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NEW EVIDENCE ON THE FIRM-UNIVERSITY LINKAGES IN EUROPE. THE ROLE OF MERITOCRATIC MANAGEMENT PRACTICES

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New evidence on the firm-university linkages in Europe. The role of meritocratic management practices

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Abstract This paper investigates the determinants of university-industry links in five European countries (France, Germany, Italy, Spain and the UK), using internationally comparable firm-level data for the period 2007-2009. Besides the usual firm-specific variables, it examines the role of meritocratic management practices in firms' decisions to collaborate in R&D. Firm innovative efforts, the export status and the R&D government support are positively related to business-university links in almost all countries, human capital and firms' size in two out of five countries under scrutiny, while belonging to science-based sectors does not seem to play a significant role. Importantly, we find that meritocratic managerial practices positively affect the firm-university nexus in Germany, France and UK, while meritocracy does not appear to enhance businesses' R&D collaboration in Italy and in Spain.

Keywords: industry-university links; European countries; R&D; manufacturing firms, meritocratic managerial practices.
JEL Code: O31; D21; C25

1. INTRODUCTION

R&D cooperation between businesses and universities is seen as a source of growth because it encourages the transfer and sharing of knowledge, thereby driving innovation and firms' performance (Jaffe, 1989; Griliches, 1998; Cohen et al, 2002a). Based on this, the Lisbon agenda and the Europe 2020 Report (European Commission, 2010) stress the role of active cooperation between firms and universities in accelerating Europe's economic competitiveness in the next decade. In other words, the strengthening of the industry-university links should contribute to achieve the 3% of GDP in R&D target by 2020 and, thus, help EU to be the smart, sustainable and inclusive economy highlighted in the Europe 2020 strategy. A consequence of this is that any study

on the determinants of R&D firm-university collaboration becomes crucial in identifying the best mix of innovation policy instruments to maximise R&D returns to private and public investments. In this respect, research should address the following issues: What profile of firm does it take to collaborate with universities? Are there cross-country differences in the determinants of university-industry links? Might these differences potentially offer insight to improve political instruments promoting collaboration?

Despite the relevance of these questions at European level, insufficient attention has been given to this area of research. An extensive body of empirical work focuses on specific countries and only a few studies consider more than one country (Fontana et al, 2006; Mohnen and Hoareau; 2003; Aristei et al 2016; Bellucci and Pennacchio, 2016). When a cross-country analysis is carried out, data are pooled, thereby not applying a comparative view to this phenomenon, while when a comparison between countries is provided (Abramovsky et al 2009 and Franco and Gussoni 2014), the studies focus on different types of cooperation and consider different factors, time periods and sets of countries from ours. For example, Abramovsky et al (2009) examine the roles of knowledge flows, cost and risk-sharing and public financial support in firms' decisions to collaborate, Franco and Gussoni (2014) explore the differences between the manufacturing and the service sectors in the cooperative behaviour of firms, Aristei et al (2016) focus on internal knowledge, appropriability conditions and incoming spillovers, while Bellucci and Pennacchio (2016) examine mainly cross-national differences in the characteristics of innovation systems and the role of universities within them.

Compared to the related literature, a distinguishing feature of this work regards the introduction of managerial practices as a determinant of the firm-university collaboration in R&D. Our research question may be summarized as follows: are meritocratic managerial practices a good predictor of firm-university R&D collaboration, seen as an *ex-ante* indicator of innovativeness?

This issue is part of the wide strand of literature on the role of workers' human capital in explaining firms' performance. For instance, Lazear (2000) focuses on the productivity effects of incentive pay, while Bloom and Van Reenen (2007) evaluate the productivity impact of managerial talent and practices. There has also been a focus on the complementary between ICT adoption and firms' management practices (Bresnahan et al. 2002; Brynjolfsson et al. 2002). In Garicano and Heaton (2010), the productivity gains related to ICT are high when firms adopt a performance-based, meritocratic management. Similarly, Pellegrino and Zingales (2017) find that Italy's slowdown depends on the failure of its firms to exploit all the advantages of the ICT revolution. According to the authors, this is also due to the lack of meritocracy in the selection and rewarding of managers. Following this line of research, we contribute to the debate by exploring whether the meritocratic management practices affect firms' behaviour in R&D collaboration, which ultimately is an effective vehicle for increasing the efficiency of innovative efforts (Cunningham and Link, 2015).

In order to evaluate which individual characteristics can be associated with the use of universities as a source of external knowledge (R&D) we refer to a sample of manufacturing firms from five European economies (France, Germany, Italy, Spain, the UK) over the period 2007-2009. The empirical analysis refers to the EFIGE dataset, a micro-based dataset which was harmonised across countries (Altomonte and Aquilante, 2012). This allows us to compare firms in terms of their different modes of R&D cooperation and to analyse how these outcomes relate to other firm specific variables. The econometric specification of the probit model we use considers a set of traditional determinants of R&D cooperation - such as innovative efforts, firm size, internationalisation, public financing and sector – plus a measure of the meritocratic practices that every firm adopts when selecting and paying its managers.

We find that meritocratic managerial practices positively affect firm-university nexus in Germany, France and UK, while no impact is found in Italy and in Spain. Respect to other firm-

specific variables, R&D efforts, export, and policies in support of R&D are positively associated with the probability of cooperating with universities, sector does not seem to play a significant role in almost any country, while human capital and firms' size are positively related to business-university links in two out of five countries under scrutiny.

The paper is organized as follows. The second section reviews part of the literature on the determinants of industry-university cooperation. In the third section, the data and the variables are presented. The econometric model and the estimation results are discussed in sections 4 and 5 respectively. The final section concludes.

2. REVIEW OF THE LITERATURE

Since the late nineties, there has been a significant increase in studies evaluating the determinants of collaborations between university and industry (Etzkowitz and Leydesdorff, 2000). A variety of factors have been analysed to explain the development of such collaborations, be it from the perspective of universities (among others, Di Gregorio and Shane 2003; D'Este and Patel 2007), the point of view of firms or both (Schartinger et al., 2001). 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 external actors. In what follows we review part of the literature aimed at evaluating the role played by the main drivers of R&D collaboration between firms and universities (R&D intensity, firm size, sector membership, R&D public support and the status of exporter).

For instance, Cohen and Levinthal (1990) argue that R&D positively affect the firm's absorptive capacity and, therefore, not only creates new knowledge, but helps the firm to exploit knowledge from external sources, for example universities. Therefore, it can be expected that the firm's level of R&D intensity will greatly influence the likelihood that it will draw knowledge

from universities. The positive link between intramural R&D and R&D cooperation has been demonstrated for several European countries (Fontana et al, 2006 for Denmark, France, Germany, Greece, Italy, the Netherlands and the UK; Laursen and Salter, 2004 for the UK; Segarra-Blasco and Arauzo-Carod, 2008 for Spain). However, there are studies that argue the opposite: capable firms may want to try substituting in-house effort for external cooperation (Love and Roper, 1999). In this case, the smaller the R&D capacity, the more active the firm will be in cooperating with partners. Along this line of reasoning, Mohnen and Hoareau (2003) and Eom and Lee (2010) find that there is no significant relationship between R&D intensity and cooperation with universities.[1]

Another key determinant of the business-university link is the firm size. While it is one of the basic tenets of the literature on university-industry relationships, the possible effect of size is *a priori* somewhat unclear. Larger firms are able to dedicate greater resources and time to building links with universities. On the other hand, smaller enterprises have fewer internal resources and need more external knowledge, which means more cooperation partners. From an empirical perspective, many studies based on European countries' data reveal that size is positively related to the probability of firms' cooperating with universities, e.g. 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.

The propensity to actively seek links with universities may be influenced by sectors, which are a proxy for technological opportunity. According to Pavitt (1984), some studies (Meyer-Krahmer and Schmoch, 1998; Santoro and Chakrabarti, 2002; Schartinger et al., 2002; Cohen et

[1] An exhaustive review of the empirical literature regarding what kind of firms use universities as knowledge external sources can be found in Vivas and Barge-Gil (2015).

al., 2002b) underline the importance of an industry–university link, arguing that science-based industries depend heavily on progress in science and technology. In line with previous studies, Laursen and Salter (2004) for the UK, and Veugelers and Cassiman (2005) for Belgian firms confirm the marked sector effect in industry-science links, which tend to be agglomerated in specific science-based industries. Segarra-Blasco and Arauzo-Carod (2008) report similar evidence for Spain.

A number of studies includes access to public funds for R&D activities among the determinants of R&D cooperation (Abramovky, 2009; Aristei et al, 2016; Belderbos et al, 2004; Busom and Fernàndez-Ribas, 2008; Franco and Gussoni, 2014; Hottenrott and Lopes-Bento, 2014; Miotti and Sachwald, 2003; Mohnen and Hoareau, 2003; Segarra-Blasco and Araunzo Carod, 2008).[2] According to these studies, firms with access to public subsidies aimed at promoting R&D activities tend to cooperate more. The availability of R&D subsidies may make a great difference in motivating firms to establish R&D partnerships. This result has been found for several European countries: Miotti and Sachwald (2003) for France, Mohnen and Hoareau (2003) for France and Spain, Busom and Fernàndez-Ribas (2008) for Spain, Belderbos et al (2004) for the Netherlands; Hottenrott and Lopes-Bento (2014) for Flanders (Belgium); Aristei et al (2016); Franco and Gussoni (2014), Abramovky (2009) for EU countries.

Finally, exporting is considered to make cooperation with universities more likely. Given that they operate in more competitive environments, exporting firms are more inclined to invest in research and to improve R&D strategies. However, Tether (2002) and Carboni (2013a) find that being export oriented is insignificant in the case of cooperating with public research organisations.

[2] For a comprehensive overview on public policies regarding R&D cooperation see the recent surveys by Becker (2015).

Besides these factors, which are identified in the literature as the main determinants of R&D being outsourced, other firm characteristics may affect cooperation, albeit they are not studied as often as those previously mentioned. Some of these are worth mentioning, such as the role of families in the management of companies and financial structures (Aristei et al, 2016), belonging to an enterprise group (Miotti and Sachwald, 2003; Mohnen and Hoareau, 2003; Segarra-Blasco and Araunzo Carod, 2008; Tether, 2002), "open search strategy", that is the propensity for a firm to rely on external sources of knowledge (Bellucci and Pennacchio, 2016; Fontana et al., 2006; Laursen and Salter, 2004), knowledge flows, and cost and risk-sharing (Abramovsky et al, 2009). Another topic in R&D cooperation regards the role of firm age. Cohen et al (2002a) suggest that start-ups are more likely to draw from universities, while 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.

Finally, economists have traditionally ignored managerial practices as a driving factor explaining industry-university links. As mentioned in the *Introduction*, scholars just evaluate the role of management practice on firm productivity and on ICT adoption (Bloom and Van Reenen 2007; Bresnahan et al. 2002; Brynjolfsson et al. 2002; Garicano and Heaton 2010; Lazear 2000; Pellegrino and Zingales 2017). Therefore, no study assesses if and to what extent better-managed firms differ from bad-managed firms in terms of collaboration with universities.

3. DATA AND VARIABLES

The empirical analysis is based on the EU-EFIGE/Bruegel-Unicredit dataset[3] which contains data from a survey and balance-sheets. Data was collected in 2010 and covers the years from 2007 to

[3] The EU-EFIGE/Bruegel-Unicredit database is part of the EFIGE "European Firms in a Global Economy: internal policies for external competitiveness" project. This is supported by the Directorate General Research of the European Commission through its 7th Framework Programme and coordinated by Bruegel. For details on the EFIGE dataset, see Altomonte and Aquilante (2012).

2009. The EFIGE survey was conducted on a representative sample of manufacturing firms with more than ten employees in seven European countries (Austria, France, Germany, Hungary, Italy, Spain and the UK). The analysis focuses on the five largest EU countries (France, Germany, Italy, Spain and the UK) which are also those with the highest number of firms in the sample.

The dataset comprises much quantitative and qualitative information ranging from R&D and innovation, labour organisation, financing and organisational activities, and pricing behaviour.[4] Since firms that originally reported a number of employees equal to or larger than 500 in the EFIGE dataset are capped at 500 employees, we have restricted the sample to firms with a number of employees between 10 and 499.[5]

Table 1 summarises the variables used in the analysis and provides information on their description, while table 2 reports descriptive statistics.

The sample consists of almost 13 thousand firms with about 2,800 firms for Italy, 2,700 for Germany, 2,600 firms for France and Spain, and around 1,900 firms for the United Kingdom (details are reported in Table 2). The evidence from the EFIGE data shows that a small fraction of enterprises (around 4.5%) use universities and public research laboratories as a potential source for their innovation process. Firms located in Germany and the UK have the highest shares of reference to universities (6% and 5% respectively), while French and Italian firms have the lowest shares (3% and 4%, respectively). This proportion is 4.6% in Spain.

[4] The EFIGE dataset has its limitations. It is worth mentioning that one important determinant of R&D collaboration, the distance between University and each firm, is missing in our estimations since, in order to preserve anonymity, the EFIGE database just includes randomised regional and industry identifiers. This means that users know that a given firm in a given country is in an 'industry 2' or/and in 'region 3', but they do not know what 'industry 2' or 'region 3' correspond to. Hence, region and industry variation are allowed for in the data, but variables based on geographical measures, such as the distance between each firm and University, are not allowed for in the analysis.

[5] The number of observations which we lost, that is the number of firms with a number of employees greater or equal to 500, was 367 out of the 13,828. The final number of observations becomes 12758 after taking into account missing values in variables.

When we consider the variables directly relating to innovation, the data show that, on average, the expenditure on R&D is only 3.6% of annual turnover. This percentage ranges from 4.1% in Germany to 3% in France. The percentage of firms with a higher share of graduate employees with respect to the national average share of graduates is higher for France, Italy and Spain, and lower for Germany and UK.

Furthermore there are some cross-country disparities in firms size (Italian and Spanish firms the smallest in the sample) and when we consider exporting, sectoral membership and public financing. For example, the highest percentage of exporting firms is found in Italy (73.4%) and, of the five EU countries. Italy also has the highest percentage of firms which benefit from tax allowances and financial incentives for R&D activities (18.4%) followed by France (17,7%), Spain (17,5%), UK (15,3%) and Germany (9,3%). The largest shares of science based firms are in Germany (around 7%). At the opposite side, the frequency of high-tech firms is low in Italy (3,4%) and in Spain (3,5%) (Table 2).

Table 1 - Description of variables used in the empirical investigation

VARIABLE	DESCRIPTION
COLL	dummy equal to one if a firm has undertaken R&D investments acquired from universities and R&D centres in 2007-2009, and zero otherwise
Meritocracy	firm-level index on the meritocracy of the managers
RD	average 2007-2009 R&D intensity (R&D expenditures as percentage of total turnover) of firms
Size	number of employees in 2008 (in log)
hk	*hk* is a dummy equal to one if the firm has a higher share of graduate employees with respect to the national average share of graduates
Science Based	dummy equal to one if a firm is in the "High-tech industry" according to the Pavitt taxonomy, and zero otherwise
GovSupport	dummy equal to one if the firm benefitted from tax allowances and financial incentives for R&D activities made in the 2007-2009 period, and zero otherwise
Export	dummy equal to one if the firm was direct exporter in 2008 or had been actively exporting in the years before 2008

Table 2 - Characteristics of firms, mean values

Variable	France	Germany	Italy	Spain	UK	Total
Maximum no. of observations	2623	2,726	2,862	2,635	1,912	12,758
Percentage of observations (%)	20.6%	21.4%	22.4%	20.7%	15.0%	100.0%
COLL	0.033	0.058	0.041	0.046	0.050	0.045
Meritocracy	2.095	1.978	1.275	1.815	2.291	1.853
Size	3.489	3.679	3.368	3.351	3.485	3.473
RD	2.989	4.138	3.883	3.172	3.634	3.569
Human capital	0.329	0.223	0.318	0.291	0.229	0.281
Export	0.615	0.640	0.734	0.630	0.656	0.656
GovSupport	0.177	0.093	0.184	0.175	0.153	0.157
Science based	0.041	0.069	0.034	0.035	0.047	0.045

Source: authors' elaborations on EU-EFIGE/Bruegel-UniCredit dataset.

Finally, the analysis takes into account the role of the meritocracy of the managers. Following Pellegrino and Zingales (2017), the meritocracy index is computed by summing the binary variables equal to one in the case that, respectively, i) managers can take autonomous decisions in some business areas; ii) managers are rewarded with financial benefits; iii) any of executives worked abroad for at least one year; iv) the firm is not directly or indirectly controlled by an individual or family-owned entity and, if it is, the chief executive officer (CEO)/ Company Head of the firm is a manager recruited from outside the firms; v) firm share of managers related to the controlling family is not higher than the national average.

From table 2 it emerges that meritocracy is around 2 in all countries but Italy, for which it is on average less than 1,3. Table 3 reports the value assumed by the variable in the five countries analysed. The highest frequency of zero values in the meritocracy variable is observed in Italy (meritocracy is zero for 757 Italian firms, that is 26,7% of the sample), while the lowest one is in the UK (100 firms, that is 5,5% of the sample). Italy is also the country with the highest percentage of values equal to one (1023 firms which are 36,1% of the sample). The highest percentages with the values of two, three and four are observed in France (34%), UK (27,6%) and Germany (11,6%),

respectively, with UK reporting also the highest percentage (3,9%) of the value five in the meritocratic intensity. In brief, table 3 highlights how meritocracy differs from one country to another. The following section will test the hypothesis that this country-heterogeneity in the meritocracy of managers may be translated to differences in firms' attitude to undertake R&D collaboration.

Table 3 – Meritocracy index, frequencies

Meritocracy	France		Germany		Italy		Spain		UK	
	Absolute	*Percent*	Absolute	*Percent*	Absolute	*Percent*	Absolute	*Percent*	Absolute	*Percent*
0	226	*8.9*	337	*12.8*	757	*26.7*	315	*12.0*	100	*5.5*
1	548	*21.6*	729	*27.7*	1,023	*36.1*	910	*34.7*	401	*22.0*
2	861	*34.0*	701	*26.6*	695	*24.5*	673	*25.7*	541	*29.7*
3	600	*23.7*	476	*18.1*	266	*9.4*	461	*17.6*	503	*27.6*
4	256	*10.1*	305	*11.6*	74	*2.6*	197	*7.5*	208	*11.4*
5	43	*1.7*	86	*3.3*	22	*0.8*	67	*2.6*	71	*3.9*
Total	2,534	*100.0*	2,634	*100.0*	2,837	*100.0*	2,623	*100.0*	1,824	*100.0*

Source: authors' elaborations on EU-EFIGE/Bruegel-UniCredit dataset.

4 ECONOMETRIC SPECIFICATION

This section sets up the models used in the empirical analysis. In order to analyse the relationship between industry and university, we estimate the following probit model for each country:

$$P(COLL_i = 1/\boldsymbol{x}_i) = \Phi(\alpha_0 + \alpha_1 RD_i + \alpha_2 Size_i + \alpha_3 hk_i + \alpha_4 Science\ based_i + \alpha_5 Gov\ support_i + \alpha_6 Export_i) \quad [1]$$

Where *COLL* is equal to 1 if a firm purchased R&D from universities and/or research centres in 2007-2009 and zero otherwise.

The independent variables included in eq. [1] are derived from the literature focusing on firms' decision to cooperate with public research centres (cfr § 2). *RD* is the average percentage of total turnover that the firm invested in R&D over the 2007-2009 period; *Size* indicates firm size as measured by (a logarithm of) its number of employees in 2008; *hk* is a dummy equal to one if

the firm has a higher share of graduate employees with respect to the national average share of graduates; *Science Based* is a dummy equal to one if the firm is in the "High-tech industry", while *Gov Support* assumes the value of one if the firm benefitted from tax allowances and financial incentives for R&D activities carried out in the 2007-2009 period and zero otherwise*; Export* is equal to one if the firm was a direct exporter in 2008 or had been actively exporting in the years before 2008.

As discussed in the previous section, we have then included the meritocracy variable and hence estimated also the following model:

$$P(COLL_i = 1/\boldsymbol{x}_i) = \Phi(\alpha_0 + \alpha_1 Meritocracy_i + \alpha_2 RD_i + \alpha_3 Size_i + \alpha_4 hk_i + \alpha_5 Science\ based_i + \alpha_6 Gov\ support_i + \alpha_7 Export_i) \quad [2]$$

with *Meritocracy* indicating the meritocracy index as previously defined (cfr § 3).

5 RESULTS

Results on the probability of collaborating with universities and research centres in each country are reported in table 4. [6]

As expected, estimates show that the probability of collaborating is positively correlated with R&D investments (*RD*), indicating that, on average, a higher level of R&D expenditure allows firms to gain more benefits from interactions with universities. Firms invest in R&D also to increase their absorptive capacity. This, in turn, implies a greater ability to internalize external knowledge, thereby encouraging firms to seek links with universities. For this reason, firms whose R&D capacities are large enough to absorb external knowledge usually establish relationships with

[6] Due to the cross-sectional structure of the data, most of the explanatory variables are contemporaneous with the phenomenon to be explained, that is links with universities regarding R&D. While one should be cautious in interpreting estimates in terms of causal relationships between variables, they can be seen as associations.

external partners. Our results are in line with those of Fontana et al (2006), Laursen and Salter (2004), Segarra-Blasco and Arauzo-Carod (2008), who found a positive effect of R&D on university-firm cooperation for several European countries.

The estimates also confirm the importance of firm size in explaining why some firms draw more from universities. In line with existing studies (among others Tether, 2002; Laursen and Salter, 2004; Mohnen and Hoareau, 2003; Segarra-Blasco and Arauzo-Carod, 2008), in almost all countries, the larger a firm is, the more likely it is to cooperate with universities. Firms which have benefitted from tax allowances and financial incentives for R&D activities (*Gov Support*) are more likely to collaborate with universities and R&D centres. According to these results, firms with access to public incentives aimed at promoting R&D activities are likely to cooperate more in all the five EU countries here analysed, so confirming the results from previous empirical works that report this for several European countries (Miotti and Sachwald, 2003; Mohnen and Hoareau, 2003; Busom and Fernàndez-Ribas, 2008; Abramovsky et al, 2009; Franco and Gussoni, 2014).[7] This finding is consistent with individual country R&D policy which encourages co-operation between firms and universities and facilitates technology transfer from the public sector. Differently phrased, it reflects the focus of the policies in operation in several European countries (Abramovsky et al, 2009).

Human capital seems to significantly foster the R&D cooperation between firms and universities in Germany and Italy only, while it does not appear to affect the industry-university

[7] Miotti and Sachwald (2003) find that R&D subsidies encourage public/private and also horizontal cooperation between French firms. Mohnen and Hoareau (2003), who use a sample of mostly French and Spanish firms, show that receiving subsidies is the factor which has most influence on the probability that a firm will set up a public–private partnership. Busom and Fernàndez-Ribas (2008) point out that public support significantly increases the chances that a Spanish firm will cooperate with a public research organization. Abramovsky et al (2009) examining four European countries (France, Germany, Spain and the UK), find a significant positive correlation between public support and the probability of cooperation only in the manufacturing sector but not in the service one for the case of UK and Spain. Finally, Franco and Gussoni (2014) confirm results for Italy, Spain, Germany, Norway, Belgium, Romania and the Czech Republic.

linkage in the other three countries. The empirical results show that there are no cross-country disparities in industry-university interaction among European countries when we consider exporting and belonging to a knowledge intensive sector, except for Italy. The probability of cooperating with universities is higher for exporting firms, while sector does not seem to play a significant role: the idea that universities are important sources of open science and R&D cooperative activities in high-tech sectors is not empirically verified.

The findings for Italy differ to some extent from those for other countries, reflecting the specific institutional and industrial context in which firms operate. Indeed, Italian science based firms tend to have a higher propensity to cooperate with universities while firms operating in other sectors are likely to rely more on strategies based on the acquisition of innovation embodied in capital goods developed by external suppliers (Carboni, 2013b). Finally, in line with the results obtained by Carboni (2013a), we find that there is no significant difference between exporters and non-exporters in their cooperating with public research organisations. The explanation for this result probably relates to the fact that Italian exporting firms are characterised by high R&D efforts and innovative performances (Castellani and Zanfei, 2007) which render them less dependent on the external knowledge generated by universities.

When the meritocracy variable is included in the regression (eq. 2) results on the role of the other factors do not substantially vary, except that size has a weaker effect, being significant only for Italy and Spain. Meritocracy variable has a positive and significant effect in France, Germany and in the UK. The analysis shows that in these three countries firms are more inclined than others to select and reward managers using criteria based on merit (see table 3). This practice is translated into a positive effect on the probability of firms to undertake R&D collaboration with universities and public research centers. When managers are selected on loyalty rather than merit (this mainly occurs in Spain and in Italy), there is no impact of meritocracy on the firm-university

links, as its estimated parameter is not significant, albeit still with a positive sign (Table 4). Although investigating why Italy and Spain are less inclined than others to adopt modern managerial practices goes beyond the scope of this paper. However, some reasons may be related to the massive weight of family firms in these two countries (Bloom et al 2008; Bugamelli and Lotti 2018). Indeed, family-owned firms tend to select managers by considering the closeness and fidelity to the ownership rather than the merit and the sector specific skills required to managers for comparing the growth opportunities of any innovative strategy (Bandiera et al 2008; Bloom and Van Reenen 2007; Pellegrino and Zingales 2017). Along this line of reasoning, we might argue that if in Italy and Spain the fidelity model of managerial talent is more widespread than the performance model, then the R&D collaboration with university is hardly perceived at firm level as a source of growth.

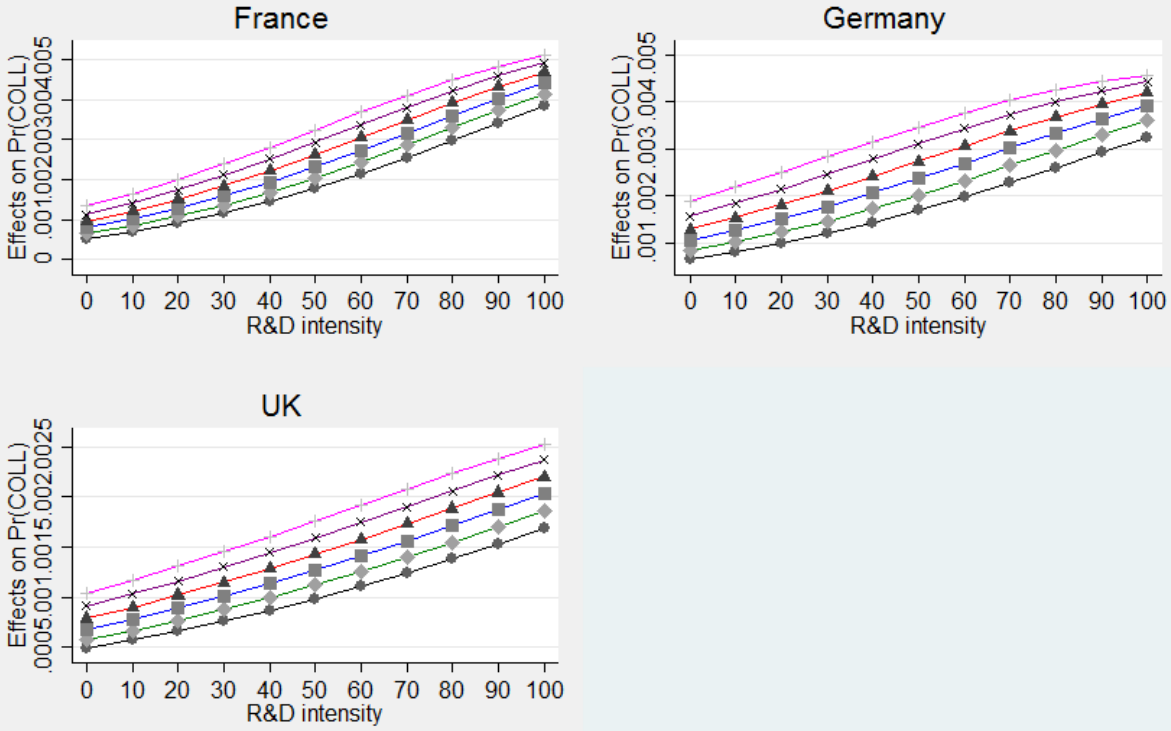
A by-product of the study comes from the joint reading of the estimates regarding R&D intensity and meritocracy. Since meritocracy is not significant for Italian and Spanish firms, figure 1 displays the partial effect of R&D on collaboration when meritocracy move from zero to five in France, Germany and the UK. At any level of R&D intensity, the effect of meritocracy on innovative collaboration is clearly visible looking at the difference between the lowest (meritocracy is zero) and highest (meritocracy is five) lines. In brief, adopting meritocratic criteria in selecting the managers amplifies the effect of any effort in R&D activities.

Table 4 - Estimation results on the probability of collaboration with universities

	Model 1					Model 2				
VARIABLES	France	Germany	Italy	Spain	UK	France	Germany	Italy	Spain	UK
Meritocracy						0.0068**	0.0139***	0.0054	0.0004	0.0085**
						(0.0032)	(0.0036)	(0.0033)	(0.0033)	(0.0043)
Size	0.0060	0.0124***	0.0186***	0.0108**	0.0157***	0.0031	0.0053	0.0146***	0.0108**	0.0091
	(0.0037)	(0.0045)	(0.0043)	(0.0044)	(0.0055)	(0.0041)	(0.0049)	(0.0047)	(0.0050)	(0.0059)
RD	0.0011***	0.0015***	0.0010***	0.0010**	0.0009**	0.0009***	0.0012***	0.0010**	0.0010**	0.0008*
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
HK	-0.0029	0.0246**	0.0183**	0.0098	0.0192	-0.0053	0.0236**	0.0177**	0.0099	0.0148
	(0.0069)	(0.0113)	(0.0080)	(0.0086)	(0.0128)	(0.0071)	(0.0114)	(0.0079)	(0.0086)	(0.0125)
Export	0.0197***	0.0481***	0.0062	0.0163*	0.0285***	0.0198***	0.0419***	0.0047	0.0160*	0.0277***
	(0.0069)	(0.0079)	(0.0088)	(0.0084)	(0.0099)	(0.0071)	(0.0084)	(0.0089)	(0.0084)	(0.0099)
Gov support	0.0647***	0.1322***	0.0720***	0.1256***	0.0555***	0.0640***	0.1345***	0.0707***	0.1245***	0.0518***
	(0.0134)	(0.0225)	(0.0129)	(0.0185)	(0.0172)	(0.0135)	(0.0228)	(0.0128)	(0.0185)	(0.0172)
Science based	-0.0092	0.0134	0.0439*	0.0124	0.0229	-0.0102	0.0094	0.0434*	0.0121	0.0187
	(0.0109)	(0.0172)	(0.0234)	(0.0201)	(0.0241)	(0.0111)	(0.0168)	(0.0231)	(0.0200)	(0.0234)
Observations	2,623	2,726	2,862	2,635	1,912	2,534	2,634	2,837	2,623	1,824
log likelihood	-323.7	-512.7	-413.9	-391.5	-347.5	-317.9	-486.8	-403.9	-388.6	-321.1
pseudo-R2	0.145	0.146	0.147	0.207	0.0802	0.146	0.162	0.149	0.207	0.0816
Wald chi2	109.7	175.6	143.1	204.9	60.61	108.4	188.5	142	203.5	57.07
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: average partial effects are reported. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Figure 1
Average partial effects of R&D intensity at different levels of meritocracy



5. Discussion and Conclusions

The importance of knowledge transfer between university and business is unquestionable and reflected in the number of research studies published in recent years. The distinguishing features of this paper are to identify the differences and the common characteristics of industry links with universities and research centres across European countries (France, Germany, Italy, Spain and the UK) and to introduce the meritocratic management practices as a key determinant of R&D collaboration. We use a sample of about 13 thousand small and medium-sized enterprises (EFIGE data, 2007-2009) and perform probit estimations. Main results are as follows.

With respect to the role of standard firm level factors, we find that some similarities between countries exist, although they are not always homogeneous. Indeed, as far as innovative efforts, R&D subsidies and export status are concerned, estimations indicate that they positively

affect R&D cooperation in (almost) all the countries under review, while, human capital, firms' size and sector do not seem to play a significant role whatever the country. We also present some evidence on an additional explanation for differences in industry-university collaboration, namely that they reflect variations in management practices. In particular, we find that meritocratic managerial practices positively affect firm-university nexus in Germany, France and UK, while meritocracy does enhance businesses' R&D collaboration in Italy and in Spain. The significant effect of merit in management in Germany, France and in the UK is used to show its relevance in increasing the probability to collaborate at any level of R&D intensity. Three main implications may be drawn from these findings.

First, the estimates underline the central role that firms' research and innovation capability and R&D subsidies have regarding collaboration. R&D-intensive firms is more likely to cooperate with universities. This is consistent with the absorption hypothesis: only firms with significant R&D efforts are able to draw on knowledge from universities and research centres. Furthermore, the empirical evidence shows that public policies have a key role in promoting collaboration between universities and firms by offering public funds to encourage private R&D. This seems to suggest more general policies aimed at offering public funds to innovative firms, especially if exporters and with significant R&D activity. However, the positive (indirect) impact R&D policies on collaborative innovation signals that a potential overlapping between different public schemes may be at work, as R&D support is not necessarily focused on cooperation. Therefore, and similarly to others (Abramovsky et al 2009; Franco and Gussoni 2014), this study reinforces the need to avoid redundancy in R&D policies aimed at increasing innovative cooperation.

Second, there are also important differences across countries, potentially reflecting differences in economic structure. Indeed, human capital, firms' size and sector do not seem to play a significant role in all countries, signaling that some firm characteristics which might explain

industry-university links are country specific. Therefore, a great deal of caution is required when implementing actions that are meant to generalize the university-industry relationships. In Europe, policies have, over recent years, mainly been directed at creating incentives for universities to interact with firms. Our results, though, indicate that there may not be an appropriate level of demand from certain firms, because these may not have the requisite features to be able to absorb external knowledge.

Finally, the paper shows that more meritocratic firms tend to cooperate more with university, thereby confirming the role of organizational practices in spurring innovation (Bloom and Van Reenen, 2007). Improving management practice may be an effective way to achieve high standard of collaboration with university, thereby promoting innovation and gaining from the opportunity to access rapid, cost effective and sustainable competitive advantage. For this reason, adopting modern management practices must be the priority in case of long tails of badly managed family-owned firms, as in Italy and in Spain.

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Appendix A

Table A1 - Estimation results on the probability of collaboration with universities,
Estimated coefficients

	Model 1					Model 2				
VARIABLES	France	Germany	Italy	Spain	UK	France	Germany	Italy	Spain	UK
Meritocracy						0.1053**	0.1431***	0.0733	0.0054	0.0928**
						(0.0488)	(0.0369)	(0.0449)	(0.0423)	(0.0469)
Size	0.0941	0.1256***	0.2475***	0.1376**	0.1657***	0.0481	0.0541	0.1976***	0.1388**	0.0989
	(0.0577)	(0.0451)	(0.0557)	(0.0567)	(0.0576)	(0.0632)	(0.0506)	(0.0631)	(0.0637)	(0.0646)
RD	0.0166***	0.0153***	0.0136***	0.0123**	0.0090**	0.0145***	0.0126***	0.0133***	0.0125**	0.0085*
	(0.0044)	(0.0044)	(0.0051)	(0.0050)	(0.0044)	(0.0046)	(0.0046)	(0.0051)	(0.0050)	(0.0045)
HK	-0.0455	0.2292**	0.2322**	0.1214	0.1876	-0.0831	0.2247**	0.2284**	0.1231	0.1521
	(0.1115)	(0.0977)	(0.0962)	(0.1039)	(0.1167)	(0.1141)	(0.1003)	(0.0979)	(0.1045)	(0.1216)
Export	0.3541**	0.5944***	0.0859	0.2240*	0.3395**	0.3494**	0.5135***	0.0657	0.2203*	0.3419**
	(0.1429)	(0.1216)	(0.1276)	(0.1239)	(0.1335)	(0.1435)	(0.1246)	(0.1286)	(0.1245)	(0.1394)
Gov support	0.7519***	0.8531***	0.7253***	1.0670***	0.4695***	0.7372***	0.8771***	0.7237***	1.0606***	0.4561***
	(0.1149)	(0.1031)	(0.0989)	(0.1083)	(0.1188)	(0.1159)	(0.1053)	(0.1001)	(0.1089)	(0.1240)
Science based	-0.1620	0.1257	0.4346**	0.1450	0.2095	-0.1791	0.0915	0.4363**	0.1425	0.1803
	(0.2170)	(0.1506)	(0.1794)	(0.2157)	(0.1935)	(0.2223)	(0.1558)	(0.1796)	(0.2159)	(0.2017)
Constant	-2.7620***	-2.8320***	-3.1268***	-2.8385***	-2.7208***	-2.7935***	-2.8114***	-3.0466***	-2.8497***	-2.7107***
	(0.2302)	(0.2024)	(0.2197)	(0.2223)	(0.2375)	(0.2328)	(0.2099)	(0.2253)	(0.2251)	(0.2498)
Observations	2,623	2,726	2,862	2,635	1,912	2,534	2,634	2,837	2,623	1,824

Note: standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1