R&D COOPERATION BETWEEN FIRMS AND UNIVERSITIES. SOME EVIDENCE IN FIVE EUROPEAN COUNTRIES

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Aim

- The aim of this paper is to investigate which firm characteristics are conducive to university-industry R&D cooperation

- We provide empirical evidence on a sample of European manufacturing firms from the five largest European economies (France, Germany, Italy, Spain, the UK)

Motivation (1/2)

- The Lisbon agenda and the EU Report Europe 2020 stress the important role of cooperation between firms and universities in maintaining Europe's economic competitiveness

- Cooperation between businesses and universities encourages the transfer and sharing of knowledge, helps to create long-term partnerships and opportunities and drives innovation

Motivation (2/2)

- Insufficient attention has been given to this topic
- Empirical research focuses on specific countries (Tether, 2002; Laursen and Salter, 2004; Segarra-Blasco and Arauzo-Carod, 2008; Busom and Fernàndez-Ribas, 2008; Veugelers and Cassiman, 2005; Belderbos et al, 2004; Miotti and Sachwald, 2003; Schartinger et al, 2001) probably because there are few databases that facilitate analysis of the links between universities and firms across countries
- Exceptions are the studies by Fontana et al (2006) and Mohnen and Hoareau (2003) **but** they pool the data of the countries considered and, therefore, do not apply a comparative view to this phenomenon

REVIEW OF THE LITERATURE (1/3)

In the literature which analyses the *firm perspective*, several variables have been identified as being important in affecting firms' decisions relating to R&D cooperation with partners

- *R&D expenditures*

- *Firm size*
  - The effect is a priori unclear:
    - Larger firms are able to dedicate greater resources and time to building links with universities
    - Smaller enterprises have fewer internal resources and need more external knowledge, which means more cooperation partners

REVIEW OF THE LITERATURE (2/3)

- *Sectors*
  - According to Pavitt (1984), some studies underline the importance of industry–university cooperation, arguing that science-based industries depend heavily on progress in science and technology

- *Firm age*
  - Young firms depend on technological innovations and scientific progress and are therefore more inclined than others to engage in interaction with universities
  - The issue is more controversial for older firms
    - On the one hand, older firms may have established a set of links with universities over time and, thus, have more experience in cooperation which may lead to a higher propensity to interact
    - On the other hand, older firms can be expected to be less dependent on external knowledge generated at universities, because these firms have been able to accumulate a stock of knowledge within the firm

REVIEW OF THE LITERATURE (3/3)

Public funds for R&D activities

- Firms with access to public subsidies aimed at promoting R&D activities tend to cooperate more

Exporting

- Given that they operate in more competitive environments, exporting firms are more inclined to invest in research and to improve R&D strategies

Other variables:

- Belonging to an enterprise group
- Type of innovative activities

DATA AND VARIABLES

- Source: EU-EFIGE dataset
  - Representative sample of manufacturing firms with more than ten employees in seven European countries (Italy, France, Spain, the United Kingdom, Germany, Hungary and Austria), over the period 2007- 2009

  Our analysis focuses on the five EU countries with the highest number of firms in the sample

ECONOMETRIC SPECIFICATION

We estimate the following probit model for each country:

$$P(COLL_i = 1 / \mathbf{x}_i) = \Phi(\alpha_0 + \alpha_1 INNO_i + \alpha_2 RD_i + \alpha_3 Size_i +$$
$$\alpha_4 ScienceBased_i + \alpha_5 Young_i +$$
$$\alpha_6 GovSupport_i + a_7 Export_i)$$

i=1,…,N firms

Description of variables

VARIABLE	DESCRIPTION
COLL	dummy equal to one when a firm has undertaken R&D investments acquired from universities and R&D centres in 2007-2009 and zero otherwise
INNO	dummy equal to one when a firm reports introducing at least one innovation (product or process innovation) during the 2007-2009
RD	average 2007-2009 R&D intensity (R&D expenditures as a share of sales) of firms
Size	number of employees in 2008 (in log)
Science Based	dummy equal to one if a firm is in the "High-tech industry" according to the Pavitt taxonomy and zero otherwise
Young	dummy equal to one in the case of a firm which is less than 6 years, and zero otherwise
GovSupport	dummy equal to one if the firm benefitted from tax allowances and financial incentives for R&D activities in the period 2007-2009 and zero otherwise
Export	dummy equal to one if the firm is direct exporter in 2008 or has been actively exporting in years before 2008

Distribution of firms by country in the dataset

Country	N. firms	N. Industry-university cooperation	% Industry-university cooperation
France	2886	90	3%
Germany	2815	164	6%
Italy	2958	121	4%
Spain	2781	125	5%
UK	2021	107	5%
Total	13461	607	5%

Main descriptive statistics by country

Variable	France		Germany		Italy		Spain		UK	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
COLL	0,031	0,174	0,058	0,234	0,041	0,198	0,046	0,209	0,053	0,224
INNO	0,557	0,497	0,642	0,480	0,673	0,469	0,692	0,462	0,667	0,471
RD	3,057	7,479	4,201	7,811	3,951	7,358	3,250	7,233	3,687	8,762
Size	3,495	0,886	3,689	0,955	3,369	0,751	3,357	0,801	3,496	0,863
Science based	0,037	0,190	0,067	0,250	0,032	0,177	0,033	0,179	0,048	0,214
Gov support	0,177	0,382	0,092	0,290	0,186	0,389	0,179	0,383	0,147	0,355
Export	0,619	0,486	0,641	0,480	0,734	0,442	0,629	0,483	0,662	0,473
Young	0.062	0.241	0.071	0.258	0.066	0.249	0.061	0.240	0.098	0.298
Obs. (max n°)	2886		2815		2958		2781		2021	

Estimation results on the probability to collaborate with universities

VARIABLES	France	Germany	Italy	Spain	UK
INNO	0.0207***	0.0492***	0.0296***	0.0262***	0.0546***
	(0.0063)	(0.0078)	(0.0069)	(0.0083)	(0.0084)
RD	0.0009***	0.0011***	0.0009**	0.0009**	0.0006
	(0.0002)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Size	0.0049	0.0085**	0.0163***	0.0080*	0.0129**
	(0.0034)	(0.0043)	(0.0042)	(0.0043)	(0.0054)
Science based	-0.0082	0.0154	0.0551**	0.0126	0.0312
	(0.0106)	(0.0173)	(0.0255)	(0.0200)	(0.0243)
Young	-0.0088	-0.0222*	-0.0178*	0.0068	-0.0060
	(0.0117)	(0.0134)	(0.0107)	(0.0181)	(0.0159)
Gov Support	0.0501***	0.1263***	0.0696***	0.1177***	0.0392***
	(0.0113)	(0.0211)	(0.0121)	(0.0176)	(0.0150)
Export	0.0154**	0.0433***	0.0026	0.0126	0.0234**
	(0.0067)	(0.0081)	(0.0092)	(0.0084)	(0.0105)
Observations	2,874	2,812	2,957	2,717	2,021
log likelihood	-338.6	-523.0	-424.2	-400.3	-374.7
pseudo-R2	0.154	0.163	0.160	0.210	0.105
Wald chi2	123.5	204.3	162.1	213.3	87.72
p-value	0	0	0	0	0

Estimation results on the probability to collaborate with universities: the effect of product and process innovation

VARIABLES	France	Germany	Italy	Spain	UK
Product	0.0180***	0.0258***	0.0251***	0.0193**	0.0577***
	(0.0068)	(0.0086)	(0.0071)	(0.0078)	(0.0093)
Process	0.0086	0.0507***	0.0229***	0.0059	0.0050
	(0.0066)	(0.0087)	(0.0070)	(0.0078)	(0.0103)
RD	0.0009***	0.0010**	0.0008**	0.0009**	0.0005
	(0.0002)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Size	0.0048	0.0076*	0.0147***	0.0076*	0.0124**
	(0.0034)	(0.0043)	(0.0042)	(0.0043)	(0.0054)
Science based	-0.0082	0.0183	0.0528**	0.0110	0.0301
	(0.0106)	(0.0176)	(0.0248)	(0.0196)	(0.0240)
Young	-0.0086	-0.0228*	-0.0173	0.0068	-0.0070
	(0.0117)	(0.0129)	(0.0108)	(0.0180)	(0.0155)
Gov Support	0.0482***	0.1248***	0.0676***	0.1182***	0.0361**
	(0.0112)	(0.0210)	(0.0119)	(0.0179)	(0.0147)
Export	0.0151**	0.0423***	0.0009	0.0126	0.0203*
	(0.0067)	(0.0082)	(0.0095)	(0.0084)	(0.0108)
Observations	2,874	2,812	2,957	2,717	2,021
log likelihood	-337.6	-512.5	-418.6	-400.8	-370.8
pseudo-R2	0.157	0.180	0.171	0.209	0.114
Wald chi2	125.4	225.3	173.2	212.3	95.47

Other results

- We have also included other variables in the model:
  - a dummy equal to one if the *firm belongs to a group* and zero otherwise
  - a dummy to take into account the role of *families in the management* of companies (value 1 if the share of managers who are related to the controlling family is higher than the each national average)

  Results show that:
  - there is no significant difference in the probability of cooperating with a university in R&D activities between firms belonging to a group and firms which do not belong to a group
  - there is no significant difference between family and non-family managed firms in terms of collaboration with universities

Our main findings (1/2)

1. Some determinants of R&D cooperation differ across countries. This supports the view that there is heterogeneity in the relationships between firms and universities

   - *Firm age* and the *process innovation* have positive impacts in Germany and Italy

   - If firms are *exporting firms*, this affects R&D cooperation in the case of France, Germany and the UK, but not in Italy and Spain

   - Only in Italy do firms in the *science based sector* tend to have higher propensity than firms in other sectors to collaborate with universities

Our main findings (2/2)

2. Firms' research and innovation capability play a central role in R&D collaboration. R&D-intensive firms and product innovators are more likely to cooperate with universities

   - These results are consistent with the "absorption hypothesis": only firms with important internal R&D activities are able to extract knowledge from universities and research centres

3. Public policies have a key role in promoting collaboration between universities and firms by offering public funds to encourage private R&D

4. Larger firms are, in almost all cases, more likely to cooperate with science institutions than smaller ones

Conclusions (1/2)

- Some firm characteristics which might explain university-industry cooperation are country specific

  ➔ a great deal of caution is required when developing policies that generalise university-industry relationships

- We find some common results for European countries

  ➔ public policies can stimulate R&D cooperation by offering public funds to innovative firms, especially large firms with important internal R&D activity

Conclusions (2/2)

- In Europe, policies have over recent years mainly been directed at creating incentives for universities to interact with firms

- These results, though, indicate that there may not be an appropriate level of demand from firms in certain economic contexts because these may not have the requisite features to be able to absorb external knowledge

Thank you for your attention

REVIEW OF THE LITERATURE

R&D expenditures

- **(+)** Fontana et al, 2006 for Denmark, France, Germany, Greece, Italy, the Netherlands and the UK; Laursen ad Salter, 2004 for the UK; Segarra-Blasco and Arauzo-Carod, 2008 for Spain.

- **(-)** Love and Roper, 1999: capable firms may want to try substituting in-house effort for external cooperation. In this case, the smaller the R&D capacity, the more active the firm will be in cooperating with partners.

- **(Not significant)** Mohnen and Hoareau (2003) and Eom and Lee (2010).

REVIEW OF THE LITERATURE

Sectors

- According to Pavitt (1984), some studies (Meyer-Krahmer and Schmoch, 1998; Santoro and Chakrabarti, 2002; Schartinger et al., 2002; Cohen et al., 2002b) underline the importance of industry–university cooperation, arguing that science-based industries depend heavily on progress in science and technology.

- Laursen and Salter (2004) and Veugelers and Cassiman (2005) confirm the marked industry effect in industry-science links, which tend to be agglomerated in specific science-based industries.

REVIEW OF THE LITERATURE

Firm size

(+) Tether (2002) and Laursen and Salter (2004) for the UK, Mohnen and Hoareau (2003) for Germany, France, Ireland and Spain, Veugelers and Cassiman (2005) for Belgium, Miotti and Sachwald (2003) for France, Schartinger et al (2001) for Austria, Segarra-Blasco and Arauzo-Carod (2008) for Spain, Fontana et al (2006) for Denmark, France, Germany, Greece, Italy, the Netherlands and the UK.

REVIEW OF THE LITERATURE

Firm age

- Cohen et al (2002a) suggest that start-ups are more likely to draw from universities

- Laursen and Salter (2004) do not find support for the hypothesis that the propensity of a firm to draw knowledge from universities is influenced by the firm's age.

REVIEW OF THE LITERATURE

Public funds for R&D activities

- Firms with access to public subsidies aimed at promoting R&D activities tend to cooperate more : Miotti and Sachwald (2003) for France, Mohnen and Hoareau (2003) for France and Spain, Busom and Fernàndez-Ribas (2008) for Spain and Belderbos et al (2004) for the Netherlands.

REVIEW OF THE LITERATURE

Type of innovative activities

- Mohnen and Hoareau (2003) find a positive relationship between the introduction of radical innovation and the extent of reliance on universities and research centres.

- Laursen and Salter (2004) only find partial support for the hypothesis that the firms which are more active in terms of product innovations are those that rely most on public sources.

- Fontana et al (2006) maintain that companies involved in process innovation are more likely to cooperate with public research organisations, while there is no evidence of a significant correlation between product innovation and engagement in collaboration with universities.

REVIEW OF THE LITERATURE

Exporting
- Tether (2002) and Carboni (2013) find that being export oriented is insignificant in the case of cooperating with public research organisations.

Belonging to an enterprise group
- Have more knowledge about the capabilities of universities (Tether 2002) and it is easier for them to access information and establish contacts (Mohnen and Hoareau 2003).
- They have more internal resources, which, on one hand, give more opportunities for finding a partner outside the firm, but, on the other hand, might mean that they do not need universities as knowledge sources because they can use knowledge from within their group (Tether 2002).
- ***Empirical results*** are ambiguous: Tether (2002), and Segarra-Blasco and Araunzo Carod (2008) find a ***positive*** relationship whereas Mohnen and Hoareau (2003) and Miotti and Sachwald (2003) find a ***negative*** relationship. Belderbos et al (2004) confirm that belonging to a group increases R&D cooperation with customers and suppliers, but not with universities or research institutions, while Eom and Lee (2010) find this relationship to be insignificant.