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9

Academic Entrepreneurship: What Changes When Scientists Become Academic Entrepreneurs?

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1. Introduction

The evolution of the academia has been extensively studied. The first academic revolution explained by Jencks and Riesman (1968) made research an additional function of the academia besides the traditional task of teaching. But in the last decades academia adopted another function – the "capitalization of knowledge". This second revolution created the entrepreneurial university which integrates economic development into the university as an academic function along with teaching and research (Etzkowitz, 1998). In recent years academia has become more involved in economic and social development, has more intensively commercialized their research results, patented and licensed activities. In addition, academic spin-off companies emerged and managerial and attitudinal changes occurred in respect to collaborative project with industries (Van Looy et al., 2004).

Academia and individual academic institutions are now a primary source of new knowledge production and innovation (Brennan & McGowan, 2007). It is widely acknowledged that the commercialization of scientific and technological knowledge produced in public-funded research institutions, including universities and research centres, and brought to the marketplace has a fundamental role in wealth creation, economic growth and technological innovation, and plays a significant role in new venture creation, growth of existing firms, and new job creation (Harmon et al., 1997; Mansfield, 1991; Ndonzuau et al., 2002; Siegel et al., 2003). Research by Jaffe (1989), Mansfield (1991), Acs et al. (1992), Mansfield (1998), and others indicates that in important segments of the economy technological change has been based significantly on knowledge that was spun from academic research.

The spin-off process is therefore one important means of transferring and commercializing technological innovations (Carayannis et al., 1998). Since the early 1980s, there has been a growing tide of commercial enterprise emerging from academic organizations (Sljivic, 1993). New technology-based firms established from academic research have been present in the USA for many decades (Brett et al., 1991; Roberts, 1991). In Europe, the establishment of new

technology-based firms from academic research is still in the initial stage of development. Although the first academic spin-offs in Europe appeared in the 1970s, they were not yet specifically encouraged since they diverted effort from basic research and academia usually did not pay any attention to them or often even opposed their development (Stankiewicz, 1994). Spinning off new ventures from academic laboratories gained acceptance in Europe as a valid method of technology transfer in the 1990s (Degroof & Roberts, 2004), although the entrepreneurial activities of scientists are by no means a totally new phenomenon. For example, entrepreneurial activities by scientists occurred in the 17th century in German pharmaceutical science; however, these activities did not affect academic research sites (Etzkowitz, 1998). In the 1990s, entrepreneurship was also recognized as a key instrument of technology innovation. This was an important change in Europe, where academic institutions have traditionally considered that technology transfer and commercialization were outside of their mission (Owen-Smith et al., 2002) and entrepreneurship has not been as developed as in the United States (Organisation for Economic Co-operation and Development, 1998).

Although the evolution of academia has been widely explored, different periods defined and the related changes explained, little research has focused on the crucial actor – the academic entrepreneur. We argue that analysing how entrepreneurs change their way of work after they become academic entrepreneurs, which is after they establish their academic spin-off company as a result of research activities at the university, is important for a better understanding of academic entrepreneurship in academic spin-off proliferation. Although this is an important research topic, only a few studies were related to this topic. Recently, Jain et al. (2009) compared role identity modification of university scientists involved in commercialization activity and found that scientists typically adopt a hybrid role identity that comprises a focal academic self and a secondary commercial persona. Besides that, previous studies addressed different topics, e.g. the patent activity of academic entrepreneurs (Krabel & Mueller, 2009; Wright et al., 2008), collaboration with industry (Cohen et al., 2002; Gulbrandsen & Smeby, 2005; Perkmann & Walsh, 2007, 2008), technology transfer from academia to industry (Shane, 2004), publication of papers and research results (Goldfarb & Henrekson, 2003; Ndonzuau et al., 2002), different types of academic consulting (Perkmann & Walsh, 2008), and basic versus applied research (Grandi & Grimaldi, 2005; Rahm, 1994; Van Looy et al., 2004).

The aim of this chapter is to make a further step into the investigation of changes in academics` way of work in terms of cooperation with the industry (consulting, industry-related projects), patent activities (applied and granted patents), publication of scientific papers, and research activities (basic versus applied research), after they become academic entrepreneurs. The sample consists only of academic entrepreneurs – academics that own their own company – since the chapter explores how they combine the two activities. Etzkowitz (1998) argues that academic entrepreneurs are often eager to conduct applied research at the academic laboratory and product development in the firm.

The rest of the chapter is structured as follows. In the next section, we develop the research hypotheses. We continue with the explanation of the methodology used in this research and the presentation of the results. In the last part, the conclusion and interpretation of results are presented.

2. Hypotheses development

This section presents the development of research hypotheses.

2.1 Cooperation with industry

Among collaborative forms of interaction between academics and industry, academic consulting is widely practiced (Perkmann & Walsh, 2008) and it is also by consulting that university research impacts on industrial R&D (Cohen et al., 2002). Consulting typically involves interaction between the academic and industry in order to find the best and most appropriate solution to a problem (Denis & Lomas, 2003). A lot of research has investigated the academia-industry cooperation relationship from different points of view (e.g. Blumenthal et al., 1996; Cohen et al., 2002; Gulbrandsen & Smeby, 2005; Landry et al., 2006; Mansfield, 1995; Perkmann & Walsh, 2008) but no research has yet analysed how academics change their attitude toward cooperation with industry after they establish their spin-off company. Thus, in the next paragraphs we summarize results of different authors about academia-industry cooperation relationship that will facilitate us in postulating the related research hypothesis.

Landry et al. (2006) argues that researchers which are active in consulting activities with private firms, government agencies, or organizations associated with their research field, will more likely engage in spin-off creation themselves. If we consider Gulbrandsen` and Smeby`s (2005) results that industry cooperation positively and significantly predicts the establishment of firms, we can also suppose that after academics establish their academic spin-off companies, they would practice consulting even more than prior spin-off establishment. In support of this preposition also Mansfield`s (1995) study of 66 U.S. firms as well as 200 U.S. academic researchers suggests that as a project matures, industry funding begins to grow and academics become more involved as industry consultants.

Further, Blumenthal et al. (1996) surveyed 2,052 academics at 50 U.S. universities in the life science field and found that industry-funded academics are more commercially productive than those who are not industry funded. From these results, it can be deducted that industry-funded and thus industry-related projects foster academics into collaboration with industry. Therefore, also academic entrepreneurs will presumably get more involved with industry in terms of industry-related projects and consulting after spin-off creation since they will be directly involved with industry and will presumably conduct more projects ordered by the industry. Based on this discussion we propose that academic entrepreneurs will be more involved in consulting to companies, in industry-related projects, and that they will devote more time to projects which are ordered by the industry than prior the establishment of their spin-off companies. The research hypotheses are proposed as follows.

Hypothesis H1a: *On average, after spin-off creation academic entrepreneurs will be more engaged in consulting to companies than prior spin-off creation.*

Hypothesis H1b: *On average, after spin-off creation academic entrepreneurs will devote more time for projects that are ordered by the industry than prior spin-off creation.*

Hypothesis H1c: *On average, after spin-off creation academic entrepreneurs will be more involved in industry-related projects than prior spin-off creation.*

2.2 Patent activities

At the invention stage, universities have an important role to play in the generation of new scientific and technological knowledge that has traditionally been codified in the form of a patent (Wright et al., 2008). In the past few decades there has been an increase in the number of patents granted to universities (Krabel & Mueller, 2009). Scientists are becoming more proactive in commercializing their research results. Eventually, patenting is a possible commercialization channel (Krabel & Mueller, 2009). In this section we present the literature review that will help us in postulating the hypotheses on changes that occur in regard to academic's attitude about patent activities after they become academic entrepreneurs.

Krabel and Mueller (2009) argue that patenting activity and joint research with industrial partners facilitate academics engagement in entrepreneurship. In her study about academic perceptions of university-firm technology transfer, Rahm (1994) found a moderate to strong correlation between being a spanning researcher and having filed for or been granted a patent. Researchers who have interacted with firms in an effort to transfer knowledge, know-how, or a technology (spanning researchers) differ from university-bound researchers (researchers with no technology transfer experience) in that they are more likely to hold patents than their colleagues (Rahm, 1994). Additionally, scientists also show interest to turn their ideas into products and to exploit them financially and those who hold a patent are four times more likely to be nascent entrepreneurs than those scientists without a patent (Krabel & Mueller, 2009).

Moreover, Gulbrandsen and Smeby (2005) showed that cooperation with the industry positively and significantly predicts patenting as an output of research and development activities. Blumenthal et al. (1996) demonstrated that industry-funded academics applied for more patents, issued more patents and licensed more patents than academics without industrial support. These contributions lead us into the consideration that academics that are more involved with industry are more active in the patenting field. They apply for and are granted more patents then academics with no industry connections. Further, we propose that also academics will carry out more patenting-related activities after they become academic entrepreneurs since engagement with industry and exploitation and commercialization of their knowledge will increase. On the basis of this discussion we postulate the next research hypotheses.

Hypothesis H2a: *On average, academics will apply for more patents after they establish their own company than prior the establishment.*

Hypothesis H2b: *On average, academics will be granted more patents after they establish their own company than prior the establishment.*

2.3 Publication of scientific papers

For most academics, publications are still the favoured and valued output of their work (Gulbrandsen & Smeby, 2005). According to Merton (1957 cited in Siegel et al., 2004), a primary motive of university scientists is recognition within the scientific community, which results from publications in top-tier journals, presentations at prestigious conferences, and federal research grants. Publishing articles in prestigious journals and international reviews

is particularly recommended to increase the likelihood of advancement. This strategy has been popularized within the academic community in the evocative slogan "publish or perish" (Ndonzuau et al., 2002). Researchers wish to have their papers cited because this is a signal that they have established a reputation within the academic community (Goldfarb & Henrekson, 2003), which is the primary motivation for university scientists (Siegel et al., 2003). Different scholars have argued that publishing papers and striving for citations is a central objective of academic research, as citation measures are associated with higher income and prestige (e.g. Dasgupta & David, 1994; Diamond, 1986; Stern, 2004) and also as a recognition from other scientists, which may lead to election to a national academy and the ultimate accolade, the Nobel prize (Etzkowitz, 1998).

Although logical in a "scientific" sense, incentives to publish research results extensively have perverse effects from the standpoint of the economically oriented exploitation of those results (Ndonzuau et al., 2002). Indeed, as soon as research results are published, results lose a major part of their economic attractiveness. That is why industry, concerned with keeping information from competitors, may demand that no publications come from collaborative efforts. A single publication may be enough to remove all of the information's originality value, since once it is in the public domain, it cannot benefit from legal protections such as patents, which are often decisive in a valorisation policy (Ndonzuau et al., 2002). These considerations lead us into proposing that academic entrepreneurs who have their own spin-off companies that are based on academic research results and are more embedded with industry will publish less than before they have establish their own company. Consequently, we also argue that fewer publications will result in fewer citations by other scholars. Thus, the following two research hypotheses are postulated.

Hypothesis H3a: *On average, academics will publish less after they establish their own company than prior the establishment.*

Hypothesis H3b: *On average, academics will receive fewer citations after they establish their own company than prior the establishment.*

2.4 Type of research

Basic research refers to experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view (Organisation for Economic Co-operation and Development, 2002). The primary aim of the investigator therefore is a fuller understanding of the subject under study (Axelrod & Hamilton, 1981). Commonly, academics are oriented more toward basic research than to applied research since scientists are driven by their curiosity or interest in a scientific question. On the other hand, applied research refers to original investigation undertaken in order to acquire new knowledge but is directed primarily toward a specific practical aim or objective (Organisation for Economic Co-operation and Development, 2002) with market potential, and thus it is more interesting for commercialization than basic research. Therefore, industry is interested in application and development (Rahm, 1994) rather than conducting basic research. Applied research assures a more rapid return from developing marketable products, which is of great importance for small spin-off companies.

In their study of industry funding and university professors' research performance, Gulbrandsen and Smeby (2005) found evidence that professors with industrial funding describe their research as applied to a larger extent. Researchers who have interacted with firms in an effort to transfer knowledge, know-how, or a technology are a bit more likely than other researchers to feel pressured to become involved with applied industrial research efforts since they sense that granting agencies, as well as university, department, or central administration, will look favourably upon such activity.

Further, Mansfield (1995) found positive effects between research productivity and involvement with industry. This leads us into consideration that academic entrepreneurs who are also more involved with industry will conduct more applied research and less basic research. In their study on academics' organizational characteristics and the generation of successful business ideas Grandi and Grimaldi (2005) suggest that non-academic partners joining the initial academic team bring a more detailed knowledge of the market and customers and more practical knowledge. Consequently, scholars devoted to applied research generally pay much more attention to industry requirements and to understanding the potential for market applications of academic research results. Thus, the spin-off company that also has non-academic partners will presumably conduct more applied research than basic research.

Based on this discussion we argue that academics will be more involved in applied research and less involved in basic research after they establish their own company since empirical evidence suggests that involvement with industry implies more applied than basic research. Therefore, we postulate the last four research hypotheses.

Hypothesis H4a: *On average, academics will be less involved in basic research after they establish their own company than prior the establishment.*

Hypothesis H4b: *On average, academics will be more involved in applied research after they establish their own company than prior the establishment.*

Hypothesis H4c: *On average, percentage of research funds for basic research in complement to total research funds will be lower after academics establish their own company than prior the establishment.*

Hypothesis H4d: *On average, percentage of research funds from industry will be higher after academics establish their own company than prior the establishment.*

3. Methodology

The methodology is discussed in terms of questionnaire development, sampling and data analysis, and measures.

3.1 Questionnaire development

The study was based on data that were collected by self-administered questionnaire. For the purposes of cross-cultural generalization Hills and LaForge (1992) have emphasized the importance of conducting entrepreneurship research in international contexts. In line with this suggestion the questionnaire was mailed at three different European universities, namely University of Cambridge (United Kingdom), Eindhoven University of Technology (The Netherlands), and University of Ljubljana (Slovenia).

Dillman's (2000) tailored design method, which is a set of procedures for conducting successful self-administered surveys that produce both high-quality information and high response rates, was used. Dillman (2000) points out that questionnaire's design (respondent-friendly questionnaire) have an impact on response rates and on measurement error. Poor questionnaire layout can cause questions to be overlooked or can bias the offered responses. A respondent-friendly questionnaire is attractive and encourages people to read words in the same order as other respondents read them. People are guided by graphic layout features, from the cover page through the last question. A well-designed layout prevents items or answer categories from being missed (Dillman, 2000). Moreover, a light yellow paper was used for the questionnaire to ensure that the questionnaire was distinguishable from all other questionnaires that a respondent might receive and also from other papers on the respondent's desk.

The questionnaire was initially prepared in English. In the United Kingdom (Cambridge University) and in The Netherlands (Eindhoven University of Technology), where the understanding of English among academics is excellent, the survey was administered in English. In the case of Slovenia (University of Ljubljana), the survey instrument was first translated into Slovenian language and then back-translated (Brislin, 1970, 1980; Hambleton, 1993) into English.

A survey package contained an eight-page questionnaire, a personalized cover letter, a token of appreciation, and a stamped return envelope. Approximately one week after the survey package was sent, a personalized thank you e-mail was sent to express appreciation to the respondents if they had returned the questionnaire, and to urge a response from those who had not responded yet. To reduce costs and to enable respondents who prefer to fill out the questionnaire using internet, a unique identification number and a link to the Slovenian or English internet version of the questionnaire were provided in the first and the second follow-up e-mail. To prevent duplicates, each respondent had an identification number that allowed him or her to complete the questionnaire only once. Dillman (2000) assumes that certain populations—such as university professors, government employees, workers in many companies and corporations, and members of some professional organizations—generally have e-mail addresses and internet access and are therefore good candidates for web surveys. The internet version of the questionnaire was identical to the paper version in terms of the contents, numbering, and positioning of questions. The internet version of the questionnaire was also very similar to the paper version in terms of the visual appearance (e.g. background/paper colour). If, after three weeks, the survey had not been returned or filled out using the internet version of the questionnaire, a personalized e-mail reminder was sent. In the event that a questionnaire had been misplaced, a PDF version of the questionnaire was attached to the e-mail. For those respondents who preferred to fill out the questionnaire using the internet, an identification number and a link to the internet version of the questionnaire were provided via the e-mail.

3.2 Sample and data analysis

Out of the 3,152 surveys mailed (946 in Slovenia, 1,171 in The Netherlands, and 1,035 in the United Kingdom) 133 (4.2%) were returned as undeliverable (23 (2.2%) in Slovenia, 53 (4.5%) in The Netherlands, and 57 (5.5%) in the United Kingdom). No pattern could be observed among undelivered surveys. Respondents were asked to return the blank questionnaire if

for some reason they preferred not to respond. There were 115 (3.8%) blank questionnaires returned by those who were unwilling to participate in the study (54 (5.9%) in Slovenia, 32 (2.9%) in The Netherlands, and 29 (3.0%) in the United Kingdom). One questionnaire from a Slovenian respondent had a high proportion (more than 20%) of missing data and was therefore excluded. The Tailored design method (Dillman, 2000), which was used to guide and support the survey process, thus resulted in an overall response rate of 35.0% (48.3% in Slovenia, 30.7% in The Netherlands, and 27.4% in the United Kingdom) and a valid response rate of 31.2% (42.4% in Slovenia, 27.8% in The Netherlands, and 24.4% in the United Kingdom).

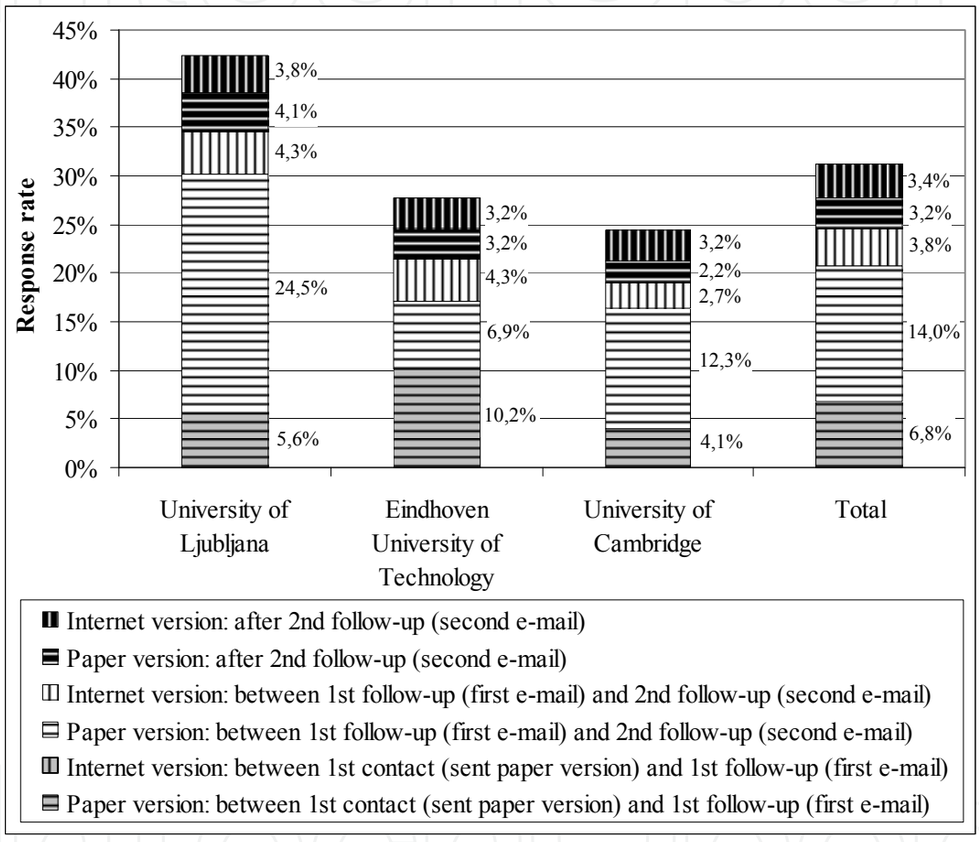


Fig. 1. Valid response rates after each contact (divided between responses by postal mail and through the internet) for the three different universities

Figure 1 details the valid response rates after each contact (divided between responses by postal mail and through the internet) for the three different universities. An average valid response rate before the first follow-up was 6.8% (all respondents responded using the paper version of the questionnaire, because the link to the internet version of the questionnaire was not included until the first follow-up). An average valid response rate before the second follow-up was 24.6% (20.8% – paper version; 3.8% – internet version). An average total valid response rate was 31.2% (24.0% – paper version; 7.2% – internet version).

Not all respondents were academic-entrepreneurs (most of them were non-entrepreneurial academics). A sample for this study consisted of 98 academic-entrepreneurs which

answered to the questionnaire. The average academic-entrepreneur was 43 years old, was married (68.0%), worked an average of 52.6 hours per week, and has had a total of 18.1 years of professional experience (12.6 years at the academic institution[s] and 5.5 years at other institutions). Detailed respondents' personal characteristics are presented in Table 1.

Gender	
Male (in %)	90.8
Female (in %)	9.2
Married	
No (in %)	32.0
Yes (in %)	68.0
Average number of children	1.3
Parents own business	
No (in %)	68.4
Yes (in %)	31.6
Close friends own business	
No (in %)	16.3
Yes (in %)	83.7
Average number of working hours per week (in hours)	52.6
Average age (in years)	43
Average number of years of employment	
Total (in years)	18.1
At the academic institution(s) (in years)	12.6
Total minus at the academic institutions(s) (in years)	5.5
Highest degree attained at the academic institution	
PhD student/Researcher/ Assistant (in %)	37.1
Lecturer/Instructor (in %)	8.2
Assistant professor/ Assistant research scientist (in %)	13.4
Associate professor/ Associate research scientist (in %)	12.4
Full professor/ Research scientist (in %)	21.6
Honor research scientist/ Senior research scientist (in %)	5.2
Other (in %)	2.1

Table 1. Respondents' personal characteristics

The potential nonresponse bias was assessed by comparing responses of early and late waves of returned surveys (Armstrong & Overton, 1977). Results suggested that non-response bias does not appear to be a problem in the dataset. The overall number of questionnaires with missing data was small. In the sample of academic-entrepreneurs, there was 1.8% missing values. The pattern of missing data was also examined. Based on the low percentage of overall missing data and no pattern in the missing data spread across variables, the missing data can be considered to be missing completely at random (Hair et al., 1998; Rubin, 1976).

Paper and internet versions of the questionnaire were compared using a two-sample Kolmogorov-Smirnov test. Out of 98 received questionnaires from academic-entrepreneurs,

75 (76.5%) questionnaires were received by postal mail and 23 (23.5%) were received through the internet. For most of the items, there was no statistically significant difference ($p < 0.05$) in the respondents' answers. However, it seems that those who responded through the internet are more involved in consulting with their own company and have received fewer citations to their scholarly publications in the last three years. Since, after the first follow-up, the respondents were able to choose between the paper version and the internet version of the questionnaire (both were available to them), these minor differences between the paper version and the internet version of the questionnaire do not seem to threaten data validity.

A one-sample t-test was used to determine whether the mean for each construct is significantly different from the midpoint of the scale. The midpoint of the scale indicates a neutral position. The results were analysed using SPSS.

3.3 Measures

All items measured the difference between the way of academics work before they have established their own company and after the establishment. All items were measured on a five-point scale ranging from "1"-much less to "5"-much more.

Cooperation with the industry was measured with the following three items: (1) "On average, I am now (much less / less / the same / more / much more) involved in consulting to companies than before I have established my own company." (2) "On average, I now spend (much less / less / the same / more / much more) time for projects which are ordered by the industry than before I have established my own company." (3) "I am now (much less / less / the same / more / much more) involved in industry-related projects (number of projects) than before I have established my own company."

Patent activities were measured with the following two items: (1) "In last three years I have applied for (much less / less / the same / more / much more) patents than in the last three years before I have established my own company." (2) "In last three years I have been granted (much less / less / the same / more / much more) patents than in the last three years before I have established my own company." Following Coombs et al. (2006), a three-year period was used to measure the academic's patent activity rather than an aggregated measure of the academic's total patent library. If an academic established a company less than three years ago, a time period since establishment and the same time period before establishment was used.

Publication of scientific papers was measured with the following two items: (1) "In last three years I have published (much less / less / the same / more / much more) scientific papers in peer-review journals than in last three years before I have established my own company." (2) "In last three years I have been cited (much less / less / the same / more / much more) than in the last three years before I have established my own company."

Type of research was measured with four items: (1) "On average, I am now (much less / less / the same / more / much more) involved in basic research than before I have established my own company." (2) "On average, I am now (much less / less / the same / more / much more) involved in applied research than before I have established my own company." (3) "Percentage of research funds for my basic research in complement to my total research

funds is now (much lower / lower / the same / higher / much higher) than before I have established my own company." (4) "Percentage of research funds from industry for my research projects is now (much lower / lower / the same / higher / much higher) than before I have established my own company."

4. Results

Table 2 shows an analysis of the responses regarding each hypothesis. Examination of the hypotheses is presented in the following paragraphs.

Item	Related hypothesis	Mean	Std. dev.	t-value	Sig.
Cooperation with the industry					
Consulting to companies	H1a	3.32*	1.03	3.10	0.003
Time devoted for projects which are ordered by the industry	H1b	3.48*	1.07	4.41	0.000
Involved in industry-related projects	H1c	3.55*	1.08	5.03	0.000
Patent activities					
Applied for patents	H2a	3.11	0.89	1.18	0.240
Granted patents	H2b	3.05	0.89	0.59	0.554
Publication of scientific papers					
Published scientific papers	H3a	2.94	1.07	-0.56	0.573
Number of citations	H3b	3.04	0.95	0.37	0.710
Type of research					
Involved in basic research	H4a	2.54*	0.93	-4.88	0.000
Involved in applied research	H4b	3.31*	0.84	3.60	0.001
Percentage of research funds for basic research in complement to total research funds	H4c	2.66*	0.84	-4.02	0.000
Percentage of research funds from industry	H4d	3.29*	0.85	3.39	0.001

Note: N = 98; * Sig. < 0.05; Scale = 1-much less; 2-less; 3-the same; 4-more; 5-much more

Table 2. Research results (test value = 3-"the same")

The first three hypotheses (H1a, H1b, and H1c) which were related to cooperation with the industry were supported. Hypothesis H1a which predicted that after spin-off creation academic entrepreneurs would be more engaged in consulting to companies than prior spin-off creation was supported (mean value of 3.32 that is statistically significantly larger than the test value of 3.00 on 5-point scale). Hypothesis H1b which proposed that after spin-off creation academic entrepreneurs will devote more time for projects that are ordered by the industry than prior spin-off creation was supported as well (mean value of 3.48 that is statistically significant larger that the test value). Hypothesis H1c which predicted that academic entrepreneurs would be more involved in industry-related projects after they establish their spin-off company was supported (mean value of 3.55).

The results presented in Table 2 shows that hypotheses related to patenting and publication of scientific papers were not supported. Based on research results we cannot argue that there are any changes in the way academics work after they establish their own company in terms of the number of applications for patents (H2a), number of granted patents (H2b), number of published scientific papers (H3a), and number of citations (H3b).

Last four hypotheses (H4a, H4b, H4c, and H4d) that were related to the type of research were supported. Hypothesis H4a which predicted that after spin-off creation academic entrepreneurs would be less involved in basic research than prior spin-off creation was supported (mean value of 2.54). Hypothesis H4b which proposed that after spin-off creation academic entrepreneurs would be more involved in applied research than prior spin-off creation was supported (mean value of 3.31). Hypotheses H4c and H4d which were related to percentage of research fund for basic research (H4c) and percentage of research funds from industry (H4d) were also supported. Mean value of 2.66 for the percentage of research funds for basic research was statistically significantly lower than the test value of 3.00. Mean value of 3.29 for the percentage of research funds from industry was statistically significantly higher than the test value of 3.00.

5. Conclusion

Although spin-off creation and knowledge transfer from academia to industry has been widely investigated, there are still little studies focused on the key actor – the academic entrepreneur. Therefore, this chapter has analysed how do academics change their way of work after they become academic entrepreneurs. With this study, we contribute to the literature by performing an analysis about changes in academia-industry cooperation relationship, patent activities, publications activities and research activities after academics establish their own companies.

The study reveals that academic entrepreneurs are on average statistically significant more active in cooperation with industry in terms of consulting to companies, time spent for projects ordered by the industry and involvement in industry-related projects than before they have established their spin-off company. The result is not surprising since academic entrepreneurs are by virtue of having established their spin-off companies more involved in business activities than traditional academics with no or little connections with industry. Academic entrepreneurs spend more time on business matters and are more in contact with industry. This avails them with avenues for conducting industry-related project more than their non-industry-related colleagues from universities since they have also practical-business experiences, social ties, and relevant contacts. Thus, our findings suggest that academic entrepreneurs will be involved in consulting to companies more than prior spin-off establishment. The reason may be found in industry-and-business-related experience and entrance in real business with their spin-off companies which provides them reputation and experience. Since academic entrepreneurs are more involved in the real economy and have more contacts in the industry, they easily gain industry-related projects and are presumably also more interested in more applied project then academics that are not connected with the industry. Our results are consistent with scholars (Blumenthal et al., 1996; Gulbrandsen & Smeby, 2005; Landry et al., 2006; Mansfield, 1995) that argue that academics` cooperation with industry fosters spin-off creation and commercialization

productivity of academics which suggests that academics who are more involved with industry will cooperate even more after their spin-off establishment.

It is also interesting that academics after spin-off establishment are on average statistically significant more involved in applied research and less in basic research than prior spin-off establishment. This result shows that it is common for academic entrepreneurs that are more interested in research which is more connected with industry and has direct applicable value. This is reasonable since these academics are also entrepreneurs at the same time and consecutively practically business oriented. This finding is consistent with authors that found a positive relationship between industry-funding and applied research (Gulbrandsen & Smeby, 2005; Poyago-Theotoky et al., 2002; Rahm, 1994; Van Looy et al., 2004). Our results also reveal that academic entrepreneurs after they establish their spin-off companies employ more funds for applied research then before which coincides with more applied research conducted after the spin-off creation. In consequence, it also arises that academics also employ a minor percentage of research funds for their basic research after they become academic entrepreneurs. Based on these research results, we can argue, that those academics that establish their own companies do not stop research; they just shift their research interest from basic to more applied research.

There seem to be almost no changes in patent and publication activities of academics after they become academic entrepreneurs. After the spin-off creation, academic entrepreneur on average publish the same amount of papers and receive on average the same number of citation then prior becoming academic entrepreneurs.

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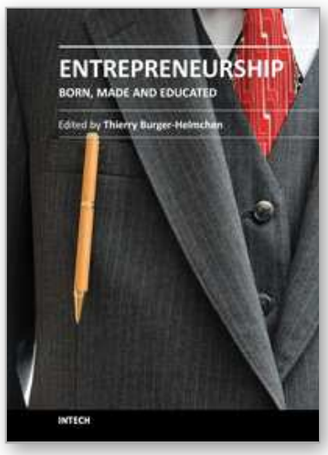
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Entrepreneurship has a tremendous impact on the economic development of a country. As can be expected, many public policies foster the development of self- entrepreneurship in times of unemployment, praise the creation of firms and con- sider the willingness to start new ventures as a sign of good fortune. Are those behaviours inherent to a human being, to his genetic code, his psychology or can students, younger children or even adults be taught to become entrepreneurs? What should be the position of universities, of policy makers and how much does it matter for a country? This book presents several articles, following different research approaches to answer those difficult questions. The researchers explore in particular the psychology of entrepreneurship, the role of academia and the macroeconomic impact of entrepreneurship.

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