Frontiers of Entrepreneurship Research

Volume 31 | Issue 16
CHAPTER XVI. INTERNATIONAL

Article 1

6-11-2011

DOES REGIONAL PROXIMITY STILL MATTER IN A GLOBAL ECONOMY? THE CASE OF FLEMISH BIOTECH VENTURES

Janne-Louise L. Taks
Dutch Ministry of Economic Affairs

Andrea M. Herrmann
Columbia University, ah2904@columbia.edu

Ellen H. M. Moors
Utrecht University

DOES REGIONAL PROXIMITY STILL MATTER IN A GLOBAL ECONOMY? THE CASE OF FLEMISH BIOTECH VENTURES

Janne-Louise L. Taks, Dutch Ministry of Economic Affairs, the Netherlands
Andrea M. Herrmann, Columbia University, USA; Utrecht University, the Netherlands
Ellen H. M. Moors, Utrecht University, the Netherlands

Abstract

When internal knowledge bases are insufficient for developing innovations, companies tend to collaborate with external R&D partners. According to a long-standing literature on 'clusters', 'industrial districts', 'local production systems' and 'regional innovation systems', geographical proximity between innovation partners is considered a precondition for inter-organizational collaborations: Proximity is said to facilitate trust, the transfer of tacit knowledge, and the intensity of interactions. This article investigates the importance of geographical proximity for R&D collaborations between biotech firms and their innovation partners. Are geographically close innovation partners more likely to collaborate? Studies of the Flemish biotech industry shed light on this question. Regression analyses combined with qualitative interview data reveal that geographical proximity has become less important for inter-organizational collaborations. Due to lower communication and transportation costs, innovation partners can easily collaborate even when they are not situated close to each other. This leads us to conclude that globalization transforms inter-organizational collaborations.

Introduction

How Geographical Proximity Matters for R&D Collaborations

Amongst contributors to the competitiveness literature, agreement is broad that innovations constitute a key factor of corporate competitiveness in a globalizing economy. This seems particularly true for developed economies, where high wages and ancillary wage costs can only be balanced by a steady increase in labour productivity resulting from process innovations, or by product innovations that offer superior value added to customers (see inter alia Porter 1990; Lundvall 1992; Nelson 1993; Hall and Soskice 2001). To remain competitive in today`s global economy, firms in developed capitalist countries therefore often compete in innovation-intensive, so-called ´high-tech` industries. This insight has led politicians across the Western world to acknowledge the development of high-tech industries as one of the key drivers of national competitiveness (European Commission 2003; Dutch Government 2008).

While innovation scholars tend to agree that there is no linear relation between the amounts invested in research & development (R&D) and the innovation output, as numerous functions play together for innovations to materialize (Hekkert et al. 2007), agreement is equally broad that innovations do not occur without R&D activities. Only when public and private organizations actively engage in R&D can innovations materialize on a broader scale. Importantly, though, innovations in high-tech industries do often not result from the R&D activities of a single actor. The complexity of sophisticated technologies typically requires the collaboration of several innovators, including public bodies, firms, and academic institutes. High-tech innovations tend to prosper

whenever basic scientific knowledge, often discovered by public and academic organizations, is fruitfully merged with applied knowledge, typically developed by private firms.

In order to foster competitiveness in high-tech industries, one fundamental question therefore is how to foster R&D collaborations. It is interesting to note how scholars of inter-organizational collaborations increasingly diverge in their answers to this question. In the early days, dating back to the late 1970s, agreement was broad that geographical proximity between collaboration partners, i.e. their embeddedness within the same locally limited production network, is a key driver of R&D collaborations. More precisely, this literature on local networks[1] highlights that actors in the same region can meet easily and, hence, more frequently due to reduced geographical distance. Regular meetings facilitate the development of trust and the transfer of complex tacit knowledge which, in turn, is both: crucial for the development of sophisticated technologies and transferrable most easily through face-to-face contact. Therefore, the embeddedness within the same regional cluster increases the intensity of interaction between collaboration partners and, ultimately, the rate of high-tech innovations (Zucker and Darby 1996; Nooteboom 1999; Cooke 2002).

More recently, however, several scholars have found geographical proximity to be (ever) less important for R&D collaborations. In a globalizing economy, innovation partners increasingly seem to collaborate across regional and, even, national boundaries (McKelvey et al. 2003; Berger 2005; Saxenian 2006; van Geenhuizen and Reyes-Gonzalez 2007; Phlippen 2008). For example, Berger (2005) traces how – in industries as diverse as textiles and computers – a single product is invented, designed, and assembled in numerous countries around the globe. Similarly, Saxenian (2006) argues that the ICT sector in the US co-develops with that of Israel, Taiwan, China, and India because scientists, business associations, lawyers, suppliers, and producers collaborate closely across national borders.

Consequently, the question arises whether geographical proximity still matters for R&D collaborations in today`s global economy. *Does the embeddedness within the same local network increase the intensity of R&D collaborations between the involved parties*?

To shed light on this question, this article analyses quantitative and qualitative data on R&D collaborations in the Flemish biotech sector. For two reasons, biotech companies provide particularly insightful cases to study. First, due to their innovation intensity and the massive amounts of investment required for bringing new drugs to the market, biotech firms are particularly susceptible to cooperate with providers of basic and applied knowledge. Second, and as a corollary of the first, local networks are frequently observed phenomena in the biotech sector. Biotech firms typically cluster within one region, close to universities, hospitals, and other public research organizations (PROs) with which they cooperate to develop new drugs. If geographical proximity matters for the intensity of R&D collaborations, then it matters in the biotech sector. In other words, should local proximity turn out *not* to facilitate intense R&D cooperation in the biotech sector, chances are high that it is even less important for firms in other high-tech industries.

A particularly comprehensive dataset to study the importance of geographical proximity for R&D collaborations in the biotech sector is a database provided by the IWT (the *Agentschap voor Innovatie door Wetenschap en Technologie*), which is the Flemish government agency for Innovation through Science and Technology. This database includes information on all R&D collaborations between public and private organizations in Flanders that were sponsored by the government between 2003 and 2007. Quantitative regression analyses of this dataset combined with evalu-

ations of qualitative interview data deliver striking results. Contrary to the long-standing bulk of the local networks literature, geographical proximity turns out not to influence the intensity of R&D collaborations. These findings lead us to conclude that globalization – understood here as increasing flows of goods, capital, and people across national borders due to decreasing transportation and communication costs as well as decreasing barriers to trade – transforms R&D collaborations in that cooperation across, rather than within, local networks gain momentum.

To illustrate this argument, the remainder of this article is structured as follows. Based on a review of the literatures on inter-organizational collaborations in general and local networks in particular, the analytical framework of this paper is developed in section 2. The data and methods used to shed light on the importance of local networks for the intensity of R&D collaborations are discussed in section 3. Section 4 presents the results, which are critically reviewed in the conclusions, section 5.

Literature and Analytical Framework

New Answers to a Long-Standing Research Question

The origins of the literature on local networks are typically ascribed to Alfred Marshall. He was the first to observe that economies of scale are obtained from a division of labour between firms, 'which can often be secured by the concentration of many small businesses of a similar character in particular localities' (Marshall 1920: 266).

Until the recession caused by the oil shocks of the 1970s, organization researchers generally considered Fordist companies as most profit-yielding: Their all-inclusive in-house manufacturing was said to minimize production costs due to the optimization of individual production steps. Interestingly, though, the Fordist production giants turned out to be more prone to failure during the oil-shock recessions than the small-scale producers embedded in local networks: It was enough for one department of a Fordist company to experience a bottleneck in order to endanger the production process of the entire company.

Contrary to large Fordist companies, small firms continued to prosper during the economic crises of the 1970s. Seeking to explain this puzzle, studies of local networks gained momentum. Contributors to the literature on *industrial districts* revealed how close collaboration makes it possible to divide the production process of one good between small firms located in the same region. Geographical proximity facilitates frequent meetings, the development of trust, and the transfer of tacit knowledge between these small-scale manufacturers. The specialization in individual production steps leads to increased flexibility. If one of the firms faces economic difficulties, the production process can rapidly be redesigned. And even if small-scale producers go bankrupt, they can be replaced comparatively easily (Piore and Sabel 1984; Pyke et al. 1990; Pyke and Sengenberger 1992; Cossentino et al. 1996).

Later strands of the literature on local networks, including Porter`s *cluster studies* (Porter 1998, 2000) as well as the work on *regional innovation systems* (Saxenian 1994; Cooke et al. 1997, 1998), shift focus. They no longer study the importance of local cooperation for entire production processes, but rather focus on R&D activities. Consequently, these literatures explain how the frequency and types of innovations can differ between local networks, depending on the ability of the embedded actors to collaborate with each other.

At the beginning of this millennium, studies on 'local production systems' (Crouch et al. 2001, 2004) reassess the arguments proposed in previous strands of the local network literature. Does globalization alter local production processes? Does it affect the importance of geographical proximity for inter-organizational cooperation in general and for joint R&D activities in particular? Interestingly, the contributors to this literature do not find evidence that would answer these questions in the affirmative: Geographical proximity remains important for the development of trust, the transfer of tacit knowledge, the exchange of ideas, the division of production steps between several small firms and, ultimately, for the rate and type of innovations made. In short, local networks are found to resist pressures for change resulting from increasing international competition.

Most recently, however, analysts of inter-organizational cooperation increasingly provide different results which illustrate how globalization transforms inter-organizational cooperation boundaries (McKelvey et al. 2003; Berger 2005; Saxenian 2006; van Geenhuizen and Reyes-Gonzalez 2007; Phlippen 2008). In her most recent book, for example, Saxenian (2006) provides insightful evidence on how ICT entrepreneurs in the US cooperate intensely with small firms in Israel, Taiwan, India, and China. According to Saxenian, these firms succeed only due to their close collaboration across national boundaries, which enables US companies to gain complementary knowledge from specialized niche producers abroad, whereas the non-US firms benefit from 'transferring (…) the institutions of entrepreneurship from American technology regions like Silicon Valley to their home countries' (p. 6). In short, various authors describe that close R&D collaborations take place between organizations that are geographically distant.

To assess the importance of local proximity for R&D collaborations, the first – and the key – hypothesis to be tested in this paper is:

H1: Firms that are geographically close to potential innovation partners collaborate more intensely on joint R&D projects than firms that are geographically distant from potential innovation partners.

Several other factors can be hypothesized to influence the intensity with which firms engage in R&D collaborations. The size of firms seems particularly important in this respect. Small firms are typically more dependent on externally generated knowledge than large companies as the former have more limited internal knowledge bases and R&D resources (Nooteboom 1999; Das and Teng 2000). Small firms may therefore be more likely to engage in R&D collaborations than large firms. Consequently, the second hypothesis to be tested in this paper is:

H2: Small firms collaborate more intensely on joint R&D projects with external partners than large firms.

According to Saxenian (1991), most small firms in high-tech industries are spin-offs that are located close to the organization (university or company) from which they originated. Typically, spin-offs continue to entertain intense relationships with their parent organization. Consequently, small firms can be expected to have more intense R&D collaborations with local cooperation partners than large firms (Sonn and Storper 2003; Phlippen 2008). These insights suggest that the following interaction effect between corporate size and regional proximity should be tested as a third hypothesis:

H3: Small firms that are geographically close to potential innovation partners collaborate more intensely on joint R&D projects than large firms that are geographically distant.

Industries differ in their innovation processes as well as their use of internal and external knowledge respectively (Pavitt 1984). High-tech industries are knowledge-intensive, which implies that firms in these industries spend a higher share of their funds on R&D than firms in low- or medium-tech industries. To access the necessary knowledge resources, firms in high-tech industries are likely to entertain more intense R&D collaborations with innovation partners than firms in low- and medium-tech industries. In line with Freeman (1991) and Powell et al. (1996), a fourth hypothesis should thus be tested on how the technological sophistication of industries influences the intensity of R&D interactions between innovation partners:

H4: Firms in high-tech industries collaborate more intensely on joint R&D projects with external partners than firms in medium- and low-tech industries.

An important advantage of regional proximity is its capacity to enable the transfer of complex tacit knowledge which, in turn, is both vital for high-tech industries and typically only transferable face-to-face. Organizations that are geographically close usually find it easier to exchange information face-to-face (Zucker and Darby 1996; Nooteboom 1999). Due to the high degree of complex tacit knowledge needed in high-tech industries, it is likely that high-tech firms cooperate particularly intensely with other actors of the same regional network. Consequently, a fifth hypothesis to be tested studies the interaction effect between the technological intensity of a firm and the regional proximity to its collaboration partners:

H5: High-tech firms that are geographically close to potential innovation partners collaborate more intensely on joint R&D projects than low-tech firms that are geographically distant.

The various hypotheses tested in the reminder of this paper are graphically presented in figure 1.

Data and Operationalizations

Measuring the Key Concepts

The biotech industry provides a particularly fruitful case to gain insights into the importance of regional proximity for the intensity of R&D collaborations: Biotech firms are knowledge intensive, yet active in various segments of different technological intensity, and they have a strong tendency to cluster within regions.

Consequently, and in line with the above conceptualizations, our units of analysis are R&D collaborations that biotech firms entertain with external innovation partners. A company is classified as a biotech firm whenever it is involved in 'the application of science and technology to living organisms as well as parts, products and models thereof, to alter living or nonliving materials for the production of knowledge, goods and services' (OECD 2006).

To gain insights into the intensity of R&D collaborations of biotech firms, the IWT – the Flemish Agency for Innovation through Science and Technology[2] – offers the most comprehensive database. More precisely, the IWT database includes information on all Flemish biotech firms that have received subsidies for R&D collaborations with PROs in the period between 2003 and 2007. Overall, data is available for 154 R&D collaborations.

The data makes it possible to operationalize the dependent variable – *intensity of R&D collaborations* – as the total time of R&D activities performed by a biotech firm and an external

innovation partner. For each subsidized R&D collaboration between a biotech firm and a PRO, the total number of months of human work (measured in full-time equivalents) was calculated between 2003 and 2007. Multiple collaborations between a biotech firm and a PRO during this time period were added up.

Furthermore, the independent variables were measured as follows: *Regional proximity* is operationalized as the co-location of R&D collaborators within the same regional cluster. More precisely, we follow the approach of van Geenhuizen and Reyes-Gonzales (2007: 1686) and require `a cluster to contain at least one knowledge institute and 10 young entrepreneurial companies.` We also follow Geenhuizen et al. in that we consider a biotech firm to be close to a PRO within the cluster whenever the geographical distance between the two innovation partners can be bridged by car in less than 15 minute. `The underlying idea is that within this time–distance range several unplanned personal contacts per day can be made, allowing for a smooth transfer of tacit knowledge.` (van Geenhuizen and Reyes-Gonzalez 2007: 1686-1687).

In line with the OECD (2005: 46) standard definition, *a firm's size* is measured as the average number of employees per year (in full-time equivalents) over the period 2003-2007.

Within the biotech *industry*, several segments can be identified that vary in their technological and, hence, their R&D intensity, namely the sub-industries of red, green, and white biotechnology (OECD 2006). While red biotech firms focus on activities that seek to improve human and animal health, green biotech firms develop applications for agricultural products, whereas white biotech firms focus on environment-related devices such as industrial processing or natural resource extraction. Unlike red biotech products, green and white biotech products do not need to go through the process of lengthy clinical trials. Given that clinical trials are highly technology-intensive and require the exchange of tacit knowledge, firms active in red biotech segments are typically more R&D intensive than firms in green and white biotech segments. Whether, or not, a firm is active in the red biotech segments is therefore taken as an indicator of the R&D intensity of its industry.

It should finally be noted that we base our analyses not only on quantitative analyses of the IWT dataset, but also have collected qualitative data to assess the importance of regional proximity for knowledge diffusion. More precisely, we conducted interviews with two university researchers and five research officers of Flemish biotech firms in order to gain more in-depth insights into the causalities underlying the regression results.

Results

Quantitative Analyses and Qualitative Explanations

We began our studies with OLS regression analyses of the IWT data. To understand whether the dataset conforms to the statistical standard assumptions underlying OLS regressions, both the dependent as well as all independent variables were checked for normal distribution of scores. Given that the distribution of scores turned out to be skewed for the dependent variable (*intensity of R&D collaborations*) and the independent variable *corporate size*, the scores of both variables were transformed into logistic numbers.

To test hypotheses H1 to H5, we conducted five sets of OLS regression analyses. While the first set (models 1a-c) tests the individual impact of all main effects – *geographical proximity*, *corporate size*, and

industry (independent variables) – on the *intensity of R&D collaborations* (dependent variable), models 2a-c assess the joint impact of any combination of two main effects. The joint importance of the three main effects (model 3a), as well as the impact of *geographical proximity* and *corporate size* together with their *interaction effect* (model 3b), and also the influence of *geographical proximity*, *industry* together with their *interaction effect* (model 3c), are respectively tested in the third set of models. Models 4a and 4b assess how the three main effects together with one of the two interaction effects influence the *intensity of R&D collaborations* respectively. Model 5, the most complete model, finally assesses the relative influence of all five predictors on the dependent variable. Consequently, the OLS regression equation for model 5 can be written as follows:

$$\ln Y_i = \beta_0 + \beta_1 * x_1 + \beta_2 * \ln x_2 + \beta_3 * x_3 + \beta_4 * x_4 + \beta_5 * x_5 + \varepsilon$$

where:

Y_i = intensity of R&D collaborations
β_0 = constant
x_1 = geographical proximity
x_2 = corporate size
x_3 = $x_1 * \ln x_2$
x_4 = industry
x_5 = $x_1 * x_4$
ε = residual

The results of these analyses are presented in table 1.

The results of the OLS regressions show that the three main effects – geographical proximity, corporate size, and industry – have a significant and additive impact on the intensity of R&D collaborations. When controlled for each other in model 3a, the explanatory power of the model is notably higher ($R^2_{\text{Model 3a}} = .214$) than when each main effect is regressed individually (see R^2 of models 1a-c), or together with another main effect (see R^2 of models 2a-c), on the intensity of R&D collaborations. It is furthermore noteworthy, that the inclusion of the interaction effect testing hypothesis H3 (*geographical proximity * corporate size*) leads to multicollinearity problems in model 3b, (average $VIF_{\text{Model 3b}} = 5.061$), model 4a (average $VIF_{\text{Model 4a}} = 4.052$), and model 5 (average $VIF_{\text{Model 5}} = 3.875$). Consequently, we retain model 4b as the most parsimonious model and reject hypothesis H3.

At first sight, model 4b seems to confirm hypotheses H1, H2, H4, and H5 because all main effects, as well as the interaction between geographical proximity and an industry`s technological intensity, come out as significant predictors of the R&D collaborations` intensity. Interestingly, though, the relationship between *geographical proximity* and R&D intensity (*H1*) is not only strong and statistically significant but negative. In other words, innovation partners that are close to each other collaborate less intensely in joint R&D activities than innovation partners which are more distant. Whenever a biotech firm is as close as a 15-minutes drive to its innovation partner, the log likelihood of an intense R&D collaboration decreases by 0.297 points. Intense R&D collaborations seem more likely between innovation partners that are geographically distant rather than close. This finding falsifies hypothesis H1.

The falsification of hypothesis H1 is corroborated by qualitative interviews with two university researchers and five research officers working for five Flemish biotech firms. These interviewees explained that their search for R&D partners is mostly driven by the intention to gain access to complementary, high-quality knowledge resources. Biotech firms search for `key scientists` in

the field who have the required expertise. Whether, or not, these scientists are geographically close to the own firm is of little importance. The research officers furthermore explained that their firms were university spin-offs which conduct more technologically advanced research than the parent universities from which companies had spun off. The chances of finding complementary knowledge are better at PROs which are not located in the same cluster. While the interviewees indicated that face-to-face interactions and trust are important in order to identify partners for joint R&D collaborations, they also highlighted that meetings at conferences and workshops are sufficient for the development of trust-based relations. In sum, due to ever better and cheaper opportunities to communicate and travel to distant locations, geographical proximity seems ever less important for the development of trust and, consequently, for the intensity of collaborations between innovation partners.

Model 4b furthermore reveals that the influence of a *firm`s size* is statistically significant, yet positive. An increase in firm size by one log unit of employees increases the log likelihood of a more intense R&D collaboration by .257 points. Interestingly, this finding disconfirms hypothesis *H2* which suggested the opposite relationship. This result was both confirmed and explained by the university researchers interviewed. According to these experts, small firms are perceived as less reliable and attractive collaboration partners because small companies have less financial and knowledge resources to offer. These more limited knowledge bases can imply that potential collaboration partners encounter difficulties when trying to understand each other, which, in turn, hinders an efficient knowledge transfer. The interviewed researchers furthermore mentioned that large firms tend to `know their way` to the PROs, whereas small firms often have difficulties in recognizing new knowledge opportunities and adequate collaboration partners.

With regard to the *knowledge intensity of an industry*, the OLS results of model 4b show support for hypothesis H4. Firms active in the red biotech industry are more likely to contribute to knowledge diffusion than firms that are active in green or white biotech industries (standardized B = .217). According to the research officers interviewed at red biotech firms, this result is explained, precisely, by the reasoning that led us to formulate hypothesis H4. The technological intensity of new drugs implies that firms cannot deliver the necessary expertise on their own. They need to complement their internal knowledge base with adequate external know-how. To conduct clinical trials, red biotech firms are, for example, highly dependent on the expertise of hospitals. In a similar vein, the interviewed university researchers described how their PROs were dependent upon both the expertise of small red biotech firms as well as the up-scaling technologies of large red biotech firms. The research officers interviewed at green and white biotech firms, in turn, confirmed that their firms do not necessarily need to access complementary knowledge resources and are therefore less dependent on R&D collaborations with external knowledge providers.

We furthermore learn from models 3c and 4b that the interaction effect hypothesized by H5 indeed has a positive and statistically significant impact on the outcome: Red biotech firms that are located close to their cooperation partners are likely to collaborate more intensely (standardized B = .198). At first sight, this finding may seem at odds with our previous result on hypothesis H1, where we found that innovation partners are more likely to collaborate if they are geographically distant. Note however that the interaction effect hypothesized by H5 describes the effect of proximity and industry once *controlled for* geographical proximity. In other word, across all firms, those are most likely to engage in intense R&D collaborations that are *not* located close to their innovation partners. However, amongst those that *are* located close to their innovation partners,

those firms active in high-tech industries are likely to collaborate with external R&D partners more intensely than those firms that are active in low-tech industries.

Discussion and Conclusions

Why Geographical Proximity Matters Less for R&D Collaborations in a Globalizing Economy

This paper has endeavoured to shed new light on a long-standing research question: How does geographical proximity influence the intensity of inter-organizational R&D collaborations? Until the beginning of this millennium, the literature on inter-organizational collaborations provided a strikingly unanimous answer: Proximity matters! It matters because it enables frequent meetings between innovation partners, the development of trust, the transfer of tacit knowledge and, thus, intense R&D collaborations (Pyke et al. 1990; Pyke and Sengenberger 1992; Saxenian 1994; Zucker and Darby 1996; Porter 1998; Nooteboom 1999; Crouch et al. 2001; Cooke 2002). Over the past few years, however, researchers have started to provide new answers: Geographical proximity seems to become less important for intense R&D collaborations. With decreasing transportation and communication costs – that is, with increasing globalization – meetings between innovation partners become less expensive and, hence, more frequent. Whether, or not, the innovation partners of a company are located close to its own premises seem to become ever less important for entertaining intense R&D collaborations – even across national boundaries (see Berger 2005; Saxenian 2006 in general; see McKelvey et al. 2003; van Geenhuizen and Reyes-Gonzalez 2007; Phlippen 2008 in particular).

Our studies of R&D collaborations between Flemish biotech firms and PROs support the latter view. While our quantitative analyses of 154 R&D collaborations highlighted that Flemish biotech firms cooperate more closely with PROs that are not embedded within the same cluster, qualitative interviews with university and corporate researchers shed light on the causal mechanisms: To be innovative, firms require expert knowledge that often exceeds their own, internal knowledge resources. Consequently, firms look for external innovation partners, whereby trust is an important precondition for successful R&D collaborations. Yet, geographical proximity does no longer seem to be vital for enabling the development of trust-based relations. Meetings at conferences and workshops seem sufficient for researchers to get to know each other and decide whether, or not, they want to engage in joint innovation projects. Low transportation and communication costs facilitate intense interactions irrespective of whether the company and its innovation partners are located close to each other. These insights lead us to conclude that globalization transforms the nature of inter-organizational R&D collaborations: Geographical proximity no longer matters.

This finding has several implications. The first one concerns the question of how fruitful innovation policies could look like. The decreasing importance of geographical proximity for inter-organizational R&D collaborations raises doubts about generic policies that seek to foster innovation through the development of local clusters. Such measures only seem adequate for red biotech firms that strongly rely on the collaboration of local hospitals in order to conduct clinical trials. Less technology-intensive companies do not seem to benefit from being embedded within the same cluster as their innovation partners. Rather than aiming at generic cluster developments, innovation policies would seem more successful if they were targeted at helping firms to identify the most suitable collaboration partners – irrespective of whether the latter are located inside or outside the same cluster. Given that large firms seem better able to identify suitable collabora-

tion partners than small firms, specific policy programs for SMEs might be more successful than generic programs that are not tailored to the lower cooperation capacities of small companies.

A further, and particularly noteworthy, implication of the decreasing importance of proximity for inter-organizational R&D collaborations is that globalization offers more opportunities than commonly assumed. In the media, globalization is often perceived as a threat to corporate competitiveness. Decreasing communication and transportation costs provide consumers with more and better information and access to products around the globe. This increasing transparency implies that firms producing exportable goods need to compete globally. Globalization puts firms under increasing competitive pressure. At the same time, though, globalization also opens up new opportunities for inter-organizational collaborations. Innovation partners no longer need to be geographically close. As demonstrated so impressively by the contributions of Berger (2005) and Saxenian (2006), even international collaborations between extremely diverse innovation partners are not only feasible but highly beneficial for both sides. `Globalization (…) thus seems to be at least as much an opportunity as a threat.` (Herrmann 2008: 170).

CONTACT: Andrea M. Herrmann; ah2904@columbia.edu; (T): +1 646 546 3588; (F): +1 212 854 9890; Marie Curie Research Fellow; Center on Organizational Innovation, Knox Hall, Columbia University, 606 West 122nd Street, New York, NY 10027.

Acknowledgements

We wish to thank our interview partners for their patience in providing insights into the importance of geographical proximity for their businesses. We also gratefully acknowledge the support of the Flemish Institute for Innovation through Science and Technology, which kindly granted us access to the statistical data used. Finally we want to thank Technopolis Group B.V. Amsterdam, where this study has chiefly been carried out, and Jan-Frens van Giessel who so patiently accompanied this project within Technopolis.

Notes

1. As section 2 illustrates in more detail, this literature includes the writings on 'industrial districts' (Piore and Sabel 1984; Pyke et al. 1990; Pyke and Sengenberger 1992; Cossentino et al. 1996), the 'cluster' literature of Porter (1998, 2000), the studies of `regional innovation systems` (Saxenian 1994; Cooke et al. 1997, 1998), as well as the work on 'local production systems' (Crouch et al. 2001, 2004).
2. As suggested by its name, the IWT is a governmental agency which aims at fostering the development of technology-intensive firms.

References

Berger, Suzanne (2005), *How We Compete: What companies around the world are doing to make it in today's global economy* (New York: Doubleday) 334 pages.

Cooke, Philip (2002), 'Regional Innovation Systems: General Findings and Some New Evidence from Biotechnology Clusters', *Journal of Technology Transfer,* 27, 133-45.

Cooke, Philip, Uranga, Mikel G., and Etxebarria, Goio (1997), 'Regional innovation systems: Institutional and organisational dimensions', *Research Policy,* 26, 475-91.

--- (1998), 'Regional Systems of Innovation: an Evolutionary Perspective', *Environment and Planning,* 30, 1563-84.

Cossentino, F., Pyke, Frank, and Sengenberger, Werner (eds.) (1996), *Local and Regional Response to Global Pressure* (Geneva: International Institute for Labour Studies) 206.

Crouch, Colin, et al. (eds.) (2001), *Local Production Systems in Europe: Rise or Demise?* (Oxford University Press: Oxford) 272.

--- (eds.) (2004), *Changing Governance of Local Economies: Responses of European Local Production Systems* (Oxford: Oxford University Press) 376.

Das, T. K. and Teng, Bing-Sheng (2000), 'A resource-based theory of strategic alliances', *Journal of Management,* 26 (1), 31-61.

Dutch Government (2008), *Nederland Ondernemend Innovatieland* (Den Haag: While Paper available online).

European Commission (2003), *Green Paper: Entrepreneurship in Europe* (Brussels: Commission of the European Communities, available at http://europa.eu.int/comm/enterprise/entrepreneurship/green_paper/green_paper_final_en.pdf).

Freeman, Christopher (1991), 'Networks of innovators: A synthesis of research issues', *Research Policy,* 20 (5), 499-514.

Hall, Peter A. and Soskice, David W. (eds.) (2001), *Varieties of capitalism - The institutional foundations of comparative advantage* (Oxford: Oxford University Press).

Hekkert, M. P., et al. (2007), 'Functions of innovation systems: A new approach for analysing technological change', *Technological Forecasting and Social Change,* 74 (4), 413-32.

Herrmann, Andrea M. (2008), *One Political Economy, One Competitive Strategy? Comparing Pharmaceutical Firms in Germany, Italy, and the UK* (Oxford: Oxford University Press) 224 pages.

Lundvall, Bengt-Ake (1992), *National systems of innovation - Towards a theory of innovation and interactive learning* (London: Pinter Publishers) 342 pages.

McKelvey, Maureen, Alm, Håkan, and Riccaboni, Massimo (2003), 'Does co-location matter for formal knowledge collaboration in the Swedish biotechnology-pharmaceutical sector?', *Research Policy,* 32 (3), 483-501.

Nelson, Richard R. (1993), *National Innovation Systems: A Comparative Analysis* (Oxford: Oxford University Press) 541 pages.

Nooteboom, Bart (1999), 'Innovation, learning and industrial organisation', *Cambridge Journal of Economics,* 23, 127-50.

OECD (2005), *Framework for Biotechnology Statisticss* (Paris: Organization for Economic Co-operation and Development, available at: http://www.oecd.org/dataoecd/5/48/34935605.pdf) 52 pages.

--- (2006), *Biotechnology Statistics - United States* (Paris: Organization for Economic Co-operation and Development: http://www.oecd.org/document/36/0,3343,en_2649_34537_2674020_1_1_1_1,00.html).

Pavitt, Keith (1984), 'Sectoral patterns of technical change: Towards a taxonomy and a theory', *Research Policy,* 13 (6), 343-73.

Phlippen, Sandra (2008), *Come Close and Co-Create: Proximities in Pharmaceutical Innovation Networks (PhD Thesis # 434)* (Rotterdam: Tinbergen Institute: Erasmus University).

Piore, Michael J. and Sabel, Charles F. (1984), *The Second Industrial Divide* (New York: Basic Books) 355 pages.

Porter, Michael E. (1990), *The Competitive Advantage of Nations* (London: MacMillan Press) 855 pages.

--- (1998), 'Clusters and competition: New agendas for companies, governments, and institutions', in Michael E. Porter (ed.), *On Competition* (Boston: Harvard Business School Press), 197-287.

--- (2000), 'Locations, Clusters, and Company Strategy', in Gordon L. Clark, Maryann P. Feldman, and Meric S. Gertler (eds.), *The Oxford Handbook of Economic Geography* (Oxford: Oxford University Press), 253-74.

Powell, Walter W., Koput, Kenneth W., and Smith-Doerr, Laurel (1996), 'Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology', *Administrative Science Quarterly,* 41 (1), 116-45.

Pyke, Frank and Sengenberger, Werner (eds.) (1992), *Industrial districts and local economic regeneration* (Geneva: International Institute for Labour Studies) 294.

Pyke, Frank, Becattini, Giacomo, and Sengenberger, Werner (eds.) (1990), *Industrial districts and inter-firm cooperation in Italy* (Geneva: International Institute for Labour Studies) 237 pages.

Saxenian, AnnaLee (1991), 'The origins and dynamics of production networks in Silicon Valley', *Research Policy,* 20 (5), 423-37.

Saxenian, Annalee (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA: Harvard University Press) 226.

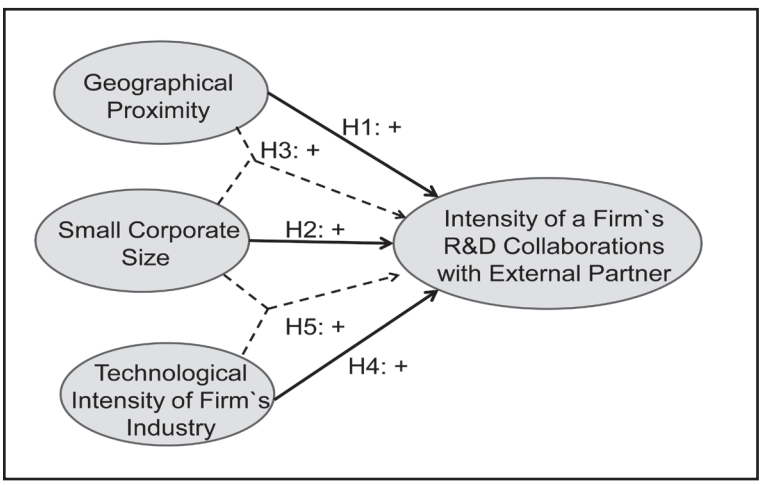
Saxenian, AnnaLee (2006), *The New Argonauts : Regional Advantage in a Global Economy* (Cambridge (Massachusetts): Harvard University Press) 424 pages.

Sonn, Jung Won and Storper, Michael (2003), *The Increasing Importance of Geographical Proximity in Technological Innovation* (Sussex, 13-15 November 2003: Paper prepared for the Conference: What Do we Know about Innovation? in Honour of Keith Pavitt).

van Geenhuizen, Marina and Reyes-Gonzalez, Leonardo (2007), 'Does a clustered location matter for high-technology companies' performance? The case of biotechnology in the Netherlands', *Technological Forecasting and Social Change,* 74 (9), 1681-96.

Zucker, Lynne G. and Darby, Michael R. (1996), 'Star Scientists and Institutional Transformation: Patterns of Invention and Innovation in the Formation of the Biotechnology Industry', *Proceeding of the National Academy of Science,* 93 (23), 12709-16.

Figure 1: Visualization of Hypotheses



Explanatory notes: _____ = hypothesized main effect

_ _ _ _ = hypothesized interaction effect

Table 1: Predictors of the Intensity of R&D Collaborations
(Results of OLS regressions: standardized B)

Independent variables	Models 1a-c (individual impact of 1 predictor)			Models 2a-c (joint impact of 2 predictors)			Models 3a-c (joint impact of 3 predictors)			Models 4a-b (joint impact of 4 predictors)		Model 5
H1: Geographical proximity	-.242***			-.197**	-.215***		-.173**	~~-.320~~	-.331***	~~-.320*~~	**-.297***	~~-.444**~~
H2: Corporate Size		.300***		.266***		.280***	.252***	~~.240***~~		~~.220***~~	**.257***	~~.225***~~
H3: Interaction Effect: Proximity × corporate size								~~.131~~		~~.158~~		~~.157~~
H4: Industry			.327***		.308***	.310***	.296***		.234***	~~.298***~~	**.217****	~~.219***~~
H5: Interaction Effect: Proximity × industry									.185*		**.198***	~~.198*~~
N	154	154	154	154	154	154	154	154	154	154	**154**	154
R^2	.059	.090	.107	.128	.153	.185	.214	.130	.169	.218	**.233**	.237

Significance levels: * < 0.10; ** < 0.05; *** < 0.01. Constant not reported in table.

Crossed-out numbers indicate distorted coefficients due to multicollinearity problems:

Average $VIF_{Model\ 3b}$ = 5.061; Average $VIF_{Model\ 4a}$ = 4.052; Average $VIF_{Model\ 5}$ = 3.875