Key knowledge providers as sources of innovation in firms

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Abstract

Studies regarding innovation pay increasing attention to the relations that firms maintain with different actors in their environment. It is generally assumed that interaction with other firms, universities and governmental organizations can be sources of knowledge that can improve the ability to drive innovation. Nevertheless, there is scarce evidence with regard to the specific role firms give these partners as providers of useful knowledge for their innovation processes.

In this paper we present research-based insights on the dynamics of the Triple Helix networks as a basis for innovation capacity building for firms in a catch-up region. Our main assumption is that firms that adopt an open collaboration strategy have a greater capacity to recombine different knowledge sources and adapt them to their innovation processes. We use a large set of indicators which enables us to identify what regional sources are considered by firms as important for gaining knowledge. By way of a survey of 737 firms located in a region in southern Spain (Andalusia), the analysis identifies types of firms which are characterized by how they focus their interest on specific groups of actors.

Keywords: Knowledge providers, firms, innovation, regions, business networks, KIBS, universities.

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1. Introduction

Research in the role of diverse actors and institutions in the promotion and diffusion of innovation has expanded the focus of observations so that a greater diversity of critical actors has entered into the whole landscape of innovation studies. In addition to the classic role of research and technology organizations (RTOs) in offsetting industries´ lack of R&D capacities and providing up-to-date technological solutions, universities are seen as important players in innovation systems. Alliances with private partners are also recognised as strategic sources of innovation. Moreover, informal contacts with suppliers, clients and competitors have become key elements in detecting new opportunities, and in incorporating tacit knowledge into their business. Lastly, an area of increasing attention is knowledge intensive business services (KIBS) providers that are integrated together with the knowledge intensive services activities (KISA) developed by the firms.

In this article we analyze the role these varied actors play as knowledge providers. Specifically, we observe how important the firms in a region consider a wide range of business networks, clients, specialized service providers, universities and local governments. Our analysis uses the Triple Helix approach and develops it by using a comprehensive set of indicators that enables us to test this analytical framework from the viewpoint of the firm. The main assumption is that innovation depends on the capacity to recombine knowledge which comes from different partners. The firms that assign importance to a diversity of sources are also those that more frequently recombine knowledge adapted to their innovation processes. It should be expected, therefore, that these companies will also be those that have more capacity for absorption and those that produce more radical innovation.

2. Conceptual framework

It is widely acknowledged that interacting spheres promote knowledge circulation and enhance innovation processes. An important body of research considers the role of interactions as potential sources of knowledge and information, although the different approaches usually focus on some specific actors and factors that shape the relationships.

First, studies on business networks focus on the existence of selective relations between specific actors. The main reasons firms establish links are mutual interest and exchange. Being technologically complementary or gaining access to scarce resources –including knowledge- drives firms to reach collaboration agreements with different kinds of partners in order to reduce the implicit risks of innovation (Tether, 2002). Cases have been found, for example, of successful cooperative networks between manufacturers and suppliers that work together in the concept and design phases of new products (Bidault et al., 1998; Chung and Kim, 2003), as well as cases where collaboration with suppliers, clients and research organizations has a positive impact on innovation (Nieto and Santamaría, 2007). Trust and social capital are essential in order to maintain these kinds of agreements. However, the consequences for innovation seem to be conditioned by the characteristics of the firm such as sector linkage, size, or the degree of intensity of internal R&D activities (Tödtling et al., 2009).

In a similar fashion, other studies emphasize the importance of knowledge intensive business services (KIBS) offered by specialized firms. That make it possible to tackle complex operations and where highly qualified human capital is a key factor. KIBS produce and disseminate crucial knowledge for innovation processes (Muller and Zenker, 2001). Some authors argue that their role as facilitators (Den Hertog, 2000) places them in the centre of innovation systems (Toivonen, 2006). Even though initially it was thought that they foster knowledge transfer in only one direction, the growing implication of the client firms makes them co-producers of knowledge. This has added to their growing recognition as drivers of economic change (Muller and Zenker, 2001). KIBS continue to grow and at the same time are going through some qualitative changes associated with outsourcing, the internationalization of services or their involvement in business strategies (Miles, 2005). These formal actors have been integrated with other informal actors (organizations, communities, etc) into a set of knowledge intensive service activities –KISA–, which are instrumental for building and maintaining a firms innovation capability (OECD, 2006; Albors et al., 2008)

A third set of studies focuses on the role of universities, which more and more are considered “growth engines”, since they provide educational capabilities, specific skills and research results which are essential for innovation, especially in certain industrial sectors (Mansfield, 1991; Pavitt, 1991). There is a wealth of literature that studies the decisive role that universities have on innovation systems due to their contribution to the creation of new

business opportunities. These interactions are especially important in the final performance of firms with regards to innovation (Salter and Martin, 2001; Campbell, 2005). Therefore, governments try to foster these interactions, in the belief that university R&D will improve the productive process and favour, in a non-linear manner, economic development in regional environments (OECD, 2007).

Finally, the innovation system framework developed in the 90s (Lundvall, 1992; Nelson, 1993; Edquist, 1997) in its national and regional variants highlights the role played by institutions. Governments are important in the innovation capacity of a country or region through the establishment of regulatory rules –such as intellectual property rights and other technical and administrative quality controls. It is also understood that the relationships between the different actors are socially rooted in a territory. This approach considers that in an economic environment various organizations and institutions interact and mutually influence each other in the development of the innovation activity. Not only are product and process innovations conducted in a country taken into account, but also R&D effort by firms and public actors and other conditioning factors for innovation derived from learning processes, incentives or the availability of qualified workers (Balzat and Hanusch, 2004).

In spite of the diverse literature, little evidence is found about the specific roles that actors in different institutional spheres play in the innovation strategies of firms located in a given regional environment. Most of the empirical approaches focus on a partial segment of the interactions a firm can mantain. A fruitful line of research is to fill this gap by contrasting empirically what kinds of sources firms consider more important for acquiring information and knowledge than can be useful for enhancing innovation capabilities. Key questions are: Which actors and channels are considered valuable from the point of view of the firm, considering the diversity of firms that can be found in a regional environment? Are there specific patterns for combining different sources of innovation?

Given the assumptions about the importance of relationships between institutional spheres, the Triple Helix (TH) acquires special significance as a heuristic to look at the different actors involved in providing knowledge and its effective application by firms. This framework helps study the inner workings of the complex phenomenon of innovation as a knowledge based stimulus for economies by way of the dynamic interactions between universities, industry and government (Leydesdorff and Etzkowitz, 1998; Etzkowitz, 2002). Understanding innovation as the result of the interaction between three institutional spheres implies that the links between actors from different cultural environments facilitates the learning process that causes shared values to emerge in the institutions which produce, diffuse, capitalize, and regulate processes of generation and application of useful knowledge (Etzkowitz, 2002). When the right conditions are present, these trilateral relationships can lead to the creation of innovative technological complexes or industrial sectors. The relevant assumption for our study is that multiple dynamics of collaboration between the three helixes favour regional growth (Etzkowitz and Klosten, 2005).

However, TH has privileged mainly the systemic level of analysis. The main focus has been to identify the dynamics between the three main spheres. Indicator sets used for that purpose do not fully capture the relationships between actors at the micro level that can be relevant in a regional innovation system. Therefore, it is necessary to go further and take into account the specificities of actors in each subsystem, trying to use indicators that reflect in more detail the possible channels for interaction. From the point of view of the firm this means descending to a lower level of observation and decomposing the variety of sources of innovation coming from the spheres of university, government, and also from other industries. Consequently, our analysis uses the TH approach as a conceptual framework that can integrate different indicators related to the relationships that a firm maintains with actors from other institutional spheres. Given that firms can draw useful resources from a diversified range of actors, we interpret them as potential “knowledge providers”.

3. Methodology

The empirical basis for our analysis resides in a survey of 737 firms located in Andalusia carried out in 2008. The data source for the survey is a registry of innovative firms in the

region[1], from which a stratified sample of the firms, by sector of activity and size, was designed. Firms selected in the sample were first contacted by post and telephone, and asked to participate in the study. Then an appointment was made with a member of the management team on the premises of the firm. Interviews were made face-to-face using a group of professional survey takers. Response rate resulting from first wave of fieldwork was 73%. Response rate from second wave to replacement firms was 76%. As a result of this process, the sample includes small, medium size and large firms in many sectors, and reflects the diversity of innovative profiles of industry in our region of study.

The survey includes a extensive set of indicators that measure the importance of different types of sources for the innovation processes of the firm. Questions about universities, governments and business networks have been included. In addition, the survey has asked about the importance of several actors, such as users, clients, KIBS, formal and informal networks, as well as about the internal knowledge of the firm. The comparative significance of the whole range of knowledge providers is estimated by using a 4-item scale ranging from "not important" to "very important". Most of these variables can be linked to one of the TH institutional spheres formed by university, state and industry. Therefore, our set of variables goes a step further in operationalizing the TH framework when used from a perspective of firm innovation due to the diverse actors and channels that are considered. Nevertheless, it must be noted that the three spheres are not decomposed with the same detail because the survey was not designed to test this hypothesis.

The analysis is done in 3 steps. First step is a descriptive account of the answers showing the relative grades of importance for each item. The second step identifies correlations and the structure of underlying dimensions through a factor analysis which combines two procedures. A principal components analysis is used for transforming categorical variables into interval variables. Then, a factor analysis using a varimax solution is applied. This enables us to reduce the original indicator set in order to map the sample of firms into groups depending on the importance given to external actors. In the third step, we apply a conglomerate analysis which results in homogeneous groups of firms. We classify the firms in terms of the knowledge providers they value and then attribute meaning to the conglomerates by determining the main characteristics of the firms in each resultant group.

4. Results

4.1. Descriptive results

Table 1 shows in the first column the percentage of firms answering that each item is "important" or "very important" for the innovation process:

- The most noteworthy item is the "internal knowledge of the firm". More than 89% of the firms states that is important or very important for innovation. "Providers" and "clients" are very close to this (between 82% and 84%).

- The second group of most relevant sources (between 70% and 80%) includes "professional meetings, congresses and exhibitions", "informal networks with firms", "personnel training services", and, "accounting and financial services". "Informal networks with universities" are also in this group.

- The third group (between 60% and 70%) includes "other firms from the same sector of activity", "training of firm workers by universities", in addition to "advisors and consultans" among others.

- Finally, some of the items are not important for the majority of the firms (less than 40%), such as "industrial development consulting", "use or renting of university facilities, "e-commerce", "legal services",and "commercial laboratories". Local and regional government are in this group.

[1] The data source for the sample was a registry of 1980 firms put together by the network of offices of the regional government (RETA) that provide innovation services to firms. The firms in the registry are those that have received some kind of public aid and consulting support related to innovation.

Table 1. Importance given to external actors as innovation sources

	Descriptive results	Factor anaiysis Components				
	% Important + Very Important	1	2	3	4	5
Internal knowledge of the firm	89,06	0,054	0,090	0,135	0,381	0,039
Commercial providers	82,97	0,043	0,734	-0,081	-0,015	0,052
Clients	83,15	0,104	0,838	-0,008	-0,123	-0,097
Other firms from the same sector of activity	69,04	0,003	0,582	-0,040	0,130	0,153
Advisors and consultants	63,01	0,071	0,391	0,105	0,307	0,047
Commercial laboratories	38,74	-0,018	**-0,610**	-0,067	-0,129	0,168
Technology centres (RTOs)	50,97	-0,018	0,117	0,214	0,588	0,011
Journals and scientific publications	63,08	0,072	0,189	0,200	0,579	-0,119
Professional meetings, congresses, exibitions	79,78	0,044	0,090	0,223	0,508	-0,137
Local government	32,65	-0,006	-0,258	-0,220	0,666	0,423
Regional government	39,97	-0,021	-0,181	-0,169	0,698	0,410
Firm associations	54,04	0,122	0,569	-0,040	0,234	0,084
Informal networks with firms	77,76	0,026	0,590	-0,130	-0,080	0,032
Industrial development consulting	24,56	0,007	-0,013	0,539	0,103	0,003
Business planning consulting	40,43	-0,015	0,030	0,606	0,074	0,127
Marketing and sales services	49,25	-0,039	-0,032	0,593	0,045	0,184
Market research and product development	40,98	0,048	-0,065	0,614	0,139	0,107
Accounting and financial services	71,10	-0,025	0,059	0,202	-0,053	0,545
Information technology services	52,37	0,023	-0,003	0,418	0,030	0,479
Personnel training services	73,54	0,009	0,042	0,286	0,083	0,606
Recruitment	54,82	-0,027	0,051	0,224	0,056	0,613
External accreditation / Certification	48,58	0,050	0,003	0,389	0,169	0,248
Legal services (intellectual property, patents, etc.)	35,82	-0,005	-0,044	0,581	0,077	0,025
E-commerce	35,01	0,022	-0,041	0,332	-0,006	0,154
Consulting from universities	65,70	0,723	-0,103	0,055	-0,014	-0,036
Commissioning of R&D projects to universities	42,70	0,757	0,158	-0,023	0,050	-0,054
Joint R&D projects with universities	59,28	0,800	-0,063	0,041	0,059	-0,054
Use or renting of university facilities	28,79	0,744	0,185	-0,040	0,052	-0,012
Use of university patents	42,28	0,721	0,159	-0,029	0,035	0,054
Training of university graduates & internships at the firm	63,87	0,703	-0,067	0,004	0,020	-0,026
Exchange of personnel with universities	42,72	0,798	0,167	0,089	-0,042	-0,035
Training of firm workers by the university	65,93	0,816	-0,074	0,004	0,039	-0,016
Participation in cooperative centres with universities	39,57	0,645	0,125	-0,035	0,041	0,080
Participation in spin-offs and start-ups	40,79	0,674	0,121	0,012	0,015	0,087
Informal networks with universities	70,72	0,773	-0,094	0,040	0,010	-0,037

4.2. Mapping key knowledge providers

Results of factor analysis can be seen in the right side of Table 1. The resulting model groups all of the variables in 5 dimensions and gives an explained variance of 47%. The five underlying dimensions are as following:

- Component 1: is formed by importance given to interactions with universities and public research centres.

- Component 2: is formed by some business partners, mainly by suppliers and clients. Other firms in the same sectors, firm associations and informal networks with firms are also part of this component.

- Component 3: is formed by some KIBS, mostly the ones with higher technological content, such as IT, marketing, product research, and business development. Accreditation and legal services contribute also to this component.

- Component 4: is formed mostly by local government, regional government and RTOs. Professional meetings and specialized journals are important scores in this component.

- Component 5: is formed mainly by KIBS with low knowledge content. Local and regional governments are also part of this component, at a lower rate than in the previous one.

Table 2. Conglomerate analysis

Conglomerate distribution		Universities	Business networks	High tech oriented KIBS	Government and Technological Organizations (RTOs)	Low tech oriented KIBS
	% of Total					
1	4,21	++	+	+	+	-
2	63,91	++	++	+++	++	+
3	31,89	-	+	-	--	-

Table 2 includes on the left the results of the conglomerate analysis in two phases that classifies the firms in three homogenous groups as a function of the combination of components derived from the factor analysis. The main features of the firms in each conglomerate are provided in the columns on the right.

- Group 1: Makes up 4.2% of the total firms. Most of the components contribute to this conglomerate which reflects an open strategy towards relationships with multiple actors. Nevertheless, the relevant feature of this group is that the factor which contributes the most is the one that refers to universities. This indicates that these are companies that consider universities as the main source of innovation, although they also attach importance to most of the other actors. These firms are of varying sizes. 50% of workers have university degrees and 25% have an R&D department. Compared to the rest, there are more companies from the manufacturing sector and personal services. In more than half of the cases they have introduced product innovation in the last 5 years. One third has made innovations that are new in the market.

- Group 2: Makes up 63.91% of the firms in the sample. Their main feature is that all of the components receive high scores in a more balanced fashion. Therefore, this group of firms does value having multiple relationships. The role attributed to universities is similar to the previous group. However, this group attaches more importance to business networks, to the government and RTOs and, especially, to some KIBS that are highly technologically oriented. The sizes are also varied. Just over 65% have workers with university degrees. There are more firms from professional and financial services and technical services. 63% of the cases declared that they were introducing product innovation and 46% innovations that were new in the market.

- Group 3: Makes up 31.89% of the sample. The distinguishing feature is that practically all of the components receive lower scores. It should be noted that some actors show values which are similar to the previous groups in areas such as suppliers, clients and some specialized services, although universities, some KIBS, and especially government play an almost irrelevant role. In short, this group of firms is the one that attaches the least importance to the different actors in the environment as sources of knowledge. This group includes smaller firms with fewer university degrees, fewer R&D departments and comparatively are concentrated in the areas of personal services and sales. They are also the ones that declare fewer innovation activities: 43% have introduced a product innovation in the last 5 years, and 29% an innovation in their market.

5. Conclusions

The comparative study of the different actors makes it possible to establish what their role is in the innovation strategies of the firms in a regional environment. Some sources are considered vital for innovation by practically all firms. Business networks and some knowledge intensive services are, therefore, resources essential for staying competitive. Other sources have little weight, such as some services provided by universities, local and regional governments, and some KIBS that are valued by a very specific group of firms.

Grouping firms by the sources they value makes it possible to observe the dynamics of the interactions in a regional environment and their relation with innovation processes. There is a minority group characterized by the fact that it assigns a special importance to universities compared to other sources, although the rest of the actors are also important. Besides, a large group exists that pays attention to almost all actors in the environment as innovation sources. This group of firms seems to be the one that is closest to the rationale of relationships indicated by the TH. The third group is clearly characterized by having a strategy that depends less on external knowledge.

The profile of the three groups of firms indicates that those that assign more importance to different actors in the environment are the same ones that have the greatest absorption capacity and declare the most innovations. With the available data it is possible to maintain in a general sense the TH thesis, taking into account that those firms characterized by their willingness to cross diverse institutional environments are also those that show more innovative features. The companies that assign importance to several sources at the same time are also those that more frequently recombine different elements adapted to their innovation processes. It should be expected that these companies will also be those that have more capacity for absorption and those that produce more radical innovation. However, the results indicate the complexity of situations that emerge within the TH scheme. On the one hand, there are very few firms that centre their strategies on collaboration with universities, but usually combine this with other actors. On the other hand, there is not a clear distinction on the traits showed by innovative and non-innovative firms, suggesting the existence of diverse innovation processes where scientific knowledge producing agents do not play a relevant role.

Finally, note should be taken of the implications for regions such as the one studied here, with an industrial sector made up predominantly of small companies concentrated in the services segment. When the university takes on a relevant role in regional innovation, it brings with it a multiplicity of collaboration relationships between different agents in the three institutional spheres. In a regional peripheral environment, innovation from universities does not exclusively consist of using technological and scientific based knowledge, but of employing the wide range of services that acquire more value when they are recombined with elements from other sources.

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