Journal of Technology Management & Innovation

Received February 2, 2012 / Accepted April 5, 2013 J. Technol. Manag. Innov. 2013, Volume 8, Issue 2

International Regional Patterns of R&D Networks Involving Low Tech SMEs

Aurora A.C. Teixeira[1], Paulo Santos[2], Ana Paula Delgado[3]

Abstract

A large number of studies have emphasized the spatial proximity of economic activity and its relation to the spatiality of knowledge creation in various types of connections. Far less attention has been paid to the understanding of the determinants of 'cultural' and geographical proximity in international R&D cooperation projects involving SMEs and the role of the quality of the Regional Innovation System (RIS). Using a database of completed European Cooperative Research projects, we conclude that: 1) technologically more complex projects are more likely to involve 'culturally' and geographically distant partners; 2) RIS related variables determine 'cultural' proximity but not geographical proximity; 3) at first sight surprisingly, international cooperation projects involving the 1st promoters of innovation-led regions (high patent propensity and high human capital levels) are culturally more distant.

Keywords: Regional innovation system; cooperation; innovation; SMEs; CRAFTs.

[1] CEF.UP, Faculdade de Economia, Universidade do Porto; INESC Porto; Rua Dr Roberto Frias, 4200-464, Porto, Portugal
Tel: +351225571214; Fax +351225505050; E-mail: ateixeira@fep.up.pt
[2] Tomorrow Options; UPTEC – Parque de Ciência e Tecnologia da Universidade do Porto, Rua Actor Ferreira da Silva, 100, 4200-298 Porto, Portugal; Tel: +351 220 301 596, Fax: +351 220 301 569; E-mail: p.santos@tomorrow-options.com
[3] Faculdade de Economia, Universidade do Porto, Rua Dr Roberto Frias, 4200-464, Porto, Portugal; Tel +351225571 2206
Tel: +351225505050; e-mail: apaula@fep.up.pt

ISSN: 0718-2724. (http://www.jotmi.org)

Introduction

Several authors have empirically and theoretically made the case for the benefits of geographical proximity (Porter 1990; Krugman 1994; Aguiléra et al 2012), or the location of firms in regional agglomerations (Storper 1995; Eriksson 2011; Magrini and Galliano 2012). Proximity is said to enhance the performance of the firms through knowledge spillovers, informal information exchange, and the easier availability of inputs, skills, and other shared resources (Scott 1992; Crespo et al 2012). Concurrently, the trend toward formalized cooperation, namely through inter-firm alliances, joint ventures, and R&D and other agreements, has been intensifying (Powell and Brantley 1992; Howells 2012; Huggins and Johnston 2012). Both these phenomena reflect the accelerating pace of innovation, and the related requirements of staying abreast of technological and market trends, integrating relevant knowledge, and developing new products and processes (Lundvall, 1992, Fischer and Zayas 2012).

Recent studies gather evidence that localized external networking is less prevalent than might have been expected (Doloreux 2004; Kingsley and Malecki 2004; Doran et al. 2012). In fact, in many instances, regional networks for technological development are not the most predominant ones (Doloreux 2004). Moreover, proximity does not seem to be an important factor in shaping the structure of informal networks or the use of information (Kingsley and Malecki 2004). This evidence concludes that the importance of proximity has in fact been overestimated (Doran et al. 2012). It further demonstrates that SMEs make use of a mixture of local/regional, national and even international knowledge sources, and that their ability to sustain networks at different regional scales is a key factor in competitiveness and innovativeness.

There is thus a pressing need to develop a more refined line or argument that breaks with the current view on the localized character of innovation in order to provide a deeper understanding of other similar forms of linkages which are more dispersed in space (Broekel and Boschma 2012). In Bunnell and Coe's (2001: 570) words, there is a "… need for a qualitative shift away from work which focuses on particular scales as the locus for understanding innovation, towards that which gives more credence to relationships operating between and across different scales." Such re-focusing would lead to both theoretical enrichment and new practical applications in public policy with regard to innovation networks. It is therefore apparent that while a large number of studies in economic geography has emphasized the spatial proximity and clustering of economic activity and its relation to the spatiality of knowledge creation in various types of connections, far less attention has been paid to the understanding of the determinants of 'cultural' and geographical proximity in international R&D cooperation projects. Furthermore, as Fritsch (2003) recognises, not much is known about the significance of interregional differences in the propensity of enterprises to cooperate, and the relationship between cooperation behaviour and the quality of the regional innovation system (RIS).

The present study seeks to address some of these gaps by providing some results on formal international R&D networks comprising SMEs and R&D institutes. In particular, it tries to assess the effect of technological complexity, project size, and the strength of the regional system of innovation on the cultural and geographic proximity of network participants. The paper proceeds as follows. The next section of the paper develops the theory and presents empirical evidence on Regional Innovation Systems (RIS), cooperation and networking. Then (Section 3) details the empirical analysis of successful R&D alliances by outlining some essential features of CRAFT projects, setting the methodology and presenting results. Finally, we present the main conclusions of the study.

Regional Innovation Systems (RIS), cooperation and networking: a review of the literature

Although the 1980s witnessed the emergence of several complementary notions connecting technology and regional development policies, the concept of RIS only became official at the beginning of the 1990s with Cooke's work (Cooke 1992) and gained widespread dissemination with the book edited by Braczyk et al. (1998) entitled Regional Innovation Systems.

The RIS was inspired in the National Innovation Systems (NSI) (Lundvall 1992; Nelson 1993) and was similarly guided by the rationale of 'spatially based innovation systems' (Asheim and Gertler 2004). Previous authors (e.g., Scott 1995) emphasized the importance of the region, seeing it as an institutional depot of a given agreed-on, evolving, collective social order. Ohmae (1995) identified the regional, rather than the national level, as the key economic scale at which leading-edge business competitiveness is being organized in practical terms. Moreover, it became a matter of substantial scientific interest as to whether a distinctive kind of innovation phenomenon might exist at regional level (Cooke 1998).

In the course of seeking for high value, better quality products, competitiveness and innovativeness have become inextricably linked to governments trying to restore their technological policies and create 'good business climates' in order to encourage their industries and firms to compete (Bell 2005). Firms, in turn, responded to increasing demand and globalized competition by forming value added partner-

ISSN: 0718-2724. (http://www.jotmi.org)

ships and strategic alliances, namely in R&D (Becker and Dietz 2004; Lin et al. 2012). At the same time, they draw in those public or quasi-public agencies with complementary assets in terms of vocational training, enterprise support and technology transfer (Busom and Fernández-Ribas 2008).

Cooperative agreements to perform R&D activities have been increasing over the last twenty years (Teirlinck and Spithoven 2013). The Community Innovation Survey (CIS), conducted in EU member countries, provides additional evidence on the importance of R&D partnerships and its variation across firms, industries and countries (Busom and Fernández-Ribas 2008). According to CIS3, on average 17% of manufacturing firms with innovative activities indicate they had cooperation agreements in 1998-2000; the share is significantly higher for large firms (61%). Partnerships with suppliers or customers are as frequent as partnerships with universities. Cross-country differences are significant: in Finland, 22% of SMEs in the manufacturing industries declared being involved in cooperative agreements in 2000, while in Spain or Italy barely 3% of SMEs did.

Several authors argue that the importance of R&D cooperation has risen steadily as a result of growing complexity, risks and costs of innovation (Coombs et al. 1996; Howells 2012; Fischer and Zayas 2012). Inter-firm collaborations occur especially within technology based industries. For instance, Arora and Gambardella (1994) demonstrate the high importance of R&D collaborations for large US chemical and pharmaceutical companies in the biotechnology sector. Colombo (1995) provides empirical evidence of complementary relationships between inter-firm cooperative arrangements and R&D intensity for a representative sample of international firms in the information technology industries (semi-conductor, data processing and telecommunications). Veugelers (1997) identifies significant positive effects of R&D cooperation in the Flemish manufacturing industry on the level of R&D investments but only if firms have established absorptive capacities as a full-time staffed R&D department. For this reason, R&D-active Flemish firms are found to be more frequently engaged in technological cooperation, the more they spend on in-house R&D.

Accompanying firms' increasing cooperation efforts, public support programs to promote R&D cooperation have been implemented since the nineteen eighties in the US, Japan and the EU. The European Union's successive European Framework Programs are a significant example. Participation rates in these programs vary widely across EU member countries. In per capita terms, Denmark, Finland and Sweden had the highest participation rates in Framework Program 5, while Spain and Italy had among the lowest rates (Busom and Fernández-Ribas 2008).

At the European level, significant efforts particularly targeting SMEs have been made to stimulate these firms' cooperative efforts as a way to overcome their research handicaps and scantiness of innovative inputs and as a booster of regional development. Cooperative research (CRAFT) is one of the main supporting measures within the EU Framework Programs targeting the R&D needs of SMEs and aiming to facilitate trans-national cooperation between SMEs and Europe's research community.

While recognizing their ability to support employment, to adapt to changing conditions, to supply small and specialized markets, to rely on local resources and induce growth at local and regional level, the literature suggests however that SMEs often face a limited spatial horizon, with few opportunities to innovate, expand and be active in international markets (Ebersberger and Herstad 2013). In this vein, the main factors that explain why SMEs would perform poorly are: lower production levels, limited access to scale economies; lack of appropriate organizational, administrative and managerial skills; and financial restrictions. These last two factors act as a barrier to access (use) new technologies or to engage human resources with the appropriate skills (Bell and Albu 1999).

Notwithstanding, there is clear evidence that SMEs actively network (Fischer and Zayas 2012). Research has shown how SMEs network in a general context (Idrissia et al. 2012), or in an entrepreneurial context (Aldrich and Zimmer 1986; Uzunca 2011). As far as innovation activities are concerned, networks spread risks and costs amongst members (Leite and Teixeira 2012) and represent an important organizational form for SMEs which often lack the adequate financial and human resources (Tomlinson and Fai 2013).

The importance of interaction in innovation processes also makes it clear that networking is an essential means of knowledge exchange and learning (Doloreux 2004; Edwards-Schachter et al. 2011). Contemporary innovation theories emphasize the interactive practice of innovation and the relation between firms and their environment. According to such innovation processes, they are not isolated in their origins, but rely on a variety of factors, internal and external to the firm (Edquist and Hommen 1999; Kline and Rosenberg 1986). External relations formed with other producers, suppliers, universities, research institutes and local support organizations can be the source of new ideas for innovation (Torres et al. 2010). As a result, innovative networks have become a persistent organizational phenomenon in industrial organization processes (Doloreux 2004).

Several hypotheses have been proposed in the literature to explain the incentives that firms have to cooperate with other firms or with public research institutions (Caloghirou et al. 2003): 1) to develop innovation, firms may need complementary intangible assets, basically information, tacit knowledge and know-how, which cannot be easily contracted. In that case, monitoring and related problems can be better solved through a partnership; 2) cooperation allows partners to share risks and costs of innovating under growing technological complexity, as well as to exploit economies of scale and scope; 3) when out-coming R&D spillovers are a serious concern, R&D partnerships provide a mechanism to internalize them; 4) R&D cooperation may allow partners to increase market power in the product market.

Most of the literature on the networking and innovation performance of SMEs tends to highlight the role of physical (geographical) and cultural proximity and to stress the quality of the territory as a determinant in the performance of firms and the local/regional economy (Lundvall 1992; Storper 1995; Lorenzen 1998). However, regional innovation networks require conditions beyond mere physical proximity and concentration to thrive (Gregersen and Johnson 1997). As RIS literature argues, the spatial proximity of innovation networks is also tied to a common social and cultural understanding, without which the relationship between close agents can be hindered (Braczyk et al. 1998). So, proximity is not just an issue of geography, but equally of the degree to which economic, organizational, relational, social and cultural realities are shared. In this sense, 'cultural' proximity might be as (or more) relevant than physical proximity.

As Doloreux (2004) correctly argues, although proximity is an important determinant of interaction and cooperative behaviour implicit in networking, firms can benefit from participating in sector or knowledge specific networks linking interregional or international partners. In a complementary line of research, Fritsch (2003), studying the effects of R&D cooperation on innovation activity of manufacturing establishments in some European regions, argues that the hypotheses that cooperation boosts innovation is too simple as regions with low/high propensity to cooperate in R&D have high/low efficiency of innovation activities.

It is thus clear that the existing literature on innovation, networking and SMEs usually sees geographical and 'cultural' proximity as explanatory variables for cooperation intensity and propensity. To our knowledge, no study has so far empirically assessed the determinants of proximity, namely to what extent innovation related variables determine the intensity of cooperation between geographically or culturally close partners. Moreover, as pointed out by Becker and Dietz (2004), there remains an unexplored gap in the literature, which deserves further research: the need for the innovation effects of joint R&D to be analyzed under dynamic aspects with special attention paid to regional innovation systems (RIS).

Method

Subjects or Participants

Using a database of 118 international cooperation projects - 'success stories' of completed CRAFT projects -, we aim at providing a contribution which may complement the existing literature on the relation between cooperation technology traits, RIS features and (cultural and geographical) proximity between cooperative participants. Thus, this study seeks to answer the following main questions: 1) What is the effect of technological complexity on the geographical and cultural distance of network participants?; 2) What is the effect of project size on the geographical and cultural distance of network participants?; and 3) What is the effect of the strength of the regional system of innovation on the cultural and geographical distance of network participants?

CRAFTs are instruments of cooperative research, specially designed for SMEs. In order to enhance the performance of member countries, their organizations and citizens, regarding R&D and innovation, the EU created, in 1984, the EU Framework Program for Research and Technological Development (FP). Bridging SMEs and R&D, the FP6 defines instruments to enhance SMEs' technological capacity. On the one hand, exploratory instruments provide financial aid to project submission (partners research, innovation and market research, viability studies); on the other hand, there is a 'cooperative research' instrument allowing consortia involving SMEs from different countries, with low or medium technological capacity and few research abilities, to entrust research and development activities to scientific institutions (Universities or Research Institutes), while owning the results.

In this study we analyze a sub-group of CRAFTs, those from the 3rd to 5th FP considered 'successful'. Based on this information, we constructed a database which contains general information on each project, mostly gathered from pdf files that describe the projects, and RIS-related variables (human capital, patent propensity and employment rate) taken from the main regional indicators published by the EUROSAT.

Although success criterion is not explicit, some contacts with CRAFT national managers convey the information that 'successful' projects were those which the main performer reckons as well-succeeded, which are in general associated to a new product/service being commercialised or in a nearby market stage. Although the inclusion of non-successful projects could have generated interesting insights, no public information on the former is available. Given that our main aim here is to assess the relation between Regional Innovation System quality and geographical and cultural proximity in international R&D cooperation projects involving low

ISSN: 0718-2724. (http://www.jotmi.org)

Characteristics	Detail
Objective	To support SMEs in their needs for research and innovation. To encourage international cooperation between SMEs and between these and research entities.
Beneficiaries	SMEs
Number of participants	Consortia involving a minimum of three SMEs from two different countries. Consortia must include at least two R&D partners from a minimum of two different members or associated countries. Other companies or final users may participate in the consortia but they must share the costs and they are not allowed a dominant role in Project development. They must be independent from other project participants.
Owners of intellectual property rights	Participating SMEs
Project value	0,5 – 2 million €.
Funding	50% research and innovation costs. 100% of consortia management costs (Maximum EU contribution 7%).
Project duration	1 to 2 years
Result dissemination	Limited

Table 1. The CRAFT program: main characteristics. Source: The Sixth Framework Program, 2004, European Commission, SME TechWeb, in http://sme.cordis.lu/craft/home.cfm, accessed on 14 March 2005.

tech SMEs, restricting our selection to successful projects does not represent a significant hindrance to the analysis. Earlier works (e.g., Cooke and Wills, 1999) also used successful CRAFTs projects as their empirical basis for testing SMEs preferences for both domestic and foreign networking. Table 2 shows that there has been a trend toward a decrease in the success rate of CRAFTs.

The 118 successful CRAFTs involved 791 SME from 21 countries (18 from the European Union plus Switzerland, Norway and Brazil). In global terms, the CRAFTs under analysis were allocated around 118 million euros, which gives an average of 1 million euros per project. From the total, 52% were financed by the UE, that is, around 61 million euros. When considering the successful CRAFTs, the main industrial areas are: Machinery and Equipment, Agriculture, Building and Metallic products. High technology activities, such as Telecommunications, Computing and R&D have a smaller contribution. This last characteristic may result from the fact that the program aims to enhance cooperative research by groups of SMEs with low or medium technological capabilities, with a restricted capacity for proper research, and encourages SMEs consortia to entrust research activities to a third party (e.g. University or R&D institutes).

	FP3	FP4	FP5
Submitted projects	331	1.749	1.071
Contracted projects	172	698	409
Successful projects	30	65	23
Success rate	**17%**	**9%**	**6%**

Table 2. Number of projects involved in the CRAFT program. Source: Framework Program IV – SME Participation 1994 – 1998, 1999, European Commission; Framework Program V – SME Participation April 1999 – April 2001, December 2001; EU, In http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

ISSN: 0718-2724. (http://www.jotmi.org)

Industry	Nº of projects	Percentage
Machinery	13	11.0
Agriculture	10	8.5
Building	10	8.5
Metallic products	10	8.5
Electric products	9	7.6
Chemicals	8	6.8
Health	8	6.8
Textiles	8	6.8
Wood industries	7	5.9
Other manufacturing industries	6	5.1
Food and beverages	5	4.2
Computing and R&D	5	4.2
Precision tools	5	4.2
Other services	5	4.2
Transports	5	4.2
Telecommunications	2	1.7
Non metallic products	1	0.8
Retail	1	0.8
Total	**118**	**100.0**

Table 3. Industry distribution of successful CRAFTs. Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

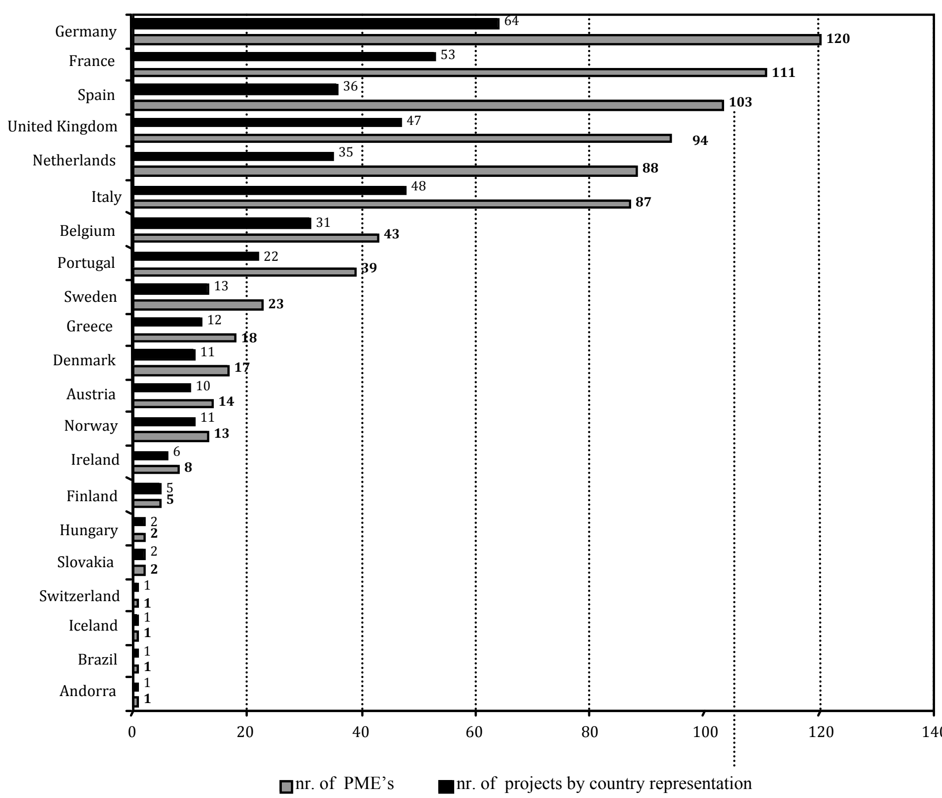


Figure 1. Number of SMEs performers by country. Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

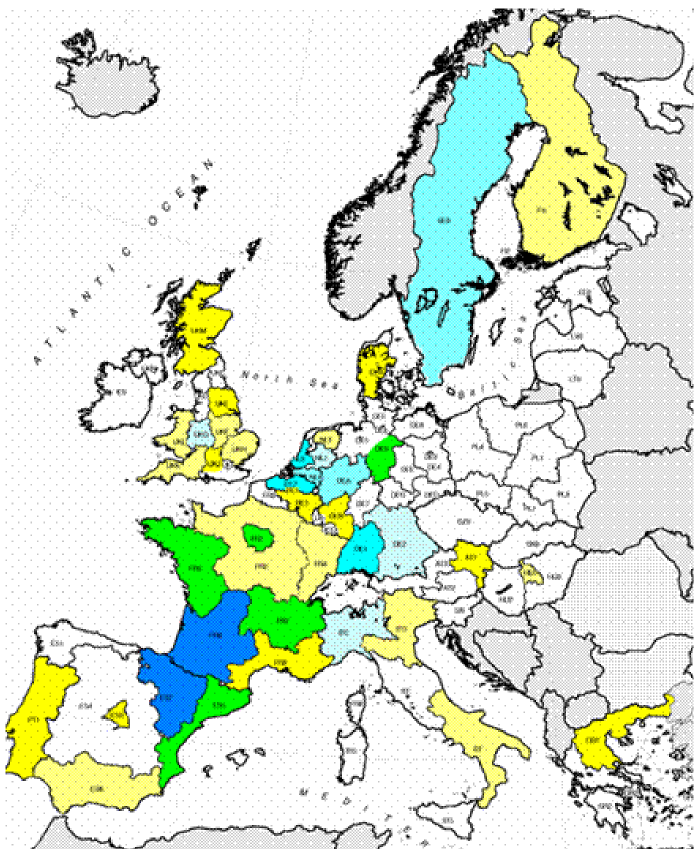
According to the Pavitt taxonomy (Pavitt, 1984), around 64.4% of projects belong to supplier dominated or scale intensive sectors. Science based sectors encompass approximately 20% of total projects.

If we analyze the country of origin of the SMEs participating in successful CRAFTs, we conclude that 73% of participating SMEs belong to Germany, France Spain, the United Kingdom, The Netherlands and Italy.

Spanish companies (103) are concentrated in 36 projects. That is, when a Spanish SME participates in a project it pushes two additional Spanish companies. Although on a smaller scale than Spain, there is also a relative intensity of internal cooperation between Portuguese partners, as each Portuguese partner seems to engage two other partners of the same nationality. The two countries with a higher number of participating companies, Germany and France, are also those that participate in a larger number of projects: 64 and 53, respectively.

Generally, cooperation between research institutions of the same country is weaker than between same country SMEs. Austria is an exception, with 3 Austrian institutions per project.

The 'successful' CRAFT database identifies the main region where each Project is developed. With few exceptions it is the region where the prime SMEs contractor is located. Although it was not possible to identify the region of origin for all the participating SMEs, we analyzed the regional origin of the first promoter in order to identify the regions with a higher 'promoting' ability. The regions with a higher promoting capacity, involved in successful CRAFTs (Table 4) are Noroeste (Spain) and Sud-Ouest (France) both with 7 projects each, Vlaams Gewest (Belgium), Baden-Württemberg (Germany) and West-Nederland (the Netherlands), with 6 projects each. Although country sizes are very different, the United Kingdom and France are the countries with more promoting regions, 8 and 7, respectively.



Nº projects	7	6	5	4	3	2	1

Figure 2. Regional distribution (NUTS I) of successful CRAFTs. Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005. The map was drawn from http://europa.eu.int/comm/eurostat/ramon/nuts/home_regions_en.html, accessed in July 2005.

ISSN: 0718-2724. (http://www.jotmi.org)

	Description	Unity	Minimum	Maximum	Average
General characteristics	No. of technological areas		1,0	10,0	2,7
	EU funding	€	39,1	76,3	50,2
	SMEs participation	€	23,7	60,9	49,8
	Pavitt's taxonomy				*Scale intensive*
	OECD's taxonomy				*Low technology*
	Average cost per SME	€	0,0	5.190.000,0	241.747,3
	Average yield per RTD	€	0,0	1.633.000,0	400.718,4
	No of represented countries		4,0	26,0	9,6
SMEs share (%)	Austria	%	0,0	57,1	1,9
	Germany	%	0,0	75,0	16,8
	Spain	%	0,0	85,7	11,1
	France	%	0,0	66,7	14,2
	Italy	%	0,0	80,0	11,5
	United Kingdom	%	0,0	66,7	10,8
	Belgium	%	0,0	100,0	5,9
	Denmark	%	0,0	60,0	2,2
	Greece	%	0,0	25,0	1,1
	Ireland	%	0,0	37,5	0,7
	The Netherlands	%	0,0	100,0	11,0
	Norway	%	0,0	50,0	2,0
	Portugal	%	0,0	64,3	4,4
	Sweden	%	0,0	75,0	3,6
RTDs share (%)	Austria	%	0,0	100,0	1,2
	Germany	%	0,0	100,0	20,3
	Spain	%	0,0	80,0	8,5
	France	%	0,0	100,0	18,7
	Italy	%	0,0	100,0	6,5
	United Kingdom	%	0,0	100,0	13,2
	Belgium	%	0,0	100,0	3,8
	Denmark	%	0,0	50,0	2,4
	Greece	%	0,0	50,0	1,0
	Ireland	%	0,0	50,0	1,0
	The Netherlands	%	0,0	100,0	11,3
	Norway	%	0,0	50,0	1,8
	Portugal	%	0,0	75,0	3,0
	Sweden	%	0,0	80,0	3,5

Table 4. Main Characteristics of successful CRAFT projects. Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

A successful CRAFT involves, on average, about 10 participating entities, generally from Germany and France, in supplier dominated and low technology sectors. In successful projects funding allocated to SMEs attains 49.8%. The average cost per SME of a standard project is 241 thousand euros, and the average yield of participating research institutions is 400 thousand euros.

Model specification and variable description

The aim here is to assess whether the intensity of cultural proximity or geographical distance in successful CRAFTs is determined by factors associated to RIS strength – human capital intensity, innovation related performance, labour market performance, etc. For this purpose, we propose two main model specifications. In both specifications, the dependent variable is explained by two sets of independent variables: variables related to project characteristics and RIS strength. The two model specifications proposed differ in the variables related to project characteristics. In particular, the restricted model considers only 'core' project characteristics, namely technological diversity, industry code (according to the Pavitt and OECD taxonomies), SMEs average project cost and RTDs average project yield. The alternative specification (enlarged model), besides 'core' project variables, also includes country specific variables. The latter reflect, for each project, the countries' weight in total SMEs and RTDs participation.

$$y_i^1 = \alpha^1 + \beta_1^1 TD_i + \beta_2^1 IC_i + \beta_3^1 SMEC_i + \beta_4^1 RTDY_i + \lambda_1^1 PAT_i + \lambda_2^1 ER_i + \lambda_3^1 HC_i + e_i^1$$

$$y_i^2 = \alpha^2 + \beta_1^2 TD_i + \beta_2^2 IC_i + \beta_3^2 SMEC_i + \beta_4^2 RTDY_i + \boldsymbol{\pi}\mathbf{CSW}_i + \lambda_1^2 PAT_i + \lambda_2^2 ER_i + \lambda_3^2 HC_i + e_i^2$$

Where

i: is a given CRAFT project;
y: is the dependent variable – promoter identity index (proxy for cultural proximity, y1) or average promoter-participant distance (proxy for geographical distance, y2);
TD: project technological diversity (natural log of the number of support technologies in a given project);
IC: project industry code (defined by the Pavitt or the OECD taxonomies);
SMEC: project cost per SME participant;
RTDY: project yield per RTD participant;
PAT: patents application per million inhabitants (1999-2001 average);
ER: employment rate (2002);
HC: post-secondary education rate (2002);
CSW: country specific weight of SMEs or RTD project participants;
α;β;λ and π: are the independent variables coefficient estimators;
e: is the random white noise error term.

In the construction of the proxy for 'cultural' proximity – promoter identity index -, we adopt the following methodology: considering the nationality of the first SME performer (1st contractor), we compute, for each project, the relative frequency of other SMEs and RTDs that belong to the same country of the 1st performer. Thus, we assume that when there are no participants of the same nationality as the 1st performer in a project, 'cultural' proximity is minimum (0). Alternatively, the maximum value that this variable could take is 100%, which corresponds to the case where all project participants belong to the same country of origin as the 1st performer.

With regard to the geographical distance proxy, we calculate, for each project, the average distance (in kilometers) between each SME participant and the 1st performer. As information on the location of each project participant is not available, distance was computed with reference to each country's capital.

The detailed description of each project supplied by CORDIS contains information on the project's number of support technologies (different technological areas associated with the project). Therefore, we take the natural log of the number of support technologies in a given project as a proxy for the project's technological diversity.

The project industry NACE code was transformed into a smaller number of industries, using the Pavitt (1984) and the OECD (1992) taxonomies. The first one aggregates industries into four main groups, by increasing order of technological complexity and nature of knowledge source – supplier dominated, scale intensive, specialized suppliers and science based. The OECD taxonomy groups industries into three main sets according to R&D intensity – low, medium and high technology industries. IC assumes the values 1 to 4 in the case of the Pavitt taxonomy and 1 to 3 in the other case.

The SMEC variable is defined as a ratio between the project's total cost, expressed in million euros, and the number of SME participants. Similarly, the RTDY represents the ratio between the project's total yield, expressed in million euros, and the number of RTD participants.

The country specific weight of each project's SME (RTD) participants is computed by taking the total number of SMEs (RTDs) belonging to a particular country as a percentage of the total SME (RTD) participants. For estimation purposes, and as depicted in Figure 1, we consider only the six main countries.

The variables related to the strength of the Regional System of Innovation were taken from the main regional indicators, published by the European Commission in the Third Report on Economic and Social Cohesion (EC, 2004). For each project we identify the NUTS level 1 where the 1st performer is located. Then we associate the NUTS level 1 corresponding values of the following variables: PAT - European Patents Office (EPO) application per million inhabitants, average 1999-2000-2001; ER - employment rate (employed population aged 15-64 as percentage of total 15-64 population, 2002; HC – number of 15-64 population who attained higher education level as a percentage of that total group age (2002).

The next table presents the main descriptive statistics and the correlation matrix of the variables under analysis. On average, 1/3 of project participants have the same nationality as the 1st promoter. 'Cultural' proximity (promoter identity index) is significantly and negatively related to technological diversity, the SME average cost, RTD average yield and human capital variable. It is significantly and positively related to the employment rate of the 1st project promoter's region. The average promoter-participant distance (proxy for geographical distance) is only significantly (and negatively) related to the SMEs cost and employment rate.

Based on the data and the constructed proxies for the relevant variables, we aim at testing three main hypotheses.

Hypothesis 1: Technologically more complex projects are more likely to involve 'culturally' and geographically more distant partners.

Projects encompassing a wider range of support technologies and belonging to intensive high technology industries would tend to require partners with more diverse and complementary technological capabilities, that is, from different regional systems of innovation. Thus, we would expect that

$$\beta_1^1 < 0; \beta_1^2 > 0 \; and \; \beta_2^1 < 0; \beta_2^2 > 0.$$

Hypothesis 2: Larger international cooperative projects involve more culturally dissimilar and geographically distant partners.

We might expect that the higher the (average) yield, that is, the size of the project, the more internationalized the project is, and therefore, dissimilarity among the nationalities involved would be more likely and the geographical distance would be greater. That is, we would expect that

$$\beta_3^1 < 0; \beta_3^2 > 0 \; .$$

Hypothesis 3: International cooperation projects involving promoters from innovation-led regions are culturally and geographically more distant.

The promoters of international cooperative projects who come from less endowed and innovative-led regions tend to concentrate on more 'national', culturally and geographically close partners. In this line, if this hypothesis is corroborated, we would expect

$$\lambda_1^1, \lambda_2^1, \lambda_3^1 < 0 \; and \; \lambda_1^2, \lambda_2^2, \lambda_3^2 > 0 \; .$$

Estimation results

The model was estimated using OLS. The number of projects included as valid observation is 114, as no regional data was available for one of the countries (Norway), and for the remaining three projects some variables are missing.

Estimation results for the 'cultural' proximity proxy are presented in Table 6 and for the geographical distance proxy in Table 7.

In general, all the estimated models present a reasonable fit. In fact, when considering jointly the adjusted R square, F-statistics, and the Durbin Watson, we have sufficient statistical evidence that the models reflect reality quite appropriately. With regard to the factors determining 'cultural' proximity, it is clear cut that regardless of the model specification (I-VI), the technological diversity variable is always highly statistically significant and negative. Controlling for all the other variables likely to influence the project's 'cultural' proximity, the lower the number of support technologies associated with the project, the higher the percentage of entities (SMEs and RTDs) with the same nationality as the 1st performer. This seems to convey the idea that technologically more homogenous (and specialized) projects tend to be less demanding in terms of international cooperation.

The above results are reinforced by the industry code variables. In both the Pavitt and OECD taxonomies, the coefficient estimates are negatively and highly significant. Given that high values for these variables translate into higher technology intensive projects, a negative coefficient indicates that these types of projects tend to attract entities belonging to a wider range of countries.

When one does not consider country specific weights, higher SME average costs seem to induce lower 'cultural' proximity as the coefficient estimates become negative and significant. This highlights the fact that more costly projects, from the perspective of SMEs, tend to attract a broader range of international partners. However, the RTD average yield does not seem to matter when explaining 'cultural' proximity.

ISSN: 0718-2724. (http://www.jotmi.org)

	Mean	Min	Max	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Promoter identity index	0,33	0	0,81	0,184	1	-0,152*	-0,287***	-0,133	-0,130	-0,201**	-0,224**	-0,056	0,206**	-0,194**
(2) Promoter-participants average distance	6,31	0	7,88	1,053		1,000	0,077	-0,004	-0,026	-0,720***	0,041	-0,009	-0,198**	-0,144
(3) Technology diversity	0,90	0	2,30	0,426			1,000	-0,178*	-0,115	0,064	0,224**	0,033	0,053	0,237**
(4) Pavitt code	2,20	1	4,00	1,106				1,000	0,746***	-0,029	-0,008	0,021	0,039	0,176*
(5) OCDE code	1,60	1	3,00	0,681					1,000	0,023	0,058	0,013	0,104	0,148
(6) SMEs average cost (million €)	0,24	0	5,19	0,537						1,000	0,123	-0,016	0,010	0,113
(7) RTD average yield (million €)	0,40	0	1,63	0,262							1,000	0,066	-0,063	-0,060
(8) Patentes (million inhabitants)	182,01	4,3	536,70	157,930								1,000	0,442***	0,085
(9) Employment rate (%)	66,51	44,4	77,00	6,199									1,000	0,206**
(10) Human capital (% post sec. education)	23,99	7,2	37,30	6,325										1,000

Table 5. Descriptive statistics and correlation matrix. Note: significant at ***1%; **5%; *10%

The introduction of country specific weight does not impact severely on 'cultural' proximity – excluding the cases of Spain and France (for SMEs), the estimated coefficients are not significant. For these two countries, although coefficient estimates are small, they indicate that the higher the percentage of French or Spanish entities, the higher the promoter identity index. This reflects that fact that French and Spanish SMEs are more prone to cooperate with SMEs of the same nationality.

RIS strength variables seem to stress that projects involving a lower 'cultural' proximity are more demanding in terms of regional innovation supporting environments characterized by a high innovation capacity (patents applications and human capital intensity). Finally, higher employment rates seem to determine higher 'cultural' proximity.

The results regarding the factors explaining average promoter-participant distance (proxy for geographical distance) are, in general, in line with those obtained for the promoter identity index.

CRAFTs characterized by a higher degree of technological diversity determine, all other factors constant, a higher average distance between promoter SMEs and other participants. This reinforces the idea stressed above that in projects with a low the number of support technologies, the percentage of entities (SMEs and RTDs) with the same nationality as the 1st performer tends to be high, explaining in part the small average geographical distance between promoters and participants.

In contrast to the previous case, industry codes (both Pavitt and OECD) present no significant statistical coefficients, conveying the idea that project industry technological features are not relevant for explaining project average promoter-participant distance.

When we control for the intensity of SMEs and RTDs belonging to countries which have a greater presence in successful CRAFTs, the larger the size of the project, in terms of average RTD yield, the higher the average distance. From a cost perspective, however, high cost per SME projects include more geographically nearby partners.

It is interesting to note that the higher the weight of participants (SMEs and RTDs) from France, Germany (only in the case of SMEs), the Netherlands and the United Kingdom, the lower the projects' average promoter-participant distance. This might be explained by the fact that projects involving SMEs from these countries have a higher propensity to include RTDs of the same nationality than other countries. This decreases the average distance between the promoter and other project participants.

Excluding the employment rate, other RSI related variables do not seem to explain average distance among the different international cooperation projects. In fact, estimates are statistically insignificant for both patent and human capital variables. In comparison to the 'cultural' proximity case, where RIS strength seems to matter greatly, when it comes to geographical distance such a role is not underlined.

The above evidence suggests that our first hypothesis 'H1: Technologically more complex projects are more likely to

ISSN: 0718-2724. (http://www.jotmi.org)

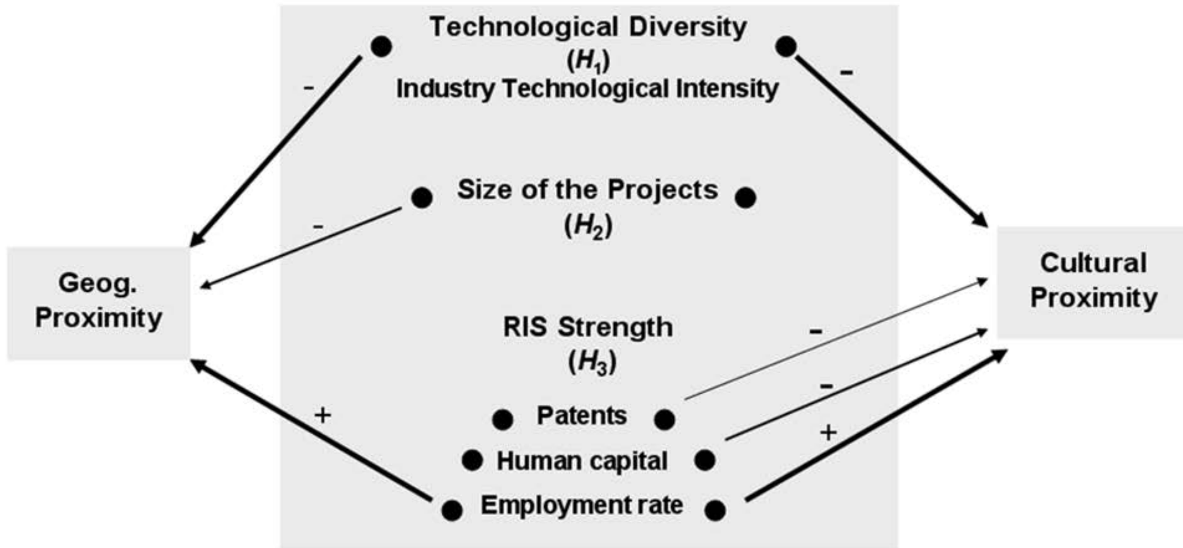


Figure 3. Summary scheme of the estimation results. Note: - and + represent the statistical negative and positive significant relation; the weight of the arrows reflect the degree of statistical significance – cf. Tables 6 and 7.

involve 'culturally' and geographically more distant partners' is corroborated. This might be explained by the fact that, when controlling for indicators of RIS strength (patent propensity, human capital intensity and labour market dynamics), projects encompassing a wider range of support technologies and belonging to high technology intensive industries (more science based, according to the Pavitt taxonomy, or high tech, following OECD typology) tend to require partners with more diverse and complementary technological capabilities. Such complementary is more likely to be found in firms from different national systems of innovation, reflecting diverse, yet interrelated technological specialization fields.

As to our second hypothesis, 'H2: Larger international cooperative projects involve more culturally dissimilar and geographically distant partners', the evidence gathered only corroborates this when we introduce the SME or RTD country weights. In this case, and assessing project size by the yield accruing to participant RTDs, we conclude that the higher the (average) yield, the more internationalized the project is and, therefore, dissimilarity among the nationalities involved is more likely (lower 'cultural' proximity) and geographical distance is greater (average promoter-participant distance).

Given that RIS related variables, namely patent propensity and human capital, become significantly negative when related to 'cultural' proximity (although not statistically significant when it comes to geographical distance), we can point out that the data corroborates in part H3, that is, 'International cooperation projects involving 1st promoters of innovation-led regions (high patent propensity and high human capital levels) are culturally more distant'. Corroborating such a hypothesis could be interpreted as meaning that promoters of international cooperative projects who come from more endowed and innovative-led regions tend to lead more complex projects from a managerial point of view. In fact, to manage a wide range of firms of different nationalities implies considerable networking and relational competencies, which are more likely to be found in firms from well-developed regions. Firms that belong to weaker regions in terms of human capital and innovative performance may generally lack strong networking competencies, and they are thus induced to concentrate on more 'national', culturally nearby partners.

Conclusion

In spite of increasing global flows of ideas, capital, goods and labour, recent research in urban economics and economic geography suggests that geographical proximity between innovators may be important to technological innovation (Sonn and Storper 2008). Many authors also claim that the rise of a knowledge-based economy and changes in the organization of the innovation process have actually increased the value of such proximity to innovation. Yet there is little empirical research on whether this latter proposition is valid. Concurrently, the trend toward formalized cooperation, namely through inter-firm alliances, joint ventures, and R&D and other agreements, has been intensifying (Huggins and Johnston 2012). Both these phenomena reflect the accelerating pace of innovation, and the related requirements of staying abreast of technological and market trends, integrating relevant knowledge, and developing new products and processes (Lundvall 1992).

Recent evidence concerning the role of proximity is puzzling. Some studies (e.g., Doloreux 2004; Kingsley and Malecki 2004; Doran et al 2012) conclude that the importance of proximity was not substantiated, gathering evidence that, in many instances, regional networks for technological development are not the most predominant ones (Doloreux 2004) and that proximity does not seem to be an important factor in shaping the structure of informal networks or the use of information (Kingsley and Malecki 2004). Others (e.g., Sonn and Storper 2008) find that proximity in the creation of economically-useful knowledge appears to be becoming even more important than was previously the case.

In the present study, with a view to complementing existing evidence in this field, using new data on successful international formal R&D alliances, we aimed to assess the determinants of 'cultural' proximity and geographical distance, highlighting the role of the quality of the regional innovation system (RIS). More specifically, we assessed the effect of project technological complexity, project size, and the strength of the regional system of innovation on the cultural and geographical proximity of network participants.

We conclude that technologically more complex projects are more likely to involve 'culturally' and geographically more distant partners and that the 1st promoter's regional patent propensity and human capital endowments (proxies for RIS strength) determine 'cultural' proximity but not geographical proximity among network participants. Seemingly at odds with most geographically related literature, we find that international cooperation projects involving 1st promoters of innovation-led regions (high patent propensity and high human capital levels) are culturally more distant. Such apparently disparate results might be interpreted as meaning that the promoters of successful international cooperative projects who come from more endowed and innovative-led regions tend to lead more complex projects. In other words, to manage a wide range of firms of different nationalities tends to imply considerable networking and relational competencies, which are more likely to be found in firms located in high quality (stronger) RIS. First SMEs promoters belonging to weaker regions in terms of human capital and innovative performance may, in general, lack strong networking competencies inducing them to concentrate on more 'national', culturally nearby partners.

This paper's findings seem to imply that if RIS quality is a relevant condition for local SMEs to access a wider, more complex R&D network, then there is room for additional reflection about whether public policy should take this explicitly into account. Most technological policies are meant, by design, to be indifferent to location, precisely because they want to stimulate knowledge diffusion, competition, and avoid generating rents (Sonn and Storper 2008). Along these lines, there appears to be some reason to think that local governments should privilege those activities that can endogenously create 'good business climates' in order to assist their industries and firms to compete (Bell, 2005). In particular, they should stimulate investment in human capital and easier procedures to facilitate and encourage patent applications, which would contribute to SMEs competencies accumulation, creating a basis for their involvement in increasingly technologically complex and more distant (successful) R&D networks. The evidence presented here emphasizes both the importance of localized technological interactions, namely the strength of RIS and the increasing relevance of long distant R&D cooperation networks.

Notes

The concept of 'successful' was provided by Margarida Garrido (Cordis).

We consider here NUTs level 1 as defined by EC prior to May 2003.
As prior literature has suggested cultural and geographical variables emerge from these results as connected factors. Recent thinking, however, suggests the linkage between these factors may be loosening as the mobility of cultures increases (Saxenian, 2005; Florida, 2004). In order to address (although partially) this point we further estimate the two set of models - one (Table A1 and A2 in Appendix) that includes the geographical (cultural) variable as an independent variable in the models that seek to explain the variability in the index of cultural proximity (geographical distance); another in which the dependent variable is a global index of cultural and geographical proximity (computed as a simple average of cultural proximity and 1-Index of geographical distance) (Table A3). The cultural and geographic variables were thus segregate and tested both jointly and separately to discern differences in the effects. The results (significance and signals of the individual estimates) obtained do not significantly differ from the original set of results, and further evidence that cultural and geographical indexes are in this sample of projects statistically significantly related.

Variable description			Model I	Model II	Model III	Model IV	Model V	Model VI
Project characteristics	Technology diversity (ln number of support technologies)		-0.111***	-0.106***	-0.111***	-0.110***	-0.106***	-0.105***
	Industry	Pavitt code (1: supplier dominated … 4: science based industry)	-0.028**		-0.029**	-0.026*		
		OECD code (1: low …3: high technology industry)		-0.043*			-0.042*	-0.038*
	SMEs average cost (million €)		-0.055**	-0.052*	-0.034	-0.049*	-0.031	-0.046*
	RTD average yield (million €)		-0.087	-0.081	-0.056	-0.058	-0.055	-0.057
	SMEs	France			0.002**		0.002**	
		Germany			0.001		0.001	
		Italy			0.0003		0.000	
		Netherlands			-0.0003		0.000	
		Spain			0.002**		0.002***	
		United Kingdom			0.001		0.001	
	RTDs	France				0.0005		0.001
		Germany				0.0004		0.001
		Italy				0.0000		0.000
		Netherlands				-0.0006		0.000
		Spain				0.0021*		0.002*
		United Kingdom				0.0001		0.000
RSI strength	Patents (per million inhabitants)		-0.0002*	-0.0002*	-0.0002	-0.0002	-0.0002	-0.0002
	Employment rate		0.010***	0.010***	0.015***	0.013***	0.015***	0.013***
	Human capital (post secondary education)		-0.004	-0.005*	-0.006**	-0.005*	-0.006**	-0.005**
	Constant		0.049	0.027	-0.386	-0.212	-0.376	-0.0229
	Nº observations		114	114	114	114	114	114
	Adjusted R square		0.212	0.209	0.245	0.216	0.240	0.211
	F-statistic		5.350***	5.275***	3.824***	3.388***	3.748***	3.322***
	D-Watson		2.011	2.056	2.171	2.098	2.212	2.149

Table 6. Estimation results (dependent variable: promoter identity index or ‘cultural’ proximity). Note: significant at ***1%; **5%; *10%

Variable description			Model I	Model II	Model III	Model IV	Model V	Model VI
Project characteristics	Technology diversity (ln number of support technologies)		0.330***	0.336**	0.331**	0.314*	0.374**	0.336*
	Industry	Pavitt code (1: supplier dominated … 4: science based industry)	0.015		-0.005	0.005		
		OECD code (1: low …3: high technology industry)		0.049			0.106	0.077
	SMEs average cost (million €)		-1.423***	-1.424***	-1.428***	-0.455***	-1.429***	-1.455***
	RTD average yield (million €)		0.327	0.316	0.428*	0.057*	0.396*	0.488*
	SMEs	France			-0.012***		-0.012***	
		Germany			-0.007*		-0.007**	
		Italy			0.002		0.002	
		Netherlands			-0.021***		-0.022***	
		Spain			-0.002		-0.002	
		United Kingdom			-0.008**		-0.009**	
	RTDs	France				-0.006*		-0.006*
		Germany				-0.001		-0.001
		Italy				0.001		0.001
		Netherlands				-0.009***		-0.009***
		Spain				-0.002		-0.002
		United Kingdom				-0.005*		-0.006*
RSI strength	Patents (per million inhabitants)		0.0005	0.0005	0.001	0.0002	0.001	0.0001
	Employment rate		-0.036***	-0.037***	-0.013	-0.032**	-0.014	-0.033**
	Human capital (post secondary education)		-0.009	-0.009	-0.001	-0.0001	-0.003	-0.001
	Constant		8.725***	8.722***	7.560***	8.586***	7.495***	8.531***
	Nº observations		114	114	114	114	114	114
	Adjusted R square		0.560	0.561	0.681	0.577	0.685	0.580
	F-statistic		21.528***	21.589***	19.542***	12.875***	19.935***	12.992***
	D-Watson		1.873	1.864	1.996	2.058	2.007	2.061

Table 7: Estimation results (dependent variable: average promoter-participant distance or ‘geographical distance’). Note: significant at ***1%; **5%; *10%

Appendix Tables

	Variable description		Model I	Model II	Model III	Model IV	Model V	Model VI
Project characteristics	Geographical distance		-0.085***	-0.084***	-0.125***	-0.101***	-0.121***	-0.099***
	Technology diversity (ln number of support technologies)		-0.084**	-0.080***	-0.070*	-0.081**	-0.063*	-0.076**
	Industry	Pavitt code (1: supplier dominated … 4: science based industry)	-0.024*		-0.027**	-0.023*		
		OECD code (1: low …3: high technology industry)		-0.038*			-0.030	-0.030
	SMEs average cost (million €)		-0.177***	-0.173***	-0.213***	-0.198***	-0.203***	-0.192***
	RTD average yield (million €)		-0.054	-0.052	0.002	-0.001	-0.005	-0.050
	SMEs	France			0.001		0.001	
		Germany			-0.0001		0.0001	
		Italy			0.001		0.0005	
		Netherlands			-0.003***		-0.003***	
		Spain			0.002**		0.002**	
		United Kingdom			-0.0002		0.000	
	RTDs	France				-0.0001		0.000
		Germany				0.0004		0.0005
		Italy				0.0001		0.0002
		Netherlands				-0.002**		-0.0013**
		Spain				0.002*		0.002*
		United Kingdom				-0.0004		-0.0003
RIS strength	Patents (per million inhabitants)		-0.0002*	-0.0002*	-0.0001	-0.0002*	-0.0002*	-0.0002*
	Employment rate		0.007**	0.007***	0.014***	0.010***	0.010***	0.013***
	Human capital (post secondary education)		-0.005**	-0.005**	-0.006**	-0.005*	-0.005**	-0.005**
	Constant		0.773***	0.756***	0.546*	0.637**	0.521*	0.610**
	Nº observations		114	114	114	114	114	114
	Adjusted R square		0.311	0.310	0.407	0.353	0.392	0.346
	F-statistic		7.369***	5.275***	6.534***	5.400***	6.198***	5.279***
	D-Watson		1.708	1.751	1.960	2.017	1.964	2.029

Table A1: Estimation results (dependent variable: promoter identity index or 'cultural' proximity)

ISSN: 0718-2724. (http://www.jotmi.org)

	Variable description		Model I	Model II	Model III	Model IV	Model V	Model VI
Project characteristics	Cultural proximity		-1.620***	-1.608***	-1.809***	-1.809***	-1.720***	-1.806***
	Technology diversity (ln number of support technologies)		0.151	0.162	0.130	0.097	0.189	0.128
	Industry	Pavitt code (1: supplier dominated … 4: science based industry)	-0.027		-0.055	-0.035		
		OECD code (1: low …3: high technology industry)		-0.024			0.029	0.008
	SMEs average cost (million €)		-1.514***	-1.510***	-1.490***	-1.553***	-1.484***	-1.546***
	RTD average yield (million €)		0.199	0.196	0.339*	0.421*	0.309	0.405*
	SMEs	France			-0.008**		-0.009**	
		Germany			-0.006		-0.005	
		Italy			0.003		0.002	
		Netherlands			-0.022***		-0.022***	
		Spain			-0.002		0.002	
		United Kingdom			0.002		-0.007**	
	RTDs	France				-0.005*		-0.005*
		Germany				-0.001		-0.0001
		Italy				0.001		0.001
		Netherlands				-0.010***		-0.010***
		Spain				0.001		0.002
		United Kingdom				-0.005*		-0.005*
RIS strength	Patents (per million inhabitants)		0.0000	0.0000	0.001	-0.0005	0.0001	-0.0005
	Employment rate		-0.019	-0.019	0.016	-0.007	0.014	-0.007
	Human capital (post secondary education)		-0.014	-0.015	-0.010	-0.007	-0.012	-0.008
	Constant		8.675***	8.651***	7.560***	8.068***	6.717***	8.011***
	Nº observations		114	114	114	114	114	114
	Adjusted R square		0.614	0.614	0.749	0.653	0.746	0.651
	F-statistic		23.497***	23.450***	25.045***	16.171***	24.690***	16.084***
	D-Watson		1.703	1.710	1.991	2.076	1.965	2.068

Table A2: Estimation results (dependent variable: geographical distance)

	Variable description		Model I	Model II	Model III	Model IV	Model V	Model VI
Project characteristics	Technology diversity (ln number of support technologies)		-0.090***	-0.089***	-0.099***	-0.089**	-0.101***	-0.088**
	Industry	Pavitt code (1: supplier dominated … 4: science based industry)	-0.021*		-0.021*	0.020		
		OECD code (1: low …3: high technology industry)		-0.038*			-0.044**	-0.039*
	SMEs average cost (million €)		-0.003	-0.052*	0.013	-0.004	0.015	0.006
	RTD average yield (million €)		-0.063	-0.059	-0.048	-0.059	-0.045	-0.058
	SMEs	France			0.003**		0.003**	
		Germany			0.001		0.001	
		Italy			0.0000		0.000	
		Netherlands			0.001*		0.000	
		Spain			0.001*		0.002***	
		United Kingdom			0.001		0.001	
	RTDs	France				0.001		0.001
		Germany				0.0002		0.0002
		Italy				0.0004		0.0002
		Netherlands				0.001		0.001
		Spain				0.001		0.001
		United Kingdom				0.001		0.001
RIS strength	Patents (per million inhabitants)		-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	Employment rate		0.008***	0.009***	0.011***	0.010***	0.011***	0.011***
	Human capital (post secondary education)		-0.0005	-0.001	-0.002	-0.002	-0.002	-0.002
	Constant		1.166	0.159	-0.063	-0.007	-0.042	-0.007
	Nº observations		114	114	114	114	114	114
	Adjusted R square		0.143	0.149	0.206	0.120	0.223	0.131
	F-statistic		3.685***	3.837***	3.256***	2.190***	3.495***	2.310***
	D-Watson		1.738	1.734	1.774	1.780	1.775	1.772

Table A3. Estimation results (dependent variable: global index of cultural and geog proximity)

ISSN: 0718-2724. (http://www.jotmi.org)

References

AGUILÉRA, A., Lethiais, V., and Rallet, A. 2012. Spatial and non-spatial proximities in inter-firm relations: an empirical analysis. Industry and Innovation, 19 (3), 187-202.

ALDRICH, H., and Zimmer, C. 1986. Entrepreneurship through social networks. In: Sexton, D., Smilor, R.W. (eds.), The art and science of entrepreneurship, 3–23. New York: Ballinger.

ANTONELLI, C., and Momigliano, A. 1981. Problems and experiences of regional innovation policy in Italy. Micros, 2, 45-58.

ARORA, A., and Gambardella, A. 1994. Evaluating technological information and utilizing it. Journal of Economic Behaviour and Organization, 24, 91-114.

ASHEIM, B., and Gertler, M. 2004. The geography of innovation, regional innovation systems. In: Fagerberg, J., Nelson, R., Mowery, D. (eds.). The Oxford Handbook of Innovation, pp. 291-317. Oxford: Oxford University Press.

BECKER, W., and Dietz, J. 2004. R&D cooperation and innovation activities of firms - evidence for the German manufacturing industry. Research Policy, 33 (2), 209-223.

BELL, G.G. 2005. Clusters, networks, and firm innovativeness. Strategic Management Journal, 26, 287–295.

BELL, M., and Albu, M. 1999. Knowledge systems and technological dynamism in industrial clusters in developing countries. World Development, 27 (9): 1715-1734.

BRACZYK, H.J., Cooke, P., and Heidenreich, M. 1998. Regional innovation systems. London: UCL Press Ltd.

BROEKEL, T., and Boschma, R. 2012. Knowledge networks in the Dutch aviation industry: The proximity paradox. Journal of Economic Geography, 12 (2), 409-433.

BUNNELL, T.G., and Coe, N.M. 2001. Spaces and scales of innovation. Progress in Human Geography, 25(4), 569-589.

BUSOM, I., and Fernández-Ribas, A. 2008. The impact of firm participation in R&D programmes on R&D partnerships. Research Policy 37 (2), 240-257.

CALOGHIROU, Y., Ioannides, S., and Vonortas, N.S. 2003. Research joint ventures. Journal of Economic Surveys, 17 (4), 541-570.

COLOMBO, M. 1995. Firm size and cooperation: The determinants of cooperative agreements in information technology industries. International Journal of the Economics of Business, 2, 3-29.

COOKE, P. 1992. Regional innovation systems, competitive regulation in the new Europe. Geoforum, 23, 365-382.

COOKE, P. 1998. Introduction, Origins of the concept. In: Braczyk H.J., Cooke, P., and Heidenreich, M. (eds.). Regional innovation systems, pp. 2-25. London: UCL Press.

COOKE, P., and Wills, D. 1999. Small firms, social capital and the enhancement of business performance through innovation programmes. Small Business Economics, 13, 219–234.

COOMBS, R., Richards, A., Saviotti, P.P., and Walsh. V. 1996. Technological collaboration. The dynamics of cooperation in industrial innovation. Cheltenham: Edward Elgar.

CRESPO, N., Isabel Proença, I.I., Fontoura, M.P. 2012. The spatial dimension in FDI spillovers: Evidence at the regional level from Portugal. Regional and Sectoral Economic Studies, 12 (1), 111-126.

DOLOREUX, D. 2004. Regional networks of small and medium sized enterprises: evidence from the metropolitan area of Ottawa in Canada. European Planning Studies, 12 (2), 173-189.

DORAN, J., Jordan, D., and O'Leary, E. 2012. The effects of the frequency of spatially proximate and distant interaction on innovation by Irish SMEs. Entrepreneurship and Regional Development, 24 (7-8), 705-727.

EBERSBERGER, B., and Herstad, S.J. 2013. The relationship between international innovation collaboration, intramural R&D and SMEs' innovation performance: A quantile regression approach . Applied Economics Letters 20 (7), 626-663.

EDQUIST, C., and Hommen, L. 1999. Systems of innovation: theory and policy for the demand side. Technology in Society, 21(1), 63–79.

EDWARDS-SCHACHTEr, M., Castro-Martínez, E., and Fernández-de-Lucio, I. 2011. International co-operation between firms on innovation and R&D: Empirical evidence from Argentina and Spain. Journal of Technology Management and Innovation 6 (3), 126-147.

ERIKSSON, R.H. 2011. Localized spillovers and knowledge flows: how does proximity influence the performance of plants? Economic Geography, 87 (2), 127-152.

ISSN: 0718-2724. (http://www.jotmi.org)

FISCHER, B.B., and Zayas, J.M. 2012. Towards a taxonomy of firms engaged in international R&D networks: An evaluation of the Spanish participation in eureka. Journal of Technology Management and Innovation 7 (3), 121-134.

FLORIDA, R. 2004. Cities and the creative class, New York: Routledge.

FRITSCH, M. 2003. Does R&D-cooperation behavior differ between regions?. Industry and Innovation, 10 (1), 25–39.

GREGERSEN, B., and Johnson, B. 1997. Learning economies, innovation systems and European integration. Regional Studies, 31(5), 479–490.

HOWELLS, J. 2012. The geography of knowledge: Never so close but never so far apart. Journal of Economic Geography, 12(5): 1003-1020.

HUGGINS, R., and Johnston, A. 2012. Knowledge alliances and innovation performance: An empirical perspective on the role of network resources. International Journal of Technology Management, 57(4), 245-265

IDRISSIA, M.O., Amaraa, N., Landrya, R. 2012. SMEs' degree of openness: The case of manufacturing industries. Journal of Technology Management and Innovation 7 (1), 186-210.

KINGSLEY, G., and Malecki, E. 2004. Networking for competitiveness. Small Business Economics, 23, 71-84.

KLINE, L., and Rosenberg, N. 1986. An overview of innovation. In: Landau, R., and Rosenberg, N. (eds.). The positive sum strategy. Washington: National Academy Press.

KRUGMAN, P. 1994. Complex landscapes in economic geography. American Economic Review, 84(2), 412-16.

LEITE, R., and Teixeira, A.A.C. (2012), Innovation diffusion with heterogeneous networked agents: a computational model, Journal of Economic Interaction and Coordination, 7 (2), 125-144.

LIN, C., Wu, Y.-J., Chang, C., Wang, W., and Lee, C.-Y. 2012. The alliance innovation performance of R&D alliances - The absorptive capacity perspective. Technovation 32 (5), 282-292.

LORENZEN, M. 1998. Specialization and localized learning. Copenhagen: Copenhagen Business School.

LUNDVALL, B.-A. 1992. National systems of innovation, towards a theory of innovation and interactive learning. London: Pinter.

MAGRINI, M.-B., Galliano, D. 2012. Agglomeration economies, firms' spatial organization and innovation performance: some evidence from the French industry. Industry and Innovation, 19 (7), 607-630.

MAILLAT, D., and Vasserot, P. 1986. Les milieux innovateurs. In: Aydalot, P. (ed.). Millieux innovateurs en Europe, pp. 67-7, Paris : GREMI.

NELSON, R. 1993. National innovation systems, a comparative analysis. Oxford: Oxford University Press.

OECD. 1992. Annual review of industrial policy. Paris: OECD.

OHMAE, K. 1995. The end of the nation state, the rise of regional economies. New York: Free Press.

PAVITT, K. 1984. Sectoral patterns of technical change: towards a taxonomy and a theory. Research Policy, 13, 343-373.

PORTER, M.E. 1990. The competitive advantage of nations. London: Macmillan.

SAXENIAN, A. 2005. From brain drain to brain circulation, transnational communities and regional upgrading in India and China. Studies in Comparative International Development, 40 (2), 95-110.

SCOTT, A.J. 1992. The role of large producers in industrial districts, a case study of high technology systems houses. Southern California. Regional Studies, 26 (3), 265-275.

SCOTT, A.J. 1995. The geographic foundations of industrial performance. Competition and Change, 1, 32-45.

SONN, J.W., and Storper, M. 2008. The increasing importance of geographical proximity in technological innovation, An analysis of U.S. patent citations, 1975-1997. Environment and Planning A, 40(5), 1020 – 1039.

STORPER, M. 1995. The resurgence of regional economies, ten years later, the region as a nexus of untraded interdependencies. European Urban and Regional Studies, 2, 191-221.

TEIRLINCK, P., and Spithoven, A. 2013. Formal R&D management and strategic decision making in small firms in knowledge-intensive business services. R and D Management 43 (1), 37-51.

TOMLINSON, P.R., and Fai, F.M. 2013. The nature of SME cooperation and innovation: A multi-scalar and multi-dimensional analysis . International Journal of Production Economics 141 (1), 316-326.

TORRES, T.Z., Pierozzi Jr., I., Bernardes, R.M., and Vacari, I. 2010. Collaborative environments in RD&I institutions of the Brazilian agricultural sector. Journal of Technology Management and Innovation 5 (3), 69-80.

UZUNCA, B. 2011. Comparative advantages of spinoff firms: An evolutionary perspective. Journal of Technology Management and Innovation, 6 (4), 80-92.

VEUGELERS, R. 1997. Internal R&D expenditures and external technology sourcing. Research Policy, 26, 303-315.

ISSN: 0718-2724. (http://www.jotmi.org)