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SPATIAL AND NON-SPATIAL PROXIMITIES IN INTER-FIRM RELATIONS: AN EMPIRICAL ANALYSIS

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Abstract

This article describes a variety of combinations with regard to proximities (spatial and non-spatial) in inter-firm relations, and identifies their main determinants. The data employed comes from a survey of more than 1400 small and medium-sized firms in the Brittany region (France), which describe the relationship with their principal partner. Apart from spatial distance between partners, it identifies three forms of non-spatial proximity – cognitive, technological and organisational – which are assessed in terms of their role in the relations. A typology of the relationships based on forms of proximity identifies a wide variety of

configurations, which depend primarily on and the nature of the relationship, and especially on the need for coordination.

JEL classification: D83; L14; O33; R3

Keywords: spatial proximity; non-spatial proximity; inter-firm relations; Brittany; France

Introduction

This article looks at the role of proximity in the mechanisms of coordination between firms. Our study is based on the analytical framework provided by proximity economics, which distinguishes between spatial proximity (i.e. geographical distance) and non-spatial proximity (Boschma, 2005; Knoben and Oerlemans, 2006; Rallet and Torre, 2005), which correspond either to a system of joint belonging, or to a system of similarity (Rallet and Torre, 2005). Literature has established several typologies of non spatial proximities which, broadly speaking, distinguish between the cognitive, social, organisational (or relational), technological, cultural or institutional dimensions of such proximity.

Literature on proximity suggests that non-spatial proximity is much more critical in coordination processes, especially when interactions are complex. It may or may not go hand-in-hand with spatial proximity: co-location is not enough to ensure interaction (Rallet and Torre, 2005). Hence the cluster is one specific market organisation (Maskell and Lorenzen, 2004) but not the only effective model (Boschma, 2005).

The existing literature suggests that inter-firm relationship can be characterized by various combinations of spatial and non spatial proximities between the partners (D'Este et al., 2006; Rallet and Torre, 2005). Moreover, these combinations of proximities are supposed to depend primarily on the nature of knowledge exchanged (tacit/codified) and the need for coordination between the partners. In particular, the role of non spatial proximities in coordination is supposed to be the highest when coordination requires the exchange of tacit knowledge.

Two combinations are primarily described by the literature. The first underpins the cluster thesis where coordination is based on the combination of both non-spatial and spatial proximities. In a second configuration, non spatial proximities compensate the lack for spatial

proximity. In other words, non-spatial proximities replace spatial proximity as a means of coordination between remote partners (Rallet and Torre, 2005). However, other combinations are not excluded but have been less analyzed. Furthermore we think that research effort is needed regarding the determinants of these combinations.

This paper aims at providing a better understanding of the configurations of spatial and non spatial proximities in inter-firm relationship and of the parameters which characterize each of these configurations. The role of the need for coordination between the partners will be specifically analysed as it is one of the main parameters underlined by the literature .

The first originality of this paper lies in the way we propose to measure non spatial proximities: indeed, we know not only if the partners share one or more dimensions of non spatial proximity, but also if these proximities have really contributed to facilitate their relations. The originality of the paper also lies in focusing on relationship between customers and suppliers, whereas the existing literature on proximity concentrates on specific kind of relationship and especially innovative relations (Boschma, 2005) between firms or between firms and universities. Moreover, our focus here is on small and medium-sized enterprises (SMEs) with between 10 and 250 employees which are very numerous in France.

Data come from the "Companies and ICT" survey made in 2008 by the M@rsouin group (a federation of research centres in Brittany, France: www.marsouin.org). We participated to this survey by defining a specific set of questions concerning the firm and its principal partner (with which the firm has the most interaction), whether the latter is a customer or a supplier. Specific questions about spatial and non spatial proximities have been included. 1424 firms have answered this part of the questionnaire and constitute the sample of analysis.

The paper is structured into five parts. The first defines the analytical framework. The second describes the construction of the data and the methodology of the multivariate analysis. The third part provides a descriptive analysis of the different forms of proximity. The fourth part establishes a typology of the combinations of proximities and identifies the associated characteristics. The fifth part concludes.

1- Framework of analysis

The basic hypothesis of the literature on proximity is that space in itself is not a medium for coordination between socio-economic agents and that the role of non-spatial forms of proximity needs to be examined as a support for coordination (Rallet, 2002; RERU 1993 and 2008). This means that the relations between socio-economic agents can be analysed as particular combinations between spatial and non-spatial proximity, in which non-spatial proximity can take several forms: organisation, social relationship, cognition, technology…

1.1 Dimensions of proximity

On the premise that there exist numerous kinds of non-spatial proximities, proximity economics has developed a range of typologies (Bouba-Olga and Grossetti, 2008; Boschma, 2005; Knoben and Oerlemans, 2006; Zeller, 2004). They do not precisely coincide, although they have many features in common. Generally, the following 5 broad categories emerge: within each category, various measures are proposed by the literature:

- *geographical* proximity concerns the spatial distance between the agents. It is often measured either by the Euclidean distance between the firms or by the belonging to the same territory, at different scales (same cluster, same metropolitan area, same region…). However when the data make it possible, it is more accurate to consider the access cost measured in terms of travel time and money (Moodysson and Jonsson).

- *cognitive* proximity refers to a shared knowledge base and shared skills. In some cases, a distinction is made between technological proximity, based on the use of similar technological expertise, and cognitive proximity (Knoben and Oerlemans, 2006). Furthermore, some authors identify a cultural proximity distinct from cognitive proximity (Boschma, 2005), whilst others view it as an element of so-called institutional proximity (see below). Various measures exist in the literature. P.A. Balland (2011) uses a matrix of geodesic proximity, at level two, i.e. a matrix of partners of partners. In Noteboom et al., 2007, cognitive proximity is measured in terms of correlation between technological profiles of the firm and its partner (derived from patent data). Because lot of empirical studies focus on innovation, technological proximity is generally measured using patents data which provide information about technological fields (Benner and Waldfogel, 2008; Cantner and Meder, 2006; Stuart and Podolny, 1996).

- *organisational* proximity refers to the existence of rules and procedures that link agents within an organisational framework. It identifies two dimensions, the intensity of the relations and the degree of autonomy within these organisational frameworks. The belonging to the same organization is often used as a measure of organisational proximity (Balland, 2011). However other measures are also used: for instance P. D'Este and al. (2006) take a prior experience with a partner as a measure of organisational proximity. R. Shaw (2003) measures organisational proximity between an individual and its firm by asking the individual the extent to which his identity is close to the identity of its firm. In L. Oerlemans and M. Meeus, 2005, organisational proximity is measured first *via* a count of the number of research collaborations of the firm with a variety of external actors, and second *via* the answer to a question asking the firm how often in the last 5 years external organizations thought up ideas for, or made important contributions to, the realisation of innovations.

- *social* proximity refers to the existence of socially embedded relationships between agents (Bouba-Olga and Grossetti, 2008). In the research by L.H. Weber (2010), social proximity between a firm and the Zhejiang Institute of Technology (ZIT) is determined by the fact that surveyed firms declare close contact with the ZIT. In the work by K. Frenken et al. (2010), social proximity refers to the extent two organizations have collaborated in the past.

- finally, *institutional* proximity refers to politically and/or culturally embedded relationships (Talbot, 2008). However, some authors identify cultural proximity as a category in its own right (Gertler, 1995; Wilkof et al., 1995). Institutional proximity is measured in various ways depending primarily on the scale of analysis: the territory (country or region) with its legislative conditions, labour relations, etc. or the organization, with its norms and rules (Knoben and Oerlemans, 2006). Studying collaborative scientific research in science-based technologies between universities R. Ponds et al. (2007) consider that organisations with the same incentive structure regarding knowledge production are institutionally close. P.A. Balland (2011) measures institutional proximity between partners in R&D projects by the belonging of the same institutional form.

1.2 Combinations of proximities

The role of proximities in the relationship and coordination between organizations (firms, universities, etc.) has been questioned by a huge literature. A first set of studies analyzes the links between proximities and cooperation and shows that firms are more likely to cooperate with a partner with whom they share non spatial proximities (Autant-Bernard et al., 2007; Cantner and Meder, 2007; Ferru, 2010; Singh, 2005). A second set of studies discusses the role of proximities on economic performance and especially on innovative performance of firms (Broekel and Boschma, 2011; Oerlemans and Meeus, 2005) or regions (Lagendijk and Lorentzen, 2007). They show a positive correlation, but also that too much of proximities can be harmful (Broekel and Boschma, 2011). Finally, a third set of studies

discusses the role played by spatial and non spatial proximities in knowledge creation and exchange (Boschma, 2005; Knoben and Oerkemans, 2006; Rallet and Torre, 1999). An important debate concerns the need for spatial proximity, especially when tacit knowledge is exchanged. Indeed, tacit knowledge requires a certain amount of face to face interactions, and spatial proximity makes face-to-face interaction easier and inexpensive. However it has been demonstrated that spatial proximity is neither a necessary nor a sufficient condition for coordination to occur (Freel, 2003) insofar as non spatial proximities are a powerful means of coordination, even when coordination implies the exchange of tacit knowledge (Boschma, 2005). To some extent, non spatial proximities can compensate for the lack of spatial proximity (Rallet and Torre, 2005). To summarize, non spatial proximities are supposed to be more necessary if the relation requires a high level of coordination and especially the exchange of tacit knowledge, particularly when the parties are geographically distant.

Therefore, literature suggests that several combinations of spatial and non spatial proximities are feasible, and that the nature of knowledge (and more largely the need for coordination) is of primary importance. Hence, we think that research effort has still to be made concerning the description and characterisation of the combinations of proximities in inter-firm relations, especially because literature has focused on two combinations (see introduction). Moreover the existing literature on proximity has concentrated on specific kind of relationship and especially on innovative relations (Boschma, 2005).

This paper aims at demonstrating the diversity of the existing combinations of proximity in the relations between customers and suppliers, and characterizing these combinations, especially in terms of the need for coordination.

2- Data and methodology

We defined questions aimed to identify several forms of proximity between the firm and its principal partner and to provide information on the nature of the relationship. After a description of these data, we describe the methodology used to establish a typology of combinations of proximities and identify the associated characteristics.

2-1 The survey

The M@rsouin research group conducts a regular survey with a representative sample of SMEs (10 to 250 employees) located in the Brittany region in north-west France, focusing on their use of Information and Communication Technologies (ICT). The respondent is usually the chief executive. The 2008 survey was conducted with 2000 Breton firms in the industrial, commercial and service sectors (excluding agriculture).

As members of the M@rsouin group, we included in the 2008 survey a specific set of questions about the firm's relation with its principal partner. We explicitly defined this entity as the partner with which the firm has the most relations (in term of interaction), whether customer or supplier. We chose to focus on the principal partner because, whereas firms tend to be involved in several relations (Wassmer, 2010), we prefer collecting detailed information on only one relationship by firm than slight information on several partners. We chose to focus on customer-supplier relationships first because all firms established this type of relation and second because it represents a large variety of relationships. In particular, the complexity of the exchanges and then the nature of the knowledge transferred may be very different from one to another relationship. Therefore we included in the survey several questions about the partner and the relation, in order to characterise this relation ex-post. Of the 2000 businesses that answered the questionnaire, 1424 identified a relationship with a

partner and answered all the corresponding questions. These 1424 firms are our analysis sample[1].

2-2 Proximities between the partners

Geographical proximity is measured in the questionnaire by the spatial separation between the firm and its principal partner, divided into the following five categories: ultra-local (less than 5 km), local (5 to 50 km), regional (50 to 250 km), national (more than 250 km, but in France) and international (outside French borders).

Concerning non spatial proximities, our aim was to measure not only the presence (or absence) of different forms proximity between the partners but also to evaluate if these proximities contributed to facilitate the relation. We chose to focus on three forms of proximity which could easily be perceived by firms and which impact on the relation could be evaluated by them.

In the survey, cognitive proximity is identified by "the presence of a common culture, code or language". It therefore includes a possible cultural dimension, which is not distinguished here from the more language-related dimension. Technological proximity is characterised by "the compatibility of technological equipment". Organisational proximity is expressed as "the convergence of methods of organisation" between the firm and its partner. Concretely, companies were asked whether each of these proximities had or had not facilitated their relations with that partner, with four response options: greatly, slightly, not at all and not applicable (meaning that the firm does not share this form of proximity with its partner).

Measuring the impact of social or institutional proximity in the relationship would require questions that would be too complex to implement simply and, above all concisely, in

[1] The distribution of this sub-sample is close to that of the whole sample (which is representative of the Brittany region) in terms of firms' size and business sector.

such a questionnaire. However, we introduced in the survey some questions that may reveal the presence of these other forms of proximity. The firms were asked whether they knew their principal partner before starting the relationship with three possible levels of response (well, slightly, not at all). We also know the anteriority of the relationship with the partner (4 modalities from less than two years to more than ten years). Firms were also asked if they trusted their partner (greatly, slightly or not at all). According to the existing typologies of proximities, these three variables reflect social proximity. Finally, the survey indicates if the partner belongs to the same parent group or to the same business sector than the firm. It constitutes an indication on the institutional proximity between the partners.

2-3 Characteristics of the relation

2-3-1 Nature of knowledge and need for coordination

The first part has underlined the relations between proximity and the nature of knowledge exchanged. A way to collect information on the nature of knowledge in a quantitative survey was to question the firms about the need for coordination in the relationship. Our assumption was that the identification of a great need for coordination reflected the necessity of transferring tacit knowledge.

The need for coordination was measured in two ways. Firstly, the companies were directly asked about the need for coordination in the relationship. They could choose between four levels of response: very close coordination, close coordination, little coordination and no coordination. Secondly, a question defined the degree of standardisation of the product or service supplied by the partner, if the latter is a supplier, or to the partner, if it is a customer. This variable included three possible types of product or service: standard, adapted to the firm's/partner's demand or specifically developed for the firm/partner. In our view, this is a

second way of measuring the nature of knowledge exchanged and consequently the need for coordination which is highest when the product or service is specific.

2-3-2 Other characteristics of the relationship

Some other characteristics of the relationship may contribute to characterise the combinations of proximities. Firstly, the nature of the partner (customer or supplier) should be of importance. Secondly, because we focus on customer-supplier relationship, we expect the level of dependency between the partners to be relevant: we assume that if one partner is very dependent from the other non spatial proximities will tend to be of highest importance in the relationship. Dependency is measured by two questions. A first question asks the firms if they impose their conditions to their partner or on the contrary if they comply with their partner's conditions. They can answer greatly, slightly or not at all. A second question indicates the part of the principal partner in the sales or in the purchases of the firm (in percent).

Furthermore, the combination of different forms of proximity may also be affected by the financial implication of the firm in the relationship. We then asked firms whether they perform or not specific investment (in ICT or other investment) in this relation, and if so, if this investment was imposed by the partner or necessary for the firm.

2-4 Methodology

The goal of the paper is twofold. First, we want to identify the different combinations of spatial and several forms of non-spatial proximity that firms shared in supplier-customer relationship. Second, we aim to determine the characteristics, of the firms and the relationship, associated with each identified combination.

To meet this goal, we used multivariate analysis. Multiple correspondence analysis (MCA) is one such method to analyze the associations among many categorical variables, with the purpose of visualizing the most salient relationships in the data. The idea is that each

respondent is characterized by the modalities chosen in the survey. Respondents can therefore be represented in a multidimensional space. Since we cannot observe points in a space with more than three dimensions, it becomes necessary to reduce the dimensionality. These points are projected on a lower-dimensional subspace which is chosen to capture as much of the dispersion of the profiles as possible. A new orthogonal set of axes (the factors) is found, so as to maximize the inertia of the projected points onto the new axes (Greenacre, 1984).

To search for a typology of the different forms of proximities, an ascending hierarchical classification has then been carried out on the individuals describe by the identifying factors (identifying in by the MCA), using the Ward's minimum variance method. This method (Ward, 1963) seeks at each step to form a new cluster which minimizes the internal variance of the new merged class. Inertia is computed from the coordinates of the elements to be classified on the factor axes (Lebart, Morineau, and Warwick, 1984). The construction is continued up to the root of the tree, to the cluster containing all the individuals in the sample. A classification that best summarizes the information is then chosen.

Four variables of proximity were used in the classification: spatial, cognitive, technological and organizational proximities (they are called the active variables). As the goal was to measure the link between spatial proximity and the extent to which non spatial proximities facilitate interactions, we do not introduce as active variables in the analysis the variables which measure only the presence or absence of other forms of proximity. However, they have been integrated in the analysis as supplementary variables, such as all the other variables presented above. These supplementary variables do not contribute to the construction of the factors in the MCA, but we know how their modalities are represented in each class of the typology. This allows us to determine the link between each of these variables and the combination of proximities.

Before analysing the results of the classification in part 4, a short descriptive analysis of the active variables is presented in part 3.

3- Spatial and non-spatial proximities: a descriptive analysis

3- 1- Spatial proximity

Before beginning the analysis of the link between the different forms of proximity we need briefly to provide some statistics regarding each of these forms of proximity. Table 1 provides a summary of the answers to the question on the distance between the respondent firm and its principal partner. It provides a perspective on the low importance of strict physical proximity in choosing a partner, in line with many previous studies (Autant-Bernard et al., 2007; Bathelt et al., 2004; Boschma, 2005; Knoben and Oerlemans, 2006; Rallet and Torre, 1999). The result is all the more interesting in that our sample is made up exclusively of SMEs, given that the Marshallian argument on industrial districts is based on the externalities of spatial proximity between SMEs. This shows that the geography of inter-firm relations depends on coordination systems that have no predetermined geographical basis, even for small or medium-sized companies.

Table 1: Spatial distance from the principal partner

Distance of the principal partner							
	Less than 5 km	Between 5 and 50 km	Between 50 and 250 km	National scale (over 250 km)	International scale	No answer	Total
	7.79%	30.80%	17.84%	33.71%	9.62%	0.24%	100%

Source: M@rsouin survey, 2008

In the case of the Breton SMEs that constitute our sample, it is very rare for the principal partner to be located less than 5 km away (only 8% of cases): indeed the Brittany region is not very dense and the probability to find a partner in a radius of 5 km is low. Logically, the 5 to 50 km bracket is better represented. Nonetheless, only slightly over a third of the Breton firms work with a partner less than 50 km away. So almost two thirds have a principal partner some distance away, and in most cases moreover, that partner is situated outside the region (more than 250 km away) but in France. This is all the more remarkable in that our sample includes service activities, where the need for spatial proximity would in principle seem greater. On the other hand, few of the Breton firms have a principal partner located abroad (less than one in ten). Moreover, a chi-square test indicates a strong correlation between the distance from the main partner and the distance between the firm and its main partners. Thus the distance from the principal partner in a sense reflects the firm's distance from its main customers (or suppliers, depending on the case).

3-2- Non-spatial proximities

Table 2 presents the scores for each of the three questions relating to non-spatial proximities. The "no answer" rate is very low, which suggests that the question was seen as relevant by a large majority of respondents.

Table 1: Factors that facilitated relations (in % of firms)

	Greatly	Slightly	Not at all	Not applicable	No answer	Total
Existence of a common culture/code/language	39.54%	22.26%	18.75%	18.54%	0.91%	100%
Compatibility of technological equipment	31.6%	24.09%	26.97%	15.94%	1.4%	100%

Convergent methods of organisation	26.26%	26.69%	28.72%	16.15%	2.18%	100%

Source: M@rsouin survey, 2008

For each question, fewer than 20% of the firms considered that they do not share the type of proximity in question with their partner (answer "not applicable"), which is quite low. In all, very few companies answered "not applicable" to the three questions, which conversely means that almost all the firms consider that they share at least one of the three proposed types of non-spatial proximity with their partner. However, this does not mean that they consider that these proximities actually contributed to facilitating relations with that partner. Indeed, the scores for the "not at all" response, which means that the relevant aspects of proximity did not contribute at all to facilitating relations, are relatively high, between 19% (cognitive dimension) and 29% (organisational dimension). These results suggest that it is indeed useful to determine not only whether companies think that they share certain forms of proximity, but also whether they consider that these proximities actually contribute to the relationship with their partner, in particular for purposes of knowledge transmission. However, the literature does not explicitly make this distinction, often, it seems, assuming that the existence of one or more forms of proximity means that it or they actually contribute to the relationship.

Moreover, between half and 60% of the companies responded that the form of proximity in question facilitated relations with their partner "greatly" or only "slightly". If we exclude the firms that answered "not applicable", we can say that between 65% and 75% of the companies which claimed to be close to their partner responded "greatly" or "slightly". This finding is significant in two respects: firstly, it would seem that when the companies consider that they share a form of non-spatial proximity with their partner, then a large majority of them also feel that this helps to facilitate their relations, but secondly, that this

contribution varies in significance from case to case. The cognitive dimension gets the highest score, with almost 40% of the firms surveyed feeling that this factor contributed greatly to facilitating relations with their main partner. Indeed, there is quite a large difference between this and the other two dimensions. This result is logical, in so far as communication primarily depends on good mutual understanding based on common elements of culture and language. The score for the cognitive dimension confirmed the relevance of our measurement of non-spatial proximities.

4- Combinations of proximities and associated characteristics

4-1 A variety of combinations

The Multiple Correspondence Analysis and the ascending hierarchical classification conducted provide us a typology of the firms of the sample in eight groups. Table 3 presents, for each group of the typology, the modalities of the variables (active and supplementary) which are over represented in the group (and then which are representative of the group). Ni is the number of firm in group i (i = 1 to 8). For each modality, Table 3 presents in brackets first the percent of firms characterised by this modality in the group and second the T Value, which measures the relative importance of each modality in the group. The higher the T-Value, the more the modality is representative of the group.

Table 3: Combinations of proximity: a typology in eight groups

Spatial proximity	**Non spatial proximities**
GROUP 1 ; N1 = 108	
Between 5 to 50 km (91.67 ; 13.85)	Technological: not at all (79.63 ; 11.70) Organizational: not at all (75.93; 10.31) Cognitive: not applicable (30.56; 2.93)
GROUP 2 ; N2 = 236	
Between 5 to 50 km (54.66; 7.19) National scale (45.34; 5.16)	Technological: slightly (77.97 ; 19.49) Organizational: slightly (83.47; 20.34) Cognitive: slightly (46.61; 9.24)
GROUP 3 ; N3 = 173	
Between 50 and 250 km (100 ; 26.98)	Technological: slightly (37.57; 4.01)

	Organizational: slightly (44.51; 5.23) Cognitive: slightly (33.53; 3.61); greatly (55.02; 3.44)
GROUP 4 ; N4 = 258	
National scale (59.69 ; 9.43) Between 5 and 50 km (40.31; 3.59)	Technological: greatly (87.98; 21.17) Organizational: greatly (84.11; 21.99) Cognitive: greatly (71.71; 11.54)
GROUP 5 ; N5 = 191	
National scale (62.30; 8.63)	Technological: not at all (92.15; 20.60) Organizational: not at all (94.24; 20.62) Cognitive: not at all (78.01; 19.62)
GROUP 6 ; N6 = 121	
International scale (100 ; 27.02)	Technological: greatly (47.11; 3.61)
GROUP 7 ; N7 = 106	
Less than 5 km (100 ; 27.02)	Technological: not applicable (26.42; 2.72)
GROUP 8 ; N8 = 224	
Between 5 and 50 km (39.11 ; 2.50)	Technological: not applicable (90.50; 24.97) Organizational: not applicable (89.94; 24.42) Cognitive: not applicable (39.11; 2.50)

Several observations arise from Table 3. Firstly, whereas previous results (Aguiléra and Lethiais, 2011) contrasted firms that have a geographically close partner (in the same region) with firms wit geographically distant partner (outside the region), results are much more complex here. Indeed, only three of the eight groups contain firms whose partner falls within a single geographical bracket. In fact, we obtain a group made up exclusively of regional scale relationships (group 3), another exclusively containing companies involved in international scale partnerships (group 6) and finally a third group that contains only companies engaged in ultra-local relationships (group 7). The other five groups combine local, regional and national relationships and are distinguished by other forms of proximities. In particular, two groups contain both local and national relationships (group 2 and 4), demonstrating similarities in non-spatial proximities between these two geographical scales.

Technological and organisational proximities are systematically associated whereas cognitive proximity is less frequently found in combination with the other two forms of proximity. Only one group (group 4) contains a very large proportion of the companies that declared that each of the three forms of non-spatial proximity had facilitated relations.

As expected the different forms of non spatial proximity and their contribution to facilitating relations are not specifically associated to a particular geographic scale of the relationship. Group 4, where the three non spatial proximities greatly facilitate the relationship, is 60% made up of national scale relationships and 40% of local relationships. Symmetrically, whereas a very large majority of the firms in group 5 (that primarily contains companies in national scale relationships) state that none of the forms of non-spatial proximity had facilitated relations, the firms in group 1 (which contains more than 90% of companies involved in relationships with local partners) state that neither technological proximity nor organisational proximity had facilitated relations.

We also identify a group characterized by the absence of the three forms of proximities (group 8). It is made up with 39.11% of local relationships which is the only scale of distance overrepresented in this group. It means that geographical proximity may coexist with the absence of other forms of non spatial proximity.

Another interesting point emerges from the comparison of groups 6 and 7. Group 6, (international relationships) contains 90% of the partnerships with foreign firms in the sample. In this group, the answer “technological proximity has greatly facilitated the relationship” is over-represented while the other forms of non spatial proximity do not appear. Conversely, only the absence of technological proximity appears in group 7 (ultra-local relations). It suggests that technological proximity is of particular importance in distant relationships, whereas this form of proximity appears most of the time unnecessary in very close relations.

This analysis shows that the two combinations over-represented in the literature (see before) are represented in the typology. However our analysis also identifies close and distant relationships in which other forms of proximity are either absent or do not facilitate the

relationship. The next step consists in identifying the other variables that characterize the different combinations.

4-2- Characteristics of the combinations

The supplementary variables associated with each group are presented in Table 4. Following the presentation of the variables in part 2, they have been separated into three categories: the presence of other forms of proximity, the need for coordination and the other characteristics of the relation. The T Value, which informs on the representativeness of the modality in the group, is indicated in brackets.

Table 4: Supplementary variables associated to each combination of proximities

OTHER FORMS OF PROXIMITY	NEED FOR COORDINATION	OTHERS CHARACTERISTIC OF THE RELATION
GROUP 1: local scale; technological and organisational proximities do not facilitate the relation, cognitive proximity is not applicable		
Partner not member of the same parent group (3.30)	No need for coordination (2.14)	No specific investment in ICT (4.08) or others (3.46) Firm not dependent on its partner (2.74)
GROUP 2: local and national scales; non-spatial proximities slightly facilitate the relation (n=236)		
Partner slightly known before (2.49)		Partner not dependent on the firm (2.03)
GROUP 3: regional scale; technological and organisational proximities slightly facilitate the relation, cognitive proximity slightly or greatly facilitates the relation		
Relation in place for 5 to 10 years (1.97)		Partner is a customer (2.02)
GROUP 4 : local and national scales; non-spatial proximities greatly facilitate relationships		
Partner member of the same parent group (5.15) Partner well known before (3.17) Trust in the partner : a lot (2.83) Partner in the same business sector (2.08)	Very close coordination (3.18)	Investments in ICT imposed by the partner (5.23), necessary for the firm (3.28) Other investment necessary (3.20) and imposed (2.32) Partner 50% or more in the firm sales or purchases (3.20) Firm very dependent on its partner (3.03) or inversely (2.51)
GROUP 5 : national scale; non-spatial proximities do not facilitate the relationships		
Partner slightly known before (3.77) Partner not member of the same parent group (2.20)	Little coordination (3.77) Product/service standard (3.27)	No specific investments in ICT (5.82) or others (6.03) Partner less than 50% in the firm's sales or purchases (2.76) Firm not dependent on its partner (2.52)
GROUP 6: international scale; technological proximity greatly facilitates the relation		
Partner member of the same parent group (2.40)	Close or very close coordination (2.35)	Partner supplier (3.61)

	Product/service standard (2.13)	Partner a little dependent on the firm (2.83) or inversely (2.10) Investment in ICT imposed by the partner (2.29)
GROUP 7: ultra-local scale; technological proximity not applicable		
Partner not in the same business sector (2.68) Partner not member of the same parent group (2.15	Good/service adapted to the firm's or partner's demand (2.41)	
GROUP 8: local scale (not only); non spatial proximities not applicable		
		Partner less than 50% in the firm's sales or purchases (2.08) Firm not dependent on its partner (2.03)

Group 8, characterized by the absence of non spatial proximities, do not present other specific features except that the firm is not dependent of its partner. We would have expected a low need for coordination but it doesn't appear in the analysis.

As expected, spatial and non spatial proximities combine in different ways: geographical proximity is associated with non spatial proximities which facilitate the relationship (in group 4) and which do not (in group 1); and geographical distance is associated with non spatial proximities which facilitate the relationship (in group 4) and which do not (in group 5).

Groups 1, 4 and 5 are distinguished, firstly by the presence of other forms of proximity, secondly by the level of coordination in the relationship and thirdly by the dependency between the two partners. Group 4, in which the three forms of non-spatial proximity greatly facilitate local or national relationships, is mostly characterised by social and institutional proximities between the partners. Indeed a significant proportion of the firms knew their partner well before the relationship began and declares a high level of trust. In addition the partner belongs to the same parent group more often than in the whole sample, and often to the same business sector. Moreover, most of the relationships entail a high or very high level of coordination. The partner frequently represents more than 50% of the firm's activity, which

implies a high degree of dependency. Finally, relationships in this group are often accompanied by specific investments, in particular in ICT.

Group 5 is mostly composed of national relationships (62%), with the rest of the group being divided between local and regional relationships. In this group, however, the three forms of non-spatial proximity do not facilitate relations for almost all the firms. The associated characteristics of the relationships that emerge from group 5 are the opposite of those that characterise group 4. First, the firms do not share social and institutional proximities: firms do not know their partner well before beginning the relationship, and the partner generally does not belong to the same parent group. In this group, moreover, the relationships apply more to standard goods or services. The firm is therefore generally not very dependent on its partner. The partner accounts for less than 50% of the firm's business (purchase or sale) and no specific investment has been made in connection with the relationship.

As in group 5, most of the firms in group 1 declare that the three forms of non-spatial proximity did not facilitate their relation. Although the geographical scale differs, as group 1 mainly contains local relationships, the other characteristics of the two groups are very close. Firms in group 1 do not share institutional proximity with their partner and have no need for coordination with him; moreover they do not depend on their partner and no specific investment has been made.

The first result which emerges from this analysis is that the factors associated with the presence and role of non spatial proximity in facilitating the relation do not differ depending on the geographical scale of relationship.

More precisely, the conclusions that can be reached from this analysis are as follows:

- as expected, inter-firm relationships are characterized by various combinations of spatial and non spatial proximities depending especially on the need for coordination. The combination of both spatial and non spatial proximity is one case among others;
- spatial proximity is not always associated with non spatial proximity; furthermore, when the partners are close and share non spatial proximities, the latter can play only a limited role in the relation;
- cognitive, technological and organisational proximities are largely correlated;
- according to literature, the three forms of non-spatial proximity greatly facilitate relations in the case of relationships that entail a high degree of coordination and do not facilitate them when the relations concern standard products or services, whether the partners are close or far away;
- interestingly, whether the partners are close or far away, the three forms of non-spatial proximity greatly facilitate relations when these relations also reflect the presence or social and institutional proximity, i.e. when the two partners have known each other for a long time, trust each other, belong to the same sector and the same parent group. Otherwise, they do not facilitate relations. In other words, social and institutional proximities tend to reinforce the role of cognitive, organisational and technological proximities;
- whether the partners are close or far away, the different forms of non-spatial proximity greatly facilitate relations when the partners have a relationship of dependency and when the relationship is accompanied by specific investments. Otherwise, they do not facilitate them. Thus, dependency and financial implication in the relation seems to stimulate the construction and the use of non spatial proximities;

It is important to note that, as regards these last three findings, the methodology used it enables us to demonstrate links but not to determine the direction of cause and effect.

Conclusion

The wealth of this work is that it is based on relational data that make it possible to identify and measure different types of proximity, to analyse the different combinations of spatial and non spatial proximities through which firms coordinate, and to characterize the combinations in terms of the nature of the relationship they have with their main partner.

The identification of the proximities in the questionnaire is twofold. It is firstly thematic: cognitive proximity is identified by the existence of a common code and language, technological proximity by the compatibility of the equipment used in the relationship, and organisational proximity by the convergence of methods of organisation. Then it is based on the firm's response as to whether these proximities facilitate relations. Indeed, it is not enough for the conditions for a form of proximity to be present. That proximity may or not facilitate the interactions.

Against this background, we have demonstrated a number of findings.

- We firstly showed that non-spatial proximities are generally combined in facilitating or not the relationship. Technological and organizational proximities are always associated and facilitate interaction in the same way whereas cognitive proximity is less frequently found in combination with the other two forms of proximity. Moreover, social and institutional proximities tend to reinforce the role of cognitive, organisational and technological proximities. If it were to be confirmed, we could reduce the number of relevant non-spatial proximities in empirical studies.
- We secondly highlighted a wide variety of combinations of spatial and non spatial proximity. Some combinations well-known in the economic literature emerge from the

typology: non spatial proximity which facilitates the relation may arise both in the presence of spatial proximity, sustaining the idea that coordination is based on the combination of both types of proximity and in the absence of spatial proximity, supporting the thesis that non-spatial proximities can replace spatial proximity in the coordination between remote partners (Rallet and Torre, 2005). We also show that spatial proximity is not systematically associated with non spatial proximities. In addition, when partners are geographically close non spatial proximities may play only a limited role in coordination.

Finally, this study has identified some links between the combination of proximities and the nature of the relationship. According to the literature, it has confirmed that the importance of non spatial proximities in facilitating relations rises with the need for coordination. Moreover, other characteristics of the relationships, less studied in the literature on proximity, are found to be relevant: firstly the dependency between the partners, and secondly the financial implication in the relation, measured by the implementation of specific investments. A particularly interesting finding is that all the factors associated with the presence and the use of non spatial proximity in the relationship do not change with the geographical scale of relationship.

Of course, our study presents some limitations. On the one hand, the results are dependent on the way we chose to measure the different forms of non spatial proximity. On the other hand, we chose to focus only on the relationship with the principal partner. The results then reflect only strong ties and are not intended to provide an exhaustive view of inter-firm relations.

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