

Theme: CIRCLE Workshop

PhD students in the entrepreneurial university - a study of perceived supportiveness from the university context for academic entrepreneurship

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Introduction

Commercialisation of research results has become an increasingly important activity within universities, as a part of the dissemination of knowledge and as a mechanism for increased economic and societal impact (Etzkowitz 1998; Rothwell 1982; Fontes 2005; Vincett 2010). Many universities have developed their strategies, organisations and practices on all levels in order to evolve into a more entrepreneurial university, as part of the overall development of triple helix relationships in society (Etzkowitz & Leydesdorff 2000; Etzkowitz et al. 2000). Hence, the engagement of scientists in entrepreneurial activities, such as spin-off creation, patenting and consulting, has become a part of the academic role that is supported by most institutions. At the same time universities are complex organizations with distributed authority, intricate power structures and bureaucratic and unclear decision-making structures. Therefore it is not self-evident whether and how organizational supportiveness is received by the targeted individuals. This study investigates the perceived supportiveness of academic entrepreneurship as seen from the perspective of the next generation of academics; the PhD students. We define academic entrepreneurship as all forms of proactive behaviour of academics to commercialize their research findings, such as patenting, licensing, new business creation and consulting (Klofsten & Jones-Evans 2000).

In many cases, studies of academic entrepreneurship omit PhD students. We propose that it is vital to study this specific group because PhD education has become a considerable part of many universities' activities with PhD students performing a major share of university research (Enders 2002). PhD students are also considered as an important channel for knowledge transfer and an increasing number of PhD students interact with industry (Thune 2009; Bienkowska & Klofsten 2012). Moreover, understanding how PhD students perceive academic entrepreneurship is particularly important because they represent the new generation of academics that will shape the universities in the future. Studies of senior

academics (principal investigators) show that individual-level factors are more pronounced than the social environment in explaining academic entrepreneurship (Clarysse et al. 2011). However, first-time inventors tend to co-invent with more senior principal investigators (Colyvas and Powell 2007). Moreover, the decisions of faculty members to disclose new inventions are highly conditioned by the local work environment, following the behaviour of their department chairs (Bercovitz and Feldman 2008). Hence, the perceived supportiveness of commercialization activities may have a direct impact on the behaviour of younger academics and, more importantly, leave a long lasting impact on the university organization as the current PhD students gain more senior positions.

Despite a growing number of studies of university support for academic entrepreneurship, the subject of supportiveness of different hierarchical levels within the university context remains relatively unexplored. Many studies have investigated the relationship between academic entrepreneurship and policies and structures at the central university level (Di Gregorio and Shane 2003; Lockett et al. 2003; Van Looy et al. 2011). However, there are significant differences in the level of academic entrepreneurship between different fields of research. Moreover, as indicated above, the strongest influence on the decision of individual academics to behave entrepreneurial may be at lower levels within the university, such as the department or immediate supervisor. To improve our understanding of what constitutes a supportive environment for academic entrepreneurship, a more fine grained measure of university supportiveness is needed.

The purpose of the following paper is to investigate whether PhD students perceive different levels of support to academic entrepreneurship at different levels within the university organization. We base our study on survey responses from 464 PhD students within the same university. The paper proceeds as follows. In the next section we review the literature on university support of academic entrepreneurship and present a conceptual

framework. Next, the methodology section describes the survey data of PhD students and the analysis conducted. Sample characteristics are presented in the following section. After that, our findings are elaborated on and finally, conclusions and policy implications are discussed.

Theoretical background

Some universities serve as successful examples of entrepreneurial institutions with high levels of entrepreneurial activity (O'Shea et al. 2007; Guerrero et al 2013), while the majority of universities struggle to develop a significant level of entrepreneurial activity, for instance in terms of spin-off activity (Harrison and Leitch 2010; O'Shea et al. 2005; Wright et al. 2007). Governments and universities have put in place a number of initiatives to promote academic entrepreneurship, ranging from legislative changes (Mowery and Sampat 2005), government support schemes (Rasmussen 2008; Rasmussen and Gulbrandsen 2012), university policies (Brunitz et al. 2008), and the establishment of technology transfer offices (TTOs) (Nosella and Grimaldi 2009). Despite many initiatives at government and university level, the extent of academic entrepreneurship is unevenly distributed among and within institutions (Bercovitz and Feldman 2008; Louis et al. 1989).

Part of the explanation of this variation is related to the institutional support for academic entrepreneurship within universities (Fini et al. 2011; Lockett et al. 2003; Powers and McDougall 2005). Regardless of institutional support, the extent of academic entrepreneurship is dependent on the propensity of academics to become entrepreneurs (Aldridge and Audretsch 2011; Clarysse et al. 2011; Ebersberger and Pirhofer 2011; Fini et al. 2009; Krabel and Mueller 2009; Karlsson and Wigren 2012). Hence, for university initiatives to become successful, they need to be able to change the behaviour of academics.

An emerging stream of research has investigated how the institutional context influences entrepreneurial behaviour among academics. The seminal study by Louis et al. (1989), on a

sample of life scientists, found that local group norms influenced scientists' entrepreneurial behaviour, while the university policy and structure showed little effect. Other studies show that the local environment can strongly influence faculty engagement in academic entrepreneurship (Kenney and Goe 2004), and there is a significant variation in the level of entrepreneurial activity between departments within the same university (Bercovitz and Feldman 2008).

There might be several reasons why academics behave differently in different environments, but the entrepreneurship literature recognise entrepreneurial intentions as the best predictor of actual entrepreneurial behaviour (Kolvereid and Isaksen 2006; Krueger et al. 2000). Entrepreneurial intentions can be altered by the environment because people tend to comply with social norms. This is in line with the findings that first-time inventors tend to co-invent with more senior principal investigators (Colyvas and Powell 2007) and that the decision of faculty members to disclose new inventions follow the behaviour of their department chairs (Bercovitz and Feldman 2008). Moreover, it has been empirically confirmed that perceived role models are significantly related to entrepreneurial intentions among academics (Prodan and Drnovsek 2010). Hence, the perceived support towards academic entrepreneurship within the university is clearly of importance when academics decide whether or not to behave entrepreneurially (Rasmussen and Borch 2010).

Universities are heterogeneous organizations and it has been recognized that the level of support may vary between different hierarchical levels, for instance the supervisor, research group, department and central university level. Still, the perceived support at different levels within a university has to our knowledge not been examined quantitatively. For universities to be better able to target their efforts of becoming more entrepreneurial institutions, more knowledge is needed on the level of support perceived by academics at different levels in the university organization. This is particularly relevant in the case of PhD students who will be

the next generation of scientists. Moreover, due to their subordinate position, PhD students are likely to be more sensitive to their institutional environment than their more senior colleagues.

Methodology

The data collection for this study started with a pilot study during 2009 focused on a programme for PhD students aimed to encourage entrepreneurial attitudes and develop skills and knowledge about commercialization of research results. The next step in our research process was a survey of PhD students at Linköping University in Sweden during 2010 where the results of the pilot study were used as an input. A web-based questionnaire was sent out to all current PhD students at this university (1 126 persons) of which 464 (41%) responded.

The questionnaire was structured in four sections. First, background information was gathered concerning respondents' age, gender, nationality, as well as experiences from entrepreneurship, working life and voluntary organizations.

Second, questions about students' opinions towards commercialization of research results (hereafter called CRR) were asked. Seven items were tested, including possibilities to combine research and commercialization as well as entrepreneurial intent. Third, attitudes towards university environment's supportiveness of commercialization activities were measured using a seven-point Likert-like scale. Six items related to the different levels of the university hierarchy were tested (central administration, faculty, department, division, research group, and supervisor). Finally, questions about collaborations with external actors and mobility placements during PhD education (e.g. time spent at other organizations) were addressed. Collaboration was broadly defined as collaborative projects or partnerships with organizations outside Linköping University; while mobility was described as having spent a

part of PhD education at another organization outside the university. The collected data has been analyzed in SPSS using methods such as ordinal regression analysis.

Sample characteristics

The empirical data accessible in this study emanates from PhD students from all four faculties at Linköping University. Due to the small number of PhD students at the faculty of Educational Sciences its results are presented together with the faculty of Arts and Humanities (which at Linköping University includes Social Sciences). The profile of respondents is presented in Table 1.

The division of students amongst faculties is as follows: 104 (22.6%) PhD students from the faculty of Arts and Humanities (including Social and Educational Sciences), 158 (34.3%) from Health Sciences, and 199 (43.2%) are students from Science and Engineering. The median age of respondents is 32 years and 233 (50.2%) are women while 231 (49.8%) are men.

Most of the respondents (337; 72.6%) have had more than a year's of working experience before starting the PhD education. About one third (31.4%) have been holding a leading position (e.g. group leader, manager or chairman) in a business or organisation. Furthermore, over half (301; 64.9%) of the respondents have been active in voluntary or non-profit associations and in 173 (57.5%) cases they have held a leading position in such organisations. 63 respondents (13.6%) have founded their own business, and two thirds of the respondents (309; 67.0 %) have either parents or other relatives or both with experience from self employment.

Table 1. Profile of responding PhD students

PhD student profile	% of valid responses (number in brackets)
<i>Faculty affiliation (N=461)</i>	
Science and Engineering	43.2 % (199)
Health Sciences	34.3 % (158)
Arts and Humanities (including Social and Educational Sciences)	22.6 % (104)
<i>Gender (N=464)</i>	
Female	50.2 % (233)
Male	49.8 % (231)
<i>Median age (N=456)</i>	
All valid responses	32 yrs
<i>Previous work experience (N=464)</i>	
Yes, more than a year	72.6 % (337)
Yes, less than a year	20.9 % (97)
No	6.5 % (30)
<i>Leadership experience from working life (N=433)</i>	
Yes	31.4 % (136)
No	68.6 % (297)
<i>Previous voluntary org experience (N=464)</i>	
Yes	64.9 % (301)
No	35.1 % (163)
<i>Leadership experience from voluntary org (N=301)</i>	
Yes	57.5 % (173)
No	42.5 % (128)
<i>Previous experience from self employment (N=463)</i>	
Yes	13.6 % (63)
No	86.4 % (400)
<i>Parents have experience from self employment (N=464)</i>	
Yes	33.8 % (157)
No	66.2 % (307)
<i>Other relatives have experience from self employment (N=461)</i>	
Yes	58.4 % (269)
No	41.6 % (192)
<i>Collaboration during PhD studies (N=460)</i>	
Firms/firms in combination with public org and/or university	26.5 % (122)
Triple Helix constellation	8.3 % (38)
University/research org only	18.9 % (87)
Public org/public org & university	15.7 % (72)
No collaboration	38.9 % (179)

The majority of responding PhD students (281; 61.1 %) are engaged in external collaborations as part of their PhD studies at Linköping University. One fourth states that they have collaboration with a private firm, in some cases along with collaborations with other groups of

actors. Moreover, 38 PhD students indicate that they are involved in collaborations with both private and public organisations, and therefore can be characterised as future key individuals of Triple Helix collaborations.

Findings

The survey of PhD students at Linköping University shows that there are both differences and some similarities between faculties when it comes to PhD students' experience of supportiveness for commercialization of research results.

Table 2. Perceived supportiveness of different hierarchical level of university organisation for commercialisation of research results (tested for significant differences between groups).

PhD student's faculty affiliation Supportiveness	Science & Engineering	Health Sciences	Arts & Humanities (incl. Social and Educ. Sciences)	ANOVA Significance Level
Central administration is supportive towards researchers' possibilities to CRR	4.40	4.37	4.49	.681
My faculty is supportive towards researchers' possibilities to CRR	4.54	4.08	4.01	.000
My department is supportive towards researchers' possibilities to CRR	4.61	3.95	3.93	.000
My division is supportive towards researchers' possibilities to CRR	4.72	3.96	3.50	.000
My research group level is supportive towards researchers' possibilities to CRR	4.87	4.10	4.01	.000
My PhD supervisor is supportive towards researchers' possibilities to CRR	4.92	4.15	4.30	.000

Table 2 shows that PhD students from the faculty of Science & Engineering perceive their supervisors and research groups as most supportive among all hierarchical levels (average score 4.92 for supervisors and 4.87 for research groups). At the faculty of Health Sciences both the central administration level and the supervisors receive highest scores (4.37 and 4.15

respectively), while department and division levels are on average perceived as unsupportive (with average scores of less than four). A similar pattern can be observed at the faculty of Arts & Humanities. There was no significant difference in how PhD students from different faculties perceive the University central administration's supportiveness.

Next, ordinal regression models were used to analyse PhD students' opinions about the supportiveness for commercialisation from three hierarchical levels: supervisors, departments, and central administration. The results are presented in Table 3.

Table 3. Ordinal regression models of perceived supportiveness of different hierarchical levels.

	Supervisor perceived as supportive	Department perceived as supportive	Central admin. perceived as supportive
Age of PhD student	0.007 (0.356)	-0.007 (0.374)	-0.044 (11.345) ***
Gender (Male = 1, Female = 2)	-0.009 (0.002)	0.029 (0.020)	-0.156 (0.523)
Faculty of Arts & Sciences incl. Educational Sciences	-0.824 (10.347) ***	-1.000 (12.844) ***	0.476 (2.842) *
Faculty of Health Sciences	-0.877 (13.929) ***	-0.945 (13.807) ***	0.292 (1.269)
Faculty of Science & Engineering	Redundant	Redundant	Redundant
Received information about CRR	0.480 (5.573) **	0.503 (5.608) **	0.794 (13.202) ***
Collaborative projects with firms	0.785 (11.655) ***	0.489 (4.367) **	0.183 (0.560)
Nagelkerke R2	0.122	0.117	0.084

Unstandardized estimators are given with Wald chi-squares between parentheses.

*p< 0.10; **p< 0.05; ***p< 0.01.

The results show that receiving information about commercialisation of research results is positive for perceived supportiveness at all three hierarchical levels. One third of the respondents state that they have received such information. Many of them indicate that they have been reached by several different information channels such as internal meetings, PhD student courses, innovation pubs, leaflets, as well as seminars and lectures. Furthermore, it can be noted that being involved in collaborative projects with firms during PhD education is significantly positive for perceived supportiveness of both supervisor and department, while

no significant correlation could be found for the central administration level. As was shown in Table 1, one fourth of the respondents (122 PhD students) have indicated that they are involved in such collaborations. Of these 38 (31 %) PhD students collaborated with SMEs (firms with less than 250 employees); 58 (48 %) collaborated with large firms with more than 250 employees, such as Ericsson; whereas 26 (21 %) collaborated with both SMEs and large firms simultaneously.

In Table 3 faculty of Science & Engineering is used as base level and compared to the other faculties: Arts & Sciences including Educational Sciences and Health Sciences respectively. Both supervisor and department levels are perceived as significantly less supportive by PhD students from these faculties than by Science & Engineering respondents. However, this analysis shows that when account is taken for control variables, central administration is perceived as significantly more supportive by PhD students from the faculty of Arts & Sciences than by those from Science & Engineering .

In the models we control for age and gender. It is shown that age of the respondent is significant for perceived supportiveness of central administration with higher age being correlated with less perceived supportiveness. Age did not relate to the perceived supportiveness of department or supervisor. Gender was not significant in any of the models.

Conclusions and policy implications

This study deals with an important group of academics namely PhD students. Despite their large numbers and potential impact on the future of universities, they are often overlooked in studies of academic entrepreneurship. As a response to that we have presented a study of how PhD students perceive supportiveness for commercialisation of research results from different hierarchical levels within the university organization, from supervisor to the central administration level.

It has been shown that the perceived supportiveness of CRR indeed varies at different hierarchical levels within the university. However, the pattern differs between different fields of research. Within the faculty of Science & Engineering, the perceived supportiveness is increasing at lower levels in the organization. At the other two faculties this relationship is U-shaped with the highest perceived supportiveness at central and local level and lower supportiveness at middle level.

Another conclusion is that spreading information about CRR through multiple channels and bespoke communication strategies is an important signal from the organization showing that CRR is desirable and valued. Relevance for different faculties and subject areas should be considered when communicating an entrepreneurial agenda at universities. It is a vital function for the entrepreneurial university that needs to be integrated throughout its all activities and should not be overlooked when developing other higher-order forms of support for commercialisation such as technology transfer offices.

We have shown that collaboration with firms is correlated with higher perceived supportiveness for CRR from supervisor and department level. These findings could be interpreted in many ways. One possibility is that collaboration is more often present in research environments with values and norms that are positive towards commercialisation where collaboration is an accepted and/or encouraged part of doing research and educating PhDs. Another explanation could be that collaborations in themselves influence perceptions of PhD students so that they are more attuned to observing and recognising the support available around them.

Furthermore, this study shows that PhD students from the faculty of Science & Engineering perceive their supervisors and their departments as more supportive towards CRR compared to other PhD students. This could be explained by traditions and practices within subject areas at this faculty which indicates that developing the whole university

environment into an entrepreneurial university is a long-term endeavour that includes for example role models, good practices, and using appropriate communication and examples that fit with existing local academic cultures.

One major implication from our paper is that all levels of the university hierarchy should be considered when studying the prerequisites for academic entrepreneurship. As a coherent entrepreneurial approach within the organization is important when implementing and managing various schemes aimed to promote commercialization of research results, effort should be put into involving the middle levels. It is also important to consider the varying institutional culture within the university and strive for tailor-made strategies and activities. As noted above, there might be a need for involving the departments and divisions, i.e. the middle levels of the university hierarchy, more strongly into the promotion of entrepreneurial activities. Furthermore, incentive mechanisms and evaluation criteria should be developed in order to take into account a wide spectrum of entrepreneurial commitments, including e.g. outreach and network-building activities, triple helix collaborations, contract research and spin-off ventures.

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