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INTERNATIONAL R&D COOPERATION WITHIN THE EU FRAMEWORK PROGRAMME: THE CASE OF SPANISH FIRMS

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STRUCTURE AND STRATEGY FOR CORPORATE R&D

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1 - Introduction

In order to understand the international R&D cooperation, it is necessary to locate this phenomenon within the globalization process. Narula (2007) distinguishes two kinds of globalisation drivers related, on the one side, to political and economic factors and, on the other side, to technological factors. Within the first category, financial liberalisation, supra-national institutions, economic integration and liberalisation of economic systems are pointed out, whereas the technological factors refer to the rapid technological change, the widespread use of information and communication technologies (ICT), the rising costs and risk of innovation and the increasing need for complementary technological capabilities within the firm.

The interaction of these social and technological trends fosters the interdependence of regions and firms and, as a consequence, the homogeneity of consumption patterns and the enlargement of the market. R&D cooperation appears in this context as a strategic answer to the global economy, allowing enterprises to seek partners who provide the best opportunities for learning and innovating, regardless of their location.

In fact, the evidence shows that R&D cooperation is increasing around the world, reaching an all-time peak in 2003, according with the last available data (National Science Board, 2006). Domestic alliances among US companies lead the statistics, followed by alliances between U.S. and European companies. Cooperation carried out exclusively among European companies is about 12% of the total reported agreements. This percentage could be a reference figure to understand the scope of the present work.

R&D cooperation among European firms has been supported by the R&D Framework Programme (FP) since 1984. The FP offers public funding for R&D cooperative projects developed by private or public organisations, self-organized as trans-national consortia.

Throughout the years, the FP has become a suitable source of data on international cooperation within the European Union, since research consortia meet all the requirements to be considered research joint ventures (RJV), defined as "*cooperative agreements engaging companies, Universities and government agencies and laboratories to pool resources in pursuit of a shared R&D objective*", as some authors have remarked (Caloghirou *et al*., 2004).

Prior literature concerned with RJVs (Hernán, Marín and Siotis, 2003) has found empirical evidence to explain why a firm decides to engage in research consortia. Nevertheless, these studies use data only from financed projects, without considering those applications that, after the evaluation process carried out under the auspices of the European Commission (EC), do not receive any financial aid.

The probability of a firm to take part in a consortium within the FP must be regarded as the result of a two-phase process. Firstly, the firm decides to engage in the consortia or not and, secondly, the project is approved or rejected.

From this dual perspective, the present work aims to explain which factors determine the participation of the Spanish firm in R&D consortia within the Framework Programme, distinguishing between the decision to apply and the agency selection. For that purpose,

we analyze the participation of Spanish firms in the FP during the period 1995-2005, using a data base provided by the CDTI (the public organism in charge of monitoring the participation of Spanish firms within the FP) that contains much relevant information about the projects and the participants. This information is available for both, projects that, after the evaluation process, have received grants and those which have not received any financial aid. We also use data provided by the SABI database that consists of company accounts for over 1,000,000 Spanish firms.

Through this approach, this paper provides empirical evidence for policy makers –interested in promoting the Spanish participation within the FP– and for all those people concerned with the strategic relevance of international R&D cooperation.

The second section of the paper summarizes theoretical and empirical works about R&D cooperation, stressing the international dimension of the process. Following, the third section focuses on the UE Framework Programme as analytical context and remarks the institutional factors that must be taken into account. Section 4 concerns the empirical model and the descriptive analysis of the data. Main results from the econometrical estimations are exposed in section 5 and, finally, relevant conclusions are drawn in section 6.

2 - International R&D cooperation in the literature

International R&D cooperation is a complex research topic, involving many factors that, until now, are not explained by a unique and common accepted model. Thus, theoretical approaches propose partial explanations of the process, whereas empirical works are limited by two obstacles: (i) the difficulty to identify economic and technological indicators suitable for every collaboration type and (ii) the lack of internationally normalized statistics (Archibugi and Iammarino, 2002).

Basically, theory about international R&D cooperation results from the confluence of two main trends: R&D internationalisation and R&D collaboration (Lundin, Frinking and Wagner, 2004). The first one, based originally on the IDE theory, has been very fruitful, proposing models that explain how and why multinational enterprises (MNEs) carry out their R&D activities abroad and incorporating progressively new perspectives from the evolutionary innovation theory (Niosi, 1999). Recent studies on international R&D investments stress the importance of the two-side perspective, regarding the knowledge flows between the host and the home country and the strategic relevance of the spillovers generated in both economies (Veugelers, 2005).

Authors concerned with R&D cooperation have focused, mainly, on two questions: which are the drivers of research partnerships and which effects has the cooperation on both, the individual partners and the industry. According to the transaction costs theory, knowledge is an intangible asset and thus market R&D contracts are incomplete, unable to capture all the value generated by this kind of activities. Through the cooperation, firms avoid the high cost of internalizing R&D activities, whereas minimize the cost of an incomplete transaction (Hagedorn, Link and Vonortas, 2002). In addition, industrial organization researchers argue that knowledge is a public good, exposed to market failures and spillovers. Cooperation seems to be a suitable strategy to internalize these spillovers within formal consortia (Cassiman and Veugelers, 2002). The relationship between the

corporate strategy of the firm and the R&D cooperation process has been also stressed by some authors. Since innovation is a knowledge-intensive activity, cooperation allows to learn from partners and to incorporate complementary capacities (Teece *et al.*, 1997). The dynamic of R&D has been related also to the competitive position of the firm, appointing that cooperation facilitates a rapid answer to the market changes (Porter, 1986).

An attempt to joint disperse approaches — and one of the most cited works—, is the taxonomy developed by Archibugi and Michi (1995). These authors identify three categories concerning the internationalization of R&D activities: international exploitation of nationally produced innovations; global generation of innovation and global techno-scientific collaborations. The last category includes joint ventures for specific innovative projects and productive agreements with exchanges of technical information and/or equipment. This taxonomy explains, through a simple model, the alternatives that firms have to manage their R&D activities, assuming that the global economy is the context where decisions are taken.

Regarding empirical literature, the border between R&D cooperation and international R&D cooperation is quite diffuse. In fact, the main available data sources, such as the CATI-MERIT, the Financial Thomson Strategic Alliances or the NCRA-RJV databases, contain information from both, domestic and cross-border joint ventures. Works concerning the drivers of the international R&D cooperation add some specific arguments to the traditional set of advantages related to cooperation (shared cost and risk, access to complementary knowledge, learning opportunities and spillovers internalization). Thus, some authors remark that, when knowledge is a firm-specific or country-specific asset, i.e. an immobile and not marketable asset, international cooperation increases the probability to capture knowledge wherever it is generated (Archibugi and Iammarino, 2002) as well as to learn from the interaction between technology and foreign markets (Narula and Hagedoorn, 1998). Improvements in telecommunication and transport facilitate personal contact between geographically distant partners and reduce the coordination costs (Narula, 2003). These arguments, gathered also by the literature on firm internationalisation to explain the location of R&D activities abroad, reflect a mayor issue: in a global context, the strategic nature of R&D activities is reinforced when they are developed under international cooperation.

The Cooperative Agreements and Technology Indicators (CATI) database, developed by the Maastricht Economic Research Institute in Technology (MERIT) includes information about research joint ventures (RJVs) reported publicly in journals, books and company publications during the last decades. Authors working with the CATI-MERIT database (Hagedoorn, 2002; Hagedoorn, Link and Vonortas, 2002) indicate that technological alliances, which involve, mainly, partners from the Triad ─ North America, the European Union and Japan ─ have dramatically increased between 1970 and 1998, reaching an all-pike in 2003 (National Science Board, 2006). The share of international partnerships over the total was about 55% during the 1990s, whereas a great part of domestic alliances are due to intra-US collaboration in two main fields: information technology and biotechnology. It is also remarked that inter-firm research partnerships are mainly concentrated in a small number of high-technology industries. The increasing normalisation of intellectual property rules reinforces the election of contractual agreements and networks instead of equity joint ventures (Narula and Hagedoorn, 1998).

Recent studies based on the Thomson Financial Joint Venture database —containing information from the Security and Exchange Commission (SEC) and its international counterparts—, confirm many of the previously mentioned results (Moskalev and Swesen, 2007): joint ventures (JV) are more frequent within technologically intensive industries such as drugs, chemical, electronic and electrical equipment, telecommunications and communications equipment, due to the high risk associated to their activity. In fact, between 1990 and 2000 one of each three JV registered by this database was a technological or R&D agreement. The international dimension of these agreements is also a remarkable feature, since 64% and 50% of all technological and R&D ventures respectively, involved cross-border participants.

Other relevant data source comes from the U.S. National Cooperative Research Act, a legislative initiative enacted in 1984 to promote cooperation among U.S. firms. Last works carried out from these data conclude that R&D cost-sharing is an important incentive for the RJV formation. Moreover, variables such as the firm-size differences, the number of members in the RJV, the activity branch of the firm and the impact on R&D investments are significant factors in determining technological cooperation (Röller, Siebart and Tombak, 2006).

3 - R&D cooperation within the EU Framework Programmes

The EU Framework Programme (FP) is the main political instrument supporting cooperative R&D within the European Union. It was born in 1984 with the aim of coordinating dispersed R&D activities funded by the European Commission. Since then, seven editions of the FP have been launched, evolving towards increasing budgets, new participation models and wider research priorities (Georghiou, 2001).

Projects carried out under the FP are representative of international R&D cooperation processes since partners from different nations formalize consortia and invest their own resources in cooperative research activities, in order to obtain appropriable results.

Moreover, the operative scheme of the FP has retained over the seven editions some crucial aspects, making possible the analysis of homogeneous long data series (Roediger-Schula and Barber, 2006). These common aspects are the following:

- Promoters: all projects are promoted by self-organized consortia.

- Financial scheme: supported projects have a limited duration and their R&D activity are co-financed by grants, coming from the European Commission, and private funds, coming from the consortia partners.

- Cooperation scheme: consortia are shaped by different kinds of partners, located in different nations (usually, consortia are integrated by firms, public research centres, Universities and users).

- Evaluation scheme: selection criteria are based on scientific excellence and relevant socio-economic aspects. Evaluation is carried out by independent experts in each technological area and coming from all the UE member countries.

Considering that micro-data on international R&D cooperation are scarce, it is obvious that information referred to the firm participation in the FP has a great value for empirical studies. Moreover, the cooperation scheme, involving private and public organisations, has an additional value in contrast to other existing databases. In fact, some research trends have surged in the last years using this information.

One of them, supported by the IV FP through the TSER (*Targeted Socio-economic Research)* programme, is concerned with the study of RJVs defined as "*cooperative agreements engaging companies, Universities and government agencies and laboratories to pool resources in pursuit of a shared R&D objective"* (Caloghirou *et al*., 2004). For this purpose, researchers developed a complete database containing information about R&D projects supported by the FP and involving, at least, one firm.

Empirical works carried out under this initiative have analyzed why firms decide to participate in RJVs, concluding that the probability to engage in research consortia is positively related to the industry R&D intensity, the firm size and its past experience in research cooperation (Hernán, Marín and Siotis, 2003). These authors do not find any significant bias associated with the firm nationality, although they suggest that firms from larger countries are less likely to participate in cross-border RJVs.

A more recent research line has worked with the EUPRO database, containing all available information in the CORDIS project database. Some authors have analysed the structure of collaboration networks formalized under the FP, finding that these networks are shaped according to a stable path throughout the years, in spite of operative and structural changes taking place within the FP (Roediger-Schluga and Barber, 2006). Moreover, they confirm that, throughout the consecutive editions of the programme, a central and stable core has emerged, shaped by the most participative organisations.

In general, authors working with data provided by the FP recognize that results of any analysis should be interpreted taking into account the formal context where R&D cooperation is carried out. At this respect, some aspects must be pointed out.

Along the seven editions of the programme, budget allocated to the FP has increased. Moreover, the distribution of total budget among the thematic priorities has changed, according to specific economic and political goals. So, in the first years, energy was the protagonist, whereas information technology leaded the latter editions. Regarding the technological distribution of budgets some authors conclude that the EU authorities have favoured projects in R&D intensive industries (Marín and Siotis, 2002).

From the origin of the FP, new participation instruments have been incorporated, determining, in a non-residual way, the features of consortia partners and the dimension of R&D projects. At this respect, the most remarkable fact is the inclusion of the Integrated Projects and the Networks of Excellence in the VI FP, in order to co-finance more ambitious R&D initiatives.

Thirdly, institutional context and administrative requirements of the FP should be taken into account in order to explain firm participation. In this sense, recent studies (Siune, Schmidt and Aagaard, 2006) stress the following factors:

- Access to information about opportunities and formal requirements determines both, the decision to participate in the FP and the success of a proposal. Information diffusion is managed by the EC – mainly through the web page of CORDIS[1]–, and also by the National Contact Points (NCPs), offices in charge of providing individual assistance and promoting the national participation in the FP. At this respect, one relevant contribution of the Commission and the NCPs is the assessment in finding partners, which could be considered one of the obstacles to carry out cooperative R&D projects.

- High degree of administrative formalization facilitates the evaluation of proposals, but could discourage firms from applying, especially those without previous experience within the FP. Otherwise, expert and independent evaluators guarantee the fair selections of proposals, but this procedure requires a continuous updating of their knowledge about specific objectives of the FP (Marimón, 2004).

- Before receiving the approved financial aid, the consortium coordinator and the Commission should sign a contract in order to formalize concrete aspects. Some authors (Siune, Schmidt and Aagaard, 2006) have reported that firms, especially SMEs, perceive this negotiation phase as a resources-consuming requirement that could delay the timing of the R&D project.

- Intellectual property rights are regulated by the mentioned contract. By requiring this agreement among partners, the Commission pursuits to promote good practices within the cooperation project. Nevertheless, a too strict regulation could discourage firm participation (Caloghirou and Vonortas, 2000).

From all these factors, it could be pointed out that the FP is a more favourable scenario for firms that already perform R&D activities, especially within the FP, and, thus, could allocate resources and knowledge to apply and to elaborate proposals according to the administrative and technological requirements. Moreover, the firm size, as an indicator of resources and information availability, and the technological area, as indicator of funding opportunity, seem to be relevant variables to explain why a firm apply within the FP. But, otherwise, the lack of experience and resources could be neutralized by the existence of public mechanisms aimed at promoting firms participation, assessing them or, even, financing the elaboration of proposals[2].

4 - Empirical model and data

The aim of this paper is to describe the factors that determine the firm's participation in a R&D consortium financed by the FP. Most of the empirical studies that try to explain the participation in national or international aid programmes have only information about

[1] http://cordis.europa.eu/
[2] In the case of Spain, the NCP (Centre for the Development of Industrial Technology, CDTI) offers financial support to elaborate a proposal.

financed projects and, therefore, are not able to distinguish between the firm's decision to apply for the aid and the agency selection among the proposals (see, for example, Blanes and Busom, 2004, referred to the participation in R&D subsidy programs). The main disadvantage of this lack of information is that the selectivity problem is not considered. However, in our database we also have data about rejected applications. Taking this into account, we can express the probability of participation in a financed R&D cooperative project as the following joint probability:

$$\begin{aligned}\Pr(participation = 1) &= \Pr(application = 1, award = 1 \mid x) \\ &= \Pr(award = 1 \mid application = 1, x) \cdot \Pr(application = 1 \mid x)\end{aligned}$$

To estimate both probabilities, the empirical model consists of two equations: The first one describes the decision of applying for a FP cooperation project involving, at least, one Spanish firm. The equation to be estimated takes the form:

$$y_{1i} = \begin{cases} 1 & \text{if } y_{1i}^{*} = f(x_{1i}\beta_1 + u_i) > 0 \\ 0 & \text{otherwise} \end{cases} \qquad \textbf{(1)}$$

where y_{1i}^{*} is a latent dependent variable, x_{1i} is the set of explanatory variables, β_1 the vector of coefficients and u_i is the error term. The firm *i* applies within the FP if y_{1i}^{*} is positive. Following the existing literature, and given the data availability, the following variables have been included in the model:

x_1 = *(prior experience in FP proposals, firm's size, exporter, region, liquidity ratio, intangible fixed assets, stock-market, industry activity, year)*

The second equation refers to the agency selection. Again, the decision of awarding or denying is formalized in terms of a binary model:

$$y_{2i} = \begin{cases} 1 & \text{if } y_{2i}^{*} = f(x_{2i}\beta_2 + e_i) > 0 \\ 0 & \text{otherwise} \end{cases} \qquad \textbf{(2)}$$

where y_{2i}^{*} is the latent dependent variable, x_{2i} is the set of explanatory variables, β_2 the vector of coefficients and e_i is the error term. The proposal in which the Spanish firm *i* participates is approved if y_{2i}^{*} is positive[3]. Although most of the explanatory variables in the first equation have firm dimension, the variables in this second equation have group dimension, as the agency decision about the cooperative proposal refers to all members in the consortium:

x_2 = *(leader nationality, technological area, total cost of the project, size of the consortium, participation of non-Spanish organisms, participation of Spanish organisms, participation of Spanish firms in the budget, FP budget allocated to the specific programme, year of the application, prior Spanish experience in FP projects)*

These variables are assumed to be strictly exogenous or predetermined longer in advance.

[3] Notice that more than one Spanish firm can participate in the same proposal. The relevant variable in this case is the proposal.

4.1 Database

Our analysis is based on the data from two sources that we linked together: The CDTI-PM database and the SABI database. Since the VI FP took into effect, the CDTI (*Centro para el Desarrollo Tecnológico Industrial*) is the organism in charge of the maintenance and management of the information related to the Spanish participation in the FP. As a consequence, the CDTI-PM database includes information about all the proposals[4], finally granted or not, in which participates at least one Spanish firm between 1995 and 2005. During this period, 3,492 Spanish companies applied for FP cooperative projects, reaching the amount of proposals the number of 8,178 (1,888 were finally financed).

The information of the CDTI-PM database has been completed with the one from the SABI database that contains the company accounts of more than 1,000,000 Spanish firms since year 1995 to 2005. From these, we have selected a control sample that takes into account the availability of data about the relevant variables for each firm. We have chosen all companies employing more than 200 employees. Firms employing between 10 and 200 employees are selected by a random sampling scheme for each NACE class (two-digit) level, and represent around the 4% with respect to the Spanish *Central Companies Directory* (CCD), that joins together in just one information system, all Spanish companies and their local units located in the country. This makes our control sample representative of the Spanish economy. Coverage of the data is basically restricted to firms which have at least 10 employees (annual average), but we have also included 615 micro-companies (0.5% respect the CCD, chosen again by means of a random sampling scheme) given that 219 applicants of FP cooperative projects belong to this category. Although we have information since 1995, the sample used in the empirical analysis refers only to the period 1999 to 2005, given that the V FP started in 1999 and we want to take into account the experience, if it exists, in the previous programme.

Overall, the final sample consists of an unbalanced panel of 55,981 observations, 10,423 companies, and 3,251 proposals. The information of the SABI database is used mainly to estimate the firm's decision to engage in the cooperative project, while the CDTI-PM database allows us to analyze the determinants of the agency selection.

4.2 Descriptive analysis

According to available empirical papers focused on R&D cooperation, the econometric model includes three groups of possible determinants: 1) variables characterizing the financial and technological situation of the Spanish applicant; 2) variables reflecting the features of the consortium and 3) indicators of the previous experience in R&D international collaboration.

In what follows we describe the variables that we have considered in each set of determinants.

[4] To guarantee the homogeneity of the sample, only Specific Targeted Research Projects (STREPs) and Integrated Projects are considered.

4.2.1 Firm's characteristics

As we have seen in previous sections, empirical works about the advantages of cooperation point the importance of shared cost and risk, access to complementary knowledge, learning opportunities and spillovers internalization, and also suggest that the inter-firm research partnerships are mainly concentrated in a small number of high-tech industries. Specific evidence about participation in the FP (Hernán, Marín and Siotis, 2003) confirm these regularities, concluding that the probability to participate in a RJV is positively related to the firm's size and the industry R&D intensity.

Besides the firm's size, our database includes a large set of financial indicators. However, there is not information about R&D intensity or other measures of the company's technological performance, as innovations or patents. Given the intangible character of R&D, we use instead the proportion of intangible fixed assets over total fixed assets. The difference of means test confirms that the average of this variable in the sample is higher for the applicants within the FP respect to the non-applicants (see Table 1). We take also into account if the firm's activity corresponds to a high-tech service sector or a high or medium-tech manufacturing sector according to the OCDE classification[5]. The frequencies in Table 1 reflect a high presence of these activities among the proponents, especially in the high-tech services. In addition, we consider as explanatory variables a set of geographical dummies, given that the Spanish more technological firms tend to locate in specific regions[6].

Other fact to be considered is that the importance of sharing costs through the cooperative agreement can be superior if the company is financially restricted. The liquidity ratio is included in the specification to capture the own financial capacity, under the hypothesis that firms with a lower proportion of shareholders funds over non current liabilities are more likely to find interesting the aid provided by the EC. In fact, the mean of the liquidity ratio of applicants in the sample is statistically lower than the mean of non-applicants (see again Table 1).

To complete the set of explanatory variables, we include two additional indicators. The first one is the presence in international markets through exports. The proportion of exporters among the proponents is supposed to be higher for two reasons. On the one hand, exports and international cooperation can be part of the same firm's internationalisation strategy. On the other hand, due to their superior knowledge of the international context, exporters could find more easily partners for their R&D agreements.

The second indicator reflects whether the firm stands at the stock-market. This kind of companies uses to be financially more consolidated and international funds could be less attractive for them. However, firms at the stock-market tend to show more formalized quality procedures and therefore could find easier the formal requirements of the FP, as mentioned in section 3.

In our sample, both the export and stock-market activities are less frequent among the non-applicants.

[5] See the correspondence with the NACE-2 digits classification in Table A1 of Annex 1.
[6] Find the exact variables definition in Annex 2.

Table 1
Firm characteristics in the sample: descriptive statistics

Means of quantitative variables:	All firms	Applicants	Non-Applicants	t-test(*)
Liquidity ratio	0.717	0.690	0.718	3.31 (0.0009)
Intangible fixed assets	0.153	0.201	0.150	-10.80 (0.0000)

(*): t-test=two-sample difference of means test. P-value in parenthesis.

Frequencies of binary variables (%):	All firms	Applicants	Non-Applicants
Exporter	48.01	57.20	47.46
Stock-market	1.33	4.84	1.12
Region			
Andalusia	7.47	6.01	7.57
Catalonia	24.08	23.35	24.12
Galicia	3.72	3.84	1.71
Madrid	24.21	34.36	23.60
Bask Country	7.81	15.53	7.35
Valencia	9.49	7.02	9.63
High-tech services	7.01	24.17	5.99
Post and telecommunications	1.16	4.40	0.97
Computer and related activities	4.84	14.71	4.25
Research and development	1.01	5.06	0.77
High and medium-tech manufacturing	16.50	19.84	16.30
Chemicals and chemical products	5.03	4.78	5.04
Machinery and equipment n.e.c.	4.33	4.27	4.33
Office machinery and computers	0.21	0.57	0.19
Electrical machinery and apparatus n.e.c.	1.94	1.90	1.94
Radio, television and communication…	1.08	2.37	1.00
Medical, precision and optical instruments…	0.82	1.33	0.79
Motor vehicles, trailers and semi-trailers	2.23	1.55	2.27
Other transport equipment	0.87	3.07	0.74
Number of observations:	55,981	3,161	55,820

4.2.2 Features of the consortium and the project

Drivers of technological cooperation should be also considered from the point of view of the consortium and the project. Although this type of variables is more difficult to identify, available data allow us to establish some relevant relations between the firm's decision to cooperate and the features of projects and consortia.

In order to get a initial impression of the relevance of the selected variables, in Table 2 we distinguish between supported proposals and non-supported proposals, assuming that the evaluation process carried out under the EC responsibility is a valid indicator of the viability of the cooperation process. Thus, the following variables will allow us to identify some obstacles and advantages perceived by firms that decide to cooperate.

Table 2
Features of the consortium and the project: Descriptive statistics

Means of quantitative variables:	Proposals	Supported-proposals	Non-supported proposals	t-test(*)
Size of consortium (number of partners)	12.21	14.12	11.67	-5.15 (0.0000)
Participation of Spanish firms in the budget	17.58	14.81	18.37	6.18 (0.0000)
Total cost of the project (M€)	5.94	7.14	5.60	-3.57 (0.0004)
FP budget for the specific programme	21.16	20.01	21.50	3.55 (0.0004)

(*): t-test=two-sample difference of means test. P-value in parenthesis.

Frequencies of binary variables:	Proposals	Supported-proposals	Non-supported proposals
Leader nationality			
Spanish	31.13	32.41	30.77
Italian	10.52	9.04	10.94
German	11.04	13.91	10.23
Dutch	2.83	4.31	2.41
French	8.74	10.57	8.21
British	9.97	10.71	9.76
Technological area			
Information and communication	44.54	36.02	46.96
New materials	6.18	6.26	6.16
Environment and energy	8.95	8.93	9.04
Transports	18.95	26.98	16.67
Agro-food	2.09	1.81	2.17
Aeronautic and aerospace	3.01	6.26	2.09
Innovation programmes	3.48	4.27	3.08
Participation of non-Spanish organisms	93.11	92.49	93.29
Participation of Spanish organisms	62.69	63.28	65.52
Number of observations	3,251	719	2,532

Literature shows that, by means of cooperative projects, firms try to share high cost and risk associated to their technological activity. Nevertheless, cooperation is only possible if the company finds suitable partners and is able to coordinate its relationship with them. At this respect, the role of the coordinator is a key element within the consortia. Since some authors have identified a central-core of frequent participants in projects supported by the FP (Roediger-Schluga and Barber, 2006), we suppose that, when the coordinator of the consortia belongs to the more active countries, cooperation will find less obstacles.

Coordination cost is also considered a main obstacle to engage in R&D cooperative projects. At this respect, our model will analyse three specific cost factors: the size of the consortium, the geographical dispersion of the members and the type of organisations engaged.

The size of the consortium is a determinant factor to coordinate the partnerships, but also to reach the technological objectives of the project. On the one side, coordination cost is supposed to be positively related to the number of partners, although a low number of members could not be enough to shape multidisciplinary research teams.

Regarding geographical dispersion some authors (Narula, 2003) have remarked that information technologies and transports have contributed to reduce this specific cost factor. Available data allows us to measure the geographical concentration of the consortium only from the Spanish perspective, so we have included in the model a variable that quantifies the participation of Spanish firms in the total budget of the project. Since this variable is lower for supported proposals, we could confirm that a higher dispersion is not perceived by firms as an obstacle to cooperate.

A different conclusion could be drawn considering cooperation between different types of organisations. At this respect, the existence of public organisms participating in the project is supposed to be positively related to the coordination cost, due to the different objectives and working procedures that characterized both, firms and public organisations. The statistics in Table 2 confirm that the presence of public organisms is lower for those proposals finally supported. In order to analyze also the geographical effect, we take into account separately the Spanish and the non-Spanish organisms.

Incentives to cooperate under the FP should be understood from a dual perspective: First the financial aid, and second, the possibility to harmonize the corporative R&D strategy with the institutional objectives pursued by the EC. Although financial incentives are always welcomed, any R&D project supported by the FP should be related with the technological priorities included in each call of proposals.

In order to capture the advantages that perceive the firm deciding to participate in a cooperative project, we use two groups of variables. On the one hand, the financial opportunity is measured through the total budget of the project and the budget allocated by the EC to the specific programme where the firm applies (in percentage on the total budget of each FP edition). On the other hand, the technological opportunity is represented in the model by a set of variables that identify the main technological area of the project. The descriptive statistics of these variables are shown in Table 2.

4.2.3 Prior experience in international collaboration

Hernán, Marín and Siotis (2003) also find that the firm's past experience in research cooperation increases its probability of participation. This can be explained by at least three motives. Firstly, the preparation of an application usually entails a high degree of administrative formalization, which could discourage firms from applying, especially in the case of those without previous experience within the FP. Secondly, the firm that has previously engaged in a research consortium has less problems to find suitable partners for the new alliance. Finally, the past participation in a financed cooperative programme implies that the evaluator has acknowledged at that moment the company's technological capacity.

To capture these effects we use two measures of prior experience. Both are dummy variables that take respectively the value 1 when the firm has applied for or achieved an aid in the immediately previous edition of the FP. As it can be seen in Table 3, the proportion of firms with prior experience in proposals is clearly superior in applicants respect to non-applicants in the sample. In addition, the presence of Spanish firms with past experience in supported FP projects is higher in the granted proposals than in the rejected ones.

Table 3
Prior experience in FP: Descriptive statistics

Frequency:	All firms	Applicants	Non-Applicants
Prior experience in FP proposals	8.54	45.97	6.30

Frequency:	Proposals	Supported-proposals	Non-supported proposals
Prior Spanish experience in FP projects	23.07	26.30	22.12

5 - Results

In this section we present the results of the estimation of the model depicted in section 3. As equations (1) and (2) point out, we decompose the probability of participation in a cooperative project financed by the EC into two different decisions. In the first stage, the firm decides to engage or not in the proposal. In the second stage, the European agency decides to finance or not the cooperative project.

5.1 Determinants of the firm's decision to apply

Table 4 summarizes the estimates of the model that represents the determinants of the firm's decision to engage in a research consortium. Given the binary character of the dependent variables, and taking into account the panel structure of the data, the specification has been estimated as a random effects probit model. The majority of variables are statistically significant, although marginal effects are small. This points out the requirement to complete the group of explanatory variables with explicit indicators of the firm's technological profile, that in this moment are absent of our database.

In column (1) of Table 4, the first coefficient corresponds to a dummy that stands for years 2003 to 2005, corresponding to the VI FP. This variable achieves a negative effect, which would indicate that the specific features of the sixth edition, in comparison with the fifth one, have been less favorable to the technological objectives of Spanish firms that, in consequence, have applied in a smaller proportion. When we substitute this dummy for the whole set of year dummies -see column (2)- we observe that, in addition, firms tend to submit less percentage of proposals the last year of a FP edition (year 2002), due to the lower number of calls.

The rest of explanatory variables exhibit, in general, the expected effect. As we have supposed, the prior experience in FP proposals increases the probability to apply in the next edition. Companies that export, stand at the stock-market and maintain a higher proportion of intangible fixed assets are also more likely to apply, while the liquidity ratio is negatively associated with the probability to engage in the cooperative project. With respect to the geographical indicators, firms located in Bask Country, Catalonia, Madrid and Valencia show higher probabilities to submit an application, which is coherent with the major concentration of technological firms in these regions.

Firms that develop high or medium-tech activities are also more prone to become proponents, mainly in the case of high-tech services, confirming what we have observed through the descriptive analysis. The estimates in column (3) of Table 4 show that the presence of proponents is especially important in the ICT activities. The probability to engage in a FP project increases in 8,9% for companies in the Post and telecommunications service sector, and in 1,1% for firms in the Radio, television and communication manufacturing sector.

The effect of firm's size requires further explanation. The coefficients of the set of size dummies indicate a negative impact of size on the probability to apply. However, this can be reflecting the fact that our control sample is biased towards large firms, which are chosen on a census base, while firms employing between 10 and 200 employees are selected by a random sampling scheme. To study this question, estimates in Table 5 split the sample into two sub-samples, one for small and medium sized firms (SMEs) and one for firms with more than 200 employees (large firms). According to this criterion, the results let us establish that size has in fact a negative effect in SMEs, while the impact is the opposite in the case of large firms. This non-linear relationship between the firm's size and the probability to apply within the FP could be reflecting the special effort that the Spanish organism CDTI has made to stimulate the participation of small firms in this programme.

The results in Table 5 provide additional evidence about the dissimilarities in firm's behavior by size. Notice that the liquidity ratio is significant only in the case of large firms, while the proportion of intangible fixed assets increases the SMEs' probability of being a proponent, but not the large firms' one. This evidence could confirm that intangible assets allow SMEs to internalize the profits of cooperation, improving their absorptive capacity, whereas large firm could obtain these profits by means of a stronger financial position. Moreover, the presence at the stock-market is irrelevant in the case of small and medium firms. This effect is coherent with the fact that in the Spanish economy the majority of companies that stand at the stock-market are large firms.

With respect to the activity branch, the participation of SMEs is mainly limited to high-tech services. In what refers to large firms, some manufacturing industries also accumulate a major proportion of proponents. In particular, firms in Chemicals and chemical products, Radio, television and communication, and Other transport equipment, show superior probabilities to apply than the average. The rest of explanatory variables keep their impacts respect to Table 4 and exhibit similar effects in both groups of firms.

Table 4
Determinants of the firm's decision to apply within the FP

Probit estimates

	(1)		(2)		(3)	
	dy/dx	Std. E.	*dy/dx*	Std. E.	*dy/dx*	Std. E.
VI FP	-0.001 **	0.0003				
Time dummies						
Year 2000			-0.0004	0.0006	-0.0004	0.0006
Year 2001			-0.0005	0.0006	-0.0005	0.0006
Year 2002			-0.0027 ***	0.0004	-0.0027 ***	0.0004
Year 2003			-0.0002	0.0006	-0.0002	0.0006
Year 2004			-0.0023 ***	0.0004	-0.0023 ***	0.0004
Year 2005			-0.0027 ***	0.0004	-0.0026 ***	0.0004
Prior experience in FP proposals	0.008 ***	0.001	0.008 ***	0.001	0.008 ***	0.001
Exporter	0.003 ***	0.001	0.003 ***	0.001	0.003 ***	0.001
Liquidity ratio	-0.001 **	0.000	-0.001 **	0.000	-0.001 **	0.000
Intangible fixed assets	0.003 **	0.001	0.003 **	0.001	0.003 **	0.001
Stock-market	0.040 **	0.014	0.039 **	0.013	0.040 **	0.014
Firm's size dummies (no. of workers)						
From 10 to 49	-0.002 ***	0.001	-0.002 ***	0.001	-0.002 ***	0.001
From 50 to 99	-0.004 ***	0.0004	-0.004 ***	0.0004	-0.003 ***	0.0004
From 100 to 199	-0.004 ***	0.0004	-0.004 ***	0.0004	-0.004 ***	0.0004
More than 200	-0.006 ***	0.001	-0.005 ***	0.001	-0.005 ***	0.001
Region						
Andalusia	0.002	0.001	0.002	0.001	0.001	0.001
Bask Country	0.020 ***	0.004	0.020 ***	0.004	0.019 ***	0.004
Catalonia	0.004 ***	0.001	0.003 ***	0.001	0.004 ***	0.001
Galicia	-0.001	0.001	-0.001	0.001	-0.001	0.001
Madrid	0.006 ***	0.001	0.006 ***	0.001	0.005 ***	0.001
Valencia	0.004 **	0.002	0.004 **	0.002	0.003 **	0.002
High-tech services	0.040 ***	0.006	0.039 ***	0.006		
Post and telecommunications					0.060 **	0.018
Computer and related activities					0.032 ***	0.006
Research and development					0.089 ***	0.024
High and medium-tech manufacturing	0.002 **	0.001	0.002 **	0.001		
Chemicals and chemical products					0.001	0.001
Machinery and equipment n.e.c.					-0.0002	0.001
Office machinery and computers					0.027	0.024
Electrical machinery and apparatus n.e.c.					0.001	0.002
Radio, television and communication…					0.011 *	0.006
Medical, precision and optical instruments					0.006	0.005
Motor vehicles, trailers and semi-trailers					-0.001	0.001
Other transport equipment					0.039	0.016
Sigma_u	1.197	0.030	1.199	0.018	1.198	0.018
Rho	0.589	0.007	0.590	0.007	0.590	0.007
Log of likelihood function	-8,221.09		-8,162.56		-8.139.48	
Number of observations	55,981		55,981		55,981	

Std. E.: Estimated standard error. Coefficients significant at: 1%***, 5%**, 10%*. All regressions include the constant. Dummies excluded for firms with less than 10 employees and the year 1999. Marginal effects (*dy/dx*) are computed at sample means. For dummy variables, the marginal effect corresponds to the change from 0 to 1.

Table 5
Determinants of the firm's decision by size

Probit estimates

	Small and medium-sized firms		Large firms	
	dy/dx	Std. E.	*dy/dx*	Std. E.
Time dummies				
Year 2000	-0.0011 *	0.0006	0.0005	0.0007
Year 2001	-0.0011 *	0.0006	0.0001	0.0006
Year 2002	-0.0029 ***	0.0005	-0.0014 ***	0.0004
Year 2003	-0.0004	0.0007	0.0004	0.0007
Year 2004	-0.0020 ***	0.0005	-0.0010 **	0.0004
Year 2005	-0.0024 ***	0.0005	-0.0014 ***	0.0004
Prior experience in FP proposals	0.008 ***	0.002	0.007 ***	0.002
Exporter	0.002 ***	0.001	0.004 ***	0.001
Liquidity ratio	0.0001	0.001	-0.001 **	0.0003
Intangible fixed assets	0.004 ***	0.001	0.000	0.001
Stock-market	0.002	0.004	0.019 **	0.008
Firm's size	-0.002 ***	0.0003	0.002 ***	0.0004
Region				
Andalusia	0.001	0.001	-0.0003	0.001
Bask Country	0.025 ***	0.006	0.006 **	0.003
Catalonia	0.004 ***	0.001	0.001	0.001
Galicia	-0.001	0.001	-0.001 *	0.001
Madrid	0.004 ***	0.002	0.001 *	0.001
Valencia	0.004 **	0.002	0.001	0.001
High-tech services				
Post and telecommunications	0.022 *	0.012	0.065 **	0.026
Computer and related activities	0.025 ***	0.007	0.042 ***	0.014
Research and development	0.063 **	0.025	0.150	0.114
High and medium-tech manufacturing				
Chemicals and chemical products	-0.001	0.001	0.004 *	0.002
Machinery and equipment n.e.c.	-0.001	0.001	0.005	0.004
Office machinery and computers	0.016	0.023	0.216	0.186
Electrical machinery and apparatus n.e.c.	-0.001	0.001	0.002	0.003
Radio, television and communication…	0.007	0.006	0.031 *	0.019
Medical, precision and optical instruments	0.003	0.004	0.005	0.009
Motor vehicles, trailers and semi-trailers	-0.002 *	0.001	-0.0005	0.001
Other transport equipment	0.024	0.015	0.038 *	0.022
Sigma_u	1.230	0.023	1.139	0.029
Rho	0.602	0.009	0.565	0.012
Log of likelihood function	-4,308.00		-2,831.06	
Number of observations	30,347		22,028	

Std. E.: Estimated standard error. Coefficients significant at: 1%***, 5%**, 10%*. All regressions include the constant. Dummy excluded for the year 1999. Marginal effects (*dy/dx*) are computed at sample means. For dummy variables, the marginal effect corresponds to the change from 0 to 1.

*5.2 Determinants of the **proposal award***

Table 6 shows the results obtained from the estimation of the model in which the dependent variable is the probability of the proposal award. The sample consists of 3,251 proposals for the period 1999 to 2005. In the first column we summarize the results corresponding to a probit model in which the information is treated as a pool. The coefficients in the second column refer to a random effects probit model, which takes into account that the same Spanish firm can participate in different proposals during the period. The assumption behind this second estimation is that the composition of the consortia in which the same Spanish firm participates is also likely to be more constant. Therefore, we would be controlling for the presence of consortium effects. However, in both estimates the results are quite similar, suggesting that this correction is not very important in our sample. In what follows we describe the main findings.

The econometric analysis shows that the probability of a proposal to be supported is higher when it is lead by an organization from Spain, Netherlands, Germany, France or the United Kingdom. The Spanish leadership is overestimated because we only consider proposals with participation of Spanish firms, but, in any case, it could be confirmed that proposals coordinated by Spanish organizations (private or public) have a greater probability to get financial support than those coordinated by a foreign one. Moreover, it seems that cooperation with Dutch or German partners is the best option for Spanish firms. According to these results, we can conclude that partners' selection (especially the coordinator partner) is a relevant variable for firms deciding to cooperate.

Coordination cost due to the size of consortia seems to be mitigated by the needed technological diversity of the research equipment. The number of partners engaged in a proposal has a positive effect on the probability to be supported. This fact could be also a consequence of the more ambitious goals pursued by the sixth edition of the FP.

The presence of public organisms within a consortium is a significant variable in our model, although with a negative effect on the proposal viability. That could indicate that coordination costs among private and public partners are perceived as an obstacle to cooperate. Nevertheless, it should be pointed out that this negative effect is lower when the public organisms participating in the project are Spanish instead of non-Spanish.

Coordination cost could be, in part, reduced by the effect of the previous experience in cooperative projects. Our model confirms that the probability to be involved in a supported proposal is higher when the firm has already participated in a granted project within the last editions of the FP.

Beside variables explaining obstacles to cooperation, firms would take into account that the participation in the FP entails technological and financial opportunities. According with some authors mentioned in section 3 (Marín and Siotis, 2002), the FP would give priority to some technological areas like information and communication technologies (the great part of the total budget is allocated to this field). The empirical analysis allows us to confirm this fact for the case of the Spanish firms, since variables related to some technological areas, such as ICT, transports and aeronautic technologies, are significant. Nevertheless, the variable "FP budget for the specific programme" has a negative sign, reflecting that the probability to be supported decreases slightly for those programmes with

the highest budgets. That could indicate that Spanish firms are not profiting enough from the financial opportunities within the FP.

Table 6
Determinants of the proposals award

Probit estimates

	Pool			Random effects		
	dy/dx		Std. E.	*dy/dx*		Std. E.
Year of the application						
Year 2000	0,004		0,025	0,004		0,025
Year 2001	0,005		0,025	0,005		0,025
Year 2002	0,003		0,028	0,003		0,028
Year 2003	-0,158	***	0,029	-0,158	**	0,029
Year 2004	-0,123	***	0,033	-0,123	**	0,033
Year 2005	-0,092	**	0,034	-0,092	**	0,034
Participation of non-Spanish organisms	-0,066	**	0,035	-0,066	**	0,035
Participation of Spanish organisms	-0,041	**	0,018	-0,041	**	0,018
Total cost of the project	0,006		0,011	0,006		0,011
Size (of consortium)	0,190	**	0,079	0,190	**	0,079
Size squared	-0,016		0,015	-0,016		0,015
Participation of Spanish firms in the budget	-0,003	***	0,001	-0,003	***	0,001
FP budget for the specific programme	-0,007	*	0,004	-0,007	*	0,004
Leader nationality						
British	0.053	*	0.030	0.054	*	0.031
Dutch	0.153	***	0.055	0.157	***	0.057
French	0.058	*	0.032	0.057	*	0.032
German	0.107	***	0.031	0.106	***	0.031
Italian	0.010		0.028	0.010		0.029
Spanish	0.130	***	0.025	0.133	***	0.026
Technological area						
Aeronautic and aerospace	0,328	***	0,073	0,328	***	0,073
Agro-food	-0,032		0,063	-0,032		0,063
Environment and energy	0,021		0,054	0,021		0,054
Information and communication	0,125	***	0,047	0,125	***	0,047
Innovation programmes	0,074		0,083	0,074		0,083
New materials	0,068		0,052	0,068		0,052
Transports	0,170	***	0,034	0,170	***	0,034
Past Spanish experience in FP projects	0,036	**	0,017	0,036	**	0,017
Sigma_u				0.241		0.075
Rho				0.055		0.032
Log of likelihood function	-1,602.55			-1,600.86		
Number of observations	3,251			3,251		

Std. E.: Estimated standard error. Coefficients significant at: 1%***, 5%**, 10%*. All regressions include the constant. Dummies excluded for firms with less than 10 employees and the year 1999. Marginal effects (*dy/dx*) are computed at sample means. For dummy variables, the marginal effect corresponds to the change from 0 to 1.

Some works also remark that the more ambitious objectives introduced by the VI FP could have a negative effect in those projects with a lower dimension. The dummy variables indicating in which year the firm has applied are significant with negative sign for 2003, 2004 and 2005, that is, during the VI FP. Thus, it seems that the sixth edition of the FP had a negative effect in the probability of a Spanish firm to be supported.

6 - Conclusions

The objective of this paper is to analyse which factors determine the participation of the Spanish firms in R&D consortia within the Framework Programme. For that purpose, we take into account that this phenomenon is the result of two decisions. Firstly, the firm decides to engage or not in the consortia. Secondly, the project is evaluated by the agency that approves or rejects it.

Therefore, the empirical model consists of two equations to reflect each of the decisions, in whose specification we consider three types of potential determinants: 1) variables characterizing the financial and technological situation of the Spanish applicant; 2) variables reflecting the features of the consortium and 3) indicators of the previous experience in R&D international collaboration. These variables have been constructed with data from two sources that we linked together: The CDTI-PM database and the SABI database. The first one includes information about all the proposals, finally approved or not, in which participates at least one Spanish firm since 1995. The second contains the company accounts of more than 1,000,000 Spanish firms from 1995 to 2005. From these, using a random sampling scheme we have selected an unbalanced panel of more than 10,000 firms for the period 1999 to 2005.

The estimation of the firm's probability to apply within the FP, taking into account the panel structure of the data, lets us to obtain the following conclusions: Firstly, as we have expected, the company's technological capacity, captured through its proportion of intangible fixed assets, its belonging to a high or mid-high technological sector, and its location in a high-tech region, increases the propensity to become a proponent within the FP.

Secondly, exporters apply more, which is coherent with the idea that exports and international cooperation are part of the same internationalisation strategy, or that exporters can find more easily partners for their R&D agreements.

Thirdly, the presence at the stock-market of large firms has a positive effect on their probability to apply. This can be explained by the more formalized quality procedures of firms that stand at the stock-market, which makes them easier to overcome the administrative costs implied by the formal scheme of the cooperation process.

Fourthly, in order to internalize profits from cooperation, SMEs seem to design strategies based on their intangible absorptive capacity, whereas large firms appear to trust more on their financial advantages.

Finally, the firm's size has a non-linear impact on the probability to apply. It reduces this probability in the case of SMEs and has the opposite effect over large firms. The role of the Spanish organism CDTI, that during the last years has made a special effort to encourage the participation of small firms, can be behind this regularity.

With respect to the proposal award, the main findings can be summarised as follows: Variables related to the coordination cost, such as the size of the consortium and the

presence of public organisations are significant but with different sign. Whereas the size of the consortia has a positive effect on the viability of the proposal, the presence of public centres reduces the probability to receive financial aid.

Thus, the negative impact of coordination cost due to the size of consortia seems to be mitigated by the positive outcome of the higher technological diversity associated to the research equipment. This fact could be a consequence of the more ambitious goals pursued by the sixth edition of the FP.

On the contrary, coordination among public and private organization is perceived as a relevant cost factor, although this negative effect is lower when the research centres engaged in the project are Spanish (instead of non-Spanish). This evidence could remark that the cooperation with Spanish research public centres is less costly for consortia that include Spanish firms.

In general, the national component of the consortia seems to be favourable for Spanish firms. When partners are coordinated by a national organisation, the probability to be supported is higher. It should be also remarked that cooperation projects with Dutch and German leaders are more likely to be financed.

Regarding the institutional context within cooperation takes place, we have found that prior experience in FP proposals increases the probability to apply in the next edition and also to be awarded. Nevertheless, in general, the probability of a firm to be supported within the VI FP is lower compared to the fifth one.

It should be also pointed out that the financial opportunities existing in some technological priorities, such as ICT, transports and aeronautic technologies, increase the probability for Spanish companies to be supported in those areas. Nevertheless, the variable “FP budget for the specific programme” has a negative sign, reflecting that the probability to be supported decreases slightly for those programmes with the highest budgets. Thus, the reaction capacity of Spanish firms to increasing financial opportunities seems to be still a challenge in the field of international R&D cooperation.

Regarding the above mentioned results, it could be considered that this first approach to the international R&D cooperation adds some evidence to the existing knowledge of such a complex process. Although the database used for this research has been proved to be a valid instrument, it should be completed with some additional data referring, overall, to the R&D capacity of firms and their strategy concerning intellectual property protection. Future research lines will take into account these topics.

7 - Annex 1: Classification of high-tech sectors

Table A1
Classification of high and mid-high technology sectors

NACE-Rev.1	Sectors
	High and mid-high technology manufacturing sectors
24	Chemicals and chemical products
29	Machinery and equipment n.e.c.
30	Office machinery and computers
31	Electrical machinery and apparatus n.e.c.
32	Radio, television and communication equipment…
33	Medical, precision and optical instruments…
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
	High technology services
64	Post and telecommunications
72	Computer and related activities
73	Research and development

8 - Annex 2: Variables definition

FP budget for the specific programme: Percentage of the total FP budget allocated to each specific programme

Firm's size: Number of employees in the current year (in log.).

Exporter: Dummy variable, which takes the value 1 if the company has exported during the period.

High-tech services: Dummy variable, which takes the value 1 if the company belongs to the high-tech services (NACE2 codes 64, 72, 73)

High and medium-tech manufacturing: Dummy variable, which takes the value 1 if the company belongs to any high and medium-tech manufacturing sectors (NACE2 codes 24, 29, 30, 31, 32, 33, 34, 35)

Intangible fixed assets: Intangible fixed assets over total fixed assets in the current year.

Leader nationality:
British leader: Dummy variable, which takes the value 1 if the leader of the consortium is from the United Kingdom.
Dutch leader: Dummy variable, which takes the value 1 if the leader of the consortium is Dutch.

French leader: Dummy variable, which takes the value 1 if the leader of the consortium is French.
German leader: Dummy variable, which takes the value 1 if the leader of the consortium is German.
Italian leader: Dummy variable, which takes the value 1 if the leader of the consortium is Italian.
Spanish leader: Dummy variable, which takes the value 1 if the leader of the consortium is Spanish.

Liquidity ratio: Shareholders funds over non current liabilities in the current year.

Participation of non-Spanish organisms: Dummy variable, which takes the value 1 if non-Spanish organisms participate at the consortium.

Participation of Spanish organisms: Dummy variable, which takes the value 1 if Spanish organisms participate at the consortium.

Past experience in R&D FP proposals: Dummy variable, which takes the value 1 if the firm's has applied to the FP in the edition previous to the current one.

Past Spanish experience in R&D FP projects: Dummy variable, which takes the value 1 if the firm's has participated in a cooperative project financed in the FP in the edition previous to the current one.

Region:
Andalusia: Dummy variable, which takes the value 1 if the firm is located in Andalusia.
Bask Country: Dummy variable, which takes the value 1 if the firm is located in the Bask Country.
Catalonia: Dummy variable, which takes the value 1 if the firm is located in Catalonia.
Galicia: Dummy variable, which takes the value 1 if the firm is located in Galicia.
Madrid: Dummy variable, which takes the value 1 if the firm is located in Madrid.
Valencia: Dummy variable, which takes the value 1 if the firm is located in Valencia.

Size of the consortium: Total number of members (firms, public organisms or other institutions) in the consortium (in log.).

Participation of Spanish firms in the budget: Percentage of Spanish firms participation in the total budget of the project.

Stock-market: Dummy variable, which takes the value 1 if the firm stands at the stock-market.

***Technological area*:**
Information and communication: Dummy variable, which takes the value 1 if the project is related to information and communication technologies
New materials: Dummy variable, which takes the value 1 if the project is related to new materials technologies
Environment and energy: Dummy variable, which takes the value 1 if the project is related to environment and energy technologies

Transports: Dummy variable, which takes the value 1 if the project is related to transport technologies
Agro-food: Dummy variable, which takes the value 1 if the project is related to agro-food technologies
Aeronautic and aerospace: Dummy variable, which takes the value 1 if the project is related to aeronautic and aerospace technologies
Innovation programmes: Dummy variable, which takes the value 1 if the project is related to innovation programmes

Total cost of the project: Total cost of the project in thousand euros (in log.)

Year of application: Set of time dummy variables, which take the value 1 when the proposal has been presented in this year.

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