

University-Industry Collaboration: Do the Characteristics of Academic Staff Matter?

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Abstract: It is widely recognised that a country's development, in terms of innovation and productivity, is greatly influenced by the character and intensity of interaction between the science and business communities. Despite this importance, there is still a lack of understanding regarding the underlying factors that drive the transfer of knowledge and technology. In particular, only a few empirical studies have addressed the issue of exploring the attitudes and behaviours of academic staff in this process. This paper aims to fill this research caveat. Its main objective is to investigate the influence of academic staff's socio-demographic and educational characteristics on university-industry collaboration. According to our objectives and to test these hypotheses, we decided on a mixed method. At a first stage, we performed a quantitative study, based on data gathered from a questionnaire applied to the overall population of academic staff at Bragança Polytechnic Institute in Portugal. The empirical study was carried out in 2011 and covered the total population of academic staff at BPI. We received 123 valid questionnaires, yielding a response rate of 23.7%. For data analysis, we applied descriptive statistics and logistic regression. At a second stage, a qualitative approach was chosen to evaluate university-industry collaboration, consisting of an exploratory semi-structured interview with the owner-manager of a recently created local spin-off from this higher education institution. The results reveal that age and gender are significantly related to the propensity to collaborate with industry. For instance, the probability of male academic staff collaborating with the business community is around 3.5 times higher than it is for females. Furthermore, we found that the level of formal qualification of academic staff and supervision of work placements had no influence, while the school/faculty academic staff belong to is significantly correlated with industry cooperation. Nevertheless, the interviewee considered the existence of curricular work placement as crucial. Overall, from our quantitative and qualitative data, there is a preference for exploitation of knowledge more in academic than in business terms. We present several theoretical and practical implications.

Keywords: universities-industry collaboration; technology transfer; academic staff; spin-off; Portugal

1. Introduction

In the economic literature, it is widely recognised that a country's development, in terms of innovation and productivity, is greatly influenced by the character and intensity of interaction between the science and business communities (Debackere and Veugelers, 2005). In this context, Etzkowitz (2001) stresses that universities have become drivers of regional economic development, creating new organisational mechanisms to this end, as well as for the preservation, increase and spread of knowledge. This impact of universities is found in terms of both economics and knowledge transfer. Scientific knowledge is seen as an important contribution to technological progress (Etzkowitz, 1998; Feldman, 1999; Polt et al., 2001). Policy development in this domain is moving towards universities and other higher education institutions being considered the main sources of up-to-date knowledge to be used in the search for economic growth. Hence, the transfer of knowledge and technology plays an important role in society and the university (Feldman and Desrochers, 2003).

In this regard, the spread of cooperative agreements between private businesses and university departments (Baldini et al., 2007), growing collaboration in publications (Agrawal and Henderson, 2002; Lach and Schankerman, 2008; Stephan et al., 2007; Van Looy et al., 2004), connecting researchers from different organisational contexts, increasing mobility between academia and industry (Dasgupta and David, 1994; Rynes et al., 2001) as well as firms recruiting young people receiving advanced levels of training in universities (Freeman, 2000) are all aspects which have been developed. These are only a few approaches to achieve a common goal: the spread of knowledge (Vallas and Kleinman, 2007), based on the collaboration between industry and universities.

Most recent studies, in various sectors of activity, suggest intensifying interaction between universities and industry over time (Debackere and Veugelers, 2005; D'Este and Fontana, 2007; Giuliani et al., 2010). But as yet, there is still a lack of understanding regarding the underlying factors that drive the transfer of knowledge and technology. In particular, only a few studies have addressed the issue of exploring the attitudes and behaviours of researchers at universities and research institutes in this process (e.g. Lee, 1996; 2000; Blumenthal et al., 1997; Campbell et al., 2000). Additionally, in empirical terms, the question as to how the socio-demographic and educational characteristics of academic staff influence university-industry collaboration remains underexplored. Consequently, our paper aims to fill this research caveat. To attain this objective, we selected, as the context of analysis, a Portuguese institute of higher education and a spin-off created in that region's business community.

The remainder of the paper is organised as follows: Section 2 presents a brief literature review to develop our research hypotheses. Section 3 describes the methodology followed in carrying out this study. Section 4 analyses and discusses the data obtained. Finally, Section 5 presents some conclusions, implications and suggestions for future research.

2. Theory and hypotheses

2.1 Socio-demographic characteristics

The literature has identified a number of factors influencing the probability of interactions between academia and industry, such as academics' socio-demographic characteristics, i.e. age and gender. In fact, some particular variables such as the academic's age can influence university-industry collaboration (Giuliani et al., 2010). However, the results in this regard are rather mixed and far from conclusive. Some scholars say that the need to publish is lower among older academic staff, allowing them to dedicate more time to working with industry (Levin and Stephan, 1991; Boardman and Ponomariov, 2009). Others argue that younger academic staff are more likely to be involved in university-industry collaboration, as they were already trained under the premises of interaction between the spheres and because such collaboration enhances reputation (D'Este and Patel, 2007; Bercovitz and Feldman, 2008). In this vein, we think that younger academic staff are more inclined to collaborate with the private sector.

Furthermore, the influence of academic staff's gender on the propensity to collaborate with industry is likewise ambiguous, and according to Giuliani et al. (2010), few studies have addressed this issue. For example, Buttell and Goldberger (2002) and Boardman and Ponomariov (2009) found that in certain types of collaboration, male researchers have significantly more links with industry. Kyvik and Teigen (1996) detected that women collaborate less with collaborators outside their organisation and tend to have lower collaboration rates in general. On the other hand, Gulbrandsen and Smeby (2005) and Van Rijnsoever et al. (2008) did not reveal noteworthy gender differences in their studies. For the purposes of our study, we believe that women will have less collaboration with industry and their interaction will be less intensive.

In light of these considerations, we formulate our first set of hypotheses:

H1. The propensity to collaborate with industry is related to the socio-demographic characteristics of academic staff.

H1a. The propensity to collaborate with industry is negatively related to the age of academic staff.

H1b. The propensity to collaborate with industry is higher among male than among female academic staff.

2.2 Educational characteristics

Besides the socio-demographic dimension which might influence the likelihood of academic staff collaborating with industry, certain indications were found by previous research that educational characteristics also play an essential role in this process. Klofsten and Jones-Evans (2000) stated that the level of formal education determines academic staff's cognitive background and, at the same time, attitude and propensity to work with industry. In entrepreneurship research, Clercq and Arenius (2006) found a positive effect of individual educational level on the likelihood of perceiving entrepreneurial opportunities. We also believe that a higher level of education enhances the

probability of academic staff embarking on the 'entrepreneurial path'. Due to better analytical and methodological skills, it appears more likely that academics will raise research funding from industry, and in this way, collaborate more intensively with industry (Giuliani et al., 2010).

Nonetheless, it may also be possible that the level of academics' formal education leads to more engagement in 'pure research' and interest in publishing research outcomes in scientific journals. This, we believe, is also strongly marked by the strategy, culture and idiosyncrasies of the school or faculty academic staff belong to. In cases where there is more entrepreneurial orientation in the higher education institution, interaction between academia and industry is often based on work placement. Such involvement of academics in the business process was found to be extremely valuable in transforming research results into commercial applications and value (Wright et al., 2008; Lam, 2010).

However, the empirical evidence in the literature concerning these aspects is weak. Based on the reflections above, we propose our second set of hypotheses:

H2. The propensity to collaborate with industry is related to the educational characteristics of academic staff.

H2a. The propensity to collaborate with industry is positively related to the level of formal qualification of academic staff.

H2b. The propensity to collaborate with industry is related to the school/faculty of the academic staff.

H2c. The propensity to collaborate with industry is related to the supervision of work placements by academic staff.

3. Methodology

3.1 Sample and data collection

The empirical study covered the total population of teaching staff (n=519) at Bragança Polytechnic Institute (BPI) in Portugal, which is distributed over five schools: (1) Bragança School of Technology and Management – ESTIG; (2) Bragança School of Agriculture – ESA; (3) Bragança School of Education – ESSE; (4) Bragança School of Health – ESSA; and (5) Mirandela School of Communication, Administration and Tourism - ESACT.

According to our objectives and to test these hypotheses, we decided on a mixed method. At a first stage, we performed a quantitative study, based on data gathered from a questionnaire applied to the overall population of academic staff at BPI. This survey was designed to include items about the dimensions to be analysed, i.e., detailed questions regarding the socio-demographic and educational factors likely to influence the university-industry collaboration decision. Moreover, we used the following independent variables: gender, age, academic qualifications, the school taught in and supervision of work placements in the business sector. For the dependent (or explanatory) variable, we followed Musio's (2010) procedure and employed a binary (or dichotomous) scale to determine academics' engagement in university-industry collaboration, which is 1 if the member of staff participates in different collaborations or 0 if he or she does not. The questionnaire was distributed between April and June 2011, with one reminder. We received 123 valid questionnaires, yielding a response rate of 23.7%.

At a second stage, we decided on a qualitative approach seeking to evaluate the advantages of cooperation between BPI and a recently created spin-off in the region. It consisted of an exploratory semi-structured interview with the owner-manager of this firm. As noted by Lockett et al. (2005), the formation of university-based spin-off firms constitutes a potentially important, but as yet underexploited option.

3.2 Data analyses

Different statistical analyses were applied to the data obtained. Firstly, a descriptive statistical analysis was made for the variables about academic staff from BPI. At the second stage, to validate our research hypotheses, the variables were subjected to a logistic regression model. This estimation

process was developed in order to assess the relative weights of the significant estimators influencing the probability of the university-industry collaboration decision. Finally, content analysis (Weber, 1985) was also used to evaluate the outcomes of the interview with the spin-off owner-manager.

4. Results and discussion

4.1 Descriptive analyses

Table 1 illustrates the characteristics of the final sample, in particular the socio-demographic and educational characteristics as well as the collaborative links with industry. Interestingly, the majority of academic staff participating in our survey seem to value the academic path more than the business or entrepreneurial one. However, we found a huge disparity among the different schools in this regard.

Table 1: Descriptive statistics

	ESTIG Management (n=48)	ESA Agriculture (n=29)	ESSE Education (n=21)	ESSA Health (n=12)	ESACT Tourism (n=13)	Total (n=123)
<i>Gender:</i>						
Male	33 (54.1)	16 (26.2)	3 (4.9)	2 (3.3)	7 (11.5)	61 (49.6)
Female	15 (24.2)	13 (21.0)	18 (29.0)	10 (16.1)	6 (9.7)	62 (50.4)
<i>Age:</i>						
<25 years	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)
26-35	8 (21.6)	4 (10.8)	11 (29.8)	7 (18.9)	7 (18.9)	37 (30.1)
36-45	32 (55.2)	11 (19.0)	6 (10.3)	3 (5.2)	6 (10.3)	58 (47.2)
46-55	5 (22.7)	13 (59.1)	2 (9.1)	2 (9.1)	0 (0.0)	22 (17.9)
>56	3 (60.0)	0 (0.0)	2 (40.0)	0 (0.0)	0 (0.0)	5 (4.0)
<i>Academic qualifications:</i>						
Graduate	0 (0.0)	0 (0.0)	4 (44.5)	3 (33.3)	2 (22.2)	9 (0.6)
Post-graduate	1 (33.3)	0 (0.0)	1 (33.3)	0 (0.0)	1 (33.3)	3 (0.2)
Master	23 (40.4)	6 (10.5)	11 (19.3)	7 (12.3)	10 (17.5)	57 (46.3)
PhD	24 (44.4)	23 (42.6)	5 (9.3)	2 (3.7)	0 (0.0)	54 (43.9)
<i>Collaboration with industry:</i>						
Yes	15 (27.3)	21 (38.2)	9 (16.4)	8 (14.5)	2 (3.6)	55 (44.7)
No	33 (48.5)	8 (11.8)	12 (17.6)	4 (5.9)	11 (11.2)	68 (55.3)

4.2 Explorative analyses

To analyse how academic staff's socio-demographic and educational characteristics influence the university-industry collaboration decision, the logistic linear regression model was used. Table 2 shows the respective outcomes. This model is appropriate because the response variable (integration or not in any collaboration with industry) is qualitative and dichotomic, i.e. with two possible results, 1 – yes or 0 – no. This model allows good approximation obtained with the logistic regression, which allows use of a regression model to calculate or predict the probability of the previously mentioned response variable. The following variables were taken out of the model: Academic Qualifications – Doctorate, and School taught in – ESTIG, since this did not influence adjustment of the model.

The model is statistically significant, for a level of significance under 1%, according to χ^2 distribution with 11 degrees of freedom, indicating that the model adjusts appropriately to the data. The pseudo R^2 of the model is 0.2185. For the linear model, the R^2 is interpreted as the proportion of variation in the response that can be explained by the repressor. However, there is no clear interpretation for the pseudo R^2 in terms of variance of the result from the logistic regression (Hu et al., 2006).

Our Hypotheses H1a and H1b associate the age and gender of academic staff with the university-industry collaboration decision. The results of the model show that the probability of a male member of academic staff having a link with the business sector is around 3.5 times greater than it is for a female member, being statistically significant for a level of significance under 5%. In addition, age was included in Table 2 (age²) because there may be a point of inflexion in age, in this way improving the model in mathematical terms. The probability of a member of staff's age being related to industry collaboration is around 1.8 times greater than the probability of the average age in the model, being statistically significant for a level of significance under 10%, the value being close to 1 for age², for a level of significance under 5%. Therefore, our Hypothesis H1 cannot be rejected.

However, concerning these aspects, the owner-manager of the spin-off firm mentioned that:

“My age (26) and the fact of being male did not influence my cooperation between the university and the business sector, but it might influence other academics to cooperate with firms. In my opinion, neither age nor sex influenced the creation of the spin-off. In fact, my class at BPI was formed mostly of women and all of them older than me. However, I recognise that the fact of being single is a point in my favour, since I can devote more time to my company”.

Table 2: Outcomes of the logistic regression

Variable	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]	
Socio-demographic characteristics:						
Gender	3.475	1.824	2.37	0.018**	1.242	9.724
Age	1.839	0.575	1.95	0.051*	0.997	3.394
Age ²	0.993	0,004	-2.02	0.044**	0.985	0.999
Educational characteristics:						
Degree	0.529	0.543	-0.62	0.535	0.071	3.957
Master	0.365	0.194	-1.89	0.058*	0.128	1.037
Other quali- fications	0.758	1.068	0.000	0.844	0.048	12.013
ESSA	23.441	21.544	3.430	0.001***	3.869	142.004
ESA	9.814	6.239	3.590	0.000***	2.823	34.119
ESSE	7.399	5.734	2.580	0.000***	1.620	33.790
ESACT	0.684	0.636	-0.410	0.683	0.110	4.236
Supervision of work placement	1.674	0.791	1.090	0.275	0.663	4.227

*** p ≤ 1%; ** p ≤ 5%; * p ≤ 10%

Concerning our hypotheses H2a, H2b and H2c, the empirical evidence shows that academic qualifications (degree and other qualifications) are not statistically significant, except the Master degree for a level of significance of 10%. Therefore, it is surprising that academics holding a doctorate do not have a significant connection with the private business sector. This situation reinforces the idea that vast scientific knowledge is not much of a stimulus for university-industry collaboration.

On the subject of education, the spin-off owner-manager stressed that:

“My education/training, that is, the degree in Gerontology at BPI, a post-graduate course in Health Service Management and the fact of finishing the Master in the same area at the University of Trás-os-Montes and Alto Douro influenced me and could influence other academics in cooperating with firms”.

This entrepreneur agreed with the opinion of Vallas and Kleinman (2007) who considered the growth of small start-up companies reflects the academic origins of their founders. Throughout the interview, the entrepreneur’s enthusiasm, dedication and knowledge regarding the company was obvious, something which is reflected in its success so far.

It is also of note that ‘the school where the lecturer teaches’ is the variable with the greatest statistical significance, the probability of academic staff at ESSA (health school) having a connection with business being 23 times greater than the average for the other schools. This figure may be influenced by the fact that all the courses taught at this school have work placement included in the curriculum, something which is not found in the other schools. About the matter of the area/school where lecturers teach, the entrepreneur interviewed stated that:

“The type of school I attended at BPI and being invited to lecture at ESSA in the same institution influenced me and influences other academics in cooperation with companies”.

However, from the qualitative analysis, in ESSA there is a certain lack of knowledge transmission to the business sector. On this subject, the interviewee considers fundamental the consultancy he continuously receives from BPI, without which the continuity of his firm could be in doubt. This type of knowledge transfer is fundamental inasmuch as both work consultancy and functioning relationships with producers are decisions that provide academic researchers with the opportunity to better understand the contexts in which decisions on policy and practice are made and implemented (Huggins et al., 2008; Jacobson et al., 2005).

Still related to this second hypothesis, where supervision of work placement in firms is associated with the decision to collaborate with industry, the results suggest that academics supervising work placement in businesses and having a link with them is not a statistically significant factor. From this empirical evidence, the influence of the education factor is rather mixed, so that Hypothesis H2 is only partially supported.

Nevertheless, the interviewee considers the existence of curricular work placement as crucial for consolidating the subjects taught, as well as the opportunity it gives students to demonstrate their qualities in the business world. The entrepreneur stated:

“Carrying out curricular work placement lets the business world see the level of knowledge students bring from universities”.

Again on the importance of curricular work placement, the spin-off owner-manager stresses:

“I cooperate with ESSA in the field of curricular work placement. I claim these work placements are a bonus for ESSA (BPI), for the student and also for my company. My company will use those work placements to develop new projects, since work placements allow people’s creativity to be developed”.

In this vein, various scholars share the same opinion, namely, Etzkowitz et al. (2000), Freeman (2000) and Wright et al. (2008), who consider the mobility of academics as very important for both industry and universities to know what the other is doing.

5. Conclusions and implications

The objective of this study was to analyse the influences of academic staff’s socio-demographic and educational characteristics on the university-industry collaboration decision. For this purpose, we selected a Portuguese higher education institution and a spin-off firm created from this university. Based on the logistic regression model we developed, the results revealed also that variables such as gender, age and the school taught in influence academic staff’s capacity to collaborate with the private business sector. In particular, the probability of a male academic staff member cooperating with private businesses is significantly higher than it is for a female member.

However, the cooperation entered into by the academic staff at this institution is confined to the transmission of knowledge in a rather unbusinesslike way, i.e. there is not involvement by a substantial number of academics. This limitation is linked to the very legislation of the academic career, where the lecturer is not well thought of, or duly assessed, for having a business career (Kenney and Goe, 2004). From the quantitative and qualitative data analyses, the academic staff are found to value the academic career more than the business one.

To sum up, the empirical evidence obtained does not show a clear positive effect of academic staff’s socio-demographic and educational characteristics on the university-industry collaboration decision. We accept, however, that the results should be interpreted with some reservation, since for an unequivocal reading of the cooperation between the university and the private business sector, it would be necessary to determine exactly the opinion of the whole academic community.

Furthermore, not only the characteristics of the academic staff members, but also and in particular the institutional culture, reputation, strategic positioning, research foci etc. are supposed to all have an impact on the behaviour of its academic staff towards knowledge and technology transfer activities. In the absence of these data, interpretation of our results can only be an approximation. Further analysis should focus on how the joint effect of academic staff’s characteristics and their working environments impact on their motivations for university-industry collaboration.

Another limitation of our study is that this study focuses on a single country and may reflect some peculiarities of the Portuguese context. The findings are taken from one higher education institution in Portugal, with its idiosyncratic structure and academic culture. While this is quite common in examining the university-industry cooperation, it limits the significance of our data for generalisation. Inter-university and inter-country studies are needed to introduce direct comparison of different institutional settings, particularly in geographical areas such as the European Union, where country-level educational policies and approaches are still very heterogeneous.

Despite all these limitations, we believe the results of this exploratory study make important contributions to considering and designing public policy and to finding new streams for future investigations. In fact, our results provide insights in support of university-industry collaboration based on the perceptions and expectations of academic staff. Consequently, we contribute to better understanding of what drives academic staff to collaborate with industry. Knowledge of the impact of academic staff's socio-demographic and educational characteristics is relevant insofar as it allows universities to create effective mechanisms to enhance collaborative activities with the private business sector.

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