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Motives For Inter-Firm Cooperation On R&D And Innovation: Empirical Evidence From Argentine And Spain

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Abstract

Motives and determinants supporting inter-firm technological cooperation have been extensively investigated in developed countries but scarcely addressed in developing countries. This paper addresses these issues, investigating empirically several factors influencing the likelihood to cooperate on R&D and innovation between Argentine and Spanish firms, their strategic motives and firms characteristics which influence cooperation. We draw upon data collected through a survey of 104 firms and complementary information gathered from 19 in-depth interviews, combining both qualitative and quantitative methodology. Results of a multinomial regression and the interviews show that the probability to cooperate increases with the firm size and exportation activities and decrease with the firm age whereas, opposite to literature findings, technological intensity of the firm is a non-significant variable. While for Argentine firms the principal motives are cost reduction and the possibilities for improving learning and capabilities, access to new knowledge for technological development and the search for market opportunities are the principal motives for firms located in Spain. Results of interviews also indicates that firm-specific motives and expectations may differ considerably according the activity sector, with relevant implication for norms and regulation policies in each country.

Keywords - Innovation R&D, inter-firm cooperation, motives for cooperation, funding program

JEL Codes - O31, O32, L22

1 Introduction

Since the last four decades an ample literature has shown the growth of strategic alliances for technological purposes, accompanying the emergence of globalization of R&D and innovation patterns (Porter & Fuller, 1986; Granstrand et al., 1993; Niosi, 1999; Archibugi & Iammarino, 2002; Hagedoorn & Van Kranenburg, 2003; Narula & Duysters, 2004). Internationalization of co-operation activities are driven by partnering firms' strengths and weaknesses in helping them counter with this environment of global competitiveness and greater R&D complexity (Duyster, 1996; OECD, 2008, 2010). In this context motives and selection of partners are critical aspects together with the type and nature of the agreement and the technological and specific market conditions. A considerable amount of literature deals with motives and determinants of inter-firm cooperation and their effects in the innovation performance of enterprises. However, geography of the international technological cooperation varies widely among the world and remains relatively un-investigated in numerous developing countries. One of the reasons is that a significant number of studies and empirical evidence are based on a rather 'traditional paradigm' of the management and control of multinational corporations (MNCs) and does not take sufficient account of the SMEs participation in the dynamics of cooperation (Gerybadze & Reger, 1999; Narula, 2002; Gassmann & Han, 2004). Other argument is the non-existence of databases with extensive information, with exception of MERI-CATI from Maastricht University and the Thomson Financial database. Much literature focuses in joint ventures and no in the non-equity R&D driven alliances (such as licenses, contracts, joint projects, etc.) despite they have far exceeded the percentage of international joint ventures formed over the same period (Narula & Hagedoorn, 1999; Hagedoorn & Lundan, 2001). Finally and

maybe the principal limitation is the small percentages of SMEs that engaged in cooperation on R&D and innovation (Lundin et al., 2004; Narula, 2004; OECD, 2010).

Our study attempts to diminish these research gaps, providing some empirical evidence on inter-firm cooperation between Argentine and Spanish firms. Firms pursue different goals and incentives when getting engaged in R&D collaborations, often more than one goal at the same time. Such aspects are the starting point for this paper, together with the analysis of several firms' characteristics which could influence the underlying motives of their decision to cooperate. Although authors such as Bayona et al. (2001) and Trigo & Vence (2012) in Spain and Albornoz & Estébanez (1998) in Argentina have carried out several studies, they are mostly focused on cooperation at national level. This may be the first study specifically targeting inter-firm cooperation in both countries, trying to explore the 'two sides' of technological collaboration (Lawton et al., 1991). The aim of this article is to investigate: (a) several factors that influencing the likelihood of technological cooperation between firms located in Argentina and Spain as established by theory; and (b) the strategic motives for Spanish and Argentine firms to engage in cooperation on R&D and innovation activities.

One of the shortcomings acknowledged in the literature is the generic application of the terms 'technological collaboration' or 'technological alliance' to cover a wide scope of inter-firm-agreements, within the literature this is referred to as a problem of 'multidimensionality' (Osborn & Baughn, 1990). In this paper we consider an ample definition provided by Link & Vonortas (2000) who consider technological cooperation as the relation between different organizations based on innovation with 'certain content of R&D'. In this definition strategic alliance involves equity sharing, in particular joint venture and equity investment, and contractual agreements without equity sharing such as cooperation licensing, manufacturing agreement, formal and informal R&D

agreements, joint development agreement and also informal knowledge exchanges (Porter, 1985; Mytelka, 2001; Contractor & Lorange, 2002). The paper is organized as follows. Section 2 presents a short description of the context related to innovation and technological cooperation in both countries. Section 3 provides an overview of the literature related to motives in R&D cooperation and formulates the analytical framework for our study. Section 4 describes the methodology applied, Section 5 presents and discusses our results and, finally, Section 6 concludes.

2 Cooperation in weak innovation systems

Previously to explore the existence of technological cooperation activities between Spanish and Argentine firms, it is interesting to take into account an overall picture about innovation in each country. In both cases the productive system comprises few large firms and a majority of SMEs within a context of a weak National Innovation System (Katz & Bercovich, 1993; IUS, 2012). In the Innovation Union Scoreboard Spain is considered as moderately innovative, below the European average and ranked 19 of 27 European states (IUS, 2012:33). Among the root causes of this poor performance is the small percentage of SMEs that collaborate on innovation, reduced total costs under development innovation and venture capital, but no doubt the Spanish productive structure (in which the high-tech sectors account for less than 8% of total Gross Value Added) is the factor which contributes to the low values of effort on R&D and innovation (Celikel-Esser et al., 2007; EUROSTAT, 2006, 2010; Trigo & Vence, 2012). 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; R&D industrial funding is around 30% in Argentina and 55% in Spain (INDEC, 2008; EUROSTAT, 2010; OECD, 2010). In Argentine firms the dominant innovation strategy is the external knowledge acquisition while in Spanish firms prevail the in-house R&D activities.

3 Motives for international inter-firm cooperation: literature overview

Theoretical and empirical research has approached motives for cooperation on R&D and innovation from different perspectives, and the stock of literature is quite extensive, fragmented and heterogeneous (Archibugi & Iammarino, 2002; Tether, 2002). Hagedoorn (1993) elaborated a categorization for cooperative R&D considering three complementary theoretical strands: the Transaction Cost Theory, related to the sharing of cost and risk for developing innovations (Teece, 1986; Brockhoff, 1992; Das & Teng, 1996); the Strategic Management Theory, focused on the relation between technological cooperation and corporate strategy (Dodgson, 1992; Child & Faulkner, 1998) and the Industrial Organization Theory, centred in the study of firms' strategic behavior related to the structure of markets and the spillovers generation (Gassmann and von Zedtwitz, 1998; Hagedoorn et al., 2000). Hagedoorn's taxonomy follows the innovation process from invention to the introduction of new products in the market (innovation). Other theoretical perspectives include the classical Market-power theory (Porter, 1980; Child & Faulkner, 1998); Resource-Based Theory (Conner & Prahalad, 1996; Combs & Ketchen, 1999; Tsang, 1998) and Social Exchange Theory (Das & Teng, 2002).

According to our review and the taxonomy of Hagedoorn (1993) in Table 1 we propose five categories of firms' motives for technological cooperation. However, as Tsang (1998) appoints, given that the motives for entering into a strategic alliance can be very different, the following categories can be treated as complementary and not as substitutes**.**

Table 1. Categorization of firms' motives for cooperation on R&D and innovation (adapted from Hagedoorn taxonomy, 1993:373)

DESCRIPTION	AUTHORS
Motive 1(MOT1): Access to new knowledge and jointly processes of technological development	
The principal argument is the need for even the most of diversified enterprises to cooperate with others in order to affront the technological challenges, achieve scale and to respond rapidly in the market place despite technological uncertainty. This motive is related to concrete innovation processes, cooperation with the objective to reduce the innovation time-span, shortening of the period between invention and market introduction and also diminishing technological leapfrogging. This category of motives includes: • Access to complex or specialized new technology • Product market complementarities • New product development for firm and/or for market • Switching to new promising technologies for the firm • Generation, internalization and prevention knowledge spillovers between firms and firms and public institutions	Hladik (1985); D'Aspremont and Jacquemin (1988); Link and Bauer (1989); De Bondt and Veugelers (1989); Kogut and Zander (1992); Teece (1992); Hagedoorn (1993); Häusler et al. (1994); Wang (1994); Hagedoorn and Narula (1996); Katz and Martin (1997); Tidd (1997); Robertson and Gatignon (1998); Bayona et al. (2001); Cassiman and Veugelers (2002); Kaiser (2002); Hagedoorn (2002); Miotti and Sachwald (2003); Belderbos et al. (2004)
Motive 2 (MOT2):Access new markets	
The principal argument links to commercial concerns, such as market access, exploitation of new market opportunities, monitoring of technological changes and opportunities of internationalization, entry of new products to foreign markets, expansion of improved product range, shaping the competitive environment in which partners operate. This motive includes: • Access new market and/or enabling faster market entry • Access to resources • Innovation in commercialization	Hladik (1988); Link and Bauer (1989); Dodgson (1992a, b); Sakakibara (1997); Katz and Martin (1997); Hagedoorn (2002); Miotti and Sachwald (2003); Dachs et al. (2004)
Motive 3 (MOT3): Sharing risks and costs reduction	
The principal argument is related to the reduction, minimizing and sharing of the uncertainty associated to R&D activities. The risk of innovation lies in the expected result not being obtained, not appearing with proper speed, or requiring more financial or technological funds than were originally expected. This motive encompasses: • Sharing of technological risks of the development of new technologies and learning processes • Product rationalization and thus reducing costs through economies of scale, while avoiding risks of full-scale merger • Appropriate management for spillover internalization • Increasing the effective R&D investments at the firm-level reducing 'excessive duplication of effort'	Porter and Fuller (1986); Hladik (1988); Kogut (1988); Pisano (1990); Dodgson (1991); Dodgson (1992a); Teece (1992); Pisano (1990); Hagedoorn (1993); Das and Teng (1996); Cassiman and Veugelers (2002); Tsang (1998); Bayona et al. (2001)
Motive 4 (MOT4): Search of R&D complementarities and technical assistance (capacity complementarity)	
The principal argument is that firms need to access complementary external resources in order to be able to exploit their own internally held resources better. This motive emphasizes sources and capabilities building on the Resource-Based View of the firm originally developed by Penrose (1959) and further elaborated by Teece as dynamic capabilities approach (Teece, 1992). This motive includes: • Search of technological complementarities according increased	Penrose (1959); Wernerfelt (1984); Teece (1986); Kogut (1988); Barney (1991); Teece (1992); Mowery et al. (1998); Hagedoorn et al. (2000); Tsang (2000); Cantner and

complexity and intersectoral nature of new technologies • Basic and jointly applied research though complementarities, technology transfer and reinforcement of technological synergies • Access to complementary technology, technological problem solving, jointly R&D tasks and technical assistance	Meder (2006); Quintana and Benavides (2010)
Motive 5 (MOT5): Improvement of technological and innovation competency (learning)	
The organizational literature argues as a reason for technological cooperation the possibility of acquiring and internalizing the abilities and competences of the partners in order to create/reinforce competences for the firm. Related to search of improvement of productivity through 'capture' of know-how and tacit knowledge. Companies that seek innovation through flexible production, standardization and standardized products, flexible production, get high quality products or lower their costs and thereby directing the technological opportunities of the market. This motive includes: • Learning and extracting skills from an external source • Capturing and absorbing know-how and tacit knowledge • Improvement of distribution chain and logistics	Porter and Fuller (1986); Hladik (1988); Hamel (1991); Dodgson (1992a); Hagedoorn (1993); Rothwell (1994); Steensma (1996); Sakakibara (1997); Tsang (2000)

Influence of participation in funding programmes

R&D and innovation policies can facilitate motivation to engage in international collaboration providing initiatives and instruments of financial support and easing of the regulatory conditions that restrict the potential for cooperation (Narula & Dunning, 1998; Lundin et al., 2004; Czarnitzki et al., 2007; Berube & Mohnen, 2009). Several studies find a positive effect of participation in national R&D programs on the likelihood to cooperate (Negassi, 2004; Busom & Fernandez-Ribas, 2004; Abramovsky et al., 2005). In this sense, real financing conditions differ widely between countries and can be an obstacle for cooperation. Argentina is in a less favorable situation due to the generally weak funding support for innovation together with the major macroeconomic instability. Besides in Argentina financing of innovation activities depends essentially down to the self-financing (Lugones & Suárez, 2006; Anlló et al., 2007; Kosacoff, 2007; INDEC, 2008). In our study we considered the IBEROEKA program which is a political instrument introduced in 1991 with the aim of reinforcing the industry competitiveness in 21 Ibero-American countries through scientific and technological cooperation among enterprises, universities and other research institutions. Since two

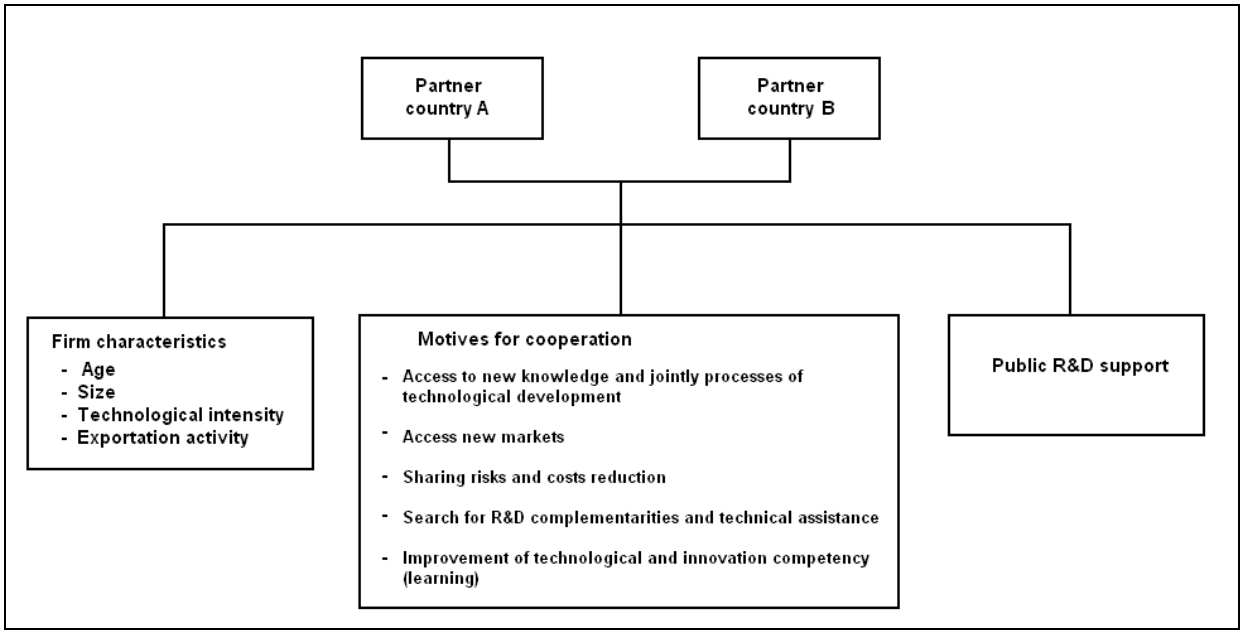
decades IBEROEKA program certified 627 projects, being the Argentine participation of 19.2%. However, certification does not mean that cooperation becomes successful due this kind of programs have limited impact in Latin America (Pérez, 2008).

Firms' characteristics and likelihood to cooperate

The positive influence of firm size on the likelihood of co-operating in R&D is supported by many empirical studies (Link & Bauer, 1989; Cassiman & Veugelers, 2002; Miotti & Sachwald, 2003; Bönte & Keilbach, 2005). In an ample literature review Dachs et al. (2004) argue that large firms are more likely to have the resources for searching partners and are thus more likely to co-operate than small firms. In this sense Fritsch & Lukas (2001) highlight the impact of the less economic activity in the case of small firms. The study of Bayona et al. (2001) confirms in Spain that larger firms are more likely to co-operate than smaller firms.

Regarding the export activities, although Dachs et al. (2004) argue that the export orientation of firms matters for their R&D co-operation, but Busom & Fernandez-Ribas (2004) do not find empirical evidence at his respect. As far as the industry is concerned, Dogson (1994) and Tether (2002) show that high-tech industries are more likely to co-operate on R&D activities. Figure 1 summarizes in a scheme the analytical framework of our study.

Figure 1. Analytical Framework



4 Methodology and sample

As we commented previously regarding the study limitations such as the nonexistence of databases and the scarce of information about cooperation –particularly in Argentina- we decided selecting a sample of companies that we suspected have been involved in cooperation activities. The data set assembled (a total of 540 firms, N=264 firms from Spain and N=276 firms from Argentina) was generated using information from a public cooperation program and an exporter firms' database provided by the Spanish Institute for Foreign Trade (Instituto Español de Comercio Exterior, ICEX). We applied a survey with a questionnaire containing 51 closed and open-ended multi-items related to firm background and general characteristics (size, sector and branch of activity, human resources, etc.), previous experience in foreign cooperation, partners selection, types of partners and agreements, in-puts and out-puts of the R&D and innovation inter-firm activities, barriers, expected outcomes and public funding. A significant percentage of

the surveyed enterprises (47%) participated in IBEROEKA government program. The survey was administered by mail and online and was complemented by information obtained through telephone interviews, resulting in a response rate of 19.3% (N= 104 enterprises, 56 Spanish firms and 48 Argentine firms). After this first data collection, we realized 19 personal in-depth interviews.

4.1 Variables definition

In the empirical analysis reported below, we begin by estimating alliance scope considering the relationship between the decision to cooperate and the respective firms' location. We start considering the sample of 104 firms seeking to model cooperation choices with the objective to examine the factors that lead companies to cooperate with other agents given their geographic location (Spain and Argentina). Thus we established cooperation as dependent variable while firm features and motives for cooperation were considered as independent variables. Three categories were assigned to the dependent variable, as follows:

- NOCOOP (No cooperation): Spanish or Argentine firms which have no cooperated with other firms
- COOPSPAIN (Cooperation with Spain): Argentine firms which have cooperated with Spanish firms
- COOPARG (Cooperation with Argentine): Spanish firms which have cooperated with Argentine firms

As principal firm characteristics we took into account size, age, technological intensity, exportation activities and participation in the IBEROEKA program. Regarding size, we classified firms in four categories according to the number of employees: firms with 100

employees, from 101 to 250 employees, from 251 to 1000 employees and more than 1000 employees.

The firm's technological intensity is determined by the productive sector that identifies the main economic activity carried out by the company. Taking into account the classification of manufacturing industries into categories based on R&D intensities we grouped the firms in two categories corresponding to a dichotomous variable which takes value 1 for firms with high and medium-high technological intensity and 0 for firms of low and medium-low technological intensity (OECD, 2011). With respect to the variable age, measured as the number of years since the firm began its activity to the present, we checked its normality of using the Kolmogorov-Smirnov test. Given a significant result (p-value <0.05), we explored the variable normalization applying a QQ-plot graph and decided to use the transformed variable [ln_age] for our study.

Considering the variables designed as 'motives for cooperation' (MOTx) we decided to apply a factor analysis according our taxonomy to facilitate our analysis and to group the different motivations (Hair et al., 1998). Specifically a principal components analysis with a Varimax rotation (with Kaiser normalization) of factor dimensions. This resulted in five dimensions (total variance explained: 66.6%) and whose information is shown in Annex I. In addition, to assess the degree of consistency (reliability) we used Cronbach's alpha, accepting as valid values equal or above 0.6. After, we defined five new dichotomous variables according to the results of the factor analysis. These variables take the value 1 if the firm states the motive for cooperating and 0 otherwise. The matrix of correlations for all the independent variables which have been used for calculating the regression are shown in the Annex II. The majority of coefficients are weak (below 0.3) which evidences that the estimation of model parameters are not

affected by multi-collinearity problems. All the variables and their description are summarized in Table 2.

Table 2. Variables definitions

VARIABLE	DESCRIPTION	TYPE
DEPENDENT VARIABLE		
Cooperation	0= firm which has no cooperated 1= firm which has cooperated with Spanish firms 2= firm which has cooperated with Argentine firms	Categorical
INDEPENDENT VARIABLES		
Firm characteristics		
Size (SIZE)	Number of employees: 0-100; 101-250; 251-1000 and > 1000	Categorical
Age (firm age) (Ln_AGE)	Number of years since firm starts its activities until 2009	Quantitative
Participation in IBEROEKA program (IBEROEKA)	Dichotomous variable which takes value 1 if the firm participated in the IBEROEKA program and 0 if the firm did not participated.	Categorical
Exportation activity (EXPORT)	Dichotomous variable which takes value 1 if the firm exports and 0 otherwise.	Categorical
Technological intensity (TECHINT)	Dichotomous variable which takes value 1 if the firm technological intensity is high or medium-high and 0 if the firm is of low and medium-low technological intensity.	Categorical
Motives for cooperation		
MOT1: **Access to new knowledge and jointly processes of technological development**	Dichotomous variable which takes value 1 if the firm considers relevant this motive and 0 otherwise. All cases include aggregated items	Categorical
MOT2: **Access new markets**		
MOT3: **Sharing risks and costs reduction**		
MOT4: **R&D complementarities and technical assistance (capacity complementarities)**		
MOT5: **Improvement of technological and innovation competency (learning)**		

4.2 Data and descriptive statistics

Around the half of the firms (52%) cooperated successfully, being the 35.6% firms from Spain that cooperated with Argentine companies and only 16.3% Argentine firms that established links with firms placed in Spain. Table 3 shows several firms'

characteristics: 41.1% of companies are SMEs and around one third of the sample (35.7%) corresponds to large firms with more than 1000 employees.

A majority of firms are exporters (76.0%) and around the half of surveyed firms participated in the IBEROEKA program, being the participation of Spanish firms the double with respect Argentine firms (35.3%). Regarding technological intensity 66.3% of firms are high and medium-high with similar percentages in both countries. ICT is the most represented sector in the sample (42.9%) and it is also one of the main sectors involved in IBEROEKA program. Other sectors represented in order of decreased importance are chemistry, biotechnology, metal-mechanics industry and electronics (interviews also were realized in these sectors).

Table 3. Description of firms' characteristics

		Cooperation with Spain	Cooperation with Argentina	Total
SIZE (in number of employees)	0-100	23,5%	29,7%	32,7%
	101-250	17,6%	21,6%	15,4%
	251-1000	23,5%	18,9%	14,4%
	>1000	35,3%	29,7%	37,5%
IBEROEKA (Yes)		35,3%	73,0%	46,2%
EXPORT (Yes)		70,6%	83,8%	76,0%
TECHINT	Low & Medium-Low	11,8%	29,7%	33,7%
	High & Medium-high	88,2%	70,3%	66,3%
AGE (in years)	Mean	12	38	26
	Standard deviation	9	72	47
	Minimum	1	3	1
	Median	10	22	18
	Maximum	35	450	450
Total		**17**	**37**	**104**

Taking into account the firms' antiquity we found that the average age is 26 years, being the Spanish firms older than the Argentine companies (38 and 12 years old respectively). Half of Argentine firms (50.0%) are very young with less than 10 years of existence while the Spanish firms are slightly older (22 years old).

The remaining variables used in the study refer to the motivations that lead companies to cooperate with others (see Table 4). For companies that with cooperate with Spain, 64.7% of them believe that the access to new knowledge (MOT1) and search of new markets (MOT2), with the same percentage, are the two main reasons to build links with other firms. Only 11.8% of these companies cooperate with the purpose to improve their skills and/or develop their competences (MOT5). For companies that cooperate with Argentina, the 64.9% of them do it to seek new markets and opportunities (MOT2) and, unlike the previous case, in second place the motive is to reduce risks and innovation costs (MOT3, 62.2%). It is important to note that access to new market is important in both cases, with practically the same percentage and while the access to new knowledge related to general processes of technological development are important for a majority of companies that cooperate with Spain (MOT1), it is relevant only for 29.7% of those that cooperate with Argentina.

Table 4. Motives for technological cooperation[1]

Motives	Cooperate with Spain [%]	Cooperate with Argentina [%]
MOT1: Access to new knowledge and jointly processes of technological development	64,7	29,7
MOT2: Access new markets	64,7	64,9
MOT3:Sharing risks and cost reduction	23,5	62,2
MOT4: R&D complementarities and technical assistance (capacity complementarities)	29,4	56,8
MOT5: Improvement of technological and innovation competency (learning)	11,8	21,6
Total	**17**	**37**

[1] Percentages do not sum to 100% because firms can consider more than one motive to cooperate.

4.3 Fitting a multinomial regression model

We have realized a multivariate analysis for comparing what are the motives that lead companies to cooperate with firms placed in other countries, in this case Argentina and Spain (Hosmer & Lemeshow, 1989). Cooperation (COOP) is the dependent variable being the possibilities 'cooperate with Argentina' (COOPARG), 'cooperate with Spain' (COOPSPAIN) and 'no cooperate' (NOCOOP) as reference category. From a theoretical point of view, our dependent variable (Y) is defined through the vector (Y_1, Y_2) constituted as follows:

$$(Y_1, \quad Y_2) \quad = \begin{cases} (0,1) \\ (1,0) \\ (0,0) \end{cases} \qquad if \qquad \begin{matrix} Y = COOPSPAIN \\ Y = COOPARG \\ Y = NOCOOP \end{matrix} \qquad \text{with}$$

$$\begin{cases} p_1 = P(\text{Cooperate with Spain}) \\ p_2 = P(\text{Cooperate with Argentina}) \\ p_3 = P(\text{No cooperate}) = 1 - p_1 - p_2 \end{cases}$$

Thus we can define the proposal model as:

$$\ln\left(\frac{p1}{p3}\right) = \beta_{01} + \beta_{11}*SIZE + \beta_{21}*Ln\_AGE + \beta_{31}*IBEROEKA + \beta_{41}*EXPORT + \beta_{51}*TECHINT + \beta_{61}*MOT1 + \beta_{71}*MOT2 + \beta_{81}*MOT3 + \beta_{91}*MOT4 + \beta_{101}*MOT5 + \varepsilon_{ij}$$

$$\ln\left(\frac{p2}{p3}\right) = \beta_{02} + \beta_{12}*SIZE + \beta_{22}*Ln\_AGE + \beta_{32}*IBEROEKA + \beta_{42}*EXPORT + \beta_{52}*TECHINT + \beta_{62}*MOT1 + \beta_{72}*MOT2 + \beta_{82}*MOT3 + \beta_{92}*MOT4 + \beta_{102}*MOT5 + \varepsilon_{ij}$$

Where β_{ij} represents the parameters to be estimated and the rates of change in the probability of cooperating or not cooperating (while one of the explanatory variables is incremented by one keeping the other constant) and ε_{ij} are the error terms. $\mathrm{Ln}\left(\frac{p1}{p3}\right)$ and $\ln\left(\frac{p2}{p3}\right)$ are the 'logit' terms and represent the probability ratio to cooperate with Spain and Argentina, respectively, or not cooperating. In the estimation of the parameters we have used the maximum likelihood method using the statistical package SPSS v.16.

5 Results

Results of the multinomial regression can be observed in the Table 5. The first group (column at left) shows the complete or 'full' Model A, which includes both firms engaged and not engaged in cooperation with all the variables. The column in the right presents a 'reduced' Model B, obtained after the elimination of the most non-significant variable for the chi-square test on the contrast likelihood ratio, testing that the AIC (Akaike Information Criterion) value was lower than in the previous model (Akaike, 1974). Thus Model B is still adjusted to the data taking into account only the significant variables. Also in Table 5 it can observe that the proposal regression model is a good predictor for determining if companies cooperate with firms from another country. Moreover, the percentage of predicted cases properly exceeds 75% in both models, confirming the quality of the prediction. In addition, the quality of the fit can be considered appropriated since the test Pseudo-R^2 is at 0.7 for the full model and 0.68 for the reduced model (Long, 1997; Hu *et al.*, 2006; Pando Fernández & San Martín Fernández, 2004).

5.1 Firms which cooperate with firms located in Spain

In both A and B models we can observe that the technological cooperation likelihood with Spanish firms increases with the firm size and decreases with firm age, so younger companies are more likely to cooperate. Although there are no unified conclusion at this respect and previous empirical evidence about these factors in the specific case of Spanish and Argentina inter-firm cooperation, this results confirm several literature findings about the positive relationship between size and cooperation (Link & Bauer, 1989; Hagedoorn & Schakenraad,

Table 5. Multinomial regression for cooperation related the cooperating country

	MODEL A (complete model)[a]		MODEL B (reduced model)[a]	
	Cooperate with Spain	**Cooperate with Argentina**	**Cooperate with Spain**	**Cooperate with Argentina**
Firm characteristics				
SIZE[b]				
101-250	1,107 (1,056)	0,226 (1,061)		
250-1000	1,790 (1,260)	1,334 (1,255)		
>1000	2,069 (1,443)	0,721 (1,392)		
Ln_AGE	-1,106** (0,505)	-0,385 (0,500)	-0,986** (0,420)	-0,320 (0,448)
IBEROEKA	0,020 (0,822)	2,215** (0,935)	0,108 (0,755)	1,954** (0,817)
EXPORT	0,104 (0,952)	1,652 (1,093)	0,678 (0,869)	2,022* (1,047)
TECHINT	-0,847 (0,972)	-0,043 (0,879)		
Motives for cooperation				
MOT1: Access to new knowledge and jointly processes of technological development	1,094 (0,803)	0,962 (0,782)	1,254 (0,780)	0,990 (0,755)
MOT2: Search of new market	0,373 (0,996	-0,803 (1,030)	1,021 (0,843)	-0,385 (0,867)
MOT3: Sharing risks and costs reduction	0,861 (0,990)	3,143*** (0,963)	0,785 (0,910)	3,116*** (0,894)
MOT4: R&D complementarities and technical assistance (capacity complementarities)	2,463** (1,238)	3,947*** (1,178)	2,389** (1,150)	3,847*** (1,133)
MOT5: Improvement of technological and innovation competency	0,699 (1,652)	2,170** (1,663)	0,514 (1,574)	1,837 (1,530)
Intersection	-3,323 (1,070)	-4,427*** (1,516)	-0,666 (0,986)	-4,510*** (1,428)
Observations	104		104	
Likelihood ratio test[c]	96,412***		91,782***	
Goodness of fit:χ^2 (d.f.)	155,353 (174)		167,747 (174)	
Pseudo R^2	0,7		0,68	

***p-value<0,01; **p-value<0,05; *p-value<0,1. [a] Reference category: No cooperate. [b] Reference category: Size<100 employees. [c] Likelihood Ratio Test (-2Log-likeihood) for Ho: $\beta i=0\ \forall i$.

1994; Röller et al., 1997; Cassiman & Veugelers, 2002; Dachs et al., 2004; Bönte & Kellbach, 2005). However, the contributions of other authors such as Pisano (1990) and Robertson & Gatignon (1998) are opposite to these results. This positive effect is explained from the perspective of the internal capacity in R&D and absorptive capacity which seem be a characteristic of large firms together the R&D and human resources availability.

In this sense, opposite to literature findings, in this study technological intensity of the firm is a non-significant variable and presents a negative sign, implying that firms of low and medium-low technological intensity are the most engaged in such activities. In the study realized by Bayona et al. (2001) they find that large and more technologically intensive firms in Spain have a greater propensity to cooperate. In model A, which includes firms engaged and not engaged in cooperation, exportation and participation in the IBEROEKA program are not influencing factors for cooperation.

Regarding the purposes of cooperation, Table 5 shows that in the model A the principal motive that significantly determines cooperation with Spanish firms is MOT4 (search of R&D complementarities and technical assistance or capacity complementarities) and, in second place, the reasons are related to MOT1 (access to new knowledge, new product development for the company to the market or new technology for the company. If consider the 'reduced' model MOT2 (search for new market and commercialization opportunities) lies in an intermediate position. The search of R&D complementarities and technical assistance (MOT4) is what really determines the cooperation with Spain and also significantly. In second place we found purposes related to the technological development of the company, new product development for the firm the market or new technology for the company (MOT1). Search for market opportunities (MOT2), costs reduction (MOT3) and the ability to learn, improve or develop skills (MOT5) are motives less relevant. In the model B the search for market opportunities lies in an intermediate position (MOT2).

5.2 Firms which cooperate with firms located in Argentina

In this case, the companies of medium size, between 250 and 1000 employees, the more likely to cooperation with Argentina. As in the case of cooperation with Spain, both age and technological intensity have a negative effect on cooperation with Argentina, although in both cases the variables have no significance. An influential factor in this case is IBEROEKA program, so that companies that have participated in it are more inclined to cooperate. Exporter firms are also most prone to perform these activities, being this variable more significant in model B (for firms that really have cooperated).

The search of capabilities complementarities (MOT4), the attempt to reduce costs (MOT3) and the ability to learn, improve and/or develop skills (MOT5) are most influential motivations for companies to cooperate with Argentina, and is also significant in all cases the full model (the last reason ceases to be in the small). Importantly, in this case, the search for market opportunities and presents a negative sign, implying that more than one reason for cooperation is a barrier, but this result is not significant in either of the two models.

The analysis of the interviews content also provides us more profound information about the divergence between partners' motives and expectations, showing also the barriers for cooperation due the influence of the context regulations and funding incentives in each country, as principal aspects (several examples are presented in Table 6).

Table 6. Comments extracted from interviews related to motives and obstacles for cooperation

FIRM DATA	COMMENTS ABOUT MOTIVES AND BARRIERS TO COOPERATE
Firm: ALTER SA (Spanish MNC) **Interviewee:** R&D director (doctor) **Sector:** Pharmaceutical & Chemical industry **Size:** large firm **Age:** 71 years old **Participation in IBEROEKA program:** yes (project not finalized)	'Currently there are no cooperative relations with Argentine companies, although there were some attempts in the last years in the IBEROEKA program… but in Argentina firms works with other time pace, firms do not comply with the commitments and sometimes **their motives do not seem the same that ours**' …'projects never materialized…' … 'We were interested in making jointly research tasks for generic drugs developments (**MOT1**]... but I think that they are more interested in the possibility of capture knowledge and learn of our firm ...' (**MOT5**) … 'Firm Y produces some medicaments that are under patent in Spain and they sell them freely in the market, therefore the quality requirements are not the same and there is no possibility of reaching an agreement for making a product .. … 'The main obstacle to cooperate in the development of generic drugs is the existence of different regulatory system, particularly referred to quality certification ... this happen with the firm X. We offer to this firm the possibility of auditing and quality certification according to European regulation but this firm X did not assume the costs ... under this conditions (we think) they manufacture for their own market' … 'It is important to harmonize both regulatory and quality to support technological collaboration beyond technology transfer. You should create a culture of quality and standards that are valid in the U.S., Europe and also in Argentina ... but it is so difficult in Argentina because firms do not want assume the costs ...'
Firm: AGROCINEGÉTICA MODELO SL, (Spanish firm) **Interviewee:** R&D responsible (engineer) **Sector:** Agro food **Size:** Medium-low **Age:** 52 years **Participation in IBEROEKA program:** Yes	'We had experience with Argentina in research and development to introduce a new product (**MOT1**). But the experience was not very good, though served from the point of view of staff exchange ... I think that it was more positive for them due the technology transfer from Spain to Argentina' (**MOT4**). **…** 'The policy instability of the country, the legal uncertainty, the extreme bureaucracy that is required for any procedure there, the excessive time span for exporting the developed product ...in these conditions cooperation is very difficult it is make it very difficult to cooperate ...' 'Overall this is a generalized contextual problem in Argentina ... the lack of supporting from their government'
Firm: CONEXUS consultores (Argentine firm) **Interviewee:** Director **Sector:** ITC **Size:** SME (50 employees) **Age:** 12 years old **Participation in IBEROEKA program:** Yes (project not finalized)	'The contact was initiated by the Spanish company... since five years ago through the website. They traveled to Spain to meet in person with the firm ... the Spanish firm is similar to ours and we *embarked* on a joint development (**MOT1**)... Our first attempt to obtain financing and start the project, but it failed due ... time mismanagement, the bureaucracy of the IBEROEKA program and its deadlines do not accompany the initiative, so that when they were halfway with urgent financial needs, they were forced to abort the project ... 'after knowing better how the program [IBEROEKA] *works* we decided to present a new project led by us. Currently this project is well and we expect to develop a new product for the firm next year. So far, the experience was extremely helpful, though it remains enter the stage of its commercialization. In principle, we are ready to continue cooperating, but for now do not dare to make another proposal

	because the resources available in our company ...both human and financial, are not enough to become involved on more than one project' ... 'The main obstacles we face to cooperate were the disregard and uncertainty about IBEROEKA ... also influenced our lack of experience. Our situation was disadvantageous about them because they had already worked with partners in other European countries and had more experience in operate with funding programs ...'
Firm: INDRA (Argentina branch) **Interviewee:** R&D responsible **Sector:** ITC **Age:** 14 years old **Size:** large firm (>1000 employees) **Participation in IBEROEKA program:** Yes (project not finalized)	… 'INDRA invests [in R&D] globally. At the local level [in Argentina] has only tried to cooperate with the National University of Cordoba (Universidad Nacional de Córdoba) for local software development' … '(INDRA) has 1200 software professionals with 80% of production for the exterior, to Cordoba and Buenos Aires. in bs as there are 90 developers and also `subtract staff to service their customers (telephone, Endesa, Iberia, Banco BBV … 'the company usually establishes joint ventures (JV) to win bids, not only at home but at regional level' … 'such unions often are not found in technology cooperation but also carried out an alliance in which each participating company brings its expertise to provide a concrete service but not to develop a new product or technology …' (**MOT4**) … 'we have different work cultures, INDRA follows the generation of quick solutions and some small and medium firms are similar in this sense to research institutions … we are working in different chronological dimensions' … 'even with the same interests coordination is very difficult'

6 Conclusion

Our principal aim in this paper attempts to provide information for a better understanding of inter-firm cooperation on R&D and innovation in Argentina and Spain taking into account the framework of the current globalization trends in technological cooperation. R&D and innovation cooperation today are widely considered as an efficient mechanism for both industrial organization of complex R&D processes and competitiveness. But the dynamics of technological cooperation at firm level is determined by a complex interplay of motives, economic constraints, and practical opportunities. In this sense, the principal conclusion that we can extract from our results is that the patterns of interaction between firms are strongly influenced by the general characteristics of the national innovation systems and the sector activities in each country, together with distinct organizational modes of governance of cooperation partnering. The innovation environment and rates of technological cooperation are weaker in Argentina than in

Spain. These weaknesses are reflected in the percentages of successful cooperation: of the 104 firms that responded to our survey, chose from a sample of firms that we consider most likely to have been involved in cooperation activities, only 54 firms (37 from Spain and 17 from Argentina) cooperated and not successfully in all cases. Regarding the factors that affect the likelihood to cooperate, our results confirm in part previous findings from the literature: the cooperation probability increases with the firm size and its exporter orientation and decrease with the firm age. Considering the influence of the firm technological intensity the relationship is non-significant and with negative sign. These results are opposite to those found in the literature, where majority of contributions maintain that cooperation in high-tech sectors is strongly related with R&D cooperation whereas in medium and low-tech sectors is not a dominant feature (Hagedoorn, 1993; Bayona et al., 2001). If we compare the firms' motivations to cooperate with one or another country the search of capacity complementarities (MOT 4) seems be the main reason to start collaborative relationships. However, while for cooperation with Argentine firms the principal firms' motives are cost reduction (MOT3) and the search for improving learning and capabilities (MOT5), these motives become almost insignificant for cooperation with Spanish firms. The same applies, but in the opposite way, with the motives of access to new knowledge for technological development (MOT1) and the search for market opportunities (MOT2) that are relevant to cooperation with firms located in Spain but not when performed with companies of Argentina. Information provided by the interviews show that cooperation is far more complex and more difficult to achieve and allow us affirm that this lack of convergence in the motives for cooperation creates unfavorable conditions acting as potential barriers and affecting negatively both the initiation and the cooperation processes. Other barriers referred for the majority of the respondents are, in order of importance, the different culture of cooperation partners, the extensive administrative procedures and bureaucracy (in major measure in Argentina than in Spain), the lack of cooperation experience and expertise in applying for public

funds and subsidies funds, difficulties inherent to specific industrial and economic sectors and scarce coordination in the decision making mechanisms.

IBEROEKA program represents a relevant effort to foster science and technology cooperation in Latin America and has contributed to the initiation of a technology cooperation culture. However, this instrument and in general policy to support inter-firm cooperation on R&D and innovation should consider the differences that affect cooperation based on sectoral and firm specific characteristics and the particular conditions of financing in each country. Some of the interviewers commented that the deficient intra- and inter-organizational coordination in the project management in the specific case of the IBEROKA program is a main barrier for the implementing of cooperation innovation activities.

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Annexes

Annexe I: Test of unidimensionality and reliability coefficients

Variables	Commonalities	Cronbach's alpha
Motive 1 (MOT1): Access to new knowledge and jointly processes of technological development		0,7
New product development for the firm	0,781	
New product development for market	0,572	
New technology development for the firm	0,600	
Motive 2 (MOT2): Search of new market		0,6
Commercialization improvement	0,72	
Access new market	0,606	
Access to resources	0,716	
Motive 3 (MOT3): Sharing risks and costs reduction		
Motive 4 (MOT4): R&D complementarities and technical assistance (capacity complementarities)		0,6
Technological problem solving	0,682	
Jointly research Realizar investigación conjunta	0,657	
Technical assistance	0,646	
Motive 5 (MOT5): Improvement of technological and innovation competency (learning)		0,6
Improvement of distribution chain	0,679	
Logistics improvement	0,666	

Annexe II: Correlations matrix of dependent and independent variables

	1	2	3	4	5	6	7	8	9	10
1 SIZE	1	-0,191	0,155	0,213*	-0,066	0,185	0,219*	-0,004	-0,049	0,014
2 Ln_ANT		1	-0,173	-0,320**	-0,260**	-0,200*	-0,106	-0,141	-0,096	-0,06
3 IBEROEKA			1	-0,066	-0,047	0,208*	0,224*	0,198*	0,264**	-0,068
4 EXPORT				1	-0,123	0,17	0,184	0,121	-0,115	0,047
5 TECHINT					1	-0,183	-0,388**	-0,197*	-0,065	-0,046
6 MOT1						1	0,439**	0,185	0,252**	0,114
7 MOT2							1	0,520**	0,201*	0,197*
8 MOT3								1	0,173	0,254**
9 MOT4									1	0,285**
10 MOT5										1

*Significant correlation at 5%. ** Significant correlation at 1%