Which companies participate in subsidised R&D projects with public labs? Evidence from the French ANR collaborative programme

Xavier de FINANCE[†]
IMRI, Université Paris-Dauphine

Marie de LATTRE-GASQUET
Agence Nationale de la Recherche

Marc ISABELLE
OSEO & IMRI, Université Paris-Dauphine

Preliminary version: 02 April 2008
(do not circulate)

[†] Institut pour le Management de la Recherche et de l'Innovation
Bureau A702 – Université Paris-Dauphine
75775 PARIS Cedex 16
Email: xavier.de.finance@gmail.com

Abstract

In the past 25 years, most developed countries have promoted policies to develop R&D partnerships between firms and public research organisations in order to foster innovation and competitiveness. In France, these relations are considered insufficient according to international benchmarks. The Agence Nationale de la Recherche, a recently founded funding agency for public research, bears the mission of supporting such partnership. The central instrument it uses for this purpose is the Call for collaborative projects, which provides a dedicated budget for selected R&D projects that are framed within public-private partnerships. From the economic point of view, such policy instrument is considered effective if it induces more and new collaborations. As a preliminary step towards an evaluation of this type, it is important to have some knowledge about which companies are prone to use this instrument. This work aims at identifying the characteristics of firms that have participated in ANR's first Calls for collaborative projects, as well as to quantify their influence on a firm's propensity to participate.

Keywords: *R&D – Collaborative research – Public funding*

JEL classification: *L2 O31 O38*

1. Introduction

The past 25 years have seen a surge in the number of collaborative arrangements between public research organisations (henceforth PROs) and firms (Cohen et al., 1998; Link, 1996; Mansfield and Lee, 1996; OECD, 2002). These collaborations are considered key elements of national innovation systems, which increase the level of innovative activities through a faster transfer of new scientific and technological knowledge into economic activities, and a better reactivity of the research sector to economic and societal needs.

However, a number of barriers tend to withhold such collaborations. Setting up and managing public-private R&D partnerships is considered difficult because of the high degree of uncertainty regarding the results that can be obtained, and because of the difficulty to supervise the stocks and flows of inputs out outputs that by and large consist in knowledge and know-how that are difficult to identify, protect and appropriate. Moreover, the rules and norms of firms and PROs diverge considerably, in terms of the objectives that are deemed legitimate as well as regarding their reward structures (Dasgupta & David, 1994). All these barriers have been extensively studied in the literature (Gibbons & Johnston, 1974; Link & Rees, 1990; Bailetti & Callahan, 1992; Senker & Faulkner, 1992; Faulkner & Senker, 1994; Ham & Mowery, 1998; Azàroff, 1982; Höglund & Persson, 1987; Van Dierdonk & al., 1990; Sheen, 1992; Lee, 1996). Mohnen & Hoareau (2003) state it sharply in their conclusions: "cultures in business and basic research institutions are too far apart to lead to cooperation unless the government establishes or forces a link."

As a matter a fact, governments have fostered closer connections between public research and private firms taking for granted that this will accelerate the transfer of publicly sponsored research results to firms in knowledge-intensive industries and, pushed further by diffusion, increase the rate of innovation for the economy as a whole (Pavitt, 1991; OECD, 2002). In due course, this collaboration would also make public research activities more relevant and responsive to firms' needs. Subsidy schemes provide an instrument to increase the partners' incentives to initiate collaborative R&D projects. According to Veugelers & Cassiman (2005), they receive the largest portion of public money spent for the promotion of industry-science links and they are used in many countries. One prominent example is provided by the EC R&D Framework Programme. In the US, several federal policy programs provide financial support for R&D collaborations between firms and PROs: the Advanced Technology

Program, the CRADAs (Collaborative R&D Agreements) and UIRCs (University-Industry Research Centers).

In France, the Agence Nationale de la Recherche (ANR), founded in 2005, is a new national funding agency for research projects that emanate from the public research sector. The promotion of collaborations between firms and PROs is part of its missions. To this end, the ANR uses a specific instrument called the Appels à Projets Partenariaux (calls for collaborative projects). The budget set aside for this instrument is allocated to selected collaborative projects between firms and public labs in specific research fields that correspond to national priorities as defined by the ANR and the government. The rules of application are quite open: firms of every size can submit a project in many research areas, and the activities can be fundamental research, applied research or pre-competitive development. A share of each partner's costs in the R&D project is financed through the instrument.

A central challenge of such subsidy scheme, referred to as the incentive effect, is to effectively leverage public-private R&D collaborations. In other words, from a normative point of view, collaborative projects between firms and public labs (or specific activities within the project) that would be initiated even in the absence of public support should not be sponsored. Moreover, collaborative R&D projects that are presumably welfare enhancing but that would not be undertaken absent a public support should receive the required subsidy. These are the two basic equations governing the efficiency of public spending on subsidy schemes for collaborative R&D projects. They must be fulfilled to guarantee the best use of public money spent in the pursuit of more / new public-private R&D collaborations, for more innovation and competitiveness in the economy.

The evaluation of public policy instruments for R&D and innovation, i.e. the assessment of their efficiency as defined above for example, is not a straightforward job. For example, the outputs of R&D activities tend to be various and difficult to quantify; the counterfactual is difficult to define (what would have happened without the aid?); etc. In the specific case of ANR's calls for collaborative projects, it would seem important, as a preliminary step, to have some knowledge about the variables that influence the decision of firms to set up collaborations with public research labs, both in the presence or absence of public support schemes.

Surprisingly, little is known from the literature about the characteristics of firms that have an impact on their propensity to form public-private R&D collaborations. Some results are even conflicting, for example regarding a characteristic of firms as important as their size: Ballesteros & Rico (2001) and Tether (2002) find that a firm's size has no influence on its propensity to form R&D collaborations with public labs; while Belderbos & al. (2004), Fritsch & Lukas (2001) and Colombo & Garrone (1996) find that larger firms tend to collaborate more with public research labs.[1]

Our study aims at adding new results in this field. Its purpose is to determine what characteristics of firms discriminate between those that participate in ANR's calls for collaborative projects and those that don't; and also to quantitatively estimate the influence of these characteristics on the propensity of a firm to participate. The paper is organised as follows: section 2 presents the literature review; section 3 describes the ANR, its calls for collaborative projects and their position in the French landscape of public policy instruments for R&D and innovation; section 4 describes the data and the methodology; section 5 presents the results, which are discussed in section 6; section 7 concludes.

2. Literature review

The motivations of firms to enter into collaborative R&D projects with public research labs have been extensively studied, as well as the obstacles that could withhold the partners from initiating such collaborations. We will first review the main related results in order to provide a global picture of these collaborations. The literature review will then be focused on the characteristics of firms that participate in R&D collaborations with public research labs. The governmental bodies or agencies that are responsible for choosing which collaborative R&D projects should be supported and which should not presumably pay a great attention to the characteristics of the applying firms in their selection process. For this reason, our review will

[1] It is worth noting that an obvious reason for such diverging results may be the fact that a firm's size (or any other characteristic) could influence the selection process by the public authority that grants the subsidy for collaborative R&D: large firms, for example, could intrinsically have a higher propensity to collaborate with public labs, but could be ruled out of a public programme specifically targeted towards SMEs. This point will be addressed later in the paper in the case of ANR's calls for projects.

differentiate between studies that address the global issue of public-private R&D collaborations, and those that focus on publicly supported collaborations.

2.1 Public-private R&D collaborations: motivations, results and obstacles

There are many motivations for the growing interactions between PROs and firms. From the point of view of a public laboratory, the essential reason is the possibility to leverage additional resources from firms to carry out their research. Several empirical studies confirmed the importance of this central motivation on the side of PROs in various national settings (Cohen et al., 1994, for the US; Meyer-Krahmer and Schmoch, 1998, for Germany; Goddard and Isabelle, 2006, for France).

Firms also benefit from a leveraging of resources through an outsourcing of R&D projects which can be either complementary or undertaken at a lower cost in PROs (see Hall, Link and Scott, 2000, for a longer discussion). Clearly, firms also gain by absorbing the latest results from public research and can upgrade their internal capabilities by tapping into the more established knowledge base in PROs (Cohen and Levinthal, 1990). This learning by interacting is an essential channel through which public research feeds into industrial innovation (Mansfield, 1991).

The preceding comments suggest that collaboration between firms and PROs is a positive sum game, but the fact that it is two highly different social systems that interact (Dasgupta and David, 1994) has very practical consequences in terms of the management of collaborations. On the side of PROs, a number of surveys addressed to technology transfer offices (TTOs) point to a number of difficulties: the scarcity of "gap funding", cultural differences, and the difficulties of matching inventions with companies. These manifest themselves in different countries (Decter, Bennett and Leseure, 2007). A study by Siegel et al. (2004) also cites weak incentives for academic researchers to invent, to disclose their inventions and to transfer them to firms as another obstacle.

Intellectual property issues constitute another barrier preventing firms from partnering with universities at the research stage, as discussed by Hall et al (2001). Using data about a set of 38 private-sector projects that were funded by the US Advanced Technology Program, they find that the probability that a firm encounters insurmountable IP barriers that refrain it from working with a university (i) increases with the project's share of public funding (through the

ATP) and (ii) decreases with the project's duration. The authors' interpretation is that IP raises stiff management difficulties when the project has clearly identifiable results ex ante and/or when these results can not easily be appropriated.

Hertzfeld et al. (2006) also tackle the issue of difficulties arising from the management of IP in research joint ventures. In line with Hall et al., they find that resolving issues of IP protection is especially difficult when one of the participants is a university. According to their sample of large US diversified firms, TTOs' personnel is inexperienced and tend to overestimate the value of invention, leading them to adopt overly tough bargaining positions. Strategic partnerships with selected universities help forming a flexible and predictable basis for collaboration, implying the existence of both contractual and relational solutions for the management of knowledge-based assets in collaborative settings.

2.2 The characteristics of firms that participate in public-private R&D collaborations

A number of studies have drawn the attention to several key characteristics of firms that could influence their propensity to collaborate with public research labs. These key characteristics are a firm's size, R&D intensity and sector of activity. From a methodological point of view, some studies consider PROs as one possible R&D partner among many others (customers, suppliers, subcontractors, competitors), while other studies are specifically focused on R&D collaborations with PROs.

The result that a firm's size has a positive influence on its propensity to collaborate in R&D overall is widely acknowledged. However, it seems that the size is an even more important factor when the partner under consideration is a PRO, probably because smaller firms face relatively more important transaction costs. More precisely, several studies that consider R&D collaborations of all types (customers, suppliers, subcontractors, competitors, PROs) find that a firm's size is significantly correlated only with its propensity to collaborate with PROs (Kleinknecht and Reijnen, 1992 ; Fritsch and Lukas, 2001 ; Tether, 2002). In an econometric study which controls for complementarities between own-firm and cooperative R&D, Veugelers and Cassiman (2005) also find that the propensity to cooperate with universities is positively correlated with firm size. Using data from CIS2 for several countries, Mohnen & Hoareau (2003) find that a one percent increase in a firm's size increases by 1.6 percent its probability of collaborating with universities or government labs.

The results found in the literature regarding the influence of a firm's R&D intensity on its propensity to collaborate with PROs are less consensual. Kleinknecht & Reijnen (1992) find that a firm's R&D intensity is significantly correlated with its propensity to enter into collaborations with PROs (but not with other types of partners). Fritsch & Lucas (2001) find a significant correlation for collaborations with PROs and other types of partners; but when the dependent variable is the number of collaborations, the influence of R&D intensity is significant only for PROs and suppliers. These results are consistent with the idea that firms needs to have some internal R&D capacity to be able to absorb scientific and technological knowledge that is produced elsewhere (Cohen & Levinthal, 1990). Conversely, Mohnen & Hoareau (2003) find that a firm's R&D intensity is not significantly related to collaborations with PROs.

Many studies also find that the industry to which the firm belongs is related to its propensity to forge collaborations with PROs. Mohnen & Hoareau (2003) find that firms that belong to what they call "scientific sectors" (chemicals, machinery and equipment, vehicles, electrical and electronic products, computer services and engineering services) have a 1.7% higher probability than firms from other sectors to collaborate with universities or government labs.

Some industrial sectors rely heavily on science, such as biotechnologies, nanotechnologies and information and communication technologies. In these high-tech sectors, the distance between basic research and the market tends to be small, meaning that new knowledge produced in PROs can readily be transferred to firms in order to be incorporated in economic applications. R&D collaborations with public research labs are very common in these high-tech sectors.

2.3 The characteristics of firms that participate in subsidized public-private R&D collaborations

In the literature, there is scarce evidence about the ability of public support to effectively leverage R&D partnerships between firms and PROs.

Ballesteros & Rico (2001) use project data from the Concerted Projects under the Spanish National R&D Plan. With this instrument put into practice in 1988, the Spanish government subsidises pre-competitive research projects (that is, R&D projects that are close to the market) run in collaboration between firms and public research labs. Ballesteros and Rico

build self-selection models of the financing granted to each concerted project, with several explanatory variables related to the firm, to the project and to the public authority that manages the aid. Their models include a selection equation that estimates the propensity of a firm to submit and be selected for a concerted project, based on the firm's attributes.

The explanatory variables in the selection equation are the firm's sector of activity, its size, and some composite variables obtained through an analysis of multiple correspondence. The composite variables include the firm's orientation towards R&D activities as well as an indicator of its research capability. The selection equation serves to correct the selection bias and not to analyse in detail the reasons behind a firm's participation in the Spanish concerted projects. However, Ballesteros and Rico find that the firms which are most intensely involved in R&D activities, and with most capacity to carry them out, are the ones most prone to making use of a concerted project. They also find that the size of a firm has no incidence on its participation in the concerted project programme.

Busom and Fernandez-Ribas (2005) use a sample of Spanish manufacturing firms to estimate the effects of receiving public support on the probability that firms set up an R&D partnership with a public research organisation. They are not considering any specific policy instrument but rather public support in general. They find that the most influential variable is the firm's R&D intensity, while the influence of the firm's size is small and significant only a the 10% level. Lastly, they find that the propensity to have R&D collaborations with PROs is higher when the firm has an internal R&D capacity, when it has a track record of filing international patents, and when it belongs to the chemistry / pharmaceuticals sector.

It is worth noticing that in these two studies, the influence of a firm's size on its participation in R&D collaborative projects is found to be non significant or weak, contrary to most results found for collaborations without public support. More precisely, whereas larger firms have a higher propensity to forge R&D collaborations with public labs, it appears that this is not the case anymore when the collaborative projects under consideration benefit from a subsidy scheme, or when the firm does receive some form of public support. Two main explanations can be given for this peculiarity. Firstly, SMEs may have greater difficulties to finance their innovations on the market and thus be more prone to apply to public subsidy programs (some form of self selection). Secondly, it may be that the government bodies or agencies that handle these programs favour SMEs in their selection process: as a matter of fact, most

governments tend to consider that their budgets would be more effectively spent on supporting SMEs, which are regularly found to benefit the more from relations with PROs, and which are considered essential for national competitiveness, job creation and economic growth.

3. The ANR and its calls for collaborative projects

The government financing of public research goes essentially through two channels : the direct funding of PROs on the one hand, which represents the main source of funding, and the competitive funding of research projects on the other hand. This type of funding selects some projects among those that are submitted by research teams, on the basis of their quality and relevance according to national priorities.

In European countries, the competitive financing of public research based on some form of research projects selection weights approximately between 25-33% of the total government funding for public research, which makes it the second source of funding (Geuna, 2001 ; Braun, 2003). Public agencies that handle the management of such programmes for public R&D include the Deutsche Forschungsgemeinschaft in Germany, the Fonds National de la Recherche Scientifique in Switzerland, the Research Councils in the UK, and the Agence Nationale de la Recherche in France.

Generally speaking, the ANR manages calls for projects that cover five main research domains: Humanities & social sciences, ecosystems and sustainable development, sustainable energy and environment, biology and health, and finally matter sciences, information and communication. In 2006, 49 calls for projects have been launched by the ANR[2]. 6 419 projects have been submitted of which 1622 have been selected for public support (success ratio of 25,3%), after evaluation by more than 10 000 independent experts. The corresponding budget was 621 M€. On average, R&D projects last 35 months, involve 3,1 partners and receive a subsidy of 382 thousand euros from the ANR.

[2] All the figures shown in this paragraph and the following come from ANR's 2006 annual report.

The calls for collaborative projects that we study here are a subset of ANR's calls for projects, which is eligible only to R&D projects set up in collaboration between firms and public research labs. Apart from this condition imposed to applicants and the general thematic priorities defined at the national level, there are no other ex ante selection criteria related to e.g. firm size, research domain or type of activities (from fundamental research to pre-competitive development).

A snapshot of the support decisions taken by the ANR under the calls for collaborative projects reveals the following features. The research domains that most benefit from aids directed to firms are "sustainable energy and environment" and "matter sciences, information and communication", where around 36% of all ANR financing goes to firms. 25% of all supported projects entail the participation of at least one firm. These collaborative projects involve more partners than the average ANR project (4,6 partners), benefit from a greater public support (650 thousand euros) and thus represent a significant part of ANR's budget (44,6%). The average intensity of aids is 41% of eligible costs (46,8% for SMEs vs. 37,5% for large firms). 61% of the budget goes to fundamental research, 33% to applied research and the remaining 6% go to pre-competitive development.

4. Data and methodology

4.1 The sample

The original dataset upon which this work is based comes from the answers to the calls for collaborative projects launched by the ANR in 2005, 2006 and 2007. Thus, the sample is comprised of all firms that submitted to this subsidy scheme at least one R&D project in collaboration with public labs during its first three years of existence. We contend that the novelty of the calls for collaborative project wipes out the possibility that firms go through some form of selection when considering the possibility to apply to the support scheme, given that they have no or few past experience. Notice that the information about the acceptance or reject of the proposal is not available in our dataset. The only information that is provided is that a firm has or has not submitted at least one project during the period 2005-2007.

This dataset has been matched with administrative and business data about each company (industrial sector, turnover, number of employees, age, etc.) extracted from the DIANE database. We have not had access so far to information related to the R&D activities of the firms in the sample, so we decided to include data about their patents. We used the EPO database to count the number of patents filed by a company in the period 1993-2003. The final sample includes complete information about 694 participating firms.

We have randomly selected a sample of control firms comprised of French companies that did not apply to any call for collaborative projects in the years 2005, 2006 and 2007. Matching methods have been used in order to obtain a consistent control sample, with a distribution of firms among industrial sectors in the control sample that is similar to that of firms in the participating sample. The final sample of control firms includes complete information about 525 companies. Thus, the whole sample comprises 1219 companies.

4.2 The variables

The dependent variable to be analysed with the different methods exposed thereafter is the participation of a firm in at least one ANR call for collaborative projects in the years 2005, 2006 or 2007 (binary variable).

The size of a firm is measured through its number of employees or its turnover. Few studies of R&D collaborations have paid attention to the age of a firm. However, given the potentially important role played by technological start-up firms or spin-offs from academic research for collaborations with PROs, we have decided to include the age variable in our models.

Technological opportunities refer to the contribution of external sources to the innovation activities of firms. Their strength and sources are important factors explaining firm-specific and cross-industry variations in R&D intensity and R&D productivity. A firm's sector of activity or technological intensity is commonly used as proxies of the technological opportunities offered to that firm. In our models, we will test both variables: the NAF code (French nomenclature) for a firm's sector of activity, and the OECD four levels scale for its technological intensity (high tech, medium-high tech, medium-low tech, and low tech). As far as service activities are concerned, we use a dummy variable to identify if the firm mainly runs knowledge intensive service activities, such as firms in the software industry or firms offering business services.

A firm's innovative capacity can be measured through the number of patents it owns (Miotti & Sachwald, 2003) or identified by the presence of a continuous R&D activity (Dhont & Pfister, 2006). We choose to use a binary variable *PATENT* that is equal to 1 if the firm has filed at least one patent with the EPO between 1993 and 2003, and 0 otherwise. We have not had access so far to data related to firms R&D budgets.

Most studies find that firms with a higher R&D intensity tend to form more collaboration (Kleinknecht & Reijnen, 1992; Fritsch and Lukas, 2001). A firm's R&D intensity can be considered as a measure of either its absorptive capacity or its research capability, i.e. its capacity to produce new scientific and technological knowledge. Some scholars consider that, for the purpose of measuring a firm's absorptive capacity, its size can be a good substitute variable to R&D intensity. Concerning a firm's research capability; we assume the *PATENT* variable can be a good substitute to R&D intensity.

The variables we chose to include in our models as well as their specifications are described in the table below.

Dependent variable	**Name**	**Values**
Firm's Propensity to participate ANR's Calls for collaborative projects		
Firm's participation in at least one Call for collaborative projects in 2005, 2006 or 2007	PARTICIPE	1 if participation 0 otherwise

Independent variable	**Name**	**Classes or values**
Firm size		
Turnover	CLASSE CA	C1 : CA < 1 000 k€ C2 : 1 000 k€ ≤ CA < 10 000 k€ C3 : 10 000 k€ ≤ CA < 100 000 k€ C4 : CA ≥ 100 000 k€
	CA	Turnover (continuous variable)
	LNCA	Log(Turnover) (continuous variable)
Employees	CLASSE EFF	C1 : employees < 20

Independent variable	Name	Classes or values
		C2 : 20 ≤ employees < 250 C3 : 250 ≤ employees < 500 C4 : 500 ≤ employees < 1000 C5 : employees > 1000
	EFF	Number of employees (discrete variable)
	LNEFF	Log (Number of employees)
Firm's age		
Firm's age at the time of its last participation to a Call for collaborative projects	CLASSE AGE	C1 : age < 5 years C2 : 5 years ≤ age < 10 years C3 : age ≥ 10 years
	AGE	Firm's age (discrete variable)
	LNAGE	Log (Firm's age)
Technological opportunities		
Firm's industrial sector (two digits in the French nomenclature)	SECTEUR	
Technological intensity (OCDE definition)	CLASSE SECTEUR	HT : high tech MHT : medium-high tech MLT : medium-low tech LT : low tech KIS : knowledge intensive services
Firm's innovative capacity		
Firm's filing of at least one OEB patent in the period 1993-2003	BREVET	0 if non patent has been filed 1 if at least one patent has been filed
Group ownership		
Presence of a major owner (according to the DIANE database)	GROUPE	1 if the firm is owned by a group 0 otherwise
State control		
French State is the firm's major owner (DIANE)	ETAT	1 if the firm is owned by the French State 0 otherwise

The following table provides some descriptive statistics about the 1219 firms in the dataset.

Results	8 variables, 1219 individus		
Attribute	**Distribution**		
CLASSE AGE	**Values**	**Count**	**Percent**
	C2	366	30,02%
	C3	613	50,29%
	C1	240	19,69%
CLASSE CA	**Values**	**Count**	**Percent**
	C2	321	26,33%
	C1	724	59,39%
	C3	110	9,02%
	C4	64	5,25%
CLASSE EFF	**Values**	**Count**	**Percent**
	C1	849	69,65%
	C2	285	23,38%
	C3	50	4,10%
	C4	35	2,87%
SECTEUR	**Values**	**Count**	**Percent**
	92 Hobbies, culture and sports	21	1,72%
	74 Business services	185	15,18%
	32 Radio, TV and communication devices	40	3,28%
	80 Education	1	0,08%
	51 Wholesale and trading	37	3,04%
	73 Research and development	151	12,39%
	72 Computing	169	13,86%
	24 Chemicals	44	3,61%
	33 Medical, precision, optics and watch devices	81	6,64%
	29 Machines and equipments	36	2,95%
	28 Metal products	34	2,79%
	15 Food and beverages	37	3,04%
	71 Rental and leasing (without operator)	1	0,08%
	17 Textile	8	0,66%
	36 Furniture and others	12	0,98%
	45 Construction	218	17,88%
	85 Health and social care	5	0,41%
	35 Other transportation equipments	5	0,41%
	22 Printing and publishing	36	2,95%
	19 Leather and shoes	2	0,16%
	64 Postal and telecommunication services	6	0,49%
	34 Automobile	5	0,41%
	65 Financial services	1	0,08%
	55 Hotels and restaurants	1	0,08%
	40 Production / distribution of electricity, gas and heat	2	0,16%
	31 Electrical equipments and devices	13	1,07%
	90 Purification and waste management	3	0,25%
	27 Metal (raw material)	1	0,08%
	25 Rubbers and plastics	6	0,49%
	52 Retail trade and repair of domestic articles	2	0,16%
	30 Bureau machines and computer hardware	1	0,08%

	20 Wood work and products	10	0,82%
	41 Water management	1	0,08%
	26 Non metallic mineral products	13	1,07%
	70 Real estate	1	0,08%
	18 Clothing and furs	9	0,74%
	21 Paper and cardboard	4	0,33%
	Values	**Count**	**Percent**
CLASSE SECTEUR	KIS	541	44,38%
	HT	142	11,65%
	OTHER	278	22,81%
	MHT	82	6,73%
	MLT	58	4,76%
	LT	118	9,68%
	Values	**Count**	**Percent**
CLASSE GROUPE	C0	1024	84,00%
	C1	195	16,00%
	Values	**Count**	**Percent**
CLASSE ETAT			
	C0	1203	98,69%
	C1	16	1,31%
	Values	**Count**	**Percent**
CLASSE BREVET	**Values**	**Count**	**Percent**
	C0	1057	86,71%
	C1	162	13,29%

4.3 The methodology

We use two statistical methods to learn more about which companies participate in ANR's calls for collaborative projects. Firstly, we run a multiple correspondence factor analysis (MCFA) to explore whether some correspondence between the firms' characteristics allow to identify different subsets of relatively homogenous firms, and whether the fact that a firm belongs to a given group is a good predictor for its participation in ANR's calls for collaborative projects. Secondly, we run a logistic regression in order to assess the influence of each firm's characteristic on the probability that it participates in the calls for collaborative projects.

The multiple correspondence factor analysis (MCFA) is preferred for exploratory statistics when descriptive variables are both quantitative (firm's turnover or age) and qualitative (sector of activity, technological intensity, patent ownership). In our case, a simple and efficient technique to perform the MCFA is to run a (simple) correspondence factor analysis on the basis of a complete disjunctive table composed exclusively of binary variables. The latter are easily derived from the original categorical (qualitative) variables, while quantitative variables are first transformed into class variables as an intermediary step.

The MCFA uses correspondences between numerous variables in order to best represent a complex dataset into a system of axes of limited dimensions. It produces graphs that project individuals and variables on the optimised factorial axis. These graphs can be used to distinguish subgroups of relatively homogenous individuals. Two individuals have close coordinates on a given factorial axis if they belong more or less to the same classes of the variables that contribute the more to that axis. Moreover, the proximity between two modalities of two different variables means that a significant proportion of individuals appears in these two modalities simultaneously.

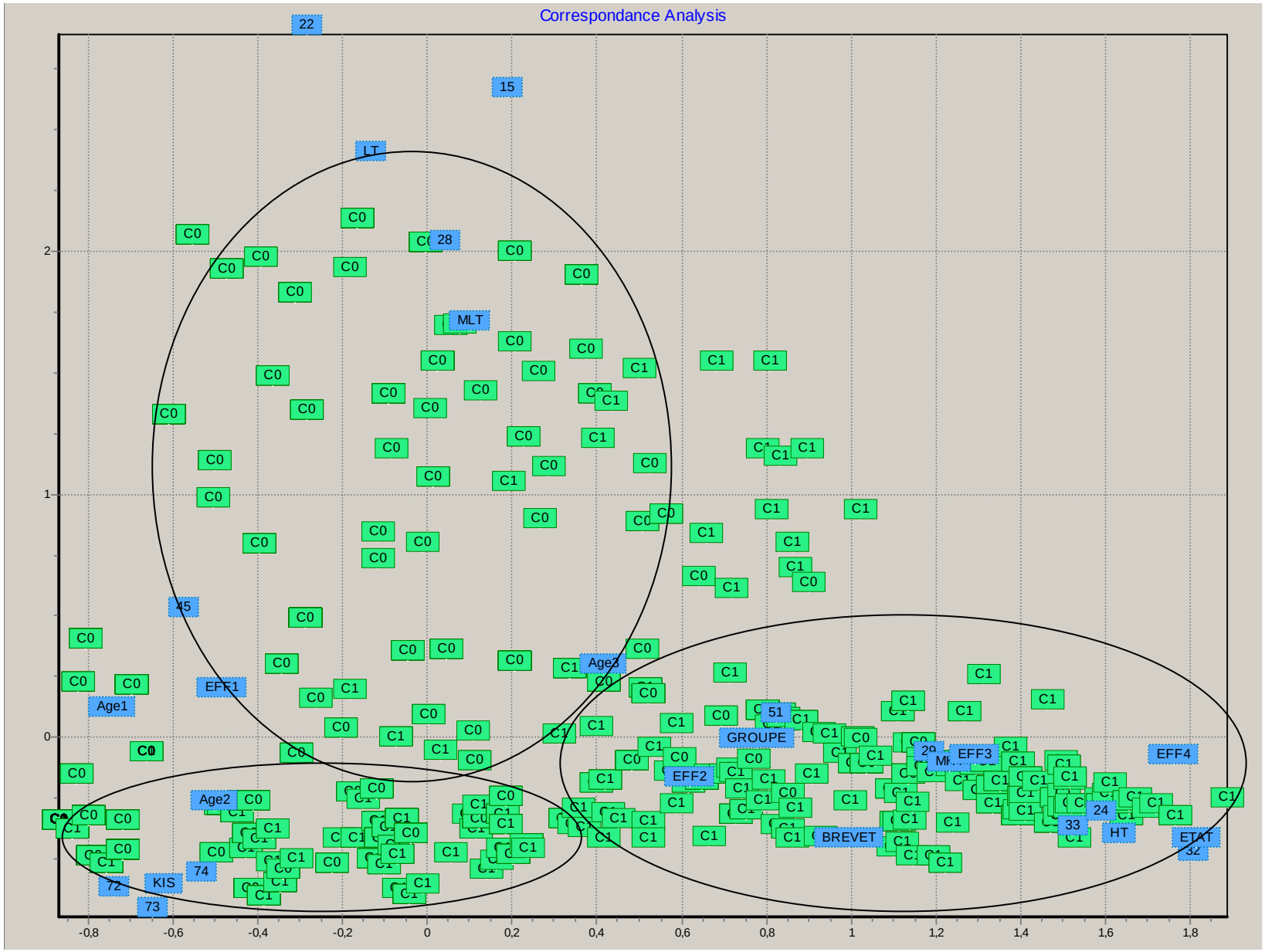
The quality of the individuals' and variables' representation on a given factorial axis can be estimated by the cosines square. The quality of the representation of the whole dataset on a limited number of axes can be estimated by the percentage of the total variance that is captured by these axes.

We also design several econometric models of the logistic type in order to quantify the influence on every firm's characteristic on its propensity to participate in ANR's calls for collaborative projects.

6. Results

6.1 Multiple correspondence factor analysis

We chose to use only the PERSONNEL variable as a proxy of a firm's size and to suppress the TURNOVER variable with which it is strongly correlated. The result of the MCFA is shown in the following graph.


Correspondance Analysis
22
15
LT
28
MLT
45
Age1
EFF1
Age2
KIS
74
72
73
Age3
GROUPE
51
EFF2
EFF3
EFF4
BREVET
HT
ETAT
33
24
32
C0
C1
2
1
0
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
1,2
1,4
1,6
1,8

The first two factorial axes are shown on this graph. The variables that contribute the most to the first axis are the firm's sector of activity, its technological intensity, its size and age. The first axis discriminates between:

- The sectors "Manufacturing of radio, television and communication equipments" (32), "Chemistry & pharmaceuticals" (24), "Manufacturing of medical, optical, precision and clock devices" (33) and "Manufacturing of machines and equipments" (29) on the one hand, and the sectors "Computing" (72), "Research and development" (73), "Construction" (45) and "Business services" (74) on the other hand;
- Business intensive service activities (KIS) and industrial companies from high tech sectors (HT);
- Large companies (EFF4) and small companies (EFF1);
- Firms that own at least one patent (PATENT) and those who don't;
- Young companies (AGE1) and old companies (AGE3)
- Companies that belong to a group (GROUPE) and those who are independent.

The quality of the variables' representation on the first factorial axis seems satisfactory given that the variables that contribute the most to that axis display relatively strong cosine squared.

The variables that contribute the most to the second axis are the firm's sector of activity and its technological intensity. The second axis discriminates between:

- The sectors "Printing and publishing" (22), "Food & beverages" (15) and "Fabricated metal products" (28) on the one hand, and the sectors "Research and development" (73), "Computing" (72) and "Business services" (74) on the other hand;
- Business intensive service activities (KIS) and industrial high tech sectors (HT) on the one hand, and industrial low tech (LT) and medium-low tech sectors (MLT) on the other hand.

Except for sector-based variables, the quality of the variables' representation on the second factorial axis is less satisfactory than for the first axis, given that the cosine squared are weaker altogether.

After the MCFA has been run, every company in the sample was labelled with the PARTICIPE variable (C1 if the company has participated in ANR's calls for collaborative projects, C0 otherwise). The PARTICIPE variable was not included in the MCFA. The MCFA graph thus displays three homogenous groups of companies. (1) Companies in the S-E

quadrant have by a large majority participated in ANR's calls for projects. (2) Companies in the N-W quadrant have by a large majority never participated in ANR's calls for projects. (3) The group of companies located in the S-W quadrant includes in roughly similar proportions companies that have participated and companies that have not participated in ANR's calls for projects.

Thus, companies that are not large and that belong to low tech or medium-low tech sectors such as Printing & publishing, Food & beverages, Fabricated metal products or Construction barely participate in ANR's calls for collaborative projects. Conversely, large or very large companies that have a strong innovative capacity and that belong to high tech or medium-high tech sectors (e.g. Manufacturing of radio, television and communication equipments, Chemistry & pharmaceuticals, Manufacturing of medical, optical, precision and clock devices and Manufacturing of machines and equipments) very actively participate. These exploratory statistics results tend to reinforce existing evidence regarding affinities of different types of companies to public research laboratories. They also provide a signal of the quality of the dataset and samples.

The last group gathers young and small-sized firms that belong to knowledge intensive sectors such as Research and development, Computing or Business services. These firms presumably have similar characteristics but heterogeneous behaviours towards ANR's calls for collaborative projects. So the MCFA raises a question regarding the factors that influence the propensity of companies in this group to participate in ANR's calls for projects. This question sounds particularly relevant given that these small, young and knowledge intensive firms form a core target of public policies for research and innovation in general, and of ANR's missions in particular.

6.2 The logit regressions

Five different models have been tested to explain the propensity of a firm to participate in ANR's calls for collaborative projects. The results are shown in the table below.

Propensity of a firm to participate in ANR's calls for collaborative projects

	Model 1		Model 2		Model 3		Model 4		Model 5	
Var.	**Coef.**	**Sig.**	**Coef.**	**Sig.**			**Coef.**	**Sig.**	**Coef.**	**Sig.**
const.	-1,932	-	-3,078	-	-3,943	-	-2,517	-	-2,889	-
LNEFF	1,589	***	1,648	***	1,840	***	1,863	***	1,833	***
45							-3,709	***		
73							5,151	***		
28							-5,704	ns		
22							-1,752	**		
29							-1,498	**		
15							-1,528	*		
72							0,642	*		
33							1,083	ns		
74							1,054	***		
24							3,026	**		
KIS			3,230	***	2,909	***			3,233	***
HT			3,748	***	4,007	***			3,842	ns
MHT			0,955	*	0,890	*			0,782	ns
MLT			*reference*		*reference*				*reference*	
LT			0,470	ns	0,103	ns			0,480	ns
LNAGE			-0,401	**					-0,685	***
Age1					0,876	***	1,189	***		
Age 2					*reference*		*reference*			
Age3					-0,424	ns	0,090	ns		
PATENT			2,951	***	2,616	***	2,637	***	2,219	***
GROUPE			-0,745	*	-0,762	*	-0,420	ns	-0,231	ns
IdF									0,473	ns
PACA									0,101	ns
Midi Py									0,734	ns
R-Alpes									0,243	ns
Error ratio	20%		13%		13%		10%		13%	

The predictive power of these models is overall quite satisfactory since the rate of firms that are adequately classified, as computed on a test sample, is comprised between 80-90%.

In every model, the firm's size LNEFF is positively correlated with the firm's propensity to participate in ANR's calls for collaborative projects. The firm's age has also a significant

correlation with its propensity to participate, whether it is included as a continuous LNAGE or a class variable AGE1, AGE2, AGE3: a firm's propensity to participate decreases when the log of its age increases; firms younger than five years have a higher probability to participate than firms of 5-10 years age, while older firms (more than 10 years age) do not have a different propensity to participate than this class of reference.

Model 4 shows that for most sectors, the sector variable is significantly related with a firm's propensity to participate in ANR's calls for collaborative projects. In particular, firms in the Research & development sector (73) have a higher probability to participate than the omitted sectors, and also firms in the Business services sector (74) although the coefficient is less important. Firms in the Chemical & pharmaceutical sector (24) also have a fairly higher probability to participate, although this result is significant only at the 5% confidence level. Conversely, firms in the Construction business (45) have a lower probability to participate than the omitted sectors.

The technological intensity variable shows that firms in the knowledge intensive KIS and high tech sectors HT have a higher propensity to participate in ANR's calls for collaborative projects, as compared to firms in the medium-low tech sectors (class of reference). In addition, firms that have a stronger innovative capacity as signalled by the fact that they have filed at least one EPO patent in the 1993-2003 period also have a higher propensity to participate.

7. Discussion

Most of these results are similar to the evidence found in the literature. In particular, we find that firms in the Chemical & pharmaceutical sectors have a greater probability to have R&D partnerships with public labs, a results also found by Busom et al. (2005). These activities are science-based, as with ICT, biotechs or nanotechnologies, and R&D activities in these firms are not too different from research activities of PROs in life sciences, a proximity that facilitates cooperation. Moreover, the knowledge intensiveness in these sectors requires that scientific and technological knowledge be shared between multiple actors, including those from the public scientific sector.

The Research & Development sector (73) is composed of firms with heterogeneous activities. For example, firms active in the biotechnologies or nanotechnologies belong to that sector, as no specific code exists for them in the French nomenclature. This sector also includes firms that supply goods or services to another firm's R&D activities, and spin-offs from university laboratories that habitually choose this code to register their activities. The higher propensity to participate in ANR's calls for collaborative projects of firms in that sector possibly reflects the fact that spin-offs durably maintain R&D collaborations with their mother institution.

Our result related to the PATENT variable we chose as a proxy of a firm's innovative capacity follows that of Busom et al. (2005), which showed that a firm's international patent filing activity is positively related to its propensity to participate in collaborative research projects. Having filed an international patent may indicate that a firm has developed a product that is new to the market, thus acting as a signal of innovative capacity to potential partners. Busom et al. also suggest that a firm needs to build an absorptive capacity to share and use knowledge and know-how produced within R&D partnerships; firms without international patent filing activities may not have reached this stage, and thus may not be able to benefit from R&D collaborations with public partners in particular[3].

We find that a firm's size LNEFF is positively correlated with the firm's propensity to participate in ANR's calls for collaborative projects, a result that corroborates that of most studies focusing of public-private R&D partnerships in general (Belderbos & al., 2004; Fritsch & Lukas, 2001; Leiponen, 2001; Röller & al., 1997; Colombo & Garrone, 1996). However, they are conflicting with those of Ballesteros and Rico (2001) who find that a firm's size has so significant influence on its propensity to submit and be selected for collaborative R&D projects with public research partners within the Concerted Projects under the Spanish National R&D Plan.

Given the proximity between this and our study regarding their focus and datasets, we could have expected more similar findings. Remember however that our dataset is comprised of firms that submitted projects to ANR in collaboration with public research partners, but that were not necessarily selected, contrary to the firms sampled by Ballesteros and Rico. They

[3] Notice that in our dataset, we have not had access to the firms' R&D investments; thus, we could not use these investments or R&D intensities as a proxy of absorptive capacity.

contend that the absence of a size effect in their study might be a result of the selection processes at play within public policy schemes aiming at reinforcing public-private R&D collaborations. Firstly, Spanish public authorities possibly favour SMEs as compared to larger firms for the allocation of public support for R&D and innovation. Secondly, firms probably go through a self-selection process while deciding to submit a concerted project or not: SMEs are possibly more prone to be in demand of public support because they face greater difficulties that larger firms to finance their R&D projects; it may also be that larger firms choose not to apply to concerted projects because the experience shows that they have a small probability of being successful in obtaining a grant.

Consequently, the discrepancy between our result and that of Ballesteros and Rico concerning the size effect leads us to several assumptions:

- ANR's calls for collaborative projects are too recent to allow companies to correctly anticipate their probability of success, depending on their size; in particular, no signal exists that ANR would preferably support SMEs rather than large firms.
- The cost of preparing projects to be submitted to ANR's calls for collaborative projects is too high for SMEs, that can not bear the risk of preparing a project that could be rejected by ANR (contrary to larger firms that could spread this risk on a greater number of submitted projects).
- SMEs are less aware than larger firms of the mere existence of ANR as a new funding agency, its calls for collaborative projects, and generally speaking the whole system of public support for R&D activities; larger firms tend to be better informed about this topic.
- French SMEs do not have the technological / financial capacity to run collaborative research projects of the ANR type. As a matter of fact, the concerted projects under the Spanish national R&D plan was dedicated to the support of pre-competitive development projects, whereas in 2005-06 ANR's budget was mainly targeted towards fundamental or industrial research projects that are characterised by higher levels of risks.
- French public research organisations may prefer to collaborate with larger firms, maybe because they know them better, or because it is more rewarding for public researchers to work with larger firms than with SMEs, which are less renowned by the scientific community.

- Lastly, it may be that our result is just a side-effect of the absence of the R&D intensity variable in our model, whereas it is the most salient variable in Ballesteros and Rico's models. The size effect we find could in fact capture the influence of the unobserved R&D intensity, which is generally greater in large firms than in SMEs.

The other original result we find is related to the age of firms: very young firms (less than five years) have a higher probability to participate in ANR's calls for projects than older firms. Several explanations can be put forward to explain this result:

- Very young firms are exposed to severe financial constraints and may be very actively looking for financial sources of every type, including public support granted by a national agency such as ANR.
- Young start-up firms that are created with the purpose of commercialising a new product they first need to develop are in strong need of R&D partnerships in the first years of their existence, but less afterwards when it is rather a strong commercial effort that is required.
- Young start-up firms that have a strong propensity to develop new technologies in collaboration with public research laboratories manage highly risky projects that have a low probability of success, leading to an important mortality rate within the first years; in a cohort process, these firms disappear from the older firms classes.
- As a funding agency for public research organisations, the ANR is better known by spin-off firms from these PROs than from the average and older) firm; the calls for collaborative projects could be viewed by these very young firms as a central instrument to leverage money and partners for their R&D.

8. Conclusion

The French Agence Nationale de la Recherche is a newly founded funding agency for public research. One of ANR's missions is to promote R&D partnerships between firms and public research organisations. The central instrument used for this purpose is the call for collaborative projects, which provides a dedicated budget for R&D projects framed within public-private partnerships. To make the best use of this public money, the calls for

collaborative projects should trigger more and new collaborations, i.e. R&D projects that would not have been started absent public support. A preliminary step towards this goal is to have some knowledge about the profile of firms that participate in ANR's calls for collaborative projects. Based of an original dataset related to the applicant firms for the 2005-07 calls, this study has the objective of identifying these firms' characteristics as well as to quantify their influence on a firm's propensity to participate in these calls.

Firstly, we identify three groups of firms within our sample, by using a multiple correspondence factor analysis:

- Large and very large firms from high tech and medium-high tech sectors, e.g. chemistry, pharmaceuticals, ICT and manufacturing of instruments, machines and equipments, have a strong appetence for ANR's calls for collaborative projects.
- Large and very large firms from high tech and medium-high tech sectors, e.g. chemistry, pharmaceuticals, ICT and manufacturing of instruments, machines and equipments, have a strong appetence for ANR's calls for collaborative projects.
- SMEs from sectors of lower technological intensity such as printing & publishing, food & beverages, the manufacturing of metal products or construction are not attracted by ANR's calls for collaborative projects.
- Smaller and younger firms that provide knowledge intensive services such as computing, research & development or business services have mixed behaviours vis-à-vis their participation in ANR's calls for collaborative projects.

These preliminary results, in particular the unclear one related to the third group of companies, are completed by several logit regressions.

These regressions show that larger firms have a higher propensity to apply to ANR's calls for collaborative projects. This result is opposite to that found by Ballesteros & Rico (2001) in a similar study focused on the Concerted Projects under the Spanish National R&D Plan, another policy instrument used for the promotion of R&D projects run in collaboration between firms and public research labs. One possible explanation for these opposite results might be that we focus on firms that only applied for grants by the ANR, while Ballesteros and Rico consider firms that have be selected for the Spanish concerted projects. So it might be that the Spanish government body responsible for the management of this instrument favours SMEs in its selection process.

The regressions also show a strong appetence of very young firms for ANR's calls for collaborative projects. Further research is required to fully grasp the meaning of this result, but we contend that it may reflect the strong and durable research links that are usually formed between spin-off firms from public research and their mother institutions. These firms were born in the public research environment and as such, they tend to benefit from past experience of applying to public support schemes.

From a more general point of view, it seems that ANR's calls for collaborative projects successfully attract firms that have a natural propensity to forge R&D collaborations with public research organisations, given their characteristics (large firms, very young firms, high-tech firms, knowledge intensive firms, firms in the chemical & pharmaceutical sector, etc.). However, our preliminary results also suggest that firms that would really need strong incentives to set up R&D partnerships with PROs, given e.g. their low innovative capacity, are not applying for ANR's calls for collaborative projects. It is specifically the case for medium-sized firms, which have recently been defined by the French government as the central target of public support for innovation.

Two main research extensions to this work could be envisioned:

- The first one would focus on the selection effects at play within ANR's calls for collaborative projects. A challenge would be to evaluate the influence of ANR's granting decisions on the characteristics of firms that participate in its calls for collaborative projects. To put it plainly, are some types of firms favoured by the selection process, be it ex ante (i.e. when applying for a grant) or ex post (i.e. when being selected for a grant)?
- The second one would focus on the evaluation of the effectiveness of ANR's calls for collaborative projects, from the incentiveness point of view. Do the calls for collaborative projects trigger more and new collaborations, i.e. R&D projects that would not have been started absent public support? Or would these projects have been started anyway, meaning that public money would have been best used elsewhere? Original treatment methods could be developed for this purpose, looking at some measure of innovativeness for three groups of firms: those that never applied for a

grant; those that applied for a grant but were not selected; those that were selected for a grant.

8. References

Abramovsky, L., E. Kremp, et al. (2004). "Understanding co-operative R&D activity: evidence from four European countries." *Institute of Fiscal Studies Working Paper*, 5(23).

Arrow, K. J. (1962). "Economic Welfare and the Allocation of Resources for Invention." *The Rate and Direction of Inventive Activity***,** 13, p.609-625.

Azaroff, L. V. (1982). "Industry-university collaboration: How to make it work." *Research Management*, **25**(3): 31-34.

Bailetti, A. J. and J. R. Callahan (1992). "Assessing the impact of university interactions on an R&D organization", *R&D Management*, **22**(2), pp. 145-56.

Ballesteros, J. A. and A. M. Rico (2001). "Public financing of cooperative R&D projects in Spain: The concerted projects under the National R&D Plan." *Research Policy*, **30**(4).

Bayona, C., T. Garca-Marco, et al. (2001). "Firms'motivations for cooperative R&D: an empirical analysis of Spanish firms." Research Policy **30**(8): 1289-1307.

Belderbos, R., M. Carree, et al. (2004). "Heterogeneity in R&D cooperation strategies." *International Journal of Industrial Organization*, **22**(8-9): 1237-1263.

Belderbos, R. et al. (2004), "Cooperative R&D and firm performance", *Research Policy*, **33**(10), p. 1477-92.

Braun, D. (1998). "The role of funding agencies in the cognitive development of science." *Research Policy*, **27**(8): 807-821.

Busom, I. and A. Fernàndez-Ribas (2004). "Firm strategies in R&D: cooperation and participation in R&D programs." *WP***.**

Cassiman, B. and R. Veugelers (2002). "R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium." *The American Economic Review*, **92**(4): 1169-1184.

Cohen, W. M. and D. A. Levinthal (1990). "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly*, **35**(1).

Cohen, W.M., R. Florida, L. Randazzese, and J. Walsh (1998), "Industry and the Academy: Uneasy

Partners in the Cause of Technological Advance," in Roger Noll (ed.), *Challenge to the Research University*, Washington, DC: Brookings Institution.

Colombo, M. G. and P. Garrone (1996), "Technological cooperative agreements and firm's R & D intensity. A note on causality relations", *Research Policy*, **25**(6), p. 923-32.

Criscuolo, C. and J. Haskel (2003). "Innovations and Productivity Growth in the UK." *CeRiBA, Centre for Research Into Business Activity, Office for National Statistics.*

Dasgupta, P. and P.A. David (1994), "Toward a New Economics of Science", *Research Policy*, Volume 23, p.487-521.

Decter, M., D. Bennett and M. Leseure (2007), "University to business technology transfer –UK and USA comparisons", *Technovation*, 27(3), p.145-55.

den Hertog, P. and R. Bilderbeek (2000). "The new knowledge infrastructure: the role of technology-based knowledge-intensive business services in national innovation systems."

Dhont-Peltrault, E. and E. Pfister (2006). "L'externalisation de la R&D : quel arbitrage entre sous-traitance et coopération?" MENER, Note Recherche. **06.02**.

Faulkner, W. and J. Senker (1994), "Making sense of diversity: public-private sector research linkage in three technologies", *Research Policy*, 23(6), pp. 673-95.

Fritsch, M. and R. Lukas (2001), "Who cooperates on R&D?", *Research Policy*, 30(2), p. 297-312.

Gibbons, M. and R. Johnston (1974), "The roles of science in technological innovation", *Research Policy*, 3(3), pp. 220-42.

Hall, B.H., Link, A.N. and J.T. Scott (2000), "Universities as Research Partners", NBER Working Paper No. 7643.

Hall, B.H., Link, A.N. and J.T. Scott (2001), "Barriers Inhibiting Industry from Partnering with Universities: Evidence from the Advanced Technology Program", *Journal of Technology Transfer*, 26, p. 87-98.

Ham, R. M. and D. C. Mowery (1998), "Improving the effectiveness of public-private R&D collaboration: case studies at a US weapons laboratory", *Research Policy*, 26(6), p. 661-75.

Link, A. N (1996). "Research Joint Ventures: Patterns from Federal Register Filings," *Review of Industrial Organization*, 11, 1996, pp. 617-628.

Link, A. N. and J. Rees (1990). "Firm size, university based research, and the returns to R&D", *Small Business Economics*, 2(1), pp. 25-31.

Mansfield, E. (1991), “Academic Research and Industrial Innovation”, *Research Policy*, 20, p. 1-12.

Mansfield, E. and J.-Y. Lee (1996), “The Modern University: Contributor to Industrial Innovation and Recipient of Industrial R&D Support,” *Research Policy*, 25, p.1047-58.

Miotti, L. and F. Sachwald (2003). "Co-operative R&D: why and with whom?-An integrated framework of analysis." Research Policy **32**(8): 1481-1499.

Mohnen, P. and C. Hoareau (2003), “What Type of Enterprise Forges Close Links with Universities and Government Labs? Evidence from CIS 2”, *Managerial and Decision Economics*, 24(2-3), p.133-145.

OECD (2002), Benchmarking Industry-Science Relationships, Paris: OECD.

Pavitt, K. (1991), “What Makes Basic Research Economically Useful?”, *Research Policy*, 20, p. 109–19.

Senker, J. and W. Faulkner (1992), “Industrial use of public sector research in advanced technologies: a comparison of biotechnology and ceramics”, *R&D Management*, 22(2), p. 157-75.

Siegel, D.S., D.A. Waldman, L.E. Atwater and A.N. Link (2004), “Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners: Qualitative Evidence from the Commercialization of University Technologies,” *Journal of Engineering and Technology Management*, 21, p. 115-42.

Tether, B. S. (2002), “Who co-operates for innovation, and why-An empirical analysis”, *Research Policy*, 31(6), p. 947-67.

Van Dierdonck, R., K. Debackere, et al. (1990), “University-industry relationships: How does the Belgian academic community feel about it?”, *Research Policy*, 19(6), p. 551-66.

Veugelers, R. and B. Cassiman (2005), “R&D cooperation between firms and universities. Some empirical evidence from Belgian manufacturing”, *International Journal of Industrial Organization*, 23(5-6), p. 355-79.

Annex 1 : Descriptive statistics by group (C0 vs. C1)

Group characterization 1

Parameters

Logiciel : Tanagra

Results

Description of "PARTICIPE"								
PARTICIPE=C1				PARTICIPE=C0			
Examples		[56,9 %] 694		Examples		[43,1 %] 525	
Att - Desc	Test value	Group	Overral	Att - Desc	Test value	Group	Overral
Continuous attributes : Mean (StdDev)				Continuous attributes : Mean (StdDev)			
Discrete attributes : [Recall] Accuracy				Discrete attributes : [Recall] Accuracy			
Class Secteur=KIS	14,2	[79,5 %] 62,0 %	44,40%	NAF=45	18	[97,7 %] 40,6 %	17,90%
NAF=73	11,2	[99,3 %] 21,6 %	12,40%	Class Secteur=Autre	14,8	[81,7 %] 43,2 %	22,80%
CLASSE BREVET=C1	11	[96,9 %] 22,6 %	13,30%	CLASSE EFF=C1	12	[54,3 %] 87,8 %	69,60%
Class Secteur=HT	9,6	[94,4 %] 19,3 %	11,60%	CLASSE BREVET=C0	11	[49,2 %] 99,0 %	86,70%
CLASSE EFF=C2	8,3	[78,2 %] 32,1 %	23,40%	CLASSE CA=C1	10,1	[55,0 %] 75,8 %	59,40%
CLASSE CA=C4	6,9	[98,4 %] 9,1 %	5,30%	Class Secteur=LT	8,2	[78,8 %] 17,7 %	9,70%
NAF=33	6,7	[92,6 %] 10,8 %	6,60%	Class Secteur=MLT	6,8	[86,2 %] 9,5 %	4,80%
CLASSE CA=C3	6,5	[86,4 %] 13,7 %	9,00%	NAF=28	6,1	[94,1 %] 6,1 %	2,80%
REGION=Île-de-France	6,4	[70,3 %] 38,6 %	31,30%	CLASSE GROUPE=C0	5,8	[46,7 %] 91,0 %	84,00%
CLASSE GROUPE=C1	5,8	[75,9 %] 21,3 %	16,00%	NAF=22	5,6	[88,9 %] 6,1 %	3,00%
CLASSE EFF=C3	5,7	[96,0 %] 6,9 %	4,10%	REGION=Champagne-Ardenne	3,6	[79,2 %] 3,6 %	2,00%
NAF=51	5,4	[100,0 %] 5,3 %	3,00%	CLASSE ETAT=C0	3,5	[43,6 %] 100,0 %	98,70%
NAF=24	5,3	[95,5 %] 6,1 %	3,60%	NAF=18	3,5	[100,0 %] 1,7 %	0,70%
CLASSE EFF=C4	5,2	[100,0 %] 5,0 %	2,90%	NAF=36	3,4	[91,7 %] 2,1 %	1,00%
NAF=32	4,9	[95,0 %] 5,5 %	3,30%	NAF=01	3,3	[82,4 %] 2,7 %	1,40%

NAF=72	4,5	[72,8 %]	17,7 %	13,90%	NAF=26	3	[84,6 %]	2,1 %	1,10%
NAF=92	4	[100,0 %]	3,0 %	1,70%	NAF=20	3	[90,0 %]	1,7 %	0,80%
CLASSE CA=C2	3,6	[65,4 %]	30,3 %	26,30%	REGION=Pays de la Loire	2,6	[60,8 %]	5,9 %	4,20%
CLASSE ETAT=C1	3,5	[100,0 %]	2,3 %	1,30%	NAF=29	2,6	[63,9 %]	4,4 %	3,00%
NAF=74	3,3	[68,1 %]	18,2 %	15,20%	NAF=15	2,4	[62,2 %]	4,4 %	3,00%
REGION=Bretagne	2,5	[72,9 %]	6,2 %	4,80%	REGION=DOM TOM	2,3	[100,0 %]	0,8 %	0,30%
CLASSE AGE=C2	1,8	[60,9 %]	32,1 %	30,00%	NAF=21	2,3	[100,0 %]	0,8 %	0,30%
REGION=Rhône-Alpes	1,5	[62,1 %]	15,9 %	14,50%	REGION=Languedoc-Roussillon	2,2	[60,0 %]	4,6 %	3,30%
NAF=90	1,5	[100,0 %]	0,4 %	0,20%	CLASSE AGE=C1	2,1	[49,2 %]	22,5 %	19,70%
NAF=52	1,2	[100,0 %]	0,3 %	0,20%	REGION=Aquitaine	2	[55,7 %]	6,5 %	5,00%
NAF=85	1	[80,0 %]	0,6 %	0,40%	NAF=25	2	[83,3 %]	1,0 %	0,50%
NAF=35	1	[80,0 %]	0,6 %	0,40%	REGION=Provence-Alpes-Côte d'Azur	1,9	[52,8 %]	9,0 %	7,30%
REGION=Midi-Pyrénées	0,9	[62,3 %]	6,2 %	5,70%	NAF=31	1,9	[69,2 %]	1,7 %	1,10%
NAF=41	0,9	[100,0 %]	0,1 %	0,10%	REGION=Haute-Normandie	1,9	[69,2 %]	1,7 %	1,10%
NAF=30	0,9	[100,0 %]	0,1 %	0,10%	REGION=Poitou-Charentes	1,8	[63,2 %]	2,3 %	1,60%
NAF=27	0,9	[100,0 %]	0,1 %	0,10%	REGION=Alsace	1,7	[56,8 %]	4,0 %	3,00%
NAF=80	0,9	[100,0 %]	0,1 %	0,10%	REGION=Limousin	1,7	[66,7 %]	1,5 %	1,00%
NAF=65	0,9	[100,0 %]	0,1 %	0,10%	REGION=Corse	1,6	[100,0 %]	0,4 %	0,20%
NAF=70	0,9	[100,0 %]	0,1 %	0,10%	REGION=Bourgogne	1,5	[59,1 %]	2,5 %	1,80%
NAF=71	0,9	[100,0 %]	0,1 %	0,10%	REGION=Picardie	1,4	[61,5 %]	1,5 %	1,10%
NAF=55	0,9	[100,0 %]	0,1 %	0,10%	NAF=64	1,2	[66,7 %]	0,8 %	0,50%
REGION=Franche-Comté	0,6	[63,2 %]	1,7 %	1,60%	REGION=Nord-Pas-de-Calais	1	[51,4 %]	3,6 %	3,00%
NAF=34	0,1	[60,0 %]	0,4 %	0,40%	REGION=Centre	1	[51,4 %]	3,6 %	3,00%
REGION=Basse-Normandie	0,1	[58,3 %]	1,0 %	1,00%	REGION=Auvergne	0,9	[52,4 %]	2,1 %	1,70%
CLASSE AGE=C3	0	[56,9 %]	50,3 %	50,30%	REGION=Lorraine	0,6	[50,0 %]	1,9 %	1,60%
Class Secteur=MHT	-0,2	[56,1 %]	6,6 %	6,70%	NAF=17	0,4	[50,0 %]	0,8 %	0,70%
NAF=19	-0,2	[50,0 %]	0,1 %	0,20%	NAF=19	0,2	[50,0 %]	0,2 %	0,20%
NAF=40	-0,2	[50,0 %]	0,1 %	0,20%	NAF=40	0,2	[50,0 %]	0,2 %	0,20%
NAF=17	-0,4	[50,0 %]	0,6 %	0,70%	Class Secteur=MHT	0,2	[43,9 %]	6,9 %	6,70%
REGION=Lorraine	-0,6	[50,0 %]	1,4 %	1,60%	CLASSE AGE=C3	0	[43,1 %]	50,3 %	50,30%
REGION=Auvergne	-0,9	[47,6 %]	1,4 %	1,70%	REGION=Basse-Normandie	-0,1	[41,7 %]	1,0 %	1,00%

REGION=Centre	-1	[48,6 %]	2,6 %	3,00%	NAF=34	-0,1	[40,0 %]	0,4 %	0,40%
REGION=Nord-Pas-de-Calais	-1	[48,6 %]	2,6 %	3,00%	REGION=Franche-Comté	-0,6	[36,8 %]	1,3 %	1,60%
NAF=64	-1,2	[33,3 %]	0,3 %	0,50%	NAF=65	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Picardie	-1,4	[38,5 %]	0,7 %	1,10%	NAF=27	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Bourgogne	-1,5	[40,9 %]	1,3 %	1,80%	NAF=55	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Corse	-1,6	[0,0 %]	0,0 %	0,20%	NAF=80	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Limousin	-1,7	[33,3 %]	0,6 %	1,00%	NAF=30	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Alsace	-1,7	[43,2 %]	2,3 %	3,00%	NAF=70	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Poitou-Charentes	-1,8	[36,8 %]	1,0 %	1,60%	NAF=41	-0,9	[0,0 %]	0,0 %	0,10%
REGION=Haute-Normandie	-1,9	[30,8 %]	0,6 %	1,10%	NAF=71	-0,9	[0,0 %]	0,0 %	0,10%
NAF=31	-1,9	[30,8 %]	0,6 %	1,10%	REGION=Midi-Pyrénées	-0,9	[37,7 %]	5,0 %	5,70%
REGION=Provence-Alpes-Côte d'Azur	-1,9	[47,2 %]	6,1 %	7,30%	NAF=35	-1	[20,0 %]	0,2 %	0,40%
NAF=25	-2	[16,7 %]	0,1 %	0,50%	NAF=85	-1	[20,0 %]	0,2 %	0,40%
REGION=Aquitaine	-2	[44,3 %]	3,9 %	5,00%	NAF=52	-1,2	[0,0 %]	0,0 %	0,20%
CLASSE AGE=C1	-2,1	[50,8 %]	17,6 %	19,70%	NAF=90	-1,5	[0,0 %]	0,0 %	0,20%
REGION=Languedoc-Roussillon	-2,2	[40,0 %]	2,3 %	3,30%	REGION=Rhône-Alpes	-1,5	[37,9 %]	12,8 %	14,50%
REGION=DOM TOM	-2,3	[0,0 %]	0,0 %	0,30%	CLASSE AGE=C2	-1,8	[39,1 %]	27,2 %	30,00%
NAF=21	-2,3	[0,0 %]	0,0 %	0,30%	REGION=Bretagne	-2,5	[27,1 %]	3,0 %	4,80%
NAF=15	-2,4	[37,8 %]	2,0 %	3,00%	NAF=74	-3,3	[31,9 %]	11,2 %	15,20%
NAF=29	-2,6	[36,1 %]	1,9 %	3,00%	CLASSE ETAT=C1	-3,5	[0,0 %]	0,0 %	1,30%
REGION=Pays de la Loire	-2,6	[39,2 %]	2,9 %	4,20%	CLASSE CA=C2	-3,6	[34,6 %]	21,1 %	26,30%
NAF=20	-3	[10,0 %]	0,1 %	0,80%	NAF=92	-4	[0,0 %]	0,0 %	1,70%
NAF=26	-3	[15,4 %]	0,3 %	1,10%	NAF=72	-4,5	[27,2 %]	8,8 %	13,90%
NAF=01	-3,3	[17,6 %]	0,4 %	1,40%	NAF=32	-4,9	[5,0 %]	0,4 %	3,30%
NAF=36	-3,4	[8,3 %]	0,1 %	1,00%	CLASSE EFF=C4	-5,2	[0,0 %]	0,0 %	2,90%
NAF=18	-3,5	[0,0 %]	0,0 %	0,70%	NAF=24	-5,3	[4,5 %]	0,4 %	3,60%
CLASSE ETAT=C0	-3,5	[56,4 %]	97,7 %	98,70%	NAF=51	-5,4	[0,0 %]	0,0 %	3,00%
REGION=Champagne-Ardenne	-3,6	[20,8 %]	0,7 %	2,00%	CLASSE EFF=C3	-5,7	[4,0 %]	0,4 %	4,10%
NAF=22	-5,6	[11,1 %]	0,6 %	3,00%	CLASSE GROUPE=C1	-5,8	[24,1 %]	9,0 %	16,00%
CLASSE GROUPE=C0	-5,8	[53,3 %]	78,7 %	84,00%	REGION=Île-de-France	-6,4	[29,7 %]	21,5 %	31,30%
NAF=28	-6,1	[5,9 %]	0,3 %	2,80%	CLASSE CA=C3	-6,5	[13,6 %]	2,9 %	9,00%

Class Secteur=MLT	-6,8	[13,8 %]	1,2 %	4,80%	NAF=33	-6,7	[7,4 %]	1,1 %	6,60%
Class Secteur=LT	-8,2	[21,2 %]	3,6 %	9,70%	CLASSE CA=C4	-6,9	[1,6 %]	0,2 %	5,30%
CLASSE CA=C1	-10,1	[45,0 %]	47,0 %	59,40%	CLASSE EFF=C2	-8,3	[21,8 %]	11,8 %	23,40%
CLASSE BREVET=C0	-11	[50,8 %]	77,4 %	86,70%	Class Secteur=HT	-9,6	[5,6 %]	1,5 %	11,60%
CLASSE EFF=C1	-12	[45,7 %]	55,9 %	69,60%	CLASSE BREVET=C1	-11	[3,1 %]	1,0 %	13,30%
Class Secteur=Autre	-14,8	[18,3 %]	7,3 %	22,80%	NAF=73	-11,2	[0,7 %]	0,2 %	12,40%
NAF=45	-18	[2,3 %]	0,7 %	17,90%	Class Secteur=KIS	-14,2	[20,5 %]	21,1 %	44,40%

Computation time : 0 ms.
Created at 13/01/2008 15:47:33

Annex 2 : Results of the MCFA (Axes 1 and 2)

Columns analysis

-		Coord.		Contributions (%)		COS²	
Values	**Weight**	coord 1	coord 2	ctr 1	ctr 2	cos² 1	cos² 2
Age1	4,98	-0,744	0,09	5	0,1	0,122	0,002
Age2	7,59	-0,503	-0,298	3,5	1,5	0,102	0,036
Age3	12,72	0,414	0,265	3,9	1,9	0,164	0,067
				12,4	3,5		
EFF1	17,61	-0,484	0,166	7,5	1	0,41	0,048
EFF2	5,91	0,618	-0,199	4,1	0,5	0,124	0,013
EFF3	1,04	1,293	-0,106	3,1	0	0,084	0,001
EFF4	0,73	1,763	-0,106	4,1	0	0,112	0
				18,8	1,5		
15	0,77	0,188	2,64	0	11,6	0,001	0,233
22	0,75	-0,287	2,894	0,1	13,6	0,003	0,264
28	0,71	0,039	2,01	0	6,2	0	0,123
29	0,75	1,185	-0,094	1,9	0	0,046	0
33	1,68	1,523	-0,399	7	0,6	0,19	0,013
51	0,77	0,821	0,065	0,9	0	0,018	0
72	3,51	-0,741	-0,651	3,5	3,2	0,094	0,073
73	3,13	-0,649	-0,739	2,4	3,7	0,065	0,084
74	3,84	-0,533	-0,595	2	2,9	0,055	0,068
45	4,52	-0,575	0,5	2,7	2,4	0,053	0,04
24	0,91	1,589	-0,338	4,2	0,2	0,115	0,005
32	0,83	1,808	-0,503	4,9	0,5	0,131	0,01
				29,6	44,9		
KIS	11,22	-0,621	-0,639	7,8	9,9	0,332	0,352
HT	2,95	1,632	-0,433	14,2	1,2	0,414	0,029
MHT	1,7	1,233	-0,137	4,7	0,1	0,115	0,001
MLT	1,2	0,101	1,676	0	7,3	0	0,132
LT	2,45	-0,136	2,373	0,1	29,9	0,002	0,564
				26,8	48,4		
GROUPE	4,05	0,775	-0,039	4,4	0	0,149	0
ETAT	0,33	1,813	-0,452	2	0,1	0,07	0,004
BREVET	3,36	0,993	-0,45	6	1,5	0,208	0,043