INTENDED TIES WITH LOCAL INSTITUTIONS AS FACTOR IN INNOVATION: AN APPLICATION TO SPANISH MANUFACTURING FIRMS.

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Abstract

In this paper we seek to check for a number of interactions between firms and external environment. We aim to contribute to the discussion on the role of the regional environment in a firm's innovation performance. We test the statistical significance of a number of particular interactions between institutions and firm innovation. In particular, we have hypothesized the association between *trade and professional institutions, technological centers, and cooperation arrangements* and innovation. In contrast with existing studies, we have provided empirical evidence of the impact of external factors on individual firms.

Key words: innovation, local institution, social capital.

INTENDED TIES WITH LOCAL INSTITUTIONS AS A FACTOR IN INNOVATION: AN APPLICATION TO SPANISH MANUFACTURING FIRMS.

The importance of the factors determining innovation has received much theoretical and empirical attention in the literature. According to most authors, innovation is associated with a core challenge for firms to succeed in today's environment (Baumol, 2004). Apart from firm-, industry- and country-specific factors affecting firm ability to innovate; social researchers have argued that the structure of firm's relationships may explain why some firms are more innovative than others. In fact, the importance of *social capital* as a factor determining innovation has received much theoretical attention over the last few years. It is now assumed that the acquisition of knowledge by firms does not only depend on the market or the hierarchy, but also on the social capital accumulated within regions through networks of interactions and learning.

It is argued that firms have capabilities for creating and sharing knowledge that improve their capacities for innovation through social networks. Knowledge spillovers are bounded by geographical distance, as is suggested by relevant contributions like those from Jaffe and Trajtenberg, 1993; Saxenian 1994, Audretsch and Feldman, 1996 and many others. They have shown that regional concentrations of innovative activity can be observed in almost all countries. It is argued that regional knowledge infrastructure (universities, research institutes R&D or regional technology policy) is crucial for the innovation performance and growth of the firms in the region. The specific capabilities of firms in creating and sharing knowledge are seen as relying on formal and informal regional institutions. In contrast with these arguments, other authors have claimed the relevance of firm-specific factors in determining innovation (Sternberg and Arndt, 2001).

Reviewing previous research, there is an open debate concerning the way aggregate (regional, district, etc.) level matters in comparison with the characteristics of individual firms. One relevant concern in the development of a precise approach of the problem consists of determining which level of analysis should be taken into account. In fact innovation is generated in a specific environment, emphasizing the influence of the aggregate (regional/national) level on firms' innovation processes. See, for instance, the literature on the National System of Innovation (Lundvall, 1992, Edquist, 1997).

On the other hand, for management and strategy research, the region simply consists of the given opportunities and threats which a firm has to deal with; moreover, they claim that organizational variables are critical for firms to be innovative (Whitley, 1999).

Over recent years in the literature on innovation, there are very few empirical tests of hypotheses, in contrast to the substantial theoretical insights that have been developed. On the other hand, despite of the fact that other scholars have also suggested that the firm-specific drivers of innovation performance are undervalued and the importance of the region may be overestimated in this line of reasoning; empirical studies at firm level are also scarce.

However, rather than follow one of these lines of argument, our point is to suggest a *interaction-based approach*; that is, considering that what is really relevant is combination of both these factors (aggregate and individual) and interaction between the two of them (Foss, 1996).

In this paper, we seek to address this gap, testing for a number of interactions between firms and the external environment. In the current context, no individual firm isolated can afford to understand and respond to complexity and gain precise knowledge needed, hence to establish links and cooperative partnerships with other actors is

required (Hagedoorn and Narula, 1996). We aim to contribute to the discussion on the role of the regional environment in a firm's innovation performance. We test whether a number of particular interactions with institutions are significantly associated with company innovation. In contrast with existing studies, we provide empirical evidence of the impact of external factors on individual firms.

The paper is structured as follows: firstly, we briefly discuss regional effects on innovation by firms. We then propose a set of hypotheses to be tested. Secondly, we describe the data and methods, and present empirical results; we then discuss these findings extensively.

THEORETICAL FRAMEWORK

It has been argued that one of the key factors in the creation of value for a firm is its ability to innovate (Barlett and Ghoshal, 1990; Andersson et al., 2002). Innovation refers to the conversion of knowledge into new products, services or processes (or the introduction of significant changes into existing ones) to be introduced on the market.

Knowledge and innovation undoubtedly come both from internal and external sources, but in the recent strategy and innovation literature a great deal of emphasis has been placed on determining factors outside the firm.

The business literature argues that organizational variables are important for firms to be innovative (see Whitley, 1999). In order to access external knowledge resources and exploit them efficiently, an individual firm must meet some requirements, such as a certain capacity to absorb this knowledge and some previous experience, involving some previous R&D investment, (Cohen and Levinthal, 1989). Firms also use external

sources for accessing additional knowledge and accessing knowledge in order to enter new fields (Hamel, 1991).

Generally, previous research has considered the impact of these external institutions at regional or district level, but there was a lack of data at individual firm level. Sternberg and Arndt (2001) have demonstrated that firm-specific determining factors for innovation are more important than either region-specific or external factors. We argue they are an important, if somewhat neglected, perspective in strategy research.

However, it is already recognized that innovation performance is not strongly related to a firm's internal R&D expenditure and personnel. In fact, some firms, especially small ones, have proved to be more innovative than others even though they invest little in R&D (Geroski 1995). It is argued that the reduction to purely individualistic competition fails to take into account organizational variables, such as cooperation between firms, research institutes and customers. Information flows between these economic agents take place in formal and informal networks that can improve the innovative outcome but can also hamper it.

Public research is often considered essential in the process of technological process, but few studies have been undertaken to measure its real impact on innovation. The aim of this study is, therefore, to assess the presence of public technological external factors. From the results, it appears that public research produces positive effects, both directly, in increasing the level of innovation, and indirectly, in encouraging private research. However, these externalities are not widespread, they are geographically localized Autant-Bernard (2001); Anselin et al., (1997). The results confirm earlier findings that academic externalities are not uniform across sectors but they also indicate important differences across sectors in terms of agglomeration effects

The idea that innovation follows a linear sequential process (e.g. basic research, applied research, development and commercialization) has been replaced by a systematic approach to innovation. Edqusit and McKelvey (2000) and Lundvall (1992) argue that innovation process should rather be considered as a complex, circular system embracing interactive elements. The literature on the National System of Innovation (see. Lundvall, 1992 Edquist 1977) focuses on the national (regional) institutional environment. It argues that institutions, such the financial system and the educational system, and government support for research influence the innovative activities of firms and sectors.

Since the ability of the firms to exploit knowledge spillovers is affected by distance between the firm and source of the knowledge, geographical concentration should be taken into account in the analysis, particularly in knowledge-based industries (Audrestsch and Feldman, 1996, Feldman, 1999). In addition to this, a vast literature has recently developed on learning regions (Maskell at el., 1998), combining the concepts of innovation and location.

Besides the systematic approach to innovation, the network approach has also gained substantial support. The seminal work by Hakansson (1987) spelt out the advantages technical development could benefit from when generated within a network of agents. However, networks can have a geographical dimension, when they involve a geographically limited locality (De Propis, 2002).

In conclusion, factors determining innovation can be found inside and outside the boundaries of the firm. However, it is important that these two levels are not isolated factors; in fact a fit between them can be required. We emphasize the importance of the territorial network in the systematic approach to determinants of innovation.

Social capital as a source of innovation

Moran and Ghoshal (1996) have argued that new sources of value are generated by means of new exploitations of resources and, more particularly, through new ways of exchanging and combining resources. Thus, innovation can be associated with the capacity for combining and exchanging knowledge resources (Kogut and Zander, 1992). The access and exploitation of knowledge need to innovate is affected also for the social structures.

We shift beyond the boundaries of the firm to question about the firm territorial environment, the local or regional embedded institutions and organizations (Cooke, et al., 2005). These factors refer to the positive externalities firms receive in terms of knowledge from the environment in which they operate (Van Waarden, 2001). In particular, inter-organizational relationships create opportunities for knowledge acquisition and exploitation (Dyer and Singh, 1998; Lane and Lubatkin, 1998). These external relationships developed by firms can be understood as *social capital*.

Social capital is defined as the sum of resources accumulated by the firm because of having a stable network of relationships (Bourdieu and Wacquant, 1992). Organizations import knowledge into the firm by means of social capital. This knowledge can be exchanged and combined with internal knowledge and, thus, by comparing both types of knowledge, the organization can observe inconsistencies in order to identify weaknesses in the existing internal knowledge, and thereby determining the benefits that a firm can derive from social capital (Anand et al., 2002). Access to external innovation sources is associated with the characteristics of the interactions of the firm in

the social networks and is regulated by the amount of social capital they possess (Yli-Renko et al., 2001).

We can conceptualize this as *bridging* social capital. Individual and organizations with geographical proximity form groups that determine attitudes, beliefs, identities and values. At the same time, to form part of a group determines access to resources, opportunities and power. There may be a high level of social capital within the group (*bonding* social capital) which helps members, but they may be excluded from other groups (they lack *bridging* social capital). Two types of social networks can be distinguished: *bonding social capital* as reinforcement of homogenous groups, and *bridging social capital* as connecting bonds formed across diverse social groups Putnam's (2000).

In the same vein as *bonding social capital*, the *strong tie argument* (i.e. Krackhardt, 1992) suggests that this provides organizations with two primary advantages, namely, exchanges of high-quality information and tacit knowledge, and this serves as a mechanism of social control that governs the inter-dependencies in partnerships (Uzzi, 1996, 1997).

According to Fukuyama the strength of the group bond implies a certain weakness in ties between individuals not related to one another (Fukuyama, 1995). Consequently, bridging social capital has a positive effect on growth, whereas bonding social capital has a negative effect on the degree of sociability outside the closed social circle. A similar point of view has been offered by the *structural holes approach* (Burt, 1992), which proposes a *dispersed characterization* as an alternative perspective, and which defines social capital in terms of information diversity and the control advantages of being the broker in relations between otherwise disconnected people within social structures. A structural hole is an opportunity to broker the flow of information between

people and to control the form of projects that bring together people standing on opposite sides of the hole (Burt, 1992). In other words, the causal agent determining whether a tie will provide access to new information and opportunities is the extent to which it is non-redundant (McEvily and Zaheer, 1999). In addition, Granovetter (1973) argues in favor of the *strength of the weak tie*, emphasizing the way that weak ties enable an agent to access new, exclusive information.

Social capital is defined as the sum of resources accumulated by the firm because it has a stable network of inter-firm relationships (Bourdieu and Wacquant, 1992: 119). Organizations import knowledge into the firm by means of social capital. This knowledge can be exchanged and combined with internal knowledge and, thus, by comparing both types of knowledge, the organization can observe inconsistencies in order to identify weaknesses in the existing internal knowledge, thereby determining the benefits that a firm can derive from social capital (Anand et al., 2002). Access to external sources of innovation is associated with the characteristics of the interactions of the firm in the social networks and is regulated by the amount of social capital they possess (Yli-Renko et al., 2001).

Proximity as cohesive factor

Many authors considered the idea of social capital as inherently spatial. Although there are long-distance ties, most of them, particularly informal ones, occur within a short range area (Malecki, 1995). In this context, previous research from diverse disciplines (regional, strategy, etc.) has dedicated a substantial amount of attention to applying and describing territorial agglomeration through concepts borrowed from the

social capital and embeddedness perspectives (per example, McEvily and Zaheer 1999; Cooke 2002)

Previous research has explained how industrial districts represent local configurations that are high in social capital, as they are characterized by mutual trust, cooperation, and entrepreneurial spirit, as well as by having a multitude of small local firms (as opposed to large firms) with complementary specialized competences (Saxenian, 1994; Dakhli and De Clercq, 2004).

Generally speaking, proximity provides frequent, repeated, non-marked, informal contacts, all of which facilitate strong ties and the density of the network of ties. These interactions stimulate exchanges of information about competitors, production technologies or recent developments, and so on (Decarolis and Deeds, 1999).

Social interactions, human resources mobility across district firms provides an opportunity for information and knowledge exchange. In effect, the use of the informal information channels for the diffusion of knowledge provides another argument in favor of the tendency towards innovation when geographically delimited (Lundvall, 1992). Moreover, trust can be better built through repeated interactions and personal contacts, and these kinds of contacts are improved through geographical proximity.

Rather than simply justifying the competitive superiority of the district's firms, our resulting model can also be used to analyze differences between firms within the district (Rabellotti and Schmitz 1991) and external differences between districts (Capello 1999). Gordon and McCann (2000) have developed the *social network model*. In this model, the social networks of certain strong interpersonal relationships can transcend company boundaries, with the result that many inter-firm social interactions may be stronger that their intra-firm ones. These interpersonal relationships depend on inter-personal trust and informal relationships. In fact, informality is viewed as being a

potential strength rather than a weakness, due to its use as a control mechanism. Social networks are a form of durable social capital, created and sustained through a combination of social history and collective action. Their strength is a problematic issue, since it depends on a number of conditions such as a prior accumulation of trust, circumstances that facilitate the monitoring of others' behavior, a source of leadership and a sense of common interest, as well as an assessment of the expectation of significant gain. Access to externalities will depend on past experience and routine interaction, as well as on investment of effort in developing personal relationships and trust. These factors may favor the development and reproduction of location-specific networks; in this case co-location will be a necessary but insufficient condition for access to all potential externalities in the area. More generally, these factors reinforce the importance of both direct and indirect weak ties (Granovetter 1973) and more pluralistic and open-ended network-building strategies in which agents develop more extensive groups of links, particularly with better connected agents. In this way pluralistic weak ties-building strategies can be more useful than a strong commitment to any single agent.

Local institutions and innovation

Following the above-mentioned arguments, the social capital perspective offers an explanation to determine innovation in firms. Advantages and constraints can be found, depending on the particular network structure. In the case of territorially clustered firms, the advantages of the dense structure and strong ties constituting bond social capital are emphasized. However, this characterization may present difficulties in developing the social capital needed for accessing new and exclusive knowledge for innovation. In order to deal with this limitations, authors have suggested the existence of intermediary

agents connect the internal dense network with the external disperse network. In this way, firms can combine bond and bridging social capital. This study analyzes the impact of the involvement of local institutions involvement on the innovation performance of the firms.

The inter-organizational network, represented by a district or region, includes not only specialized firms but also a broad range of local institutions which support the whole system. For the purposes of this research, we define *local institutions* as locally-oriented organizations that provide firms in the local area with a host of collective support services. Examples of local institutions include universities, research institutes, vocational training centers, technical assistance centers, and trade and professional associations.

In general, beyond providing firms with specific support services and other resource benefits (Baum and Oliver, 1992), local institutions act as repositories for knowledge and opportunities about competitive capabilities. Consequently, firms can take advantage of networking of ties with local institutions that provide a feasible source of information on the options available to enhance their capabilities. A number of authors have provided evidence of the impact of local institutions on company performance in territorial agglomerations (e.g. Decarolis and Deeds, 1999; McEvily and Zaheer, 1999). Moreover, the notion of an "innovation community" was put forward as an institutional arrangement fostering innovation (Lynn et al., 1996).

Noting the role of local institutions as intermediaries, a question arises: why do firms not directly access external networks or sources of resources. Several explanations can be suggested for the barriers that prevent firms gaining direct access to external networks. First, one primary reason preventing direct access to external networks is the small size of the firms in districts. Indeed, in most cases these firms do not have

significant R&D and marketing departments, so they cannot afford to make the large financial investments required by research projects or marketing campaigns.

The second reason concerns the need for an intensive exchange and combination of resources in the innovation process. A considerable inter-firm coordination effort is also therefore required. In a context with a high degree of specialization, knowledge and innovation involve efforts by other groups of firms. Specialization accelerates individual knowledge accumulation, although that same specialization makes no sense without some form of organization between individual firms, as the relevant information comes in an incomplete and lagging way. So, the problem facing firms is not so much one of how to achieve efficient allocation of the available resources, but rather how to secure the best use of the resources that each member of the district possesses for uses which are of an importance known only to them. Local institutions may act as coordinators of this process.

Finally, the high transaction cost of knowledge transfer in open external markets is also observed. The barriers can be justified, as searching for new opportunities to improve the innovation capabilities of firms implies high levels of uncertainty and risk. Firms can avoid risks by using local institutions to provide a feasible source of information on the existing options. Regarding the transmission of tacit knowledge between two organizations, difficulties in formalizing these resources make transmission through market relationships difficult. If the transaction involves specific investments, these should be safeguarded against the risk of opportunism. In this context, mechanisms to safeguard transactions arise (for example self-enforcing agreements), which involve relational trust and reputation. It has also been argued that these mechanisms are more effective and less costly as a means of protecting specialized investments (Sako 1991).

In summary, a full picture of the district or region includes a dense or cohesive network of ties, with the existence of a broad range of local institutions acting as bridging agents connecting district firms with external networks (McEvily and Zaheer, 1999).

Local institutions are important agents in territorial networks that provide specific knowledge, as a consequence of their position as intermediaries. We have backed our argument with previous research such as Baum and Oliver (1992) and McEvily and Zaheer (1999). Local institutions are in contact with many diverse and external circles and, at the same time, are close to the firms within the district. As a result, they can explore and transfer new, exclusive information, knowledge and opportunities that are continually refined because of internal redundancy, proximity and transactional intensity. As intermediaries, local institutions facilitate the acquisition of competitive capabilities by compiling and disseminating knowledge and by reducing search costs.

Because local institutions interact with a large number of firms in the geographical cluster, they are exposed to a wide variety of solutions to organizational challenges. Based on broad experience gained from observing others who have dealt with similar problems, local institutions, acting as go-betweens, compile and disseminate summaries of capabilities and routines. Indeed, local institutions facilitate managerial innovation by providing access to information and resources, which, in turn, enables firms to acquire new innovation capabilities, and to extend the existing ones, (McEvily and Zaheer, 1999).

Local institutions also reduce the search costs associated with locating external sources of the knowledge and specialized expertise that is critical for firms in the district. By maintaining an extensive network of ties, these intermediaries generate search economies (Molina, 2005).

As local institutions connect firms with external disperse and mutually unconnected networks of agents, they provide district firms with advantages suggested by the structural holes perspective. Burt (1992) suggests that these benefits occur in three forms: access, timing, and referral advantages. Moreover, because of the specific characteristics of the local institutions, the advantage – rather than the weakness – of the ties is the fact that such ties are more likely to reach someone with the type of resource required for the organization to achieve its instrumental objectives (Seibert et al., 2001).

Hence, it can be argued that local institutions' involvement has a direct effect on the capacity of district firms to innovate. The above discussion can be stated more formally through the following hypothesis.

Hypothesis 1. *The extent to which a firm is involved with local institutions will be positively associated with its level of innovation.*

In order to introduce a more fined-grained conceptualization, three different types of institutional collaboration are distinguished: membership of trade and professional associations; involvement in research institutes (as knowledge-intensive services), and the number of cooperation arrangements.

Firstly, we consider *associationism* as the degree to which a firm is committed to representative, specific trade or professional associations. This commitment can be perceived in the appointment of the CEO's or other members of the firm to membership in these associations.

Other authors have analyzed the effects of specific local institutions. Swan and Newell (1995) found evidence of the positive effect of the role played by professional associations in the diffusion of knowledge. Allison and Long (1987) gave evidence that

institutional affiliation provides a significant stimulus to productivity. Finally, Almeida and Kogut (1999) investigated how relationships between firms, universities, scientists and engineers strongly affect the extent to which knowledge spill-over occurs.

We can formulate the causal relationship by hypothesizing as follows:

Hypothesis 1a. *The extent to which a firm is involved in trade and professional institutions will be positively associated with its level of innovation*.

Technological centers make up, jointly with other institutions, one of the subsystems of national/regional system of innovation, that which supports infrastructure for innovation (Lundvall, 1992). These knowledge-intensive services play an important role in the creation and marketing of new products, processes and services of the firms involved.

Although there is a great variety of types of institutes and patterns of relationships with firms, overall, these centers undertake specific tasks related to the innovation processes of the firms' involved; for instance, technological consultancy, transferring technology from other industries, joint research projects and others.

Hypothesis 1b. *The extent to which a firm is involved in technological centers will be positively associated with its level of innovation*.

In the literature, motivation for cooperation agreements is diverse. For instance Hagedoorn (1993) mentioned the complexity of the technological development, the costly and uncertain nature of research and access to the market and the search for opportunities. Breshi and Lissoni (2001) argue that one should distinguish *intended*

(such as strategic alliances) and unintended knowledge flows in the case of local innovation systems. Strategic alliances and other types of formal cooperation arrangements constitute a source of ideas, information and other inputs for improving innovation. Firms benefit from efficiency by *exploiting* existing opportunities through sharing high-quality information and tacit knowledge, as well as through cooperative exchange (Saxenian, 1994).

Proximity in clusters fosters the development of a large number of collaborations and cooperation arrangements among firms. These cooperative relationships show diverse forms of institutionalization.

Hypothesis 1c. The *extent to which a firm is involved in cooperation arrangements will be positively associated with its level of innovation*.

METHOD

Empirical setting

The empirical research drew on a sample of Spanish industrial firms located in the eastern region of the country (Valencia Region). The industrial structure of the Valencia region is based on a number of industrial districts or clusters, chiefly in mature or traditional sectors, such as ceramic tiles, shoes, furniture, toys, etc. Similarities to the *Italian model* are frequently mentioned – even concerning the goods produced. Mention should be made of a Ford car manufacturing plant in the region that has fostered an important network of supplier firms in its vicinity. A significant tourism industry is also well established, a consequence of the region's natural resources and extensive Mediterranean coast, including important tourism destinations, such as Benidorm, Altea, Dénia, Peníscola,. Finally, the traditional agricultural sector, important some

years ago, has declined dramatically in importance, although the export of fruit and vegetables to European and American markets still continues to be considerable.

According to official data, the size distribution of firms in the region shows a predominance of SMEs. In fact micro firms (less than 6 employees) account for 48% of the total, whereas firms with more than 100 employees account for only 1% of the total.

The basic tool for promoting innovation in the Valencia Region is the IMPIVA (Institute for Small and Medium-Sized Enterprises in the Valencia Region). It is responsible for developing the innovation policy in the region through a focus on SMEs as a key strategy to enhance firm competitiveness. IMPIVA fosters a network of technological infrastructures to lend support to innovations. This activity takes the form of two networks, technology institutes and a network of European business and innovation centres.

Firms selected for our empirical research were intended to be representative of manufacturing firms in the Valencia region. A public database (DIRNOVA) enabled us to identify the address and four-digit Standard Industrial Classification (SIC) of the companies involved in the study. The DIRNOVA database was collected by IMPIVA a public agency. The DIRNOVA database contains data built from information obtained through direct interviews with managers of companies applying a systematic methodology for its collection over years.

We used firms from up to 4 different industrial segments or SIC epigraphs or headings and, in order to define the sample, we employed a random stratified selection process of firms with proportional allocation according to size and product segments. We clustered firms belonging to different industrial segments into four industrial districts, namely high-tech services, furniture, ceramic tiles and shoes.

Data collection

Data were collected using a questionnaire distributed among firms. Questionnaire was addressed to the general manager. We collected complete data for 503 firms, whose basic characteristics are shown in Table 1. Fieldwork helped to refine the choice of constructs and identify the most relevant items. Item selection was also based on the feedback obtained from a pilot survey. Fieldwork was conducted during autumn and winter of 1999. Regarding the bias caused by non-responding firms, we observed no significant mean differences between our samples and the corresponding populations of firms. More specifically, we compared differences in terms of size, and product and technological attributes. No significant differences were found and, therefore, we assumed them to be representative samples.

The variables

Independent variables

Involvement in associations

The ***involvement in associations*** variable attempted to capture the importance of firm's membership of local institutions, such as trade and professional associations. We defined this variable using an item asking respondents the number of members of the firm take an important part in representative institutions.

Involvement in technology centers

Involvement in technology centers refers to the involvement of the firm in the activities of technology centers. We defined this variable using an item asking

respondents to list the technological centers that firms regularly or frequently participate in.

Cooperation arrangements

Cooperation arrangement refers to the existence of formal cooperation arrangements involving the firm. We asked respondents how many formal cooperation arrangements were established at the moment.

Dependent variables

Innovation

In order to assess *innovation*, we used a multi-item indicator. We attempted to capture different dimensions of innovation. We asked respondents about (1) Availability of R&D department (2) Use of design (3) Number of patents owned by the firms (4) Number of licenses (5) Number of trademarks (6) Number of catalogues.

Control variables

Size. As many previous works in our field have suggested (e.g. Grant et al., 1988), we also controlled for other variables that were likely to affect performance, including *firm size* (Exhibit 1). The size variable allows us to control for economies and diseconomies of scale at firm level (Hitt et al., 1997). We used number of employees and annual sales as items.

Age. This was also included, as some authors have suggested that in industrial districts evolution over time affects performance (Pouder and St. John, 1996).

Sector. We have also controlled sector which firm belongs in order to avoid bias of specific sector factors affecting innovation.

3.4. Analysis techniques

We have provided the correlation matrix, including means, standard deviation and Cronbrach's alpha for all multi-item variables. Firstly, and in order to find out the validity of the aggregation of all multiple-item variables, we calculated the value of Cronbach's alpha for all sets of indicators. Secondly, using Pearson's correlation matrix, we analyzed the correlation of all pairs of variables. Finally, in order to test the hypotheses, we proposed a set of OLS regression models, where we used the dependent variable corresponding to the measurement of innovation. All regression models included size and age as control variables.

RESULTS

Table 1 shows descriptive statistics, Cronbach's alpha for the multiple-item variables and Pearson's correlations for all combinations of variables.

Insert table 1 about here

Firstly, we validated the aggregation of the multiple-item variables by means of Cronbach's Alpha for all sets of indicators. The least favorable values of Cronbach's alpha (with a score of .79) correspond to the multiple-item scale measuring size, the values of the alpha are within the limits of tolerance suggested in the literature

(Nunnally, 1978), and thus we considered the feasibility and coherence of the scales to be valid.

Then, with respect to the correlation obtained, the most outstanding feature was that the *Involvement in associations* variable is, as might be expected, associated with the *Involvement in technology* variable.

Insert table 2 about here

Table 2 shows the regression models used to test the hypotheses. Findings suggested a main conclusion: the high values of *R* squared show a high explanatory capacity for innovation for variables included in the model. Generally speaking, the findings lend support to the hypotheses, which predicted that firms' involvement with external associations, research centers and cooperation arrangements have a positive effect on innovation by organizational units.

Specifically with respect to hypothesis 1a, which defines company participation in associations, the model shows that this involvement has a positive effect on innovation. With respect to the second hypothesis, this also had a high explanatory capacity for the innovation variables. It is noticeable that the variable measuring the involvement of the firm with associations is the most important one. Finally, as was expected, cooperation commitment developed by firms is associated with innovation, as stated the hypothesis 1c.

Regarding to the control variables, neither age nor sector of the firms has significant positive/negative effects on innovation. On the contrary, as might be expected, the size of the firm positively and significantly affects its innovation.

5. DISCUSSION AND CONCLUSIONS

This research has attempted to contribute to a better understanding of the role of regional or local institutions in the development of the innovative capabilities of firms. Using a large sample of manufacturing firms, we have proved the association between some external linkages of a firm and its innovative capacity. These findings are supported hypotheses: in fact we have distinguished three different types of external linkages of a firm. In this way, firms with greater involvement with local institutions, associations and cooperation agreements obtain better innovation performance.

Findings also evidence that large firms have higher level of innovation. This may imply that large firms which probably have larger R&D departments show a greater capacity to absorb external resources, supporting authors as Cohen and Levinthal (1990)

Bayona et al, 2001 found evidence that the firms that acquire external technology are also more likely to cooperate with others' partners. This means the two strategies are not alternatives. These authors found that Spanish manufacturers vary their innovation behavior according to the size of the firm. The factors determining larger firms' cooperation for innovation are affected by the technological development of the industry and the nature of the innovation (cost and level of uncertainly).

García (1995) has analyzed a simple of 102 cooperation R&D agreements between Spanish firms. Findings confirm the existence of certain specific characteristics of these firms, such as a greater number of shareholders, unimportance of joint ventures or greater public financial support.

Although it is true that to some extent the rationale for this work follows that of previous research, we have aimed to complement our work with other perspectives and

to apply the analysis in a very different organizational context. Generally speaking, former research findings are coincident with ours. In McEvily and Zaheer (1999), a positive association between involvement in regional institutions and the assimilation of competitive capabilities by clustered firms is largely supported. Decarolis and Deeds's (1999) research offered evidence of a causal relationship between location and fimr performance.

The main discrepancies arise when other findings are compared. For instance, in McEvily and Zaheer (1999), the other hypotheses where non-redundancy and geographical dispersion are related to infrequent interaction are not confirmed by our data. On the other hand, Yli-Renko et al. (2001) found support for a positive association between non-redundancy and knowledge acquisition by firms, and trust is negatively related to acquisition of knowledge. Differences with respect to our findings are probably due to the existence of the local institutions variable, which can compensate for or diminish the effect exerted by other variables on the dependent variable.

Our analysis supports a number of prescriptions for firms' strategies. We argue that firms should interact with local institutions and other cluster participants in order to improve environmental conditions (Molina and Martínez 2003, 2004). Dynamics between the formation of tacit and codified knowledge and other elements of innovation processes call for a reassessment of institutional arrangements. A full explanation of the benefits of the systemic effects probably comes from the individual company capabilities perspective. The *distinct capabilities* of the firm may be based on specific resources for exploiting the local environment or on fitting characteristic organizational features to the district environment. These capabilities allow synergies to be obtained from the use of different shared resources. Firms may pursue diverse strategies for knowledge and skills resourcing (Lam 1997), including, among others, strategic

partnerships with key institutions so as to be able to influence the education and training of future researchers; research collaboration with individual academics or departments in universities in order to gain early access to research; or finally, the creation of hybrid research organizations between firms and institutions that allow common research programs to be carried out.

In addition to this general contribution, at least a couple of other issues remain to be discussed in further detail, namely, the possible negative effect of local institutions and the role played by other actors in the district, in particular large firms. We agree in considering that local institutions may also have a negative effect, as they can reinforce a lock-in situation through being too strongly focused on internal networking. Moreover, a more critical analysis of the role played by local institutions should include not only the risk of lock-in but also other limitations of the model, including the lack of general coordination, the difficulties involved in protecting innovations and a possible agency problem. Therefore, the question is when or why local institutions benefit firms or prevent lock-in. Generally speaking, to the extent to which local institutions act as an interface, they benefit district firms. More specifically, success depends on how key institutions coordinate their efforts and the degree to which they cooperate in order to achieve mutual benefits. In other words, it depends on how well they function as a *collective entrepreneur* and spread any kind of advantages obtained in terms of costs and innovations and social adjustment throughout the region (Morgan 1997). Other authors have argued that the existence of a positive effect depends on the ability of people to associate with each other and the extent to which their shared norms and values allow them to subordinate their individual interests to the larger interests of the community (Putnam 1993; Maskell 2001).

On the other hand, although we have focused on local institutions, we agree on considering other participants in the district as playing the role of intermediary agents with respect to the external networks. This is the case with large firms. We also agree that there is a need for a review of the role played by large firms within the district. A more traditional view in the literature is that put forward by Becattini (1990), who emphasized small firms as being characteristic examples of the definition of an industrial district. To support this statement, a process of desegregation from large to small-sized firms is suggested by some case studies on industrial districts like those of Il Prato (Lorenzoni and Ornati 1988) or Modena (Lazerson 1995). More recently, in contrast, industrial district theorists have reviewed the presence of large firms in districts. According to Lazerson and Lorenzoni (1999), larger firms frequently organize production among groups of smaller firms, introduce technological innovations and expand existing markets. Moreover, Bellandi (2001) proposed that involvement in knowledge exchange and institutional building and the identification of *developmental embeddedness* is more probable, where and when the local factors are neither *too weak* nor *too strong* and contextual policies fostering the developmental role of large units are present. In our opinion, as claimed by some other authors, leadership can be a combined role played by institutions and large firms. Cooke (2002) suggested that the emergence of some of the more successful clusters, attributed to the role played by leading *research institutions* and the location of a dynamic *large firm* with strong links to the global economy, has a demonstration effect for other firms in the cluster, as well as providing a continuous source of spin-offs, which thus encourages the process of setting up new firms.

Despite the benefits for firms, this pattern of relationships with local institutions also presents a number of limitations or constraints. In contrast to the aforementioned

benefits, a number of challenges in transferring resources from local institutions to firms can also be highlighted. These include a lack of general coordination, difficulties in protecting innovations, and a possible agency problem. Since not all institutions had a deliberate strategy, a number of overlaps can be detected in their actions.

Finally, mention must be made of some of the limitations of our research. Because of the use of district affiliation as a control variable, we are cautious about inferring any degree of causality among the key constructs. Although we have drafted hypotheses in a way that implies certain independence among variables, it is possible that district affiliation explains other variables, such as the social capital dimensions and involvement of local institutions. Consequently, further research is needed to elaborate the relationship between the different elements of the model. Another question may be raised as to the diversity of the local institutions. As local institutions may be focused on specific industry, the information accessed by local firms may be less diverse. Thus, a deeper analysis is needed of how local institutions differ in terms of the scope of the activities they carry out.

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TABLE 1

Means, Standard Deviations, Cronbach's Alphas, and Correlations

Variables	α	*1*	*2*	*3*	*4*	*5*	*6*
1. Associations	–	1.00					
2. Institutes	–	.179**	1.00				
3. Agreements	–	.091*	.024	1.00			
4. Innovation	.88	.335**9	.226**	.177**	1.00		
5. Age	–	.112*23	.08116	-.014	.096*	1.00	
6. Size	.79	.207**	.347**	.077	.342**	.237**	1.00

N = 503. **p* <.05. ** *p* < .01

TABLE 2:

Regression Predicting Innovation

Variable	
Constant	-.003 (.47)
Associations	.125*** (.021)
Institutes	.041* (.022)
Agreements	.051** (.021)
Age	.001 (.21)
Size	.044 (.025)**
Sector	.001 (.01/)
R^2	.151
Adjusted R^2	.197 (.449)
F Statistic	21.534***

NOTE: Unstandardized regression coefficients are presented with their standard errors in parentheses. *N* = 503.**p* < .05 ***p*<.01. ****p*<.0.001.