these areas. The most well-known examples of this include Silicon Valley, close to the Stanford University, the center of biotechnology around Harvard, and MIT in Boston. Innovative activities tend to be based on strong territorial roots in many other contexts as well, including Europe and Italy (Trigilia 2007, 2005, Crouch et al. 2004; Gambardella and Malerba 1999, Keeble and Wilkinson 2000).

In these new scenarios, the spread and quality of economies external to the single firm, but internal to a certain territorial area, acquire therefore a crucial importance for enterprises. External economies can be considered the outcomes of local collective goods that increase the competitiveness of firms located in certain areas because they both lower costs and increase firms' capacity for innovation [Crouch et al. 2004]. Collective goods may exist that create external economies in the field of production for the market (e.g., specialized manpower, infrastructures, and services). Other collective goods, instead, favor the generation of new knowledge and learning, and are more relevant for innovative activities. These tend to differentiate the local systems of innovation (or high tech districts) from the traditional industrial districts.

The thrust toward globalization has, in fact, contradictory consequences for productive processes. On the one hand, it makes it easier to access codified knowledge. On the other hand, it increases the room for innovations that are able to take advantage of non-codified or tacit knowledge (not easy to reproduce). This knowledge is specific to a certain context: an organization or a territory. The actors involved in such territorial areas share, through direct interaction, special codes and develop routines and conventions that help them absorb and transform standardized knowledge into new knowledge for innovation. In this way a competitive advantage can be constructed for a territory and innovative local systems can develop not only in high technology sectors - such as IT, biotechnology, and media productions – but also in the more traditional sectors – such as those typical of the *made in Italy* - where the need for quality is increasingly linked to innovation.

But where do these competitive advantages come from? First of all, we have to consider a particular type of external economies: access to research and the possibility of connection to scientific and university structures. A second type concerns the availability of suppliers of specialized goods and services for the enterprises and the presence of specialized agents in the advanced services sector (in financial services, especially in the form of venture capital, in those that assist start-ups and those linked to marketing). A third type of positive externality is connected

to the quality of the context. Naturally, the availability of well-equipped industrial areas or technological parks, as well as adequate communication infrastructures, is important for enterprises. However, for high tech productive systems and innovative districts there seems to be an additional specificity. In these cases, the socio-cultural and environmental quality is particularly relevant. These factors influence the ability to attract and retain highly educated and qualified specialists with their families, as well as foreign students who, as research shows, often contribute to the formation of innovative enterprises (Richard Florida - 2002 and 2005 - has drawn much attention on this aspect). The "context quality", therefore, conditions the possibility that innovative professional communities are formed. This attention to the areas' characteristics can also help explain why establishment in medium-sized cities with rich educational, scientific, and cultural institutions, and with good environmental and social quality, is often an alternative for local innovative systems in comparison to establishment in great metropolitan areas (for instance, the well-known cases of Oxford, Cambridge, Basel, Cologne, and Grenoble).

The overall quality of the context is therefore important in explaining the processes of innovation and their territorial agglomeration. However, the organizational characteristics and strategies of firms should also be considered. The economic literature on innovation – especially on business economics - emphasizes this point. The growth of international competition has triggered a process of radical transformation of production. Not all firms are able to respond positively to these challenges. Recent research on industrial districts shows, for example, that enterprises which have invested in innovation and have focused on product quality are the most successful. These processes have involved a growing polarization in the performance of firms even within the district contexts. This differentiation then draws attention to the choices and strategies adopted by individual firms. In short, to understand innovation, we must not only look to the territories but also to firms.

With regard to firms, some hypotheses developed in the area of economic and organizational sociology are particularly relevant. They connect the innovative process to not just the macro-institutional context but also to several characteristics of the enterprises and their organizational choices[4]. Innovative capacity is associated with a number of structural attributes (such as size, human capital, expenditure on research and development) as well as with the presence of flexible and open methods of coordination oriented toward "work by projects." In other words, it is

[4] For an overview of research on the organizational features of innovation, see Lam (2005) and Pettigrew et al. (2003).

associated with organizational structures that facilitate horizontal, informal communications that allow the development of learning networks among different actors (researchers, external consultants, project partners, users, suppliers, etc.). In this regard, the so-called "business innovator" assumes a crucial role (Rothwell et al. 1974). This is a particularly important actor - identified by studies on industrial innovation - who has a delicate task of coordinating and controlling all the stages of the innovation process.

Studies on organizational contexts that have facilitated the achievement of scientific and technological discoveries of great importance (in particular those by Rogers Hollingsworth 2006) have emphasized several aspects: 1) the presence within the same organization of a variety of scientific and research abilities or rather, highly specialized actors in different but contiguous sectors of specialization; 2) a good standard of communication and social integration between scientists and specialists, with frequent and intense interactions not only in areas of study and research but also in informal activities; 3) an organizational leadership endowed with both a strategic vision in relation to goals and a capacity to guide and coordinate the different phases and dimensions of the innovative process (from the integration of the various work groups, to the financing of the project, to the recruitment of specialized personnel, etc.); and 4) the flexibility of the research teams.

Finally, if the organizational framework plays a crucial role in the exploitation of the internal assets of the firms, the same is true for their degree of "openness" to the outside world, that is, for the social networks that strengthen and diversify the endowment of knowledge and competitive capacities of the enterprises. Over the last few years, several studies (especially those of sociologists) have drawn attention to the crucial role played by innovative networks, especially in high tech sectors (Breschi and Malerba 2005; Powell and Grodal 2005)

3. The survey on patents in Italy

Against this background, the key assumption of our study on Italian firms[5] is that enterprises' and territories' "patenting potential" depends very much on their capacity for the social construction of innovation. In

[5] The survey, sponsored by the Institute of Social Research and Intervention in Prato (IRIS) and the Tuscany Region, was conducted in early 2008 and presented to the "Meetings of Artimino on local development" held the same year. The research team was coordinated by Carlo Trigilia and Francesco Ramella and made up of Andrea Biagiotti, Anna Lisa Caloffi, and Alberto Gherardini. For the full report see Trigilia and Ramella (2008).

other words, it relies on the effective integration of the human and social capital of enterprises, on the one hand, and the collective goods and resources deriving from local and non-local contexts, on the other. The contemporary economy is increasingly relational: it is more open to non-market factors and less governable with only contractual relations. It depends more upon contextual conditions that facilitate cooperation between individual and collective actors. Not all the territories, however, are well equipped to perform this function. This variability exists on the business front as well. In fact, the diversity of organizational choices and the differential allocation of human and social capital influence the ability of firms to exploit the opportunities offered by the external context.

The territorial articulation of the processes of innovation - which is central to our research - has been studied at the level of *Local Labor Systems* (in the paper often abbreviated as *local systems*)[6]. As an indicator we have used the number of patent applications filed by Italian enterprises between 1995 and 2004 at the European Patent Office (EPO), the European agency for the protection of intellectual property rights. Patents are a consolidated indicator in the scientific literature (especially in economics) on innovative outputs. The analytic potential of this indicator has been highlighted but its limits should not be neglected. Its main shortcoming concerns the ability to capture only "major innovations". In other words, it is less adequate to measure the type of incremental innovation widespread in traditional sectors or in small firms.

Our research, however, focuses precisely upon the innovative dynamics of greatest importance in the high (and medium-high) technology sectors, and this is the reason for the decision to use the patent indicator for inventions protected on the European scale[7]. One of the advantages of this instrument lies in the availability of homogeneous quantitative information about both the protagonists of innovations (companies and inventors responsible for the patents) and the contents of the inventions. Therefore, it is possible to carry out a comparative analysis of different contexts through indicators that show the "patenting intensity" both of territories and productive sectors.

The first fact that emerges from the survey on EPO patents in Italy is a well known territorial divide, that is, the gap existing between the regions

[6] The National Institute of Statistics (ISTAT) has divided the Italian territory in 686 "local labor markets" using data deriving from the 2001 population census. The Local Labor Systems consist of contiguous municipalities that contain the workplaces and the residences of most people living in the local area. In fact, they are classified on the basis of the daily commute-to-work: that is, they identify territories with a high degree of "self-containment" of people's daily movements for work purposes.

[7] For more details see the Methodological Appendix.

of the Center-North - the most developed part of the country - and those of the South (Fig. 1). In fact, of the more than 28,000 patents nearly half (46.7%) come from the local systems in the North-West (with Lombardia, which alone accounts for one third of the total) and another 43.3% from those of Third Italy[8], whereas Lazio and southern regions express the remaining share, 5.6% and 4.3%, respectively.

- Fig. 1 –

Analyzing the data by Local Labor Systems clearly highlights the role of large metropolitan cities, particularly the most developed ones of the central and northern regions (Fig. 2). That said, even smaller cities (more than 100,000 inhabitants) have a non-secondary role, providing about one third of total patents. This medium-sized urban dimension suggests a second territorial and productive “flywheel” of the Italian system of innovation, located in the "heart" of the Italian manufacturing development: the Third Italy regions (we will develop this point further in the next paragraph).

- Fig. 2 –

As regards the sectoral distribution of patents, more than half are concentrated in the medium-high technology sectors (particularly in the manufacture of machinery and equipment sector, which delivers 31% of patents), whereas high technology accounts for about one quarter of the total (with pharmaceuticals and medical instruments sectors playing a prominent role, with 8% and 5% of the national total, respectively) (Table 1).

- Table 1 --

4. Economic and social characters of the *leading local systems*

[8] The Third Italy includes the regions of Northeast and Central Italy with a high presence of industrial districts of small and medium-sized enterprises specialized in the "made in Italy” sectors (textiles, clothing, leather products, footwear and furniture) and in those of the “light mechanics” (manufacture of fabricated metal products, machinery and electrical equipments).

The identification of social and economic characteristics of the Italian innovative territories was one of the qualifying goals of our study. In this way, we have tried to clarify the relationship between innovative enterprises and territories. The analysis of local contexts was conducted on the two main categories of patents: those of the *high technology sectors* and those of the *non-electrical machinery sector* (Nace division 29; henceforth abbreviated as *machinery*). First we identified the leading local systems of the two sectors; they were then compared to local systems of the same sectors with a lesser capacity of patenting. The latter were used as control groups[9].

The comparison shows some interesting features: first, a strong tendency to territorial agglomeration; second, a socio-territorial profile significantly different, not only between the two sectors but also between the leading local systems and those in the control groups. The leading systems of both sectors - although representing a small share of the Italian Local Labor Systems (just over 6%) - hold the overwhelming majority of patents in both sectors: 84% in the high tech and 76 % in the machinery. Moreover, they consist of consolidated local economies with employment levels and wealth per-capita above the Italian average. However, the profile that is associated with the process of innovation is partly different in the two sectors. The high tech leading local systems show an urban-metropolitan profile, with a greater role for larger firms, advanced services. This is accompanied by greater endowments from universities and graduates. The quality of life and the presence of local public goods appear high (Fig. 3.a).

A remarkable socio-institutional context also emerges in the machinery leading systems, with infrastructure endowments and a quality of life above the national average (Fig. 3.b). In this case, however, the leading systems tend to cluster in the regions of Third Italy, particularly in the manufacturing areas specialized in the Made in Italy products and in the manufacture of machinery. Moreover, from the dimensional point of view, medium-sized enterprises are the most significant actors in local economies. The urban component plays an important role as well, but - unlike in the case of the high tech systems - there is a lesser presence of advanced services, universities, and graduates. These data lead to the

[9] The leading systems represent the 10% of the local labor systems (44-45 cases) with at least one patent application in the decade that are on the top of their sector rankings. To identify their distinctive characteristics these territories were compared not only with national averages but also with a control group built ad hoc. This second group comprised local systems that, despite having a large number of enterprises operating in the same sector of economic activities (at least 50 firms), showed a reduced capacity for patenting (number of patents between 0 and 5).

hypothesis that the patenting capacity in the machinery sector is more in continuity with the mechanisms of innovation described by the literature on industrial districts.

- Fig. 3.a and 3.b –

The comparison with the local systems of control allows us to define more clearly the contextual factors associated with successful innovative experiences. Instead of individual factors, the combination of the various components identified above appears relevant. These components together define a highly qualified context not only from the economical and productive point of view, but also in terms of local collective goods. In other words, the comparison clearly shows the systemic nature of innovation processes.

The local systems belonging to the control groups - those with a weak capacity for patenting - have a relevant entrepreneurial fabric in the sectors of reference and have a good employment dynamic (more positive than in the Italian average). However, the smaller presence of both urban centers and medium-large sized firms reduces the opportunity for enterprises operating within these areas to make use of advanced services. In addition, the weak quality of the socio-institutional context hinders their innovative potential. The local systems of control, in fact, are characterized by a strong under-endowment in telecommunications networks, services, and economic and social infrastructures, not only in comparison to the leading systems but also to the national average. The control systems are often located in the southern regions of Italy, which suffer of shortcomings in the quality of the socio-institutional context.

In summary, we can say that in order to develop a highly innovative local system an adequate institutional structure supporting the firms is necessary. This includes a good endowment of human capital and universities, a developed infrastructural network, advanced services, and a qualified urban context.

5. Patents with multiple owners and the networks of collaboration

The survey also explored the relational component of innovation from the perspective of patents with multiple owners (henceforth abbreviated as *shared patents*). A relevant number of European patents filed by Italian enterprises (1359) refer to a plurality of applicants (3,091), an average of 2.27 for each patent. These represent about 10% of total patents under consideration, involving 221 local systems. These shared

patents refer to partly different phenomena: on the one hand, to innovative partnerships that leads to joint ownership of the patents; on the other hand, to a joint ownership which does not derive from an effective collaboration on the forefront of innovation. The analysis of the information contained in the patents seems to suggest that this second modality is less frequent[10].

With regard to the territorial dimension of these patenting collaborations, it must first be noted that more than half of the people involved (1535) belong to the same local labor system and another 480 belong to different systems located in the same region. The remaining actors (1076) belong to different regions. Therefore, the majority of these patents derive from local collaborations and two thirds of these are formed by networks of individuals presumably belonging to the same family business (about half is related to subjects that have the same surname). A substantial part is related to forms of cooperation involving local firms operating in the same industry.

Within these "short networks", in addition to the prominent role of metropolitan areas (Milan, Rome, Florence, Turin and Bologna together have 40.5% of the shared patents involving actors of the same local system), a significant role of the industrial districts also emerges, primarily of those districts specialized in the "light mechanics" sectors. The role of metropolitan areas is even more relevant in the "long networks" (those involving people located in different regions). In particular, the two major cities, Milan and Rome, collectively account for 39% of the shared patents. Although not exclusively, the most stable and significant partnerships (which also involve universities and research centers) involve mainly large enterprises and, in particular, some of the major protagonists of the Italian industrial situation: ENI, Enichem, Telecom, Electrolux Zanussi, etc.

In conclusion, the contribution of territory to the growth of innovative enterprises not only passes through the material external economies but also through the intangible ones: through the possibility to develop "short networks" of face to face collaborations. However, as we have seen, there are also "long networks" that are combined with local ones. They have a more prominent role, especially for larger enterprises.

But what are the specific characteristics of firms that allow them to take advantage of the tangible and intangible collective goods of the area? A part of our research was dedicated to answering this question.

6. The leading firms in patenting

[10] In the latter case the ownership derives from an economic evaluation: for example the sale of rights to the exploitation of an invention in exchange for financial compensation, or the extension of intellectual property to family members, etc.

This part of the study made use of an exploratory survey carried out on a sample of enterprises with a high patenting capacity: firms that in the years 1995-2004 submitted three or more applications for patents in the high technology and machinery sectors[11].

The first thing to be emphasized is the economic solidity and good performance of these businesses. All had been active for several years and had significant turnover, achieved mainly at national and international levels. About two thirds had seen an increase in turnover in the three years preceding the interview (2005-8) and almost all had made new hires. These enterprises devoted much attention to research and development activities (R&D): almost all had a dedicated office and employed a lot of resources (24,000 euro per employee, equal to 12% of sales) that grew in the high technology sector and with the size of the firms[12]. Almost 40% of the turnover achieved during the decade of reference came from patented products[13]. The costs incurred for the most successful patent of each firm also shows the high productivity of these investments: the estimate of its present market value exceeds - on average - of 12 times the initial costs.

There is, however, no necessary link between expenditures in R&D and patenting[14], just as there is no relationship between patenting and innovation. Patenting activity is often taken as a proxy of the innovative outputs of the firms. In reality, it especially captures firms' attitude toward research. This is an indicator that detects primarily the technological capacity and the inventive outputs of enterprises and, secondly, their competitive strategies. It should therefore be kept separate from *business innovation*, which is the introduction of new products, processes, and

[11] For more information see the Methodological Appendix.

[12] Controlling for the economic sector, enterprises in our sample invest in R&D three times more resources than the national average. For a comparison see the Istat survey (2008) on innovation carried out by the Italian firms with more than 10 employees in the three years 2002-2004.

[13] Also, in this case, it may be useful a comparison. In Italy, the share of turnover that enterprises attach to the introduction of innovative products is around 11. 5%. The share grows both in the machinery (20.2%) and in the high-tech sectors (on average 21.9%; our elaborations on Istat data 2008).

[14] The survey did not reveal a significant relationship between the financial resources allocated to research (both in absolute terms and relative to sales) and the number of patents submitted during the years of reference. However, there is some correlation between the expenditure in R&D and economic performance of the enterprises. But it is a weak correlation, partly mediated by the innovations (in products, processes, and management) introduced by the enterprises.

solutions in the organizational and market fields that improve the competitive capabilities and advantages of the enterprises[15].

The research, in effect, does not indicate any relationship between the number of patents submitted to EPO and business innovation. Many patents are used for strategic positioning in the market, which does not necessarily entail an implementation of the invention protected. Additionally, much of the internal innovation is of an organizational and management type with highly idiosyncratic and tacit components, which do not require any legal protection. This helps us to clarify why, despite their importance in terms of turnover, there is no significant relationship between the number of patents and the economic performance of the enterprises[16].

There is a complex relationship between inventive activity and its commercial exploitation. Actually, the productive fulfillment of an invention requires a delicate phase of implementation – *business innovation* - which has an entirely autonomous logic. Innovation follows a chain-linked model, which implies a complex and reciprocal interaction between the activities of research and design, on the one hand, and the production and marketing of new products and services, on the other (Freeman 1982; Kline and Rosenberg 1986). It is this activity of implementation internal to the enterprises that generates real competitive advantages[17].

In short, the firms' choices play an important role. That said, it should also be added that their productivity for innovation is connected to the way the internal organization supports (or not) the possibility of exploiting the resources deriving from the external context and from the collaboration networks with other actors. The importance of this factor is confirmed by the relevant number of *innovative partnership* that characterizes our leading firms. Most of them, in fact, show a dense network of relations with other enterprises and universities that often

[15] For the specification of different types of innovation considered in our research see footnote 17.

[16] To detect the economic performance, we created an additive index - derived from a factorial analysis (51% of explained variance) - based on the following three variables (weighted according to the factor scores): 1) labor productivity (turnover / employees), 2) changes in employment and 3) the trend of turnover in the three years preceding the research.

[17] Indeed, innovative capacity is correlated with the growth of turnover and the overall performance of firms ($r = 0.36$; $P<0.01$). Innovative capacity was measured through a special additive index derived from a factorial analysis carried out on the innovations introduced by enterprises in the three years preceding the survey in the following areas: product design, content of the product, manufacturing process, marketing, organization of work, relationships with clients, relationship with suppliers, administrative and financial management.

extend beyond the local area[18]: 39% have some collaboration in the field of research and innovation with other large enterprises (mostly national or foreign), 49% with small and medium enterprises, and 57% with universities and research centers[19].

In addition to inter-organizational networks, links with "strategic advisers" are also relevant (the questionnaire allowed for the indication of up to 5 names). These are external experts – not employees of the firms – who are considered to be particularly important for the innovation activities and who have very close and frequent working relationships with the firms. In 68% of cases the interactions are daily or weekly. In 39% of cases these people reside in the local or regional area. The remainder is divided equally between national and foreign consultants.

These social networks are of great importance. They are built on the basis of professional and market relationships, but normally they are also strongly characterized by informal aspects of a personal nature. Through them, the internal assets of the firms are connected to the external resources (Oerlemans et al. 1998, 2001). It is these networks that allow firms: a) to combine stability of relationships and diversity of resources, b) to reduce the uncertainty related to innovation (Powell et al. 2002) and c) to mix the tacit and internal knowledge of the organizations with the more codified and semi-public knowledge of the consultants. In other words, these social networks permit the firms to mobilize heterogeneous knowledge, increasing their "requisite variety" to generate innovation (Ashby 1956)[20].
Yet the exploitation of these external resources depends on the "use capacity" internal to the firms. This synergy emerges clearly in the patent activities. An exploratory analysis carried out on the number of EPO-applications submitted by enterprises confirms the importance of both of these assets. In fact, only two variables are significant, explaining almost

[18] Unlike as noted for the shared patents (see paragraph 6) – whose collaborations takes place mainly at the local level - the vast majority of innovative partnerships here assume a national or international scale (although these do not exclude local partnerships). This difference in the relative importance of the "short networks" and the "long networks" could indicate that the ability to transcend the local context is a hallmark of the enterprises with a high patenting capacity.

[19] For a comparison: among the Italian industrial innovative enterprises only 11.3% have made use of cooperation agreements for innovation. In high technology, however, the percentage rises to 34.4% and half of these agreements concern national or foreign partners (in contrast to an average of 17.4% for the whole industrial sector; our elaborations on data from Istat 2008).

[20] On this point see also Burt (2003), Uzzi and Spiro (2002), Lester and Piore (2004) and McEvily and Zaheer (1999).

50% of the variance[21]: 1) the total number of enterprises (large and small), universities, and strategic consultants with whom the enterprise collaborates, 2) the number of people working inside the R&D office of the firm.

More generally, the analysis of the firms with a high patenting capacity highlights clearly the logic of complementarity between different resources - internal and external, local and extra-local - that governs the patenting and innovative activities. If explanations that underline only the structural characteristics of firms and their tangible and intangible assets are partial, the same applies to those that emphasize too strongly the importance of the contextual variables, the spillovers of knowledge, and the innovative partnerships. The implementation of innovations requires well-practiced and tight-knit "project teams" capable of hard work and of exchanging sensitive information, and this involves a high level of confidence and thorough knowledge of the enterprises. Yet equally important is the role of external resources: the knowledge circulating through the community of professional consultants, labor mobility, short and long-range networks, and innovative collaboration with other firms and universities. For these reasons the mix of strong ties (mainly inward-oriented) and weak ties (mainly outward-oriented) found in the most innovative firms is crucial (Ramella and Trigilia 2006; Ramella 2005)[22]. In other words, what distinguishes the "success stories" is the presence of a business strategy designed to exploit the *complementarity of innovative resources* that creatively combines diverse but synergistic factors. In fact, innovative entrepreneurs use previously unconnected resources, deriving these from different spheres of action (Granovetter 2000, 2002, 2005). While external resources increase the requisite variety of the enterprises, the internal ones enhance their "absorptive capacity" (Cohen and Levinthal 1989, 1990, Arora and Gambardella 1990).

7. Conclusions

[21] We carried out a multiple linear regression using the stepwise method of the statistical package Spss. The analysis covered only a subset of the sample: 50 firms for which all the necessary information was available.

[22] For the distinction between strong and weak ties see Granovetter (1973, 1974). Also Brian Uzzi (1999, 1997) - in relation to economic performance - has emphasized the role of "network complementarity" and the "contingent" value of social ties. A partly similar perspective has been developed by Burt (2001) reflecting on the different advantages present in the closed and dense networks and in those with many "structural holes".

With regard to the analytical questions that we set at the beginning of this paper, first it should be noted that the analysis carried out on patents tends to confirm the importance of the territory and external economies (material and immaterial) for the growth of innovative firms. The study of socio-spatial contexts, in fact, shows the importance of infrastructure and local collective goods for the leading systems in high tech and machinery sectors. This aspect clearly distinguishes them from the weakest areas in terms of capacity for patenting.

Another important result of our study concerns the relational dimension of innovation. In this respect, the survey on the leading firms supports two important theoretical conclusions. First, it confirms the importance of contextual resources and social networks innervating the processes of innovation. However, it also brings to light the importance of organizational assets and business strategies that support these relationships. These internal factors help to explain the variety of performances within one local context. Second, it reveals the complex relationship that exists between innovation and territory. The analysis on the leading systems of the high tech and machinery sectors clearly demonstrates the importance of the quality of the local context for innovative firms' processes of agglomeration. Also, the survey carried out on leading firms points to the role of relations of proximity. However, in this case, the affiliation of a firm to a specific local area has never emerged as significant in multivariate analysis. In other words, it has not shown an autonomous explanatory capacity regarding the performance of individual enterprises. Therefore, neither external economies of agglomeration, nor the innovative atmosphere that you breathe in certain areas, are sufficient to explain firms' performances. As we have seen, the innovative partnerships - with their knowledge spillovers - are not confined within local or even regional boundaries. This does not mean that the territorial location is irrelevant, but that its influence is mediated by the behavior and strategies of individual firms. It depends on firms' abilities to absorb and exploit the resources of the context, using them also to create long-range networks, spanning "structural holes" that separate them from non-redundant sources of information.

APPENDIX

The patents

The survey presented in this paper was conducted in the first half of 2008. During the first phase of research the geography of innovation in Italy was analyzed. We used the number of patent applications filed by Italian enterprises between 1995 and 2004 at the European agency for the protection of intellectual property rights as indicator. The information was collected through the database of the European Patent Office (EPO - http://ep.espacenet.com). To identify the high technology sectors we used the Eurostat-OECD classification (manufacturing industries classified according to their global technological intensity) that divides manufacturing into four classes according to a descending order of technology intensity. The *high technology manufacturing industries* include the following sectors (in brackets are the codes of the European classification NACE Rev. 1.1):

1. Aerospace (35.3)
2. Computers, office machinery (30)
3. Electronics-communications (32)
4. Pharmaceuticals (24.4)
5. Scientific instruments (33).

In the study, for comparative purposes, we have also referred to the *medium-high technology manufacturing industries*, which include the following sectors:

1. Motor vehicles (34)
2. Electrical machinery (31)
3. Chemicals (24 excluding 24.4)
4. Other transport equipment (35.2, 35.4 and 35.5)
5. Non-electrical machinery (29)

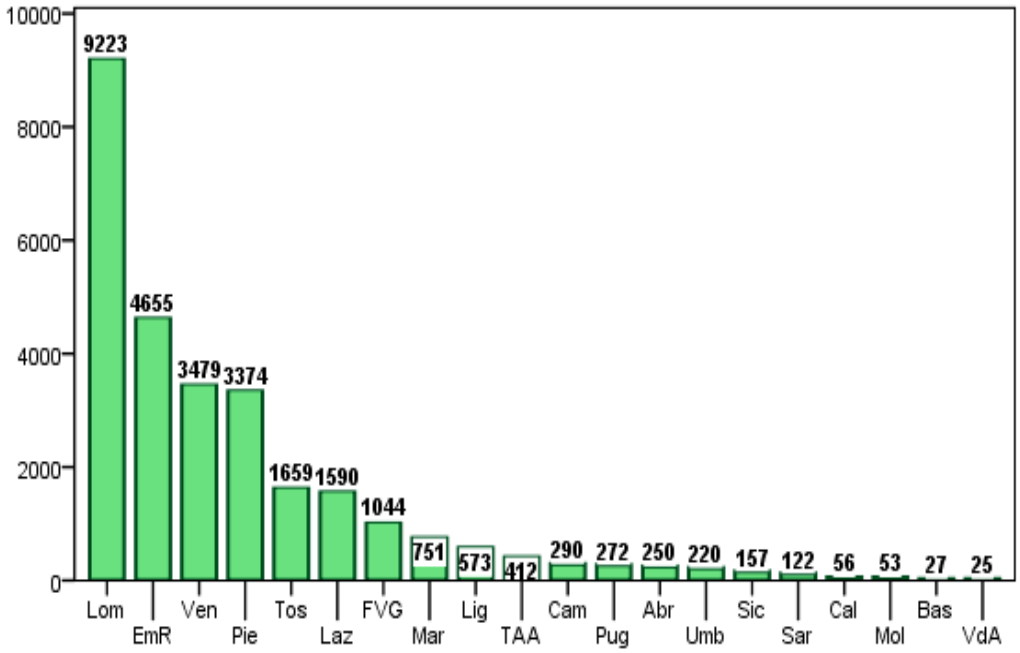
The leading firms

In the second phase of the study, the focus of analysis shifted from socio-economic characteristics of the territories to the organizational and social profile of the patenting enterprises. This part of the research referred exclusively to patents in the high tech sectors and non-electrical machinery sector (Nace division 29: manufacture of machinery and equipment). In this phase, only a first exploratory research was carried out, through a survey based on a probability sample (93 cases) of the most innovative enterprises: those that filed applications for at least 3-EPO patents over the studied

decade (universe of reference: 311 high tech patenting and 552 machinery patenting enterprises). The survey was carried out in July 2008 through questionnaires administered electronically (CAWI method: computer assisted web interviewing). The enterprises were contacted via e-mail and telephone; the contact person indicated by the firm could fill in the on-line questionnaire connecting through individual parameters (user name and password) to a website specially set up for the survey (www. brevetti.web-survey.it).

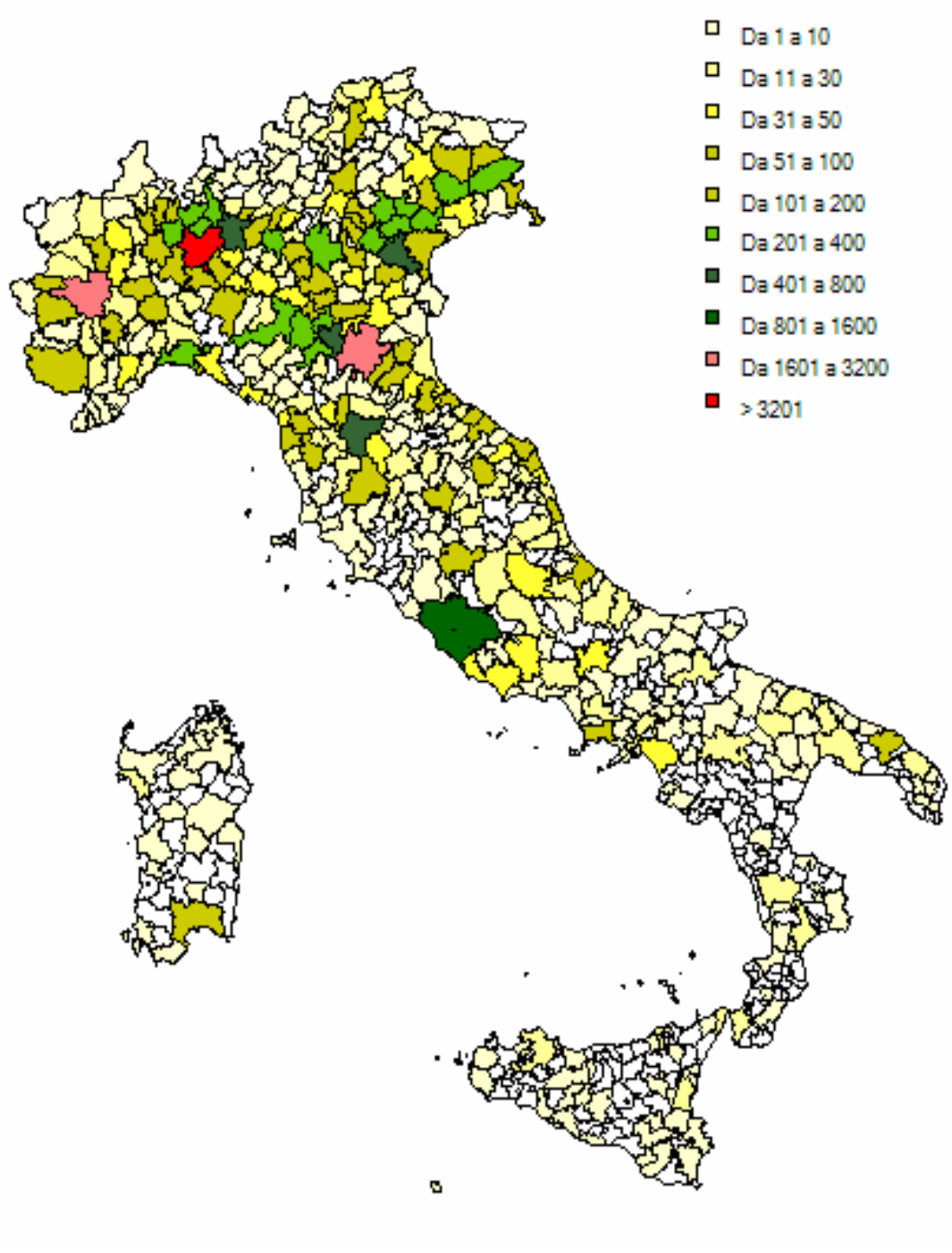
TABLES AND FIGURES

Fig. 1 EPO Patent by Region (1995 - 2004)



Source: Our research on EPO patents 2008

Fig. 2 The Patent Geography in Italy per Local Labor System



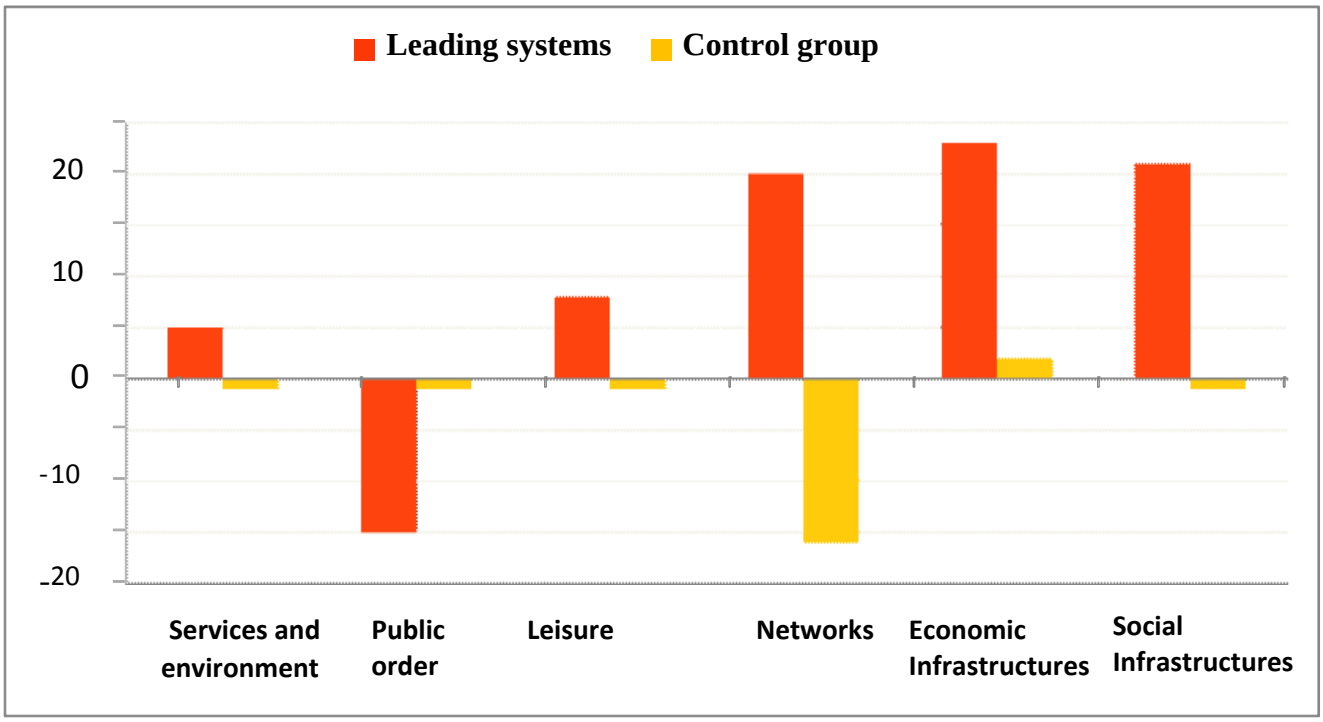
Source: Our research on EPO patents 2008

Tab. 1 Patents per technological sector

Sectors	**Patents 1995/04**	**% on Total**
Aircraft and spacecraft	62	0,22
Pharmaceuticals	2.270	8,04
Office, accounting and computing machinery	681	2,41
Radio, TV and communications equipment	1.110	3,93
Medical, surgical and orthopedic apparatus	1.345	4,76
Instruments and machines of precision and control	935	3,31
Optical instruments and photographic equipment	337	1,19
High-technology	***6.740***	***23,87***
Electrical machinery and apparatus, n.e.c.	1.213	4,30
Motor vehicles, trailers, semi-trailers and other transport	2.130	7,54
Chemicals excluding pharmaceuticals	2.105	7,46
Machinery and equipment, n.e.c.	8.789	31,13
Medium-high-technology	***14.237***	***50,43***
Building and repairing of ships and boats	151	0,53
Rubber and plastics products	1.830	6,48
Coke, refined petroleum products and nuclear fuel	131	0,46
Other non-metallic mineral products	930	3,29
Basic metals and fabricated metal products	2.076	7,35
Medium-low-technology	***5.118***	***18,13***
Manufacturing, n.e.c.; Recycling	1.011	3,58
Wood, pulp, paper, paper products, printing and publishing	259	0,92
Food products, beverages and tobacco	319	1,13
Textiles, textile products, leather and footwear	549	1,94
Low-technology	***2.138***	***7,57***
TOTAL	***28.233***	***100,00***

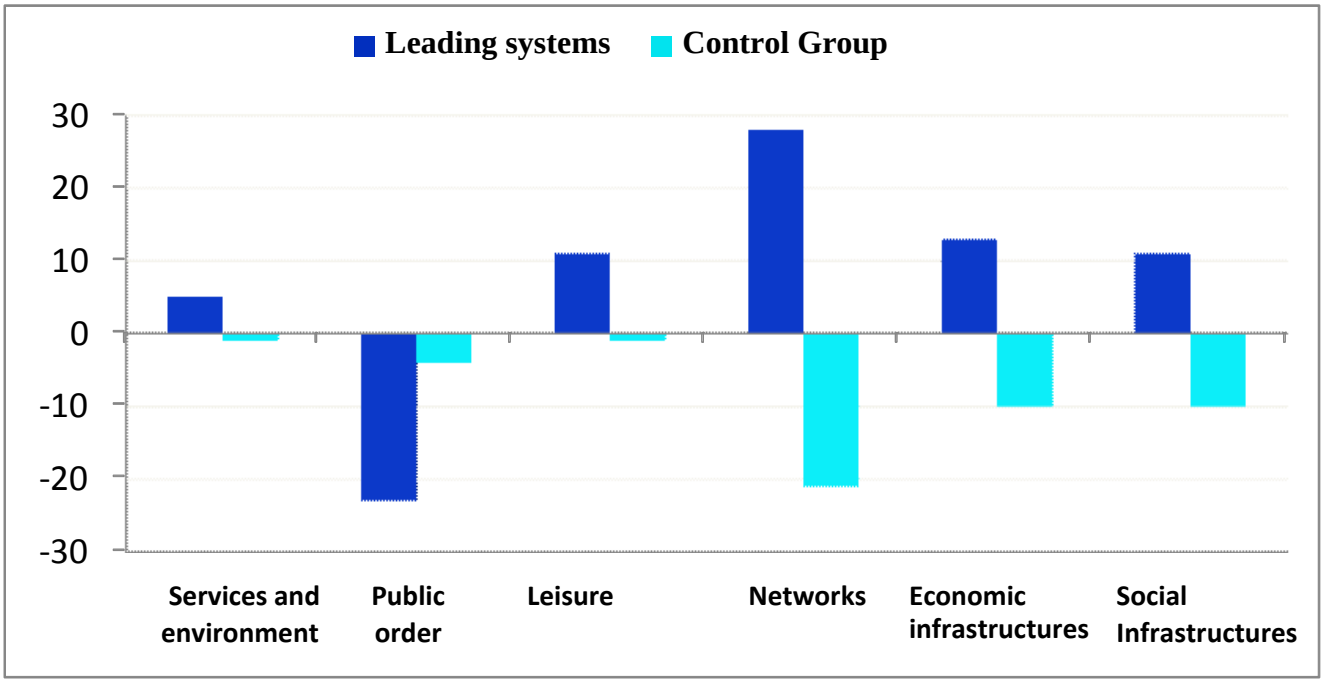
Source: Our research on EPO patents 2008

Fig. 3.a The socio-institutional context in the high tech leading local systems and in the control group



Note: This table shows the percentage deviations from the Italian average (value 0). To measure the "quality of life" at the local level three indexes were used from the 2005 study published by the newspaper “Il Sole 24 Ore”: 1) the index of services, environment and health, 2) the public order and crime index and 3) the leisure index. The first assesses the local quality of the environment, of the health and legal services, and of the collective infrastructures. The second considers the impact of different types of crimes (robbery, theft in the house and car, violent muggings and pickpocketing, juvenile crime) and records the level of local public order as inversely proportional to these crimes. The third considers the civil associations, the sports activities, the consumption of books, the local offering of film, and other leisure activities. The three indicators used to determine the endowments of local collective goods – 1. telephone networks and computer systems, 2. economic infrastructure, and 3. social infrastructure - refer to the year 2004 and derive from the Competitiveness Atlas of Provinces and Regions, edited by the Guglielmo Tagliacarne Institut and by Unioncamemere. These indices are based on the local endowment of: 1) networks and structures for telephony and telematics; 2) communications infrastructure, transport and banking structures and services; 3) cultural, recreational, educational and health care structures and services. At each local system the value of the province of reference has been used.

Fig. 3.b The socio-institutional context in the machinery leading local systems and in the control group



Note: see previous Figure (3.a)

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