Determinants of Science-Based Cooperation: Evidence in a Sample of Small and Micro Firms

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We study the determining factors of science-based cooperation in the case of small and micro firms. In this research, we propose an analytical framework based on the resource-based view of the firm and we identify a set of organisational characteristics, which we classify as internal, external and structural factors. Each factor can be linked to at least one reason, from the firm's point of view, to cooperate with universities and public research centres. Each reason can, in turn, be used as an indicator of a firm's organisational needs or organisational capacities. In order to validate the theoretical model, we estimate a logistic regression that models the propensity to participate in science-based cooperation activities within a sample of 285 small and micro firms located in Barcelona. The results show the key role played by the absorptive capacity of new and small companies.

Key Words: science-based cooperation, determinants, absorptive capacity, small and micro firms
JEL *Classification:* L26, O32

Introduction

The goal of this paper is to study the motivations that small and micro firms have to engage in science-based cooperation. To this aim, we will identify a set of determinants of cooperation based on a firm's needs and capabilities to network with science institutions. Our theoretical approach is grounded in the resource-based view – RBV – of the firm (Barney 1986a; 1986b; 1991) and is related as well to the concept of absorptive capacity suggested by Cohen and Levinthal (1989; 1990).

The RBV theory states that the essence of the firms' strategy is defined (or should be), by the own and unique set of resources and capacities of each firm (Rumelt 1984). So it has been assumed that firms' strategy is shaped by two main elements:

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- the opportunities provided by the environment, that is, market opportunities; and
- the restrictions imposed by organizational weaknesses and strengths, that is, internal assets and capacities.

Innovative agents take part in multiple and complex network relationships with the aim of sharing and acquiring knowledge. In this sense, innovation can be described as a collective process (Malecki 1991) that is increasingly interdependent and interactive.

One specific form of networking is cooperation (Vázquez Barquero 1999). In particular, we focus our interest on science-based cooperation, defined as those agreements set by firms with universities and public research centres addressed to innovation. The cooperation with universities and research centres plays an important role for the improvement of business performance, as university research has important and pervasive effects on industry R&D and innovation (for a summary, see Zucker et al. 2001, or Kim, Lee and Marschke 2005). Cooperation, however, is not a universal practice as only 25% of the innovative EU firms are engaged in cooperation activities (CIS 2006). For this reason, the strengthening of cooperation between science and business is a goal for innovation policies in the European Union (Eurostat 2009).

This paper is structured as follows. The next section is devoted to the development of our analytical framework, which is based on the relationship between organizational resources, cooperation and innovation. Our analysis follows with an empirical application to validate the identified determinants of science-based cooperation among a specific sample of small and micro firms. The section on discussion and conclusions closes the paper.

Analytical Framework

ABSORPTIVE CAPACITY

Absorptive capacity is one of the most important conceptual constructs that have emerged in the research on organization in the last decades (Lane, Koka and Pathak 2002; 2006). Its emergence coincided with the development of the RBV theory and its derivative, the knowledge-based view of the firm. The most common definition of absorptive capacity was set by Cohen and Levinthal in 1990. The authors state that:

> Absorptive capacity is the firm ability to recognize the value of new external information; to assimilate it; and to apply it with commercial purposes.

Cohen and Levinthal point out that firms' absorptive capacity constitutes a critical element that shapes their ability to develop innovations, as an organization needs some previous related knowledge in order to assimilate and use newly acquired external knowledge. As learning is a cumulative and dynamic process, learning productivity increases when the object of the process of learning is previously known. For that reason, diversity of knowledge within the firm plays a very important role regarding absorptive capacity. As a result, absorptive capacity is firm-specific and is path-dependent. It is shaped as well by the individual absorption capacities of the members of the organization individually considered. In sum, absorptive capacity is not a goal but a means – an instrument – that determines and modulates the results a firm can achieve. In fact, van den Bosch, van Wijk and Volverda 2003 state that it is a multidimensional, multilevel and trans-disciplinary construct.

The historical approach to innovation suggests that the benefits of scale and scope for internal R&D encourage a vertical integration innovation model, where large companies internalize their firm-specific R&D activities and commercialize them by means of development, manufacturing and distribution processes (Chesbrough 2006). In fact, firms develop innovations in a less hierarchical way. If companies cannot develop sufficient absorptive capacity themselves, they utilize strategic alliances in order to obtain new knowledge or use complementary external resources to exploit that knowledge (Nooteboom 1999).

Many models have been developed to explain how firms can exploit external knowledge. A common way to overcome the first-mover strategy from a rival company is imitation (Lieberman and Montgomery 1998) or, alternatively, consulting with the lead customers or suppliers can provide useful ideas about how to improve the quality and performance of firms' products and services.

Moreover, in many economies, public sources of knowledge (such as government R&D spending) are an important stimulus for private R&D (David, Hall and Tool 2000). But, as Powell, Koput and Smith-Doerr (1996) state, the construction of alliances and the development of networks by firms and institutions is an active way to incorporate external knowledge into the innovations process of firms. At present, university research is often explicitly funded by companies to generate external spillovers (Colyvas et al. 2002). In fact, spatial location results in knowledge spillovers between firms and from university research in many economic activities, especially the high-tech industries (Porter 1990; Baptista and Swann 1998).

Therefore, organizational strategy is related, among others, to the adoption and diffusion of innovations, the cooperation agreements in R&D or the development of basic research. Absorptive capacity affects all these activities (Cohen and Levinthal 1990). Specifically, it shapes cooperation for innovation with universities and research centers: firms have different absorptive capacities which, in turn, determine the propensity of the organization to establish cooperation agreements (Hernán, Marin and Siotis 2003). Absorptive capacity even plays a relevant role in the relationship among weak links with other economic agents and the achievement of innovation results, as it encourages a higher profit from the exploitation of these links with external agents (Julien, Andriambeloson and Ramangalahy 2004).

Indeed, a wide number of empirical analyses study how absorptive capacity shapes cooperation activities (see, among others, Bönte and Keilbach 2005; Cassiman and Veugelers 2002; Frenz, Michie and Oughton 2003; Hernán, Marin and Siotis 2003; Laursen and Salter 2004; or Miotti and Sachwald 2003). And particularly, formal education of the staff positively affects cooperation activities (Belderbos et al. 2004).

In order to engage in cooperation activities a sufficient capacity is required (Foss 1999), since 'firms need resources to get resources' (Eisenhardt and Schoonhoven 1996, 137). A specific and relevant case is science-based cooperation, in which firm-university relationships can be extraordinarily difficult to manage (Pavitt 2005). Transaction costs can be higher when the interlocutor is a university or a research center, because of their differences with respect to firms concerning commercial and general organizational goals and aims.

However, internal factors are necessary but not sufficient to define the absorptive capacity of the firm (Camisón and Forés 2007). Therefore, there is a clear need of an appropriate combination of internal and external assets, so absorptive capacity gets the highest rate of results and firm performance. We look at those specific (internal and external) assets. In turn, these elements can also be identified with the reasons of firms for engaging in science-based cooperation.

REASONS FOR SCIENCE-BASED COOPERATION IN SMALL AND MICRO FIRMS

Available statistical evidence on innovation shows that larger firms cooperate most (CIS, 2006). However, small and micro firms may be more dependent on external links and external resources because cooperation

TABLE 1 Reasons for science-based cooperation in small and micro firms

Structural factors	Size	Exploitation of complementarities	(C)
		Lack of resources	(N)
	Sector	Risk sharing	(N)
External factors	Institutional support	Risk sharing	(N)
	Turbulent environment	Risk sharing	(N)
Internal factors	Human capital	Exploitation of complementarities	(C)
	Ongoing R&D	Exploitation of complementarities	(C)

NOTES C – capacity to cooperate, N – need to cooperate.

would act as a mechanism to compensate size-inherent competitive disadvantages (Audretsch and Feldman 2003). In this sense, firm size is one of the elements that must be taken into account when analysing the determinants of cooperation.

Therefore, as organisational factors affect the propensity to cooperate, our taxonomy identifies three different categories of elements:

- structural factors, such as firm size or industry;
- external factors, such as the access and use of institutional support for innovation or the existence of market turbulences; and
- internal factors, such as the knowledge embedded in a firm's staff (identified as human capital) or its continuous engagement in R&D activities.

We can also identify each one of these factors as an indicator of the main reasons to engage in science-based cooperation (see table 1). From the point of view of a small firm, there are three main motivations to cooperate (Hanna and Walsh 2002; Tether 2002; Jong and Vermeulen 2004):

- lack of internal resources,
- risk sharing, and
- search of complementarities.

These three reasons are not incompatible and they can as well be understood in terms of the firm's needs or capacities to cooperate. The first two reasons have to do with need, as their rationale is the necessity to access external resources in order to compensate the organisational weaknesses. In contrast, the third reason relates to a firm's cooperation capacity, as any firm aiming to create and take advantage of potential complementarities must be able to share its (own) assets and/or knowledge.

In this theoretical approach, these factors can be considered indicators of the determinants of science-based cooperation among small and micro firms. Through an empirical application we will try to validate the theoretical framework.

Empirical Application

In order to validate the proposed analytical framework with an empirical application, we use a logistic regression to model the propensity of small and micro firms to engage in science-based cooperation. We look at self-declared cooperation activities, without distinguishing between formal agreements and weaker ties. This broad definition affords a closer and more realistic picture of these types of firms. A set of indicators is used to proxy the factors (structural, external and internal) that shape science-based cooperation activities.

FIELDWORK AND SAMPLE DESCRIPTION

The above information can only be gathered through a survey. Data collected for our specific application comes from a cross-sectional sample of 285 mainly young, small and micro firms. These firms are located in Barcelona and are either closely or loosely linked to the local development agency, an institution created by the City Council (for more details, see Fernández-Ardèvol 2009; Fernández-Ardèvol and Lladós 2009; Castells and Vilaseca 2007).

We conducted two online surveys, designed under the same conceptual framework. Fieldwork was developed between July 2005 and April 2006. Respondents had the choice of answering the survey in Catalan or Spanish, while in order to encourage the response, an institutional e-mail was sent introducing the research. The tool allows multiple consistency controls that guarantee the quality of the data and prevent respondents from answering more than one questionnaire. The first survey was addressed to entrepreneurs leading a firm who usually interact with the local development agency (256 individuals). With a response rate of 52.4%, total number of questionnaires equals 136 questionnaires. The second targeted population corresponds to the users of an internet-based platform to foster entrepreneurship. Created by the local development agency, it had more than 11,500 registered users. In this case, the response rate was 5.0% (585 questionnaires). Among them, only one set of individuals was selected for this research: entrepreneurs with an active firm. The total number of questionnaires in this second group equals 164.

Finally, merge and depuration of the two surveys led to a unique sample of 285 firms.

The studied firms present distinctive features that differentiate them from the Catalan average. Firms are characterized by their youth, as the average age is 3.3 years, and almost 60% of them started the activity during the previous 36 months. One third of the firms in the sample were incubated by the local development agency (27.7%). With an average of 4.6 full-time workers, more than 80% having less than 5 employees. In most cases, their personnel hold a university degree (76.19%), while firms' activities lie mainly in the Information and Communication Technologies (ICT) sector (28.8%) and in business services (21.1%). Firms are able to pay high salaries, as 50.9% of the companies pay annual gross wages per employee of between 18,000 and 24,000 EUR, while 17% pay over 24,000 EUR. In Catalonia, average gross annual wage in 2005 was 20,067 EUR, while the third quartile equalled 22,704 EUR (source: Spanish industrial wage structure survey, www.ine.es). Surveyed firms also show good performance indicators despite their youth.

MODEL BUILDING: SELECTION OF VARIABLES

The selection of variables for the empirical application is based on the literature review. Given the available data gathered through the survey, implemented variables are considered as follows.

Regarding structural factors, or basic organizational characteristics, the dimension is measured as the total number of employees (expressed in full time equivalent). As size would not be enough to predict the propensity to cooperate, here it is considered as a control variable and we do not present any hypothesis regarding its influence in the endogenous variable. Sector of activity is also included by taking into account whether the firm belongs to the ICT sector or not. Indeed, the survey gathered information on the next activity sectors: ICT; firm services; industrial production; commercial distribution; personal services and social activities; and other services. Given the distribution and the characteristics of the survey, we selected the ICT sector as the indicator of the necessity of risk sharing within a sector. As the ICT sector shows higher levels of innovation activities and a short life-cycle of technologies, we expect that firms in that sector will be more prone to cooperate with science agents.

Regarding external factors, the first of them is institutional support. This is a discrete and quantitative variable that gathers the intensity of in-

TABLE 2 Qualitative variables in the models (dichotomous)

Variables	Model 1	Model 2	Yes	Role in the model
Science-based cooperation for innovation	×	×	16.1%	Endogenous
Majority of employees holding a univ. degree	×	×	76.1%	Internal factor
R&D&I own department	×	×	27.0%	Internal factor
High competitive pressure (perception)		×	82.8%	External factor
ICT sector		×	28.8%	Structural factor

NOTES Valid observations = 285.

TABLE 3 Quantitative variables in the models

Variables	Model 1	Model 2	M	SD	Role in the model
Dimension: Total number of employees (full time equivalent)	×	×	4.58	6.32	Structural factor Control variable
Institutional support intensity (1–7)		×	1.86	0.99	External factor

NOTES Valid observations = 285.

stitutional support. It is bounded between 1 and 7. The lower value corresponds to those firms that are only supported by Barcelona Activa, while the higher value corresponds to those that are supported by all the seven different institutions considered in the survey. Institutions range from universities and business schools to the chamber of commerce, among others.

The second external factor shows the competitive pressure perceived by the manager of the firm, that is whether the markets in which the firm acts do or do not place relevant pressure on the business activity. This is a dichotomous variable that takes value one when competitive pressure is stated to be 'high' or 'very high' and zero otherwise.

Finally, we include two other dichotomous variables or internal factors, that could be understood as indicators of the firm's absorptive capacity:

1. human capital: whether the majority of employees have high degree qualifications, and
2. the existence in the firm of a specific R&D department.

Two models are specified. Model 1, the baseline model, has three explanatory variables: the two internal factors usually identified as indicators of absorptive capacity, and firm dimension, the control variable. Model 2, on the other hand, is an enlarged model which includes the industry and the external factor variables listed in tables 2 and 3. Both models include a constant term.

Goodness of fit *G* statistic shows that both models are significantly different from a model in which the only predictor was the constant term (see table 4). Besides, covariances among explanatory variables stay at very low levels (values not showen in the table). Complementary statistics confirm that Model 2 is preferable to Model 1: predictive capacity is similar (76.1% vs. 76.5%) but in Model 2 there is a higher balance in correct predictions for the positive category of the endogenous variable. Apart from that, Akaike and Bayes Information Criterion (AIC and BIC) are lower in Model 2, and the deviance statistics show that the contribution of the variables added to Model 1 to build Model 2 really plays a significant role. Therefore, in the next paragraphs we will set our attention on results for Model 2.

It can be seen that the dimension of the firm positively influences the probability of engaging in science-based cooperation. In light of this result we can consider that the number of employees is an indicator of absorptive capacity in the context of a sample of small companies, as the average firm size is below five employees. It confirms that, in order to assume the transaction cost inherent to science-based cooperation, the firm needs a sufficient amount of internal resources.

A higher dimension, in this context, would mean the availability of more complex and diverse knowledge and skills (Lee, Lee and Pennings 2001; Kogut and Zander 1996). So, a larger knowledge base would increase the firm's capability to engage in cooperation with science institutions because firm's perception of risk would be lower regarding these relationships.

On the other hand, the two internal factors (human capital and R&D department) positively affect the endogenous variable as well. Higher education seems to be a key determinant factor, as can be seen from the magnitude of the estimated parameter (2.132). As 76.1% of the companies in the sample have a majority of employees holding a university degree, this result is especially outstanding as it signals the importance of internal capacities to engage in science-based cooperation.

In view of these results, we can consider that the three first exogenous variables (number of workers; human capital and R&D department) act as indicators of the absorptive capacity of the sampled firms. This set of

TABLE 4 Determinants of science-based cooperation for innovation

Logit regression models	Model 1	Model 2
Endogenous: Science-based cooperation for innovation (yes = 16.11%)		
Total number of employees (full time equivalent)	0.079 (0.001)	0.073 (0.006)
Majority of employees holding a university degree	2.365 (0.003)	2.132 (0.013)
R&D&I own department	1.146 (0.001)	0.834 (0.032)
Institutional support intensity (1–7)	—	0.765 (0.000)
High competitive pressure (perception)	—	0.562 (0.331)
ICT sector	—	0.398 (0.331)
Constant term	−4.575 (0.000)	−6.482 (0.000)
Goodness of fit classification table (percentage of correct predictions, cut = 16%)		
Yes	63.0%	73.9%
No	79.1%	76.6%
Total	76.5%	76.1%
Number of observations	285	285
Degrees of freedom	3	6
Ji-squared test of global significance: G	41.755 (0.000)	64.363 (0.000)
Deviance of variables added to the model	—	22.608 (0.000)
−2 ln likelihood	210.179	187.571
Akaike Information Criterion (AIC)	216.179	199.571
Bayes Information Criterion (BIC)	227.137	221.486
Nagelkerke Pseudo R^2	0.232	0.344
Hosmer-Lemeshow test	5.364 (0.616)	6.746 (0.564)

NOTES In brackets p-values.

minimal internal capabilities seems to favour the ability of the firms to consider science institutions for cooperation, a strategy that, as Duysters and Lokshin (2007) point out, would make more complex the portfolio of external alliances.

A third group of variables corresponds to external factors. It is confirmed that institutional support has a significant and positive influence on the propensity towards science-based cooperation. However, although competitiveness pressure shows a positive influence as well, its parameter is not statistically significant. As entrepreneurs' perception is highly extreme (with 82.8% declaring that their business faces a high competitive pressure), this variable maybe is not the optimum instrument to measure the competitiveness situation in those markets in which the surveyed firms develop their activity.

Belonging to the ICT sector, which has been considered as an indicator of market dynamism, shows a positive parameter. However, it is not statistically significant either. As a consequence, the multivariate model shows that the activity sector is not significant when absorptive capacity indicators are taken into account.

Finally, as already stated in previous works (see, for instance, Fritsch and Lukas 2001), the predictive capacity of the model probably could be improved with the inclusion of variables regarding the internalization of spillovers generated by the innovative activity or the effective cost saving due to the cooperative activity. Unfortunately, that information was not available.

Discussion and Conclusion

The results show the key role played by absorptive capacity as a determinant of science-based cooperation activities among small and micro firms. More specifically, it is possible to identify two different sources of absorptive capacity: a set of internal factors and a set of external factors. Both of them improve the propensity to engage in that kind of cooperation for innovation.

From an internal perspective, the most important factor is the labour qualification, that is, the educational degree of employees. It is also confirmed that the existence of an R&D department is also very significant. Both elements are key components that help organizations to better deal with universities and research centres for cooperation. On the other hand, firm size is relevant as well. In the studied milieu of very young firms, the companies are clearly shaped by the number of employees, because the marginal contribution of a new employee would have more significance than in the case of a larger company.

From an external perspective, institutional support appears to be a crucial element for improving the absorptive capacity of small companies, as it can help these firms to strengthen their organizational knowledge and to give access to networks configured by more diverse members. We do understand, therefore, that support institutions act as an effective interface between small and micro firms and universities and research centres. Summing up, absorptive capacity positively increases the propensity to establish cooperation with universities and research centres, even among firms located in a non-university innovative milieu which is managed by the local development agency in Barcelona. In turn, the absorptive capacity can be effectively improved both from inside and outside these new and small companies.

References

Audretsch, D. B., and M. P. Feldman. 2003. 'Small-Firm Strategic Research Partnerships: The Case of Biotechnology.' *Technology Analysis and Strategic Management* 15 (2): 273–88.

Baptista, R., and P. Swann. 1998. 'Do Firms in Clusters Innovate More?' *Research Policy* 27 (5): 525–40.

Barney J. B. 1986a. 'Strategic Factor Markets: Expectations, Luck and Business Strategy.' *Management Science* 32 (10): 1231–41.

———. 1986b. 'Organizational Culture: Can it Be a Source of Competitive Advantage?' *Academy of Management Review* 11 (3): 656–65.

———. 1991. 'Firm Resources and Sustained Competitive Advantage.' *Journal of Management* 17 (1): 99–120.

Belderbos, R., M. Carree, B. Diederen, B. Lokshin, and R. Veugelers R. 2004. 'Heterogeneity in R&D cooperation strategies.' *International Journal of Industrial Organization* 22 (8–9): 1237–63.

Bönte, W., and M. Keilbach. 2005. 'Concubinage or Marriage? Informal and Formal Cooperation for Innovation.' *International Journal of Industrial Organization* 23:278–302.

Bosch, van den F. A. J., R. van Wijk, and H. W. Volverda. 2003. 'Absorptive Capacity: Antecedents, Models and Outcomes.' In *Blackwell Handbook of Organizational Learning and Knowledge Management,* edited by M. Smith, and M. A. Lyles, 273–302. Malden, MA: Blackwell.

Camisón, C., and B. Forés. 2007. 'Factores antecedentes de la capacidad de absorción de conocimiento: un estudio teórico.' In *Empresa Global y Mercados Locales:* XXI *Congreso Anual* AEDEM. *Comunicaciones, 6.–8. Junio 2007, Madrid,* edited by C. Mercado Idoeta, 48–65. Madrid: Universidad Rey Juan Carlos I.

Cassiman, B., and R. Veugelers. 2002. 'R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium.' *American Economic Review* 92 (4): 1169–84.

Castells, M., and J. Vilaseca, ed. 2007. *Entorno innovador, iniciativa emprendedora y desarrollo local.* Barcelona: Octaedro.

Chesbrough, H. 2006. 'Open Innovation: A New Paradigm for Understanding Industrial Innovation.' In *Open Innovation: Researching a New Paradigm,* edited by H. Chesbrogh, W. Vanhaverbeke, and J. West, 1–12. Oxford: Oxford University Press.

CIS. 2006. 'Community Innovation Survey 2006.' http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

Cohen, W. M., and D. A. Levinthal. 1989. 'Innovation and Learning: The Two Faces of R&D.' *The Economic Journal* 99 (397): 569–96.

———. 1990. 'Absorptive Capacity: A New Perspective on Learning and Innovation.' *Administrative Science Quarterly* 35 (1): 128–52.

Colyvas, J., M. Crow, A. Gelijns, R. Mazzoleni, R. R. Nelson, N. Rosenberg, and B. N. Sampat. 2002. 'How Do University Inventions Get into Pratice?' *Management Science* 48 (1): 61–72.

David, P., B. H. Hall and A. A. Tool. 2000 'Is Public R&D a Complement or Substitute of Private R&D? A Review of the Econometric Evidence.' *Research Policy* 29 (4–5): 497–529.

Duysters, G., and B. Lokshin. 2007. 'Determinants of alliance portfolio complexity and its effect on innovative performance of companies.' UNU-MERIT Working Paper Series 033, United Nations University, Maastricht Economic and Social Research and Training centre on Innovation and Technology, Maastricht.

Eisenhardt, K., and C. Schoonhoven. 1996. 'Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms.' *Organization Science* 7 (2): 136–50.

Eurostat. 2009. *Science, Technology and Innovation in Europe.* Eurostat Statistical Books. Brussels: European Communities. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-EM-09-001/EN/KS-EM-09-001-EN.PDF.

Fernández-Ardèvol, M. 2009. 'Determinants de la competitivitat de les petites i micro empreses en un entorn d'innovació.' PhD diss., University of Barcelona.

Fernández-Ardèvol, M., and J. Lladós. 2009. 'Science-based cooperation and business success: Transmittal mechanisms in a sample of small and micro firms.' In *Proceedings of the 10th Management International Conference, Sousse, Tunisia, 25–28 November,* 199–217. Koper: Faculty of Management.

Foss, N. J. 1999. 'Networks, Capabilities, and Competitive Advantage.' *Scandinavian Journal of Management* 15 (1): 1–15.

Frenz, M., J. Michie, and C. Oughton. 2003. 'Regional Dimension of Innovation: Results from the Third Community Innovation Survey.' Paper presented at the SIEPI 2003 conference, Urbino, 1–2 December.

Fritsch, M., and R. Lukas. 2001. 'Who Cooperates on R&D?' *Research Policy* 30 (2): 297–312.

Hanna, V., and K. Walsh. 2002. 'Small Firm Networks: A Successful Approach to Innovation?' R&D *Management* 32 (3): 201–207.

Hernán, R., P. Marín, and G. Siotis. 2003. 'An Empirical Evaluation of the Determinants of Research Joint Venture Formation.' *The Journal of Industrial Economics* 51 (1): 75–89.

Jong, J. P. J. de, and P. A. M. Vermeulen. 2004. *Determinants of Product Innovation in Small Firms: A Comparison across Industries.* Zoetermeer: EIM.

Julien, P. A., E. Andriambeloson, and C. Ramangalahy. 2004. 'Networks, weak signals and Technological Innovations among SMEs in the Land-Based Transportation Equipment Sector.' *Entrepreneurship and Regional Development* 16 (4): 251–69.

Kim, J., S. J. Lee, and G. Marschke. 2005. 'The Influence of University Research on Industrial Innovation.' NBER Working Paper Series 11447, National Bureau of Economic Research, Cambridge, MA.

Kogut, B., and U. Zander. 1996. 'What Firms do? Coordination, Identity, and Learning.' *Organization Science* 7 (5): 502–18.

Lane, P. L., B. Koka, and S. Pathak. 2002. 'A Thematic Analysis and Critical Assessment of Absorptive Capacity Research.' *Academy of Management Proceedings* 1:1–7.

———. 2006. 'The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct.' *Academy of Management Review* 31 (4): 833–63.

Laursen, K., and A. Salter. 2004. 'Searching Low and High: What Types of Firms use Universities as a Source of Innovation?' *Research Policy* 33 (8): 1201–15.

Lee, C., K. Lee, and J. M. Pennings. 2001. 'Internal Capabilities, External Networks, and Performance: A Study on Technology Based Ventures.' *Strategic Management Journal* 22 (6–7): 615–40.

Lieberman, M. B. and D. B. Montgomery. 1998. 'First-Mover Advantages.' *Strategic Management Journal* 9:41–58.

Malecki, E. J. 1991. *Technology and Economic Development: The Dynamics of Local, Regional and National Change.* London: Longman.

Miotti, L., and S. Sachwald. 2003. 'Co-Operative R&D: Why and With Whom? An Integrated Framework of Analysis.' *Research Policy* 32 (8): 1481–99.

Noteboom, B. 1999. *Inter-Firm Alliances: Analysis and Design.* London: Rutledge.

Pavitt, K. 2005. 'Innovation Process.' In *The Oxford Handbook of Innovation,* edited by J. Faberger, D. C. Mowery, and R. R. Nelson, 86–114. Oxford: Oxford University Press.

Porter, M. 1990. *The Competitive Advantage of Nations.* New York: The Free Press.

Powell, W. W., K. W. Koput, and L. Smith-Doerr. 1996. 'Interorganisational Collaboration and the Locus of Control of Innovation: Networks of Learning in the Biotechnology Industry.' *Administrative Science Quarterly* 41:116–45.

Rumelt, R. 1984. 'Toward a Strategic Theory of the Firm.' In *Competitive Strategic Management,* edited by R. Lamb, 556–70. Englewood Cliffs, NJ: Prentice-Hall.

Tether, B. S. 2002. 'Who Co-Operates for Innovation, and Why: An Empirical Analysis.' *Research Policy* 31 (6): 947–67.

Vázquez Barquero, A. 1999. *Desarrollo, redes e innovación: Lecciones sobre desarrollo endógeno.* Madrid: Pirámide Ediciones.

Zucker, L. G., M. R. Darby, and J. S. Armstrong. 2001. 'Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology.' NBER Working Paper Series 8499, National Bureau of Economic Research, Cambridge, MA.