



International Co-operation between Firms on Innovation and R&D: Empirical Evidence from Argentina and Spain

Mónica Edwards-Schachter¹, Elena Castro- Martínez², Ignacio Fernández-de-Lucio³

Abstract

This paper examines co-operative innovation and Research and Development (R&D) behaviour between Argentine and Spanish firms. Based on theoretical perspectives from the literature, we present empirical evidence obtained from 104 firms of patterns of cooperation in several processes and out-puts, highlighting firm characteristics, the motives of the collaborating parties, types of partners, R&D and innovation activities, leadership, and obstacles to cooperation. Our results reveal that the determinants of success differ considerably among countries depending on the sector, the firm specific characteristics and funding. These differences have important implications for public policy and instruments to support R&D and innovation activities.

Keywords: R&D; international cooperation; technological cooperation; innovation; cooperation patterns; argentine firms; spanish firms.

^{1,2,3} INGENIO (CSIC - UPV), Universitat Politècnica de València, Ciudad Politécnica de la Innovación (CPI), Camino de Vera s/n, Ed. 8E, 4º P. 46022-Valencia (Spain), TE: + 34 963877048 Fax + 34 963877991. Email: moed@ingenio.upv.es; ecastrom@ingenio.upv.es; ifernand@ingenio.upv.es

Introduction

Knowledge creation and networking are increasingly at the international level and are accompanying the emergence of global patterns of R&D and innovation (Archibugi and Iammarino, 2002; Narula and Duysters, 2004; Edler, 2007, 2008). Current evidence on R&D flows suggests that the global innovation environment has changed due to more intense global competition and the need to innovate more quickly and on a different scale (Niosi, 1999; Carlson, 2006; Edler, 2008). The internationalisation of R&D and innovation stems from: the complexity of global competition with the advent of new, more differentiated products and producers; institutional change as a result of liberalization; the impact of information and communication technologies (ICT); transformations in markets, competition and industrial organization; adjustments in corporate strategies and business models, among others (Ernst, 2005; OECD, 2008). The increasing costs and risks associated with technological innovation have led firms to see cooperation as the best option in many instances, particularly in capital- and knowledge-intensive sectors (Narula and Duysters, 2004). In words of De la Mothe and Link (2002:266) "Technological competition has increasingly become global in scope and related technology life cycles have shortened; firms have correctly responded to this new order by implementing multifaceted innovation strategies that reflect a new philosophy about the interdependence of competing firms. Speed in innovation is increasingly becoming the strategic benchmark upon which competitive survival will be benchmarked. As such, firms are partnering with other firms, organizations and institutions in an effort to survive".

The available literature on global technological collaborations is more fragmented and is not easily identifiable. Apart from some 'commercial' databases, mainly focused on the biotechnology and information technology sectors, there are few databases (Hagedoorn et al., 2000). Information obtained from the MERIT-CATI database -one of the few still existing databases- shows that the strategic alliances for technological purposes have substantially increased since 1970 to present, being particularly relevant in crucial technological areas such as biotechnology, new materials and information technologies (Hagedoorn 1996, 2002; Archibugi and Iammarino, 2002). Hagedoorn (2002) shows that R&D partnering is 'a game' dominated by companies from the world's most developed economies. Technological

alliances between countries of the Triad (United States, European Union and Japan) have grown 170% between 1980 and 1998 with a clear dominance of United States in major high-tech industries (Hagedoorn, 2002; Niosi and Reid, 2007). At the present and according a recent OECD report the propensity to collaborate on innovation with partners abroad varies widely among countries, ranking from less than 2% of all firms in Korea, Japan and Australia to more than 8% in Canada and New Zealand. Among European firms, for example, the share of collaboration with partners in a different country within Europe ranged from less than 2% in Italy, Rumania and Spain to more than 12% in Denmark, Finland and Belgium (OECD, 2008, 2009). In developing countries, as emerges from in depth reading of a review of the literature promoted by UNCTAD firms are only marginally involved in such collaborations (Pietrobelli 1996; Ernst, 2005).

To our knowledge and despite the extensive empirical literature on inter-firm cooperation, there is little information and few studies on cooperation in both Spain and Argentina. Several authors such as Agüero et al. (1999), Bayona et al. (2001), Hidalgo Nuchera and Albors Garrigós (2004a, b) and Heijs and Buesa (2006) in Spain, and Albornoz and Estébanez (1998) in Argentina have carried out studies, but mostly focused on cooperation at the national level. This may be the first investigation specifically targeting inter-firm cooperation in both countries.

In this context, this paper intend to explore the extent to which Argentine and Spanish firms engage in cooperative R&D behaviour and aims to shed light on the characteristics of such relationship, being its principal objectives:

- to detect and characterize cooperation relationships on innovation and R&D between Spanish and Argentine firms,
- to analyze patterns and firm characteristics that influence firms' decision to cooperate with foreign partners on their innovation and R&D activities
- to identify barriers which could influence inter-firm cooperation in both countries.

Theoretical background and literature review

Archibugi and Michie (1995) have distinguished three modes of internationalisation on innovation and R&D: a) International R&D cooperation between partners in more than one country to generate new scientific knowledge and technological know-how, whereby each partner retains its own institutional identity and ownership remains unaltered; b) International generation of knowledge and innovations carried out by multinational enterprises which create innovations across borders by building up research networks including the establishment of new R&D units in the host country or the acquisition of foreign R&D units, i.e. Foreign Direct Investment (FDI) in R&D; and c) International exploitation of innovation, know-how and technologies through means of trade, granting of licenses and patents, reverse engineering etc. (technological collaborations). But, what do we understand by “international collaborations”, including innovation cooperation activities?

There are several definitions of international cooperation involving R&D and innovation, which are considered to be the “the relation between different organizations based on innovation with a certain content of R&D” (Hagedoorn et al., 2000). In general, international cooperation on R&D and innovation is seen as a strategic decision that implies the transfer of knowledge between partners located in different countries (Barajas and Huergo, 2006). The decision to cooperate goes beyond the selection of a foreign partner and involves the company becoming familiarized with an environment that is different from its habitual one, which may have implications for the management of innovation resources and activities.

Although aspects such strategic technological alliances became the focus of considerable theoretical and empirical attention during the 1980s and 1990s, literature is fragmented and heterogeneous (Archibugi and Iammarino, 2002; Tether, 2002). There is no established theory, either in management (at the firm level) or industrial and evolutionary economics (at the industrial level) to explain the present wave of international technological cooperation. Nevertheless and following the works of Lundin et al. (2004) it is possible to establish a global scheme for analysis, taking into account the confluence of three theoretical scopes: internationalisation, cooperation and innovation (including R&D, technological and non technological innovations).

Various authors have provided extensive reviews on the phenomena of cooperation and establishment of international alliances, analyzing their evolution from 1960 (Hagedoorn, 2002; Hagedoorn and Osborn, 2002; Narula and Duysters, 2004). Research literature focuses on four areas: the reasons for cooperation; selection of partners; alliance management (control, conflicts, fulfillment of the alliance objectives, leadership); results and impact cooperation (Bayona, García-Marco and Huerta, 2001; Vonortas et al., 2003; Lundin et al., 2004). Research on understanding international inter-firm cooperation on R&D and innovation can be grouped into the following representative strands:

- Market-power theory (MPT), focused on cooperation as mediator instrument between market and firms for improving their competitive success (Porter, 1980; Child and Faulkner, 1998).
- Transaction Cost Theory, related to the cost of participating in a market and making an economic exchange (Teece, 1987; Brockhoff, 1992);
- Strategic Management Theory, focused on the relation between technological cooperation and corporate strategy (Dodgson, 1992; Child and Faulkner, 1998);
- Industrial Organization Theory, focused on the study of firms’ strategic behaviour, and the structure of markets and their interactions, paying attention to the generation of spillovers (Gassmann and von Zedtwitz, 1999; Hagedoorn et al., 2000).

Other theoretical perspectives include Social Exchange Theory (Das and Teng, 2002), Resource-Based Theory (Conner and Prahalad, 1996; Combs and Ketchen, 1999) and game theory (Sanna-Randaccio and Veugelers, 2001; Eriksson, 2007; Binenbaum, 2008).

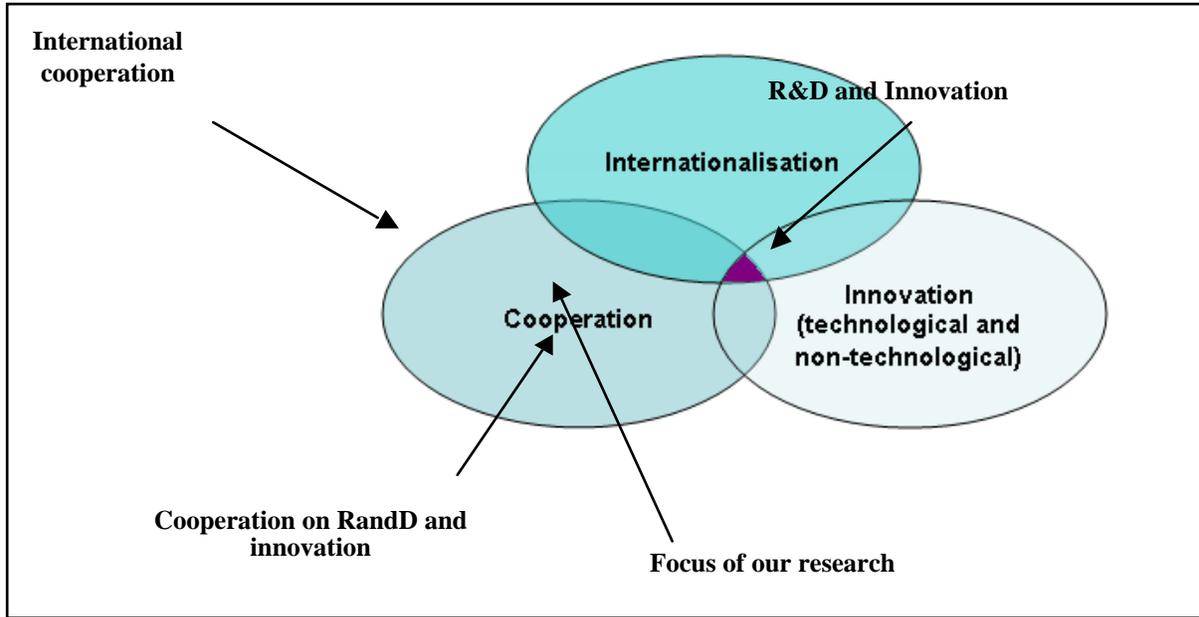


Figure 1. Analytical scheme of international cooperation on innovation and R&D (including technological and non-technological innovation).
 Source: adapted from Lundin et al. (2004, p. 7)

Table I provides a brief explanation about the principal aspects considered by the literature on of international cooperation on innovation and R&D:

Topics	Researchers
<p><i>Firm size.</i> Although there is no consensus in the literature, most authors assume a positive correlation between firm size and cooperation in R&D, and innovation intensity.</p>	<p>Molero (1998); Bayona <i>et al.</i> (2001); Hidalgo Nuchera and Albors Garrigs—(2004a, b); Narula (2004)</p>
<p><i>Firm age and experience</i> Previous experience and age of the firm are positively correlated to participation in cooperation on R&D and innovation.</p>	<p>Molero (1998); Fritsch and Lukas (2001)</p>
<p><i>Motives for cooperation.</i> Hagedoorn (1993) lists the motives for cooperation as:</p> <ul style="list-style-type: none"> (1) related to basic and applied research and some general characteristics of technological development (minimizing and sharing of uncertainty in R&D, reduction in and sharing of costs of R&D). (2) related to real innovation processes (capturing partner's tacit knowledge of technology, technology transfer, technological leapfrogging, shortening the product life cycle, and the period between invention and market introduction). (3) related to market access and opportunities (internationalisation and entry to foreign markets, new products and markets, expansion of product range).. 	<p>Hagedoorn (1993), Bayona <i>et al.</i> (2001); Nooteboom (1999); Narula (2002, 2004); Tether (2002); Vonortas <i>et al.</i> (2003); Montoro <i>et al.</i> (2006)</p>

<p><i>Activity sector and technological intensity.</i></p> <p>In the case of small and medium sized enterprises (SME), the extent and intensity to which they can use collaboration varies by the maturity of their primary technologies. Some firms operate in sub-sectors that are increasingly paradigmatic and mature, others are pre-paradigmatic and nascent.</p>	<p>Molero (1998); Hagedoorn (1993); Narula (2002); Lundin <i>et al.</i> (2004)</p>
<p><i>Cooperation agents</i></p> <p>Include the type of partner (other firm, university, research institute) and the reasons for their selection.</p> <p>Cooperation may be horizontal (between competitors) or vertical (customer, supplier), intra or inter-sectoral.</p>	<p>Dussauge <i>et al.</i> (2000); Fritsch and Lukas (2001); Lundin <i>et al.</i> (2004); Heijs and Buesa (2006); Montoro <i>et al.</i> (2006)</p>
<p><i>Agreement types</i></p> <p>Formal, informal, joint venture, equity and non-equity agreements, etc.</p>	<p>Hagedoorn (1990); Nooteboom (1999); Lundin <i>et al.</i> (2004)</p>
<p><i>Cooperation process</i></p> <p>Includes management of the agreement, initiation of contacts between firms, project management, organizational climate, leadership, etc.</p>	<p>Hagedoorn (1993); Khanna <i>et al.</i> (1998); Nooteboom (1999); López (2008); Hoffman and Schlosser (2001); Gerwin and Meister (2002); Kauser and Shaw (2004)</p>
<p><i>Regulatory conditions and funding</i></p> <p>Governments can facilitate (or not) international collaboration through financial support and easing of the regulatory conditions that restrict the potential for cooperation. Most international activities take place within established international networks and programmes. In general, there are more multilateral programmes and international instruments are not integrated with national strategies</p>	<p>Nooteboom (1999); Hidalgo Nuchera and Albors Garrigs—(2004a, b); Lundin <i>et al.</i> (2004); Heijs and Buesa (2006)</p>
<p><i>Barriers to cooperation</i></p> <p>There are several barriers: financial restrictions, lack of suitable human resources, problems of appropriability of the results among partners, additional costs and time of cooperation, finding suitable partners, coordination/communication problems, conflicts of different interests, etc.</p>	<p>Dodgson (1992); Hladik (1988); Hagedoorn (1993); Hidalgo Nuchera <i>et al.</i> (2006); Tiwari and Buse (2007); Teixeira <i>et al.</i> (2008)</p>
<p><i>Results and impact of cooperation</i></p> <p>Economic and technological improvements, including the effects of technological spillovers, the development of new products, the development of/improvements to new or existing processes, exploitation of complementary resources, acquisition/creation of new knowledge, etc.</p>	<p>Cassiman and Veugelers (1999); Hagedoorn and Schakenraad (1994); Criscuolo (2004); Kauser and Shaw (2004); Heijs and Buesa (2006)</p>

Table 1. Principal issues related to international cooperation on R&D and innovation

There were some limitations in this study considering the innovation landscapes in the world and in both countries. We must recall the general low level of resources devoted to R&D and innovation in both countries. Thus, the amount of R&D expenditures as part of GDP is around 1.3% in Spain (lower than those of most European countries) and 0.5% in Argentina (Table 2). National Innovation Surveys in both Spain and Argentina puts in evidence similar characteristics in relation to the firms' innovation behaviour and strategies: a high number of companies which declares to make R&D that contrasts with a low magnitude in their innovation efforts. In Argentine firms the dominant innovation strategy is the external knowledge acquisition while in Spanish firms prevail the

in-house R&D activities. A recent research realised by Vega-Jurado et al. (2008) with a sample of 329 Spanish manufacturing firms shows that the development of in-house R&D activities is the principal innovation strategy, while R&D contracting and cooperation with external agents has not significant effect on firm's innovative performance. In addition, inter-firm co-operations are reported to encounter high failure rates (Dans and Teng, 2000; Sivadas and Dwyer, 2000; Bönthe and Keilbach, 2005). Das and Teng (2000) account that their literature survey, comprised of 16 empirical studies, leads to the conclusion that less than half of the alliances studied can be said to have performed satisfactorily.

- (1) Low level of innovation resources. The amount of R&D expenditures as part of GDP is 0.5% in Argentina and 1.3% in Spain
- Low industry financed R&D: Argentina: 30% - Spain: 55%
 - Weak density relationships between the different actors of the respective National System of Innovation (NSI)
 - Majority of SME and few large companies
 - Little development of risk capital
 - Principal innovation strategies: in Argentina R&D acquisition (*external R&D*) and in Spain in house R&D
 - Innovative firms in Spain cooperate over innovation less than other European countries
 - Cooperation is not relevant for the majority of Argentine firms

Table 2. Argentine and Spanish innovation landscape. Sources: INDEC (2008), INE (2009) and EUROSTAT (2010)

Regarding these limitations and the lack of databases on inter-firm cooperation in both countries, we consider the particular case of firms that we believe have been involved in cooperation (firms that have participated in international cooperation programmes, and exporting firms). Although our analysis is related primarily to technology cooperation, we consider both technological and non-technological innovation activities performed by the firms.

Method

We elaborated a database containing 540 innovative firms from Spain and Argentina to administer a survey which received a response rate of 20.2%. A significant percentage (47%) of the surveyed enterprises had participated in a government program called IBEROEKA, a political instrument that was introduced in 1991 to reinforce industry competitiveness in 21 Ibero-American countries through scientific and technological cooperation among innovative enterprises and other actors (Hidalgo and Albors, 2004; Hidalgo et al., 2006). Additional information on other firms was obtained from the Spanish Institute for Foreign Trade (Instituto Español de Comercio Exterior, ICEX) database. The survey was administered by mail and online and was complemented by information obtained through telephone interviews.

The questionnaire included 51 multi-item and closed and open-ended questions distributed in three parts, as follows:

- Part 1 collected data on firm background and general characteristics (size, sector and branch of activity, human resources, etc.).
- Part 2 asked about the firm's general experience with cooperation on innovation and R&D in general
- Part 3 collected data on cooperation relationships between Spain and Argentina, focusing on in-puts, out-puts and the cooperation process (motives of the collaborating parties, cooperation modalities, types of partners, previous experience of cooperation with firms, universities, research institutes and other agents, forms of agreements, expected outcomes, investments and public support for innovation activities, results of cooperation, etc).

Results

In this study we firstly performed a descriptive analysis of the sample. Secondly we have used statistical methods to analyze the relationship between variables. Considering the type of variable, we use non-parametric analysis (U Mann-Withney and Kruskal-Wallis tests) when the variable is quantitative and Pearson's chi-square if it is qualitative (see Annex).

Firms' profile

Majority of Spanish companies claimed to be innovators (53 out of 56 firms, 94.6%) and were in favour of cooperation (51 or 91.1%). The percentage of Spanish firms that cooperated with other firms in the last three years (39 firms) was 70%. The results for Argentina are less favourable to cooperation: 20 out of 48 firms are innovators (41.7%) and 21 had cooperated with other companies (43.8%). Only 17 Argentine companies had cooperated over R&D and innovation with Spanish companies, which is only just over a third part of the companies in our sample (35.4%) (Figure 2). 80.4% (45 companies) are involved in exporting, with the percentage similar for both countries (12 out of 17 Argentine firms and 33 out of 39 Spanish firms, 70.6% and 84.6% respectively).

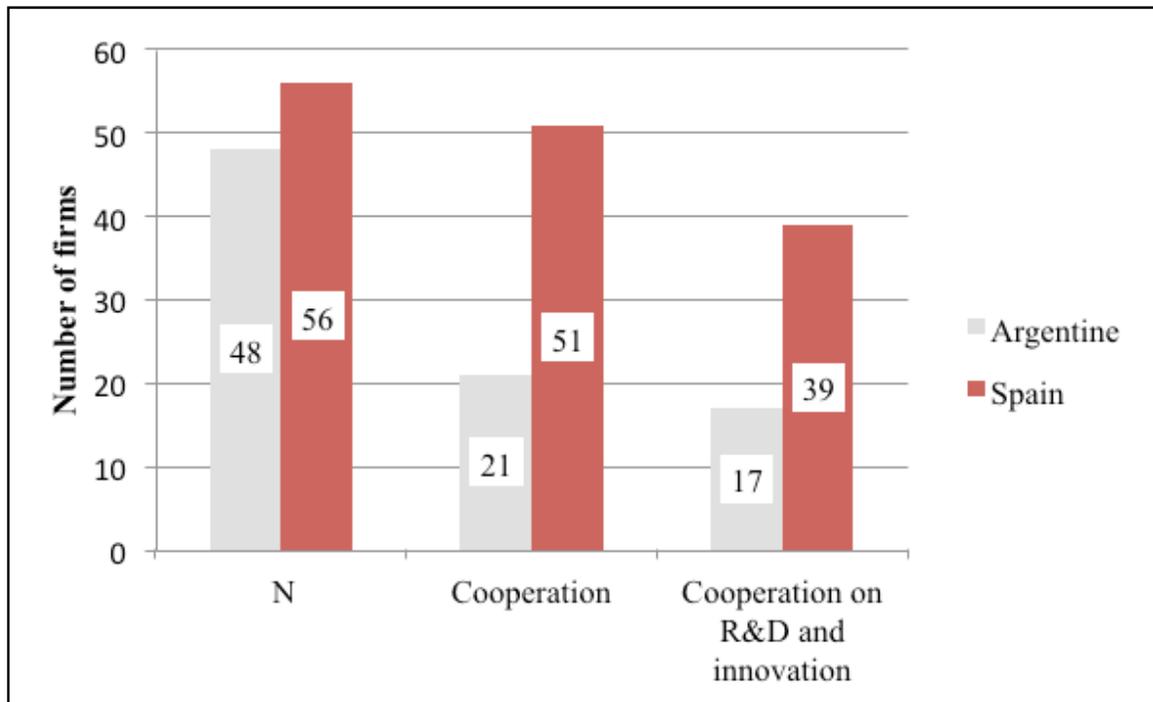


Figure 2. Cooperation between Argentine and Spanish firms

Firm size

In particular, the segment of small firms fits the knowledge profile of the Spanish firms, being SME the main collaborators: 14 out of 17 Argentine companies (82.4%) and 26 out of 39 Spanish firms (66.7%). None of the large Argentine companies in the sample had been involved in cooperation and only 5 from the Spanish sample (8.9%) had collaborated. These results are in contrast to those in the literature, which highlights big companies as being the main collaborators based on presence in the market and high level of R&D intensity (Hagedoorn and Schakenraad, 1994; Vonortas, 1997; Fritsch and Lukas, 2001; Tether, 2002; Cassiman and Veugelers, 2006). Also empirical work on Spain shows similar results (Fonfría, 1998; Bayona et al., 2001; López, 2008). In general, the state-of-the-art review evidences that relation size-innovation depends of the innovation activity. Thus, great firms predominate in the activities with mature and relatively stable technologies. Nevertheless, smaller companies tend to concentrate in clusters geographic to take advantage of synergies in technologies of faster evolution. Most authors assume a

positive correlation between firm size and cooperation in R&D, and innovation intensity (Molero, 1998; Bayona et al., 2001; Hidalgo Nuchera and Albors Garrigós, 2004a and b; Narula, 2004). As it shows in the table (Annex) for the total sample size of firm is related with companies that transfer technology from Spain to Argentina ($p < 0.1$). In the case of Argentina, receiving subsidies from the state is related to size ($p < 0.1$).

Age

Previous experience and age of the firm are positively correlated to participation in cooperation on R&D and innovation (Molero, 1998; Fritsch and Lukas, 2001). In general younger companies are more keen to cooperate: more than half of those in the sample had been established for less than 20 years and a third had been in existence for only 10 years. The highest frequency of cooperation is among companies aged 20 to 50 years old, and percentage involved in collaboration among companies more than 50 years old is only 9.1% (see Table 3). In the case of Spanish firms the age of the company is different according to the cooperation frequency ($p < 0.1$) (see Annex).

Age [year]		Argentine firms N=17	Spanish firms N=39	Total N=56 Frequency	%
Valid	Minor of 5	4	4	8	14.5
	5 to 10	3	9	12	21,8
	10 to 20	5	5	10	18.2
	20 to 50	5	15	20	36.4
	50 to 100	0	4	4	7.3
	More than 100	0	1	1	1.8
	Total			55	98.2
Missing Value			1	1	1.8
Total		56			100.0

Table 3. Age of Argentine and Spanish firms

Activity sector and technological intensity

In the case of Small and Medium sized Enterprises (SME), the extent and intensity to which they can use collaboration varies by the maturity of their primary technologies. Some firms operate in sub-sectors that are increasingly paradigmatic and mature, others are pre-paradigmatic and nascent (Molero, 1998; Hagedoorn, 1993; Narula, 2002; Lundin et al., 2004). Figure 3 shows the distribution of firms according to sector of activity. ICT is the most

represented sector in the sample with 24 companies (42.9% of the sample). It is also one of the main sectors involved in IBEROEKA (CDTI, 2009. IBEROEKA's first program was CYTED (Science and Technology for the Development) launched by the Spanish Government and the Economic Commission for Latin America (CEPAL) to improve technological cooperation between firms in Spain, Portugal and Latin America (see <http://www.cyted.org/>).

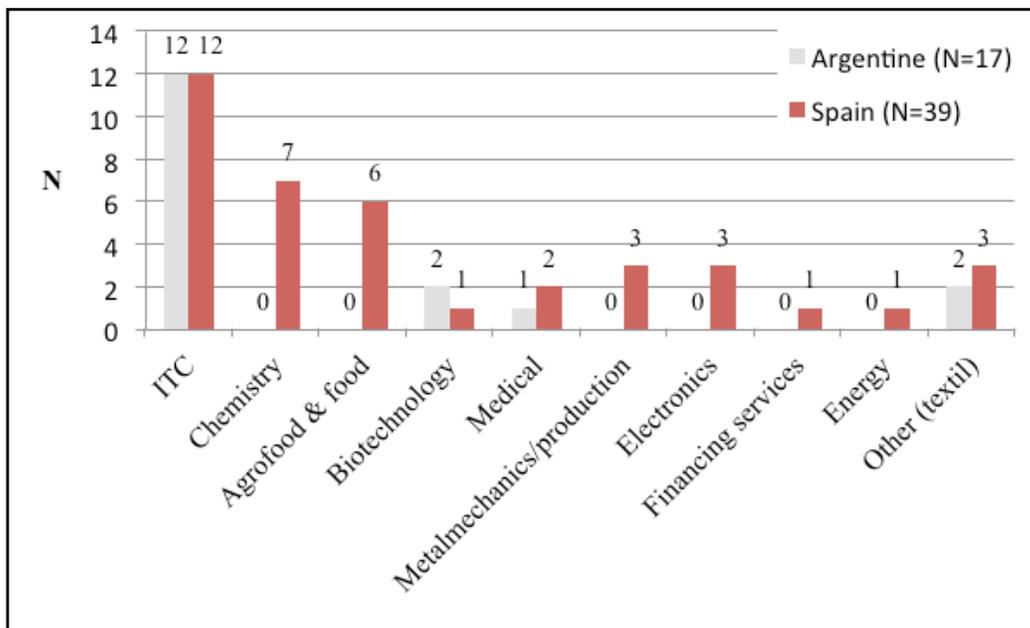


Figure 3. Argentine and Spanish firms

The 76.8% of the companies that have cooperated are of high and medium-high technological intensity and only 23.2% are low and low-medium intensity firms. This trend is especially strong for the Argentine firms (Table 4). This is in line with the literature on SME and innovation activity

in certain sectors and technologies. Two examples of high innovation performance among SME are born globals and SME participation in the EC 7th Framework Programme (FP7), where SME outshone large companies.

Technological intensity	Argentine firms N=17	Spanish firms N=39	Total N=56
High and medium-high	15 (88.2%)	28 (71.8%)	43 (76.8%)
Low and low-medium	2 (11.8%)	11 (28.2%)	13 (23.2%)

Table 4. Argentine and Spanish firms according their technological intensity

Motives for cooperation

Motives for cooperation in general

Hagedoorn (1993) lists the motives for cooperation as: a) related to basic and applied research and some general characteristics of technological development (minimizing and sharing of uncertainty in R&D, reduction in and sharing of costs of R&D); b) related to real innovation processes (capturing partner's tacit knowledge of technology, technology transfer, technological leapfrogging, shortening the product life cycle, and the period between invention and market introduction); and c) related to market access and opportunities

(internationalisation and entry to foreign markets, new products and markets, expansion of product range).

In this study, the first motive is access to new markets, followed by better commercialization and distribution and the introduction of new products to the market. Other reasons include introduction of a technology new to the company and improvements to the productive process (through a new quality system, stock reduction, etc.). Access to resources and organizational improvements seem to be less important (Figure 4).

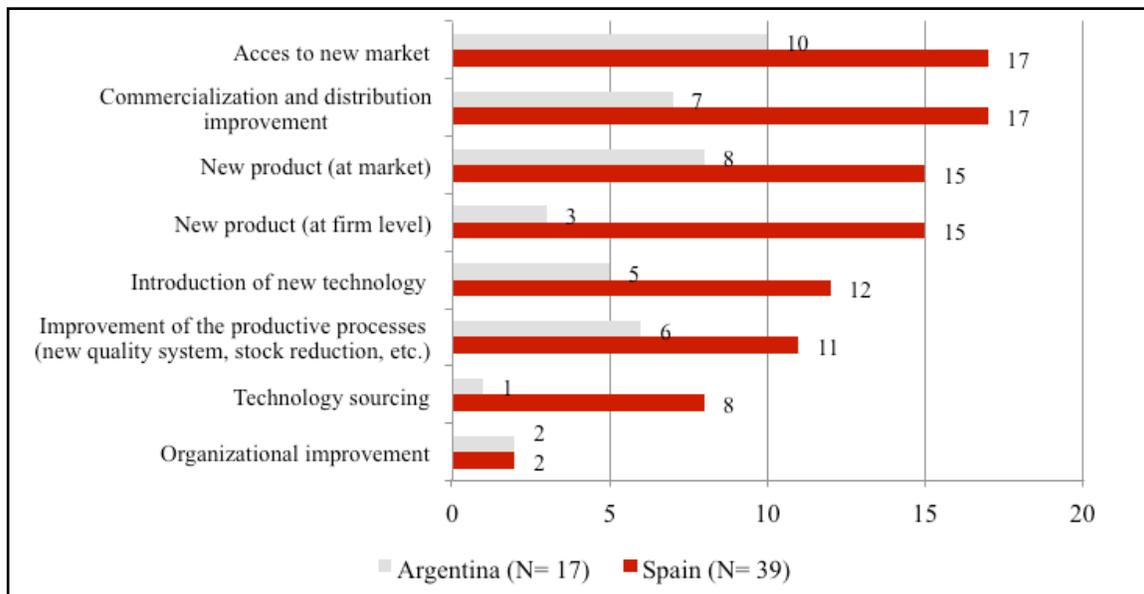


Figure 4. Motives for general cooperation between Argentine and Spanish firms (N= 56)

Motives for cooperation over R&D and innovation

The first strategy is entering new markets (27 companies cited this as the main reason in order to increase sales/exports). Joint R&D tasks, technological complementarities, technical assistance and technical problem solving are other important motives for cooperation, as a logical consequence of technological cooperation projects financed through the IBEROEKA programme (see details at Fig. 5).

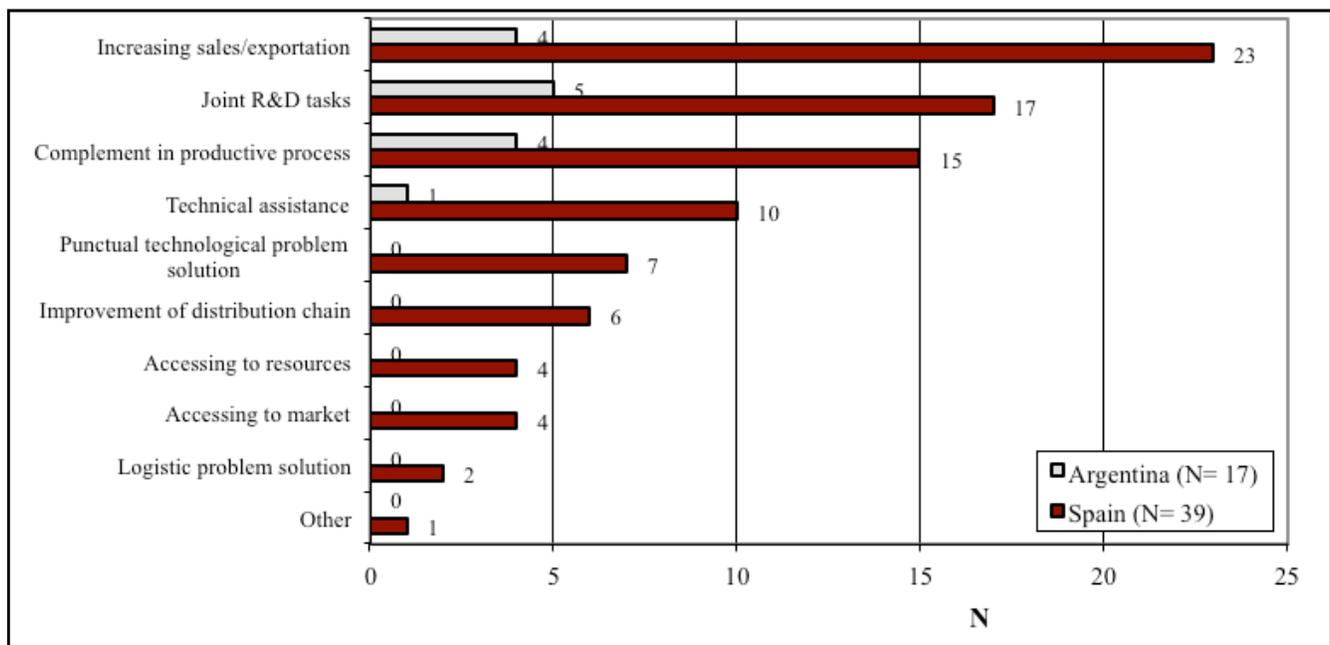


Figure 5. Motives for inter-firm cooperation on R&D and innovation (N= 56)

In contrast to the literature on motives for technological cooperation (Hagedoorn, 1993; Bayona et al. ,2001), we observe that access to markets (economic reasons) for Spanish firms is more important than technological reasons (greater focus on R&D than innovation).

Cooperation process

Partners and types of cooperation activities involved in R&D and innovation

Cooperation may be horizontal (between competitors) or vertical (customer, supplier), intra or inter-sectorial. Our results shows that client and supplier firms are the preferred partners for cooperation, with similar participation for both countries: 13 Spanish and 3 Argentine companies, and 12 Spanish and 2 Argentine firms, respectively. Other activities in order of importance are joint R&D tasks and technology transfer (Table 5). The principal reason for the selection of partners is access to new markets (5 Argentine and 19 Spanish firms), followed by the solutions to technological problems (2 Argentine and 15 Spanish firms) and cultural affinity (3 Argentine and 13 Spanish firms).

R&D and innovation activities realized in cooperation	Argentine firms N=17	Spanish firms N=39	Total (N= 56)
Joint R&D tasks	8 (47.1%)	18 (46.2%)	26 (46.4%)
Knowledge transference (from Spanish to Argentine firms)	0	13 (33.3%)	13 (23.2%)
Engineering tasks	0	10 (25.6%)	10 (17.9%)
Knowledge transference (from Argentine to Spanish firms)	9 (52.9%)	0	9 (16.1%)
Commercialization improvement	0	7 (17.9%)	7 (12.5%)
Software acquisition	0	6 (15.4%)	6 (10.7%)
Machinery acquisition	0	6 (15.4%)	6 (10.7%)
Formation (capability improvement)	0	4 (10.3%)	4 (7.1%)
Hardware acquisition	0	4 (10.3%)	4 (7.1%)
Consultancy	0	3 (7.7%)	3 (5.4%)
Organization improvement	0	3 (7.7%)	3 (5.4%)
Industrial design	0	3 (7.7%)	3 (5.4%)

Table 5. R&D and innovation activities realized in cooperation

Table 5 shows that innovation activities are more diversified in the case of Spanish firms and that technology transfer is important for both countries' firms. It is interesting to note that technology transfer occurs in both directions, being located in the group of ITC of Argentine firms.

Agreement types and cooperation frequency

There are 44 cases of formal agreements between firms (78.6%). Within the IBEROKA program the most common type of agreement was joint investment (35 firms). It was also the most frequent at the international level, where the local company contributes with capital or knowledge and facilitates access to the market, while the foreign company contributes with capital, brand image or technology. As regards overseas cooperation frequency, only around a third of firms were involved in continuous cooperation (19 firms, 33.9%) while 24 firms have engaged in cooperation only once (42.9%) (Table 6).

Cooperation frequency on R&D and innovation	Argentine firms N=17	Spanish firms N=39	Total
Continuous	0	19 (48.7%)	19 (33.8%)
More than 5 times	1 (5.9%)	2 (5.1%)	3 (5.4%)
2 to 5 times	3 (17.6%)	7 (17.9%)	10 (17.9%)
One time	13 (76.5%)	11 (28.2%)	24 (42.9%)

Table 6. Cooperation frequency on R&D and innovation

Public financing support for inter-firm cooperation on R&D and innovation

Regulatory conditions and funding

Governments can facilitate (or not) international collaboration through financial support and easing of the regulatory conditions that restrict the potential for cooperation. Most international activities take place within established international networks and programmes. In general, there are more multilateral programmes and international instruments not integrated with national strategies (Nooteboom, 1999; Hidalgo Nuchera and Albors Garrigós, 2004a; Lundin et al., 2004). The table in the Annex shows that for the total sample and in the case of the Spanish firms the participation in the program IBEROEKA is related to the product improvement (p

<0.05). Table 7 presents the types of public support for financing R&D and innovation activity: 53.6% of Spanish firms and approximately the half of the Argentine sample (8 companies, 20.5%) received some type of public support for cooperation from the state (and Europe in the case of Spanish firms). Although these are reasonable percentages, real financing conditions differ widely between countries. Argentina is in a less favorable situation due to the generally weak funding support for innovation and the major macroeconomic instability. In Argentina financing of innovation activities depends is essentially down to the individual firms (Kosacoff, 2007).

Public support for cooperation on R&D and innovation	Argentine firms N=17	Spanish firms N=39	Total (N= 56)
State	6 (35.3%)	24 (61.5%)	30 (53.6%)
Europe	-	8 (20.5%)	8 (20.5%)
IBEROEKA Programme	7 (41.2%)	28 (71.8%)	35 (62.5%)

Table 7. R&D and innovation public supporting

Barrierstointernationalinter-firmcooperation on R&D and innovation

Several barriers such as financial restrictions, lack of suitable human resources, results appropriability among partners, additional costs and time of cooperation, finding suitable partners, coordination/communication problems, conflicts of different interests, etc., affect or cause negative impact on cooperation processes (Hladik, 1988; Hagedoorn, 1993; Dodgson; 1992; Hidalgo Nuchera and Albors Garrigós, 2004a,b; Tiwari and Buse, 2007). Inter-firm networks are frequently seen as facilitating innovation by being sources of ideas, information and resources. They also can be obstacles to innovation cooperation for technical, knowledge, social and administrative reasons. We can distinguish between internal firm level barriers,

from external obstacles. According to the information obtained via the telephone interviews the main difficulties are initiation of the cooperation process, search for partners, and negotiation of agreements. In some sectors –the Chemical industry- the existence of significant differences in normative and regulation conditions is an important obstacle to cooperation. At firm level, the principal obstacle is time taken to produce firm results (14 companies, 25%), followed by non compliance with the cooperation contract, and the inadequacy human resources (Table 8).

Obstacles at firm level	Argentine firms N=17	Spanish firms N=39	Total (N=56)
Time with respect to the concretion of results	7 (41.1%)	7 (17.9%)	14 (25.0%)
Lack of fulfillment or infringement by the other party	1 (5.9%)	3 (7.7%)	4 (7.1%)
Lack of suitable human resources	1 (5.9%)	3 (7.7%)	4 (7.1%)

Table 8. Barriers to cooperation on R&D and innovation at firm level

Difficulties related to accessing finance and macroeconomic instability, followed by lack of government support and distance between partners were identified as the main obstacles. These results agree with empirical evidence for other countries (Heijs and Buesa, 2006).

Results of the cooperation experience: differences between Argentine and Spanish firms

Economic and technological results

We also analysed the results of cooperative innovation obtained by the firms, including economic and technological/innovation results. Similar to the indicators for technological results we considered the percentage of companies that obtained product or process innovations, and the frequency of commercial and organizational innovations, and patents and the licences (Table 9).

Cooperation results	Argentine firms N=17	Spanish firms N=39	Total
Product			
Product improvements	3 (17.6)	9 (23.1%)	24 (42.9%)
New product introduction	3 (17.6)	23 (59.0%)	25 (44.6%)
Patent (product)	1 (5.9%)	1 (2.6%)	2 (3.6%)
Market			
Market expansion	2 (11.8%)	17 (43.6%)	19 (33.9%)
Market openness	3 (17.6)	13 (33.3%)	16 (28.6%)
Process			
Increasing of the productive capacity	0	13 (33.3%)	13 (23.2%)
Costs reduction	1 (5.9%)	6 (15.4%)	7 (12.5%)
Improvement of human resources	1 (5.9%)	3 (7.7%)	4 (7.1%)
Patent (process)	0	0	0
Organizational improvement	0	2 (5.1%)	2 (3.6%)

Table 9. Results of the inter-firm cooperation

Firm satisfaction with the cooperation experiences

Respondents were asked to estimate the degree to which the specific benefits from cooperation were achieved. Results show that Spanish companies are more optimistic in this regard than Argentina's firms. If we consider satisfaction in terms of cooperation objectives, 13 Spanish firms (33.3%) and only 1 Argentine were totally satisfied while 15 Argentine Spanish firms (38.5%) and 3 Argentine firms (17.4%) declared being only partially satisfied. Although half of the companies in the sample said they cooperated frequently and were satisfied with the cooperation experience the degree of importance attributed to the innovation activities involved was described as "high" by only 10 Spanish companies (25.6%) and 4 Argentine (23.5%) firms (Table 10).

Importance level of the innovation activities in cooperation	Argentine firms N=17	Spanish firms N=39	Total N= 56
High	4 (23.5%)	10 (25.6%)	14 (25.0%)
Medium	3 (17.6%)	10 (25.6%)	13 (23.2%)
Low	0	8 (20.5%)	8 (14.3%)
Irrelevant	1 (5.9%)	0	1 (1.8%)
Cooperation results			
Firm decides the renovation of the cooperation agreement	5 (29.4%)	12 (30.8%)	17 (30.4%)
Deepening the cooperation bonds	6 (35.3%)	12 (30.8%)	18 (32.1%)
New knowledge was incorporated to the firm	5 (29.4%)	10 (25.6%)	15 (26.8%)
The firm profits have been incremented	2 (11.8%)	9 (23.1%)	11 (19.6%)
Patenting/licensing	1 (5.9%)	3 (7.7%)	4 (7.1%)
Firm choose to cooperate again			
Yes	9 (52.9%)	26 (66.7%)	35 (62.5%)
No	8 (47.1%)	13 (33.3%)	21 (37.5%)

Table 10. Importance level of the innovation activities in cooperation

Conclusion

This study looked at the phenomenon of cooperative R&D involving Argentine and Spanish firms, and its interrelationships in order to evaluate the quality of the interactions. We find that the difficulties involved in international inter-firm cooperation over R&D and innovation activity is not straightforward. Of the more than 100 companies that responded to our survey, those from a sample of firms most likely to have been involved in innovation and cooperation, only 56 firms had cooperated, 39 in Spain and 17 in Argentina. Although nearly half of these companies had participated in a public program designed to promote cooperation and received financial support, only 35 had engaged in cooperation activities. Argentine firms have less experience of cooperation than do Spanish firms explained in part by the less favourable financing conditions and the less stable macroeconomic context. Around 50% of Spanish firms cooperate more or less continuously, while 75% of Argentine firms had cooperated only once.

The information obtained contributes to a better understanding of inter-firm cooperation in two countries which have been overlooked by research and on which and empirical evidence is scarce. This applies especially to high and medium technological intensity SME. We also show, and in contrast to the literature on the motives for technological cooperation, that for the SME in both the countries studied, opportunities from access new markets, launching new products and greater commercialization are major reasons for cooperation. Overall, this study shows that there are some significant differences in the types of cooperation which are based on firm characteristics (size, sector of activity, innovation strategies, R&D and innovation activities). Differences in the financial mechanisms for supporting R&D and innovation between Spanish and Argentine firms are an important barrier to cooperation. Information from interviewees shows that the asymmetric distribution and conditions of financial support within the IBEROEKA programme is another major obstacle to successful cooperation initiatives.

The impact of cooperation is more positive for Spanish than for Argentine firms. The latter are less optimistic about the cooperation experience. Thirty per cent of the sample is disposed to renew the cooperation agreements and only in only a few cases had cooperation resulted in new knowledge and increased profits for the firm. Internationalisation of R&D and innovation constitutes both a challenge and an opportunity for companies and particularly for SME in high and medium high technological sectors. However, this study demonstrates that cooperation does not seem to make a significant difference to firms' innovation capacity. It also does not help to overcome weaknesses in innovation systems. IBEROEKA signifies a relevant effort in the field of science and technology cooperation in Latin America and has contributed to the initiation of a technology cooperation culture. However, new and more efficient funding instruments would be required in order to balance the countries participation in the programme. Policy to support inter-firm cooperation on R&D and innovation should consider the differences that affect cooperation based on firm specific characteristics and the particular conditions of financing.

Contributions and implications

The contribution of this paper is providing some empirical evidence on the patterns and barriers to inter-firm cooperation in innovation and R&D relationships. Both aspects have significant implications for government policy in this area in the specific contexts of Argentina and Spain. The paper finds that the different context conditions impinge upon the pattern, motives and effects of cooperation. These findings call for a differentiated strategy both by the management at firm level and by the incentives set by policy measures. It has to be noted that certain hampering factors which shape the cooperation pattern are caused within the organizations and can be improved by individual management decisions. Yet, other factors shaping the inter-firm cooperation are determined through the national institutional setting and policy framework. This calls for more profound changes and adaptations in the system which will eventually not only lead to easier and more flexible cooperation within the organizations but also to a spread of benefits more broadly in the innovation system.

All firms (N=56)										
	Cooperation frequency	Funding (regional)	Funding (state)	European Funding	Product improvement	Market improvement	Process improvement	R&D and Innovation activities	Technology transfer from Spain to Argentina	Technology transfer from Argentina to Spain
Years of activity ^a	2,602	-0,6	-1,949*	-0,207	-0,889	-1,853*	-1,086	-0,166	-0,209	-0,557
Size ^b	10,298	1,617	11,506	7,48	5,051	2,476	0,741	5,639	9,124*	5,972
IBK ^b	0,898	0,029	5,063*	0,689	9,009***	1,005	1,466	4,538**	3,341*	1,646
Technological intensity ^b	2,504	1,213	0,464	0,643	0,835	0,262	0,722	0,637	0,935	0,48
Argentina (N=17)										
	Cooperation frequency	Funding (regional)	Funding (state)	European Funding	Product improvement	Market improvement	Process improvement	R&D and Innovation activities	Technology transfer from Spain to Argentina	Technology transfer from Argentina to Spain
Years of activity ^a	3,585	-0,507	-0,507		-0,526	-0,526	-0,742	-0,485		
Size ^b	4,452	2,404	2,769		2,55	2,55	4,032	0,275		
IBK ^b	3,516	1,409	1,409		0,215	0,215	0,243	1,431		
Technological intensity ^b	0,18	0,215	0,215		0,302	0,302	0,883	0,008		
Spain (N=39)										
	Cooperation frequency	Funding (regional)	Funding (state)	European Funding	Product improvement	Market improvement	Process improvement	R&D and Innovation activities	Technology transfer from Spain to Argentina	Technology transfer from Argentina to Spain
Years of activity ^a	4,771*	-0,549	-1,319	-0,683	-0,103	-0,902	-0,061	-0,541	-1,187	-0,43
Size ^b	9,379	2,433	14,420*	4,837	4,093	0,941	1,824	7,585	7,089	4,239
IBK ^b	2,692	1,406	9,149***	0,009	5,290**	0,138	0,869	3,164*	1,406	0,107
Technological intensity ^b	3,726	1,824	0,406	1,333	0,325	1,158	0,023	0,552	1,824	0,032

Annex/ a Kruskal-Wallis statistic for cooperation frequency and U de Mann Whitney for the rest of the cases. b Pearson's chi-square *** p-value<0,01; ** p-value<0,05; * p-value<0,1

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