



Knowledge for innovation in Europe: The role of external knowledge on firms' cooperation strategies[☆]

Jorge Gallego^{a,*}, Luis Rubalcaba^{a,b}, Cristina Suárez^a

^a University of Alcalá, Spain

^b Boston University, United States

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ABSTRACT

This paper analyzes the relationships between firms' external search of knowledge and its role in cooperation strategies for innovation. In particular, this study accounts for differences between public and private external sources of knowledge and between private–private and public–private cooperation arrangements. The empirical model is based on the Fourth Community Innovation Survey statistics for 15 countries and 40 economic branches. Although firms' internal R&D effort and size are important factors explaining engagement in cooperation for innovation, firms' external search of knowledge also plays a role. Among other insights, the results suggest the relevance of firms' absorption of science-based knowledge from public external sources in favoring firms' engagement in cooperation arrangements.

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1. Introduction

The locus of innovation should be thought of as a network of inter-organizational relations (Arora & Gambardella, 1990). Nowadays, a single organization faces increasing difficulties in innovating in isolation (Hamel & Prahalad, 1994; Shan, Walker, & Kogut, 1994; Teece, 1986; Tether, 2002), and the logic that supports a merely internally oriented and centralized approach to research and development (R&D) may be insufficient. Instead, successful innovation increasingly depends on the development and integration of external ideas in the innovation process (Cassiman & Veugelers, 2002). In order to compete in a knowledge-intensive scenario, firms have to engage with different types of partners to acquire resources (Laursen & Salter, 2006) whether they work together with other companies, universities or public research bodies (Coombs, Harvey, & Metcalfe, 2003; Fritsch & Lukas, 2001; Lai, 2011; Lai & Chang, 2010; Perkmann & Walsh, 2007; Veugelers, 1997). Accordingly, firms can and should use external ideas as well as internal ideas to advance their technologies (Chesbrough, 2003), concentrating on finding the correct balance between the development of internal knowledge and the incorporation of valuable external knowledge.

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* Correspondence to: J. Gallego, Department of Economics and Business, Facultad de Ciencias Económicas, Empresariales y Turismo, Plaza de la Victoria 2, 28802, Alcalá de Henares, Madrid, Spain.

E-mail addresses: jorge.gallegom@uah.es (J. Gallego), luis.rubalcaba@uah.es (L. Rubalcaba), cristina.suarez@uah.es (C. Suárez).

Within the increasing complexity of knowledge and technology, current actors increasingly perceive cooperation between innovation agents as a key aspect that sustains firms' innovation performances (Collins, 2006; Elango & Chen, 2012). The successful exploitation of collaborative possibilities (i.e., innovation through the combination and cross-pollination of ideas) to cooperate successfully by sharing knowledge and jointly developing new products and services may hold the key for companies seeking to gain or maintain a lead over their rivals (BarNir, 2012; Hansen & Nohria, 2004).

Part of the knowledge that firms share when cooperating for innovation can certainly be incorporated from outside their boundaries. Information and know-how trading often occur (Veugelers, 1997; Von Hippel, 1987) and also play an important role (Bönte & Keilbach, 2005; Rueda-Armengot & Peris-Ortiz, 2012) in firms' innovation performance. Accordingly, useful information for firms' innovativeness is often available in the public domain, and its utility depends to a certain degree on a company's capacity to transform this useful information into valuable knowledge. Cassiman and Veugelers (2002) find the external search of knowledge, identified as the access and use of external information from a certain knowledge source (Laursen & Salter, 2006), to be a significant determinant of firms' decisions to cooperate on innovation.

Although previous literature says a lot about the determinants of cooperation and emphasizes the relationships with respect to innovation and knowledge, little attention has been paid to analyzing the role of external knowledge on firms' cooperation strategies depending on whether firms acquire this knowledge from a private or a public source. In this context, the present study intends to explore whether public and private external search of information influences firms' propensity to engage in cooperative agreements on

innovation in a similar way. Given the often distinct nature of the knowledge generated by public research organizations (PROs) with respect to that of the private sector, an interesting question regards whether these information sources play a similar role on the formation of inter-organizational partnerships for innovation.

The study of the relationships between PROs and industry for innovation has a long-standing tradition. However, a limited number of studies present empirical evidence on the benefits firms achieve through relationships with PROs (Mowery & Shane, 2002; Rothaermel, Agung, & Jiang, 2007; Trimi & Berbegal-Mirabent, 2012). The current paper's contribution to existing knowledge centers itself on coping with the following issues. First, most studies focus on university–industry links, leaving to one side the role of other public and private institutions in firms' innovation processes. Second, very few analyses are supported by systematic data analysis or based on large survey datasets (Fontana, Geuna, & Matt, 2006; Geisler, 1995). Third, most authors confine their analysis to the manufacturing industry (Battistella, Biotto, & De Toni, 2012; Lai & Chang, 2010; Tether & Tajar, 2008).

Therefore, this study focuses on analyzing the influence of external knowledge from PROs on firms' willingness to cooperate for innovation. In doing so, this study differentiates between private–private and public–private collaboration arrangements and between cooperative and knowledge sourcing firms' strategies. The study is organized in five main sections. After this introduction, Section 2 presents a set of determinants that influence firms' engagements in collaborative arrangements, and illustrates the research premises of the investigation. Section 3 presents the data and methodology undertaken to develop the empirical analysis. Section 4 contains a series of ordered probit estimations and discusses the results of these estimations. Finally, the study provides some insights for innovation policy and management.

2. Determinants of cooperation

2.1. Knowledge factors

Literature considers R&D intensity to be a key factor in engaging cooperation related to innovation activities. In collaborative arrangements, a firm's learning capability depends heavily on its investment in R&D (Parisi, Schiantarelli, & Sembenelli, 2006) by enhancing a firm's absorptive capacity to assimilate and exploit new knowledge (Arundel & Geuna, 2004; Busom & Fernández-Ribas, 2008; Cassiman & Veugelers, 2002; Cohen & Levinthal, 1990; Drechsler & Natter, 2012; Scharfetter, Rammer, Fischer, & Fröhlich, 2002). In this respect, the development of valuable knowledge by R&D-intensive firms turns them into more attractive partners for cooperation (Rosenberg, 1990), which may, though not necessarily, favor their future engagement in collaborative innovation projects with external organizations (Muscio, 2007). Thus, the chances of firms with intensive R&D activities cooperating are much higher, as is the likelihood of concluding agreements with PROs (Fontana, Geuna, & Mireille, 2003).

However, Cockburn and Henderson (1998) argue that while investments in in-house R&D are necessary for firms to develop their absorptive capacity to utilize knowledge spillovers, this alone is not enough. Firms must be connected to the open science community by being actively involved in sharing research results. Relevant literature introduces the concept of connectedness to express the degree to which the scientists at a firm connect with their counterparts outside the boundary of the firm. Lim (2009) argues that not only is connectedness important but that this connectedness is in fact the main ingredient for creating absorptive capacity.

More recently, academics have argued about the concept of firms' openness to their external environment (and therefore their willingness to interact with their external environment in different ways) as a very important explanatory factor behind their patterns of collaboration (Alajoutsijärvi, Mainela, Ulkuniemi, & Montell, 2012; Fontana et al., 2003; Laursen & Salter, 2004). Cassiman and Veugelers (2002) find a

significant relationship between firms' external searches for information and their decisions to cooperate on innovation. Therefore, firms that rate generally available external information sources as important inputs to their innovation processes are more likely to engage actively in cooperative agreements. Accordingly, one prediction holds that firms' cooperation for innovation strategies are positively and considerably supported by firms' intensity of internal R&D and the external search for information effort. Although already well-established in the literature, this proposition is to be useful for purposes of benchmarking results.

Nevertheless, as previously considered, the literature pays little attention to analyzing how public external knowledge influences firms' propensity to engage in cooperative agreements on innovation. In the traditional model of closed innovation (Chesbrough, 2003), public research – particularly university research – proceeds upstream and independently of technological development, which then draws from the pool of research results (Cohen, Nelson, & Walsh, 2002). According to Nelson (1986), public research has little direct effect on business innovation, outside a few technology-intensive industries. However, in contexts of open and networked innovation, inter-organizational relationships between public research organizations and industry play an important role in driving businesses' innovation processes (Perkmann & Walsh, 2007, 2009; Salter & Martin, 2001).

Beyond the positive impacts of scientific results on economy (Beise & Stahl, 1999; Cohen, Florida, Randazzese, & Walsh, 1998), PROs are fundamental sources of information and knowledge for firms to reach new ideas and to support their innovation processes. As a matter of fact, the contribution of PROs to businesses innovation process development is significant (Fontana et al., 2003). Public research contributes to project completion as well as suggesting new cooperation projects (Cohen et al., 2002; Huang, Mas-Tur, & Yu, 2012; Idris & Tey, 2011). This contribution leads to increasing knowledge, skills, and R&D, in addition to greater technological potential, capacities, and performance (Arundel & Geuna, 2004; Fombrun, 1996; Hall, Link, & Scott, 2003; Heidrick, Kramers, & Godin, 2005; Lam, 2007), by exchanging complementary resources and growing competencies to generate value-added synergies (Teece, 1986).

An advanced characterization of the innovation process brings about the understanding of a firm as an open system that actively interacts with other external agents (Klevorick, Levin, Nelson, & Winter, 1995; Lee, Hwang, & Choi, 2012; Narin, Hamilton, & Olivastro, 1997; Nelson, 1990; Rosenberg & Nelson, 1994; Rothwell, 1992). Cohen et al. (2002) suggest that both public research and industry product and process development evolve through complex and intertwined processes. Accordingly, these authors argue that understanding the impact of public research on industrial R&D is central to understanding the innovation process itself. Beyond vertical (suppliers and clients) and horizontal (competitors) sources of useful knowledge on innovation, specialist public knowledge suppliers are fundamental both in early phases and downstream of the innovation process (Akgün, Keskin, & Byrne, 2012; Leyden, Link, & Siegel, 2008; Perkmann & Walsh, 2007). As a matter of fact, Pavitt (2001) shows that advanced European countries, such as the Scandinavian countries, the Netherlands and Switzerland, invest heavily in high quality academic research, the bulk of which happens inside PROs, in order to develop the countries' science base and to underpin their local industrial structures. Arundel and Geuna (2004) confirm this statement and find that the issue of connectedness is more relevant for firms with respect to public science sources than with respect to alternatives such as suppliers and customers.

This paper distinguishes between public innovation agents that provide specialist knowledge (Tether & Tajar, 2008), including universities or other higher education institutes and government or public research institutes, and other private external sources of information. Given the distinctive nature of the knowledge that either private or public organizations supply, this study proposes that: first, the effect of the acquisition of knowledge from public sources of information on firms' tendency to cooperate differs from the effect of that knowledge acquired from their counterparts in the private sector; and, second, the more firms attain

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