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Academic entrepreneurs' role in science-based companies.

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Abstract

Purpose - The aim of this paper is to present the results of a study examining the role played by academic entrepreneurs in science-based companies grown in university incubators. We aim to address whether the presence of academic entrepreneurs improves economic and financial performances. Moreover, we aim to verify if different levels of involvement of academic entrepreneurs (i.e. shareholder, member of board of director) can contribute to different levels of financial performance.

Design/methodology/approach - The research has been carried out on a sample of science-based companies originating predominantly from Northern Italy and graduated from the Turin Polytechnic Incubator, called I3P. Data about the presence of academic entrepreneurs has been obtained by interviewing the Incubator's CEO whilst companies' financial performance have been assessed by financial ratios analysis. A multiple linear regression model has been developed to test the relationship between presence of academic entrepreneurs and financial performance, whilst controlling the life cycle stage and the industry of the companies.

Findings - The results of the statistical analysis show that there is a negative relationship between the presence of academic entrepreneurs and overall financial performance of the incubator's graduated companies. However, there is a positive relationship between a deep involvement of academic entrepreneurs (acting both as shareholders and as directors) and financial performance.

Originality/value -

Given the current debate about the different conditions under which university involvement provides advantages or disadvantages for newly created firms, this study provides empirical evidence about the presence and the role played by academic entrepreneurs on science-based companies by focusing on their financial outcomes. Besides, few literature addressed the performance of academic ventures after their graduation from incubators, as such, our evidence is based on the performance after the companies' graduation from the incubator.

Keywords - Academic entrepreneurs, science-based companies, university incubator, financial performance.

Paper type - Research paper

1. Introduction

In the last decade, universities in developed countries fostered a strong ability to get involved in business and entrepreneurial activities. The increase of these activities is justified by the industry's growing demand for innovation which represents a key driver to maintain and enhance competitiveness. Today's universities are recognised as relevant sources for innovation (Von Hippel, 1988) as demonstrated by the continuous advances in the biotech and the nanotech industries (Zucker *et al.*, 1998, Darby and Zucker, 2006) where hopes for a better quality of life reside.

The "entrepreneurial university" generates technology advances and facilitates innovations through activities such as patenting and licensing, spinning-out strategic research and knowledge, and links with intermediaries such as science parks, incubators and technology transfer offices. With the help provided by these structures, science advances find the right environment and can lead to the creation and the development of new products and services.

The mission of university has changed in the last years: it has become more and more "entrepreneurial" (Mowery *et al.*, 2004; Siegel *et al.*, 2007). In almost every industrialized country a university not only has to provide educational and teaching activities and to be involved in research and knowledge production but it has also to be involved in the commercialization of its scientific and technological advances.

The high variability of activities of universities in this field has attracted a growing interest of academic scholars in the last 30 years, approximately since 1980 when the enactment of Bayh-Dole Act in the U.S.A. started what is known as "academic entrepreneurship" (Mowery and Sampat, 2004).

A comprehensive literature review about this theme (Rothaermel *et al.*, 2007) found 173 articles published on 28 academic journals during twenty-five years (1985-2005). The phenomenon is very attractive given that 127 of those were published during the last five years of analysis (2000-2005). In other words, the growing entrepreneurial activity of universities is related to a growing interest from academic scholars. The entrepreneurial activity of universities is wide and subject to a large number of factors (Mowery *et al.*, 2001; Etzkowitz, 2003; Friedman and Silberman, 2003; Jacob *et al.*, 2003; Gulbrandsen and Smeby, 2005) and as a consequence the resulting literature is fragmented over the different research streams (Siegel, 2006). Many scholars are studying different aspects of university-business relationship from various standpoints and by applying various methodologies (Rothaermel *et al.*, 2007; Grimaldi *et al.*, 2011). However, the extensive adoption of qualitative studies, the lack of systematic, longitudinal data and the contrasting outcomes of quantitative studies tightened the difficulty of developing a dominant theoretical paradigm (Aldrich and Baker, 1997; Rothaermel *et al.*, 2007). As such, the position and role of universities and their resources at each of the different stages of their business involvement are points of great debate in the current literature. Given the increasing lack of findings and the boost in research competitiveness, it is timely and important to better address the study of the factors influencing the outcomes of the entrepreneurial university.

This paper adds a significant contribution to the existing literature by analysing the influence of the presence and the role of "academic entrepreneurs" in post-incubated science-based companies. As "academic entrepreneurs" we mean people with a role in an academic institution as a faculty staff (i.e. full, associate and assistant professors) who are, at the same time, shareholders and/or directors of a science-based company.

These companies spend only the first stage of their life in incubators and then are supposed to graduate. Industries in which these companies are operating are very

risky and, as such, while some of them continue their growth even after the graduation, some others are not able to survive (Schwartz, 2009). Between our group of science-based companies, some obtain satisfying financial performances while some others do not. The presence (or not) of academic entrepreneurs in these science-based companies might be one of the drivers for different financial performances, as such, a deep study of these features could provide more useful findings about the effective outcomes of academic entrepreneurship.

In this article, specific consideration has been given to the analysis of the type of entrepreneurial link interesting academic people in these companies (i.e. only shareholder, only director or both). Only a few studies examined the impact of the presence of academic people on the performance of university science-based companies (Wennberg *et al.*, 2011; Clarysse *et al.*, 2011; Hayter, 2011). As such, this study contributes to the literature by providing empirical evidence on a subject that has not been fully analysed, thus helping policy makers and university administrators who are concerned about the future of the research university system.

The remainder of the paper is organised as follows. Section 2 presents the literature review and the development of the research hypotheses; section 3 presents the research design and methodology; section 4 presents the results and their discussion; section 5 addresses the conclusions and the implication of this study while section 6 is about some limitations of this study and proposes further research.

2. Background and hypotheses development

Despite the growing number of studies, the current literature on university entrepreneurship remains rather fragmented and without a dominant paradigm (Siegel, 2006; Siegel *et al.*, 2007). Its recent development, the related lack of theorisation and the few amount of longitudinal studies didn't encouraged publications on mainstream scholarly journals (Aldrich and Baker, 1997; Rothaermel *et al.*, 2007).

However, Rothaermel *et al.* (2007) were able to provide an overarching framework to encompass the different pieces making up the literature university entrepreneurship (i.e. university licensing and patenting, spin-outs, science parks, incubators, technology transfer offices, etc.). According to their study, four major research areas emerged in the field of university entrepreneurship, namely (i) entrepreneurial research university; (ii) productivity of Technology Transfer Offices, (iii) new firm creation; (iv) environmental context including network of innovation. Conflicting options over the university's system mission have been consistently identified across these four streams as a key barrier to university entrepreneurship and require further exploration (Rothaermel *et al.*, 2007).

Because the study presented in this article encompasses the field related to new firm creation, the following paragraphs analyse the major literature in this area. This stream is featured by studies focusing on universities' spin-out activities, establishment of incubators and the different internal/external factors influencing new ventures and their performance. Accordingly, the literature provides relevant knowledge about the best practices of managing new firm creations and incubators, the role of networking activities, the impact of innovation management policies and the overall assessment of the university system involvement.

Under a management perspective, different factors may contribute or impede the success of university new ventures and university incubators (Lockett *et al.*, 2005; Mustar *et al.*, 2006), for example, university intellectual property expenditure and

related encouragement of equity investments appear to contribute to the success of university spin-outs (Di Gregorio and Shane, 2003; Lockett *et al.*, 2003; Lockett and Wright, 2005; Patzelt and Shepherd, 2009) while the lack of competency in founding teams, the adoption of unrealistic expectations, resource scarcity and cultural problems are impediments to the formation and growth of university ventures (Samsom and Gurdon, 1993; Kinsella and McBrierty, 1997; Rappert *et al.*, 1999; Chiesa and Piccaluga, 2000; Steffensen *et al.*, 2000; Franklin *et al.*, 2001; Schwartz, 2009; Rajamaki, 2011).

If we apply a networking activity perspective, the ties between new university ventures and the business world (i.e. institutions, industry associations, venture capitalists) seem to increase funding rates (Shane and Stuart, 2002; Grandi and Grimaldi, 2003; Johansson *et al.*, 2005; Lofsten and Lindelof, 2005; Hytti and Maki, 2007; Salvador, 2011), a feature that can be leveraged by the quality of funding teams, the quality of human resources and their individual level attitudes in order to decrease the probability of failure (Link and Scott, 2005; Lockett and Wright, 2005; O'Shea *et al.*, 2005; Powers and McDougall, 2005; Jain *et al.*, 2009; Clarysse *et al.*, 2011). Consequently, different findings have been provided about the relationships between new ventures' performances (growth, rate of survival/failure, venture capital funding, Initial Public Offerings) and factors such as universities' policies, faculty members, faculty Technology Transfer Offices, funding teams, investors, networks and other environmental factors. As such, the overall level of the university system involvement may be called in cause as an important and controversial driver of new firms performance. Whilst most studies found that a high degree of involvement is beneficial for newly created firms (Di Gregorio and Shane, 2003; Degroof and Roberts, 2004; Clarysse *et al.*, 2005; Leitch and Harrison, 2005; Renault, 2006; Anderson *et al.*, 2007; Colombo *et al.*, 2010; Zomer *et al.*, 2010; Mian, 2011) other studies provided hindsight about its negative influence resulting in resource dependency, non beneficial reputation effects, lower production of income and delayed graduation from incubators (Cyert and Goodman, 1997; Johansson *et al.*, 2005; Rothaermel and Thursby, 2005b; Litan *et al.*, 2007; Schwartz, 2009; Swamidass and Vulasa, 2009).

Theoretically, the entrepreneurial attitude of academics might lead to an effective technology transfer, a closer links to research gains, a better availability of advanced technology and to a continuous and overarching knowledge flow (Renault, 2006; Colombo *et al.*, 2010; Fini *et al.*, 2010; Hayter, 2011). However, university driven companies may achieve negative financial outcomes because of the lack in managerial skills and entrepreneurial experience of faculty staff or because of the lack of time caused by their academic commitments. Even the conflicts between the University and business cultures could sometimes depress the performance of academic companies (Cyert and Goodman, 1997; Litan *et al.*, 2007).

The debate is still open and these issues need to be studied with the necessary depth, such as exploring how universities should redesign their mandates to effectively manage new firm creation and linkages with external innovation networks (Rothaermel *et al.*, 2007; Grimaldi *et al.*, 2011). Besides, few literature addressed the performance of academic ventures after the graduation from scientific parks or incubators (Rothaermel *et al.*, 2007; Siegel *et al.*, 2007).

As such, the aim of this research is to analyse if the presence of a university link is strengthening or weakening the financial performances of companies born in university incubators. Specifically, in this study, the university link is operationalised

as the presence and different involvement of faculty staff in companies graduated from an Italian university incubator.

A further goal of this research is to verify if different levels of involvement of academic entrepreneurs (i.e. only as shareholders, only as directors, both shareholders and directors) can bring to different levels of financial performance.

Therefore, the study aims to validate the following hypotheses:

H1: Incubators' graduated companies involving academic entrepreneurs have better financial performance than other graduated companies.

H2: Higher involvement of academic entrepreneurs can lead to better financial performance.

3. Research design and methodology

This research study has been carried out on companies “graduated” by Italian incubator I3P, where I3P stands for “Innovative Enterprise Incubator of Turin Polytechnic”. This incubator, established in 1999, is a non-profit joint-stock consortium built by Turin Polytechnic and other public entities with the aim to promote and support the creation of hi-tech enterprises, grouping the innovative potential developed in research institutions in the Piedmont area.

I3P is recognised as a global and well performing incubator (AIFI, 2001, Salvador, 2011); for example in 2004, it was awarded by Oxford University, as the world's best science-based incubator, after the Tsinghua Science Park in Beijing in 2002 and the BioBusiness Centre in Oxford in 2003. A science-based company can stay in the I3P incubator not more than three years. After, it has to leave the neck. When doing the analysis, there were 63 companies graduated by I3P. The sample of companies belong to different industries and have different ownership structures. The maximum annual turnover of these companies is not more than euro 1.5 million and the average number of employees is in the range 2-10. Because in Italy only limited companies provide public financial statements, we excluded no. 8 partnership firms and we focused on the other no. 55.

In order to address the performance on a quantitative basis, financial data was directly collected by requesting financial statements (years 2005, 2006, 2007 and 2008) from the Italian Chamber of Commerce. Data relating to the years 2005 to 2007 were available for 53 companies while 2008 data was available for only 44 companies. Anyway, our operational sample is composed by 53 graduated companies.

The complete breakdown, by industry type and financial data availability, of the sample used in this study is reported in the following table.

Table 1: Breakdown of the sample by industry and availability of financial data.

Industry	Available financial data				Total companies	%
	2005	2006	2007	2008		
Aerospace	1	1	1	1	1	2%
Biotech			1	1	1	2%
Building & Architecture	1	1	1	1	1	2%
Chemicals & Material	1	1	1	1	1	2%
Electronics & Automation	7	9	11	8	11	21%
Energy	3	3	3	4	4	8%
Environment & Territory	4	4	4	4	4	8%
Information Technology	26	27	27	21	27	51%
Mechanics	3	3	3	3	3	6%
Total	46	49	53	44	53	100%

Notes: Number of graduated companies

Subsequently, in order to analyse the characteristics of entrepreneurship involved in our sample and the related role played by academic people, we lead an interview with the CEO of the Incubator.

The interview was digitally recorded, with permission, and fully transcribed for analysis. We double checked the resulting information with the academics' lists published on the websites of Italian academic institutions and with the corporate governance data attached to financial statements. It is suggested that this use of multiple sources, known as data triangulation, helps to improve the reliability of the data collected and to capture a comprehensive picture of the studied variables (Yin, 2003, p. 98).

The following sections give insights about the analysis of the variables and the statistical approach used to test our hypothesis. Specifically, the analysis of the presence of academics provides the main independent variables of the study whilst the analysis of financial performance provides the dependent variable to apply in the statistical model.

Analysis of the presence of academic entrepreneurs

We carried out an interview with the I3P's CEO, addressing the following topics for each graduated company:

- Presence of academic entrepreneurs
- Type of corporate involvement of academic people

As discussed previously, we operationalised the presence of academic entrepreneurs as the presence of faculty staff of an academic institution (i.e. full, associate and assistant professors) who are shareholders and/or directors in a science-based company. So we excluded all other types of academic links and/or collaborations (i.e. lecturers, instructors, scholarship holders, etc.). We used a dummy variable ("*AE*") to take into account the presence of academic entrepreneurs (or not) in the companies of our sample.

Once the academic link was verified, we focused on the type of involvement of academic people; in other words we figured out for each company when the academic is only a shareholder, only a director or both a shareholder and a director. Another dummy variable ("*Inv*") is used to address the grade of corporate involvement of the academic entrepreneur in the company; a score of 0 is assigned to companies with an academic involved only as shareholders and a score of 1 is assigned when he acts both as shareholder and as director. We omitted the score assignment for academics who

act only as directors because none of the companies analysed presented this case. As such, the presence of academic entrepreneurs (“*AE*”) and the grade of their related corporate involvement (“*Inv*”) are the main independent variables of this study.

Analysis of financial performance

The preliminary purpose of the study is to address the performance of graduated companies by mainly focusing on the quantitative aspect (financial structure, profitability, turnover growth) and then to take into account the overall qualitative opinion arising from the I3P’s CEO interview.

When companies are not listed on a stock market, financial and profitability ratios can be used as main tools to assess financial and economic performance (Chakravarthy, 1986, Finer and Holberton, 2002). However, these measures may be biased because the sample is composed of entities operating in different industries with different industry-driven levels of fixed assets, variable/fixed cost ratios and competitiveness (Porter, 1980). To overcome these limits a comparison with specific industry ratio averages may be useful.

The financial ratios we computed over the four years are:

- ROA: as operating profit divided by total assets.
- ROE: as net profit or loss divided by total equity.
- D/E: as total debts to equity ratio.

The comparison with the average industry ratios was not significant and was not used in the analysis because of peculiarities in the graduated companies, such as young age, rapid levels of growth, technology development, high levels of start up funds’ absorption and different availability of subsidies (Schneider and Veugelers, 2010).

Therefore, in order to overcome the previous limits and to have a unique dependent variable to address the economic/financial performance we used the Altman’s Z score (Altman, 1968). Z scores are essentially used to predict bankruptcy but can be used as valuable indexes of overall financial performance.

In detail, we used the adaptation of the Z score developed for privately held firms (Altman, 2002) which is:

$$Z = 0.717(X1) + 0.847(X2) + 3.107(X3) + 0.420(X4) + 0.998(X5)$$

where:

- X1 = working capital/total assets
- X2 = retained earnings/total assets
- X3 = earnings before interest and taxes/total assets
- X4 = equity book value/total assets
- X5 = sales/total assets

Another limitation about the financial analysis might be that the incubated financial performance is influenced by their different life cycle stages and how their growth is supported with external funds. Usually start-up firms’ businesses became profitable and financially sustainable after some years (Rothaermel and Thursby, 2005a). Because of these arguments, in our analysis we controlled for the age of each graduated company. In this study, the reason of the presence of academics in the board (by personal choice or nominated by university in spin-out ventures) hasn’t been considered (Fini *et al.*, 2008).

Statistical approach

In order to address the impact of the presence of academic entrepreneurs on financial performance we first used normal statistics tests to highlight differences between

graduated companies with or without academic entrepreneurs. Subsequently, we developed a linear multiple regression model to better address the influence of the different independent variables on the companies' financial performance. The financial performance, our dependent variable, is the financial performance of the companies assumed as the Z score computed in a specific period.

The main independent variables are the presence of academic entrepreneurs and the grade of their corporate involvement. Because of the influence of the life stage of the company and the type of industry on financial performance, we controlled the age and the influence of industries other than the ICT (which is the industry where the majority of the companies in the sample belong).

Therefore the linear regression model is:

$$Fperf_i = \beta_0 + \beta_1 AE_i + \beta_2 Inv + \beta_3 Age_i + \beta_4 Ind_i + \varepsilon_i$$

where:

$Fperf$ is the financial performance of the company related to a particular period and is equal to the Z score computed on available financial statements data for that period;

i is the number of each different observation;

AE is a dummy variable used to account for the presence of academic entrepreneurs in the graduated company;

Inv is a dummy variable used to account for the typology of the academic corporate involvement, it assumes a value of "0" when the academic involved is only a shareholder, it assumes a value of "1" when he is both shareholder and director;

Age is the variable controlling for the age of the company in a specific financial performance period, the value is computed as the difference between the year of financial data and the year of establishment of the company.

Ind is a dummy variable controlling for the influence of industries other than the ICT one, it assumes a value of 1 when the company doesn't belong to the ICT industry.

In the following section we present and discuss our findings.

4. Results and discussion

By addressing the independent variables of the study we found that a total number of 22 companies (42% of the total sample) have a link with Universities (mainly Turin Polytechnic) but only 17 (32%) have the presence of academic entrepreneurs. Financial data and information about the entrepreneurial involvement were available for all the 17 companies. None of the academics involved in the graduated companies act only as a director, all academics involved are at least shareholders, while 9 of them act also as directors. The complete breakdown about the academic entrepreneurial presence is presented in the following table.

Table 2 - Sample breakdown - Presence / involvement of academic entrepreneurs.

Number of companies	Total	%
Graduated companies with available financial data	53	100%
Presence of Academic Entrepreneurs	17	32%
of which		
only as shareholder	8	47%
only as director	-	-
both shareholder and director	9	53%

After the analysis of available financial data and computation of financial ratios, we studied how the presence of academic entrepreneurs influences the performance of these companies. The following table presents a synthesis of financial data and computed ratios crossed with data about academic entrepreneurs.

Table 3 - Financial data synthesis and presence of academic entrepreneurs (descriptive statistics).

		Academic Entrepreneurs		TOTAL	
		No	Yes	Mean	Std. Deviation
Annual Turnover	Y2005	234.1	248.5	238.5	348.0
	Y2006	262.9	233.9	254.0	324.4
	Y2007	349.5	444.5	378.6	470.1
	Y2008	385.9	298.0	355.9	341.6
Operating profit	Y2005	7.3	-9.6	2.1	47.1
	Y2006	0.4	-18.5	-5.4	150.8
	Y2007	4.8	53.5	19.7	447.4
	Y2008	72.1	-103.6	12.2	353.5
Total assets	Y2005	229.9	277.4	244.4	312.5
	Y2006	270.1	438.9	321.8	485.1
	Y2007	315.0	565.3	391.6	643.2
	Y2008	405.0	807.3	542.1	1,255.5
Equity	Y2005	69.0	33.6	58.2	141.9
	Y2006	60.4	79.6	66.3	124.7
	Y2007	56.9	149.9	85.3	176.4
	Y2008	306.2	307.2	306.5	770.3

Notes: Means computed on available financial statements - data in Euro/000

Table 4 - Financial ratios and presence of academic entrepreneurs (descriptive statistics).

		Academic Entrepreneurs		TOTAL	
		No	Yes	Mean	Std. Deviation
ROA	Y2005	6.4%	0.0%	4.5%	19.0%
	Y2006	6.0%	-0.4%	4.1%	21.2%
	Y2007	10.0%	9.1%	9.8%	32.9%
	Y2008	15.3%	13.8%	14.8%	34.5%
ROE	Y2005	-6.3%	18.0%	1.1%	76.6%
	Y2006	2.3%	-27.6%	-6.8%	69.9%
	Y2007	6.4%	-12.7%	0.5%	62.3%
	Y2008	5.4%	12.4%	7.7%	46.9%
D/E ratio	Y2005	4.1	2.0	3.4	4.1
	Y2006	3.5	4.4	3.7	5.9
	Y2007	4.1	3.9	4.0	4.0
	Y2008	4.5	2.8	3.9	6.0

Notes: Means computed on available financial data

As can be seen in the previous table, by focusing only on the financial data and the ratios' values it could appear that the presence of academic entrepreneurs leads to a worse financial performance. However, high rates of standard deviation denotes that data is "spread out" over a large range of values and this reduces, at this level of research, the reliability of making some conclusions.

In order to overcome these limitations, the Altman's Z score was computed over the four years. As can be seen in the following table, the values of the score are lower when the companies involve academic entrepreneurs. However, significant differences are only found between the presence, or not, of academic entrepreneurs in the Z score means related to 2005, 2006 and 2008.

Table 5 – Z scores and presence of academic entrepreneurs (descriptive statistics).

Z Score (<i>Fperf</i>)	Academic entrepreneurs (<i>AE</i>)		t	Sig.	TOTAL			
	No	Yes			Mean	Std. Deviation	Min	Max
Y2005	1.87	1.67	2.09	0.041 *	1.71	1.30	-1.45	4.51
Y2006	1.94	1.49	2.48	0.016 *	1.55	1.32	-1.20	4.80
Y2007	2.27	1.99	1.57	0.132	2.18	1.73	-1.86	5.13
Y2008	2.67	1.49	2.54	0.009 **	2.28	1.79	-1.49	8.38

* $p \leq 0.05$, ** $p \leq 0.01$

Notes: means computed available financial data.

In order to add some valuable considerations it is also important to set out some levels of performance discrimination, in particular we used the discrimination range stated by Altman's further works (Altman, 2002):

- "Safe" zone: $Z > 2.99$
- "Grey" zone: $1.80 < Z < 2.99$
- "Distress" zone: $Z < 1.80$.

Although the previous differences in the means were significant, given that every company is in a different lifecycle stage (Rothaermel and Thursby, 2005a, Muller,

2010), for each of the companies in the sample, we computed an overall Z score as follows:

- the average between 2008 and 2007's Z scores for companies younger than three years;
- the average between 2008, 2007 and 2006's Z scores for companies older than three years.

In these terms, the following table presents a breakdown of the resulting levels of financial performance distribution by applying the cut-offs highlighted before (Safe, Grey, Distress) as ranges for high, medium and low performance.

Table 6 – Distribution of financial performance scores and presence of academic entrepreneurs.

		Academic Entrepreneurs (<i>AE</i>)		Total
		No	Yes	
Financial performance (Z score)	High	9 (25.0%)	2 (11.8%)	11 (20.8%)
	Medium	13 (36.1%)	8 (46.1%)	21 (39.6%)
	Low	14 (38.9%)	7 (41.2%)	21 (39.6%)
Total		36 (100%)	17 (100%)	53 (100%)

Notes: number of companies.

Indeed, from the previous analysis, the companies with academic entrepreneurs are performing worse than other companies because the majority of them gain a low Z score.

Besides, if we also take into account the different grade of academic entrepreneurship it's possible to say that companies with higher corporate involvement of academics (both shareholders and directors) perform better than companies with less corporate involvement (only as shareholders), as it can be seen in the following table.

Table 7 - Financial performance and academic entrepreneurs' corporate involvement.

		Academic Entrepreneurs' corporate Involvement (<i>Inv</i>)		Total
		only as shareholder	as shareholder and director	
Financial performance (Z score)	High	1 (12.5%)	1 (11.1%)	2 (11.8%)
	Medium	3 (37.5%)	5 (55.5%)	8 (46.1%)
	Low	4 (50.0%)	3 (33.3%)	7 (41.2%)
Total		8 (100.0%)	9 (100.0%)	17 (100.0%)

Notes: number of companies.

Before conducting the multiple regression analysis, and to highlight single relationships, we carried out a linear correlation analysis of all different variables involved in the study. Overall descriptive statistics and resulting correlation matrix are presented in the following tables.

Table 8 – Main variables study, descriptive statistics.

Main variables - Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
1. Presence of academic entrepreneurs (<i>AE</i>)	210	0	1	0.320	0.464
2. Grade of corporate involvement (<i>Inv</i>)	210	0	1	0.521	0.435
3. Age (<i>Age</i>)	210	3	8	0.332	0.472
4. Industry (<i>Ind</i>)	210	0	1	0.462	0.467
5. ROA	192	-0.756	1.818	0.083	0.321
6. ROE	192	-0.822	1	-0.037	0.605
7. D/E	192	-1.1	45	5.230	6.062
8. Z score (<i>Fperf</i>)	192	-1.862	8.371	1.701	1.501

Table 9 – Results of correlation analysis (Pearson's correlation coefficients).

VARIABLES	1	2	3	4	5	6	7	8
1. Academic entrepreneurs (<i>AE</i>)	1	-	.035	.404**	-.096	-.055	.098	-.250**
2. Grade of corporate involvement (<i>Inv</i>)	-	1	-.105	.299**	.113	-.029	.051	.221*
3. Age (<i>Age</i>)	.035	-.105	1	-.243**	.044	.096	.121	.213**
4. Industry (<i>Ind</i>)	.404**	.299**	-.243**	1	-.092	-.104	.080	-.269**
5. ROA	-.096	.113	.044	-.092	1	.397**	-.021	.637**
6. ROE	-.055	-.029	.096	-.104	.397**	1	-.038	.500**
7. D/E	.098	.051	.121	.080	-.021	-.038	1	-.060
8. Z score (<i>Fperf</i>)	-.250**	.221*	.213**	-.269**	.637**	.500**	-.060	1

* p ≤ 0.05, ** p ≤ 0.01

As can be seen from the previous table, the correlation between the financial performance variable (*Fperf*) and the other financial ratios (ROA, ROE, D/E) confirms the usability and the reliability as an overall financial score. The financial performance variable (*Fperf*, computed as the Altman's Z score) is negatively correlated with the presence of academic entrepreneurship in the graduated companies (*AE*), and is positively correlated with the grade of academics' entrepreneurship corporate involvement (*Inv*), is positively correlated with the age of the company (*Age*) and negatively correlated with the industry variable (*Ind*, which addresses if the company belongs to industries different from ICT).

The contrast between the two dimensions of academic involvement in the companies (*AE* and *Inv*) might be explained by the different growth rate of financial data among different years of analysis. Companies featuring academics involved as directors perform even better in the last periods (2007, 2008), when the companies are more mature as addressed by previous studies (Rothaermel and Thursby, 2005a).

Furthermore, to increase the validity of our study, we carried out a multiple linear regression analysis in order to address the combined relationships between our independent variables and the graduated companies financial performance. In other words, we assessed the overall influence of the presence of academic entrepreneurs

and the grade of their academic corporate involvement on the Z scores' values by controlling the age and the industry of the graduated companies.

The result of the regression analysis is presented in the following table, which also comprises of the expected sign of the relations according to our initial hypotheses: the presence of academic entrepreneurs is expected to have a positive impact on economic and financial performance and this performance should be higher when there is a higher grade of corporate involvement of the academic (i.e. acts as a director). Although we didn't expect a particular direction for the industry impact on financial performance, it's possible to say that companies belonging to industries different than the ICT one (i.e. biotech, energy, healthcare, etc.) might suffer a different profitability development due to the higher uncertainty of their outcomes.

Table 10 – Multiple linear regression results (dependent variable= financial performance).

VARIABLES	Predicted sign	β	Std. Error	t	Sig.
Intercept		1.954	0.224	8.252	0.000 **
<i>AE</i>	+	-0.633	0.209	-3.042	0.003 **
<i>Inv</i>	+	0.345	0.234	2.196	0.042 *
<i>Age</i>	+	0.119	0.038	3.053	0.003 **
<i>Ind</i>	+/-	-0.470	0.213	-2.186	0.031 *
R^2	0.128				
Adjusted R^2	0.118				
* $p \leq 0.05$, ** $p \leq 0.01$					

As can be seen by the R^2 value, the overall variance on financial performance explained by the independent variables is 12.8%. The presence of academic entrepreneurs has a negative influence on the companies' financial performance variable ($\beta=-0.633$, significant at $p=0.003$). This might sound odd but it could be explained by observing that, usually, companies linked with Universities are involved in high risk industries which require high amounts of resources and need to overcome unexpected difficulties to reach a positive cash flow in a short time. Usually, these resources are employed to develop new technologies and advanced knowledge, which can be accounted only in part as intangibles assets and quite often are recognized as research expenses (because of the accounting principles used by Italian companies) leading to bad financial statements results.

On the other hand, if academics are more committed in management because, as in this case, they act as directors of the company, better financial performance could be achieved. This is validated by the positive and significant influence of the grade of academics' corporate involvement on financial performance ($\beta=-0.345$, significant at $p=0.042$).

The age of the company has little positive influence on financial performance whilst the influence of belonging to non-ICT industries has a negative impact.

Therefore, we were able to validate in an opposite way our first hypothesis, because we found that the presence of academic entrepreneurs has a significant negative influence on financial performance. As such, incubators' graduated companies involving academic entrepreneurs have worse financial performance than other graduated companies. However, the presence of academics could improve the financial performance when they are involved in a stronger way in management. As

our findings point out, if academics act as shareholders and directors, the financial performance is influenced positively, this permits to validate our second hypothesis.

5. Conclusions

This study adds some more argumentation to the considerable debate developed in the recent years, about the outcomes of firm–university linkages in terms of economical and financial performance. Some authors (George *et al.*, 2002) point out the difficulty of addressing the effect of university-business influences on these types of performance. These difficulties may be related to the unclearness of the measures used to evaluate academic outcomes under a financial point of view. For example, revenues is an accepted performance metric for more mature companies, but it can be unsuitable for the incubator context (Rothaermel and Thursby, 2005b) where companies are just in the start up phase.

In our study we tried to use a wider measure of performance applied to all companies in an incubator context. As a matter of fact, the measure we took as a main dependent variable, formerly the Altman's *Z* score developed to assess the survival skills of a company, is able to reflect both profitability and financial performance of the companies in our sample.

The analysis of our findings points out that there is a negative correlation between the dummy variable used for addressing the presence of academic entrepreneurs and the variable used for evaluating companies' performance. This permits to fully invalidate our first hypothesis which claims: "Incubators' graduated companies involving academic entrepreneurs have better financial performance than other graduated companies". Hence, we can merely state the contrary in terms of financial performance: companies with academic entrepreneurs have worse financial performance than other graduated companies. This last statement might sound odd, but the negative relationship between the presence of academic entrepreneurs and companies' financial performance might be explained by considering the nature of the businesses involved. Companies with academic entrepreneurs operate in advanced technology sectors because of the large and specific knowledge availability in universities (Baldini, 2010). Performances of these companies are subject to a high rate of uncertainty and become eventually more effective a lot of time after the starting phase; this results in a low economic and financial performance until the research expenses and resources involved finally give rise to some real innovation and related revenues.

Besides, we need to consider that sometimes academic people are allowed to keep "a foot in each camp". In other words, professors may continue their activity in academic institutions while they can also act as companies' shareholders and/or directors. It's quite common that scientists prefer to maintain university ties in order to share ongoing research results and gain access to the scientific knowledge pool, whilst in the meantime they continue receive the benefits of dividend payouts (George *et al.*, 2002). Even a more recent research showed that university scientists take active steps to preserve their academic role identity even as they participate in technology transfer (Jain *et al.*, 2009). Moreover, this particular status may explain the low risk awareness of academic people despite the high uncertainty of the business of incubated companies (Renault, 2006). Even the lack of experience in general management was pointed out in past research and could be another cause of low economic/financial performances (Wright *et al.*, 2007). It can explain the lack of time in managerial activities requested by the business and the resulting slow performance of companies (Vohora *et al.*, 2004). In our opinion this can also be related to the different

commitments academic people are charged of, and could explain the positive relationship found between the grade of involvement of academics (only as shareholders or as both shareholders/directors) and the related financial performances and the validation of our second hypothesis: higher grade of involvement of academic entrepreneurs can lead to better financial performance.

It is true that the more academics are committed to the business of a company (i.e. not just as a common shareholder but also as a director), the more they are interested in the company goals achievements, decision making, and the more they have influence on related financial performance. This last finding shall address the attention of public institutions, and in particular Universities, while stating and issuing their policies for external commitments involving their employees (i.e. to temporarily stop lectures or researches when managerial commitments arise). It's quite interesting to note that Turin Polytechnic, the related University of the I3P incubator, has started a review process of the policies about academics committed in external companies.

Table 11 – Validation of hypotheses.

Hypotheses	Validation	
	Yes	No
<i>H1 Incubators' graduated companies involving academic entrepreneurs have better financial performance than other graduated companies</i>		X (opposite relation)
<i>H2 Higher involvement of academic entrepreneurs can lead to better economic and financial performance.</i>	X	

Of the implications relating to this research, we can say that, given the crucial value of innovation for survival in the advanced technology industry, these results suggest that academic people may also have a valuable role in entrepreneurship. Potential benefits of the presence of academic entrepreneurs could improve companies' performance only if academics are not only used as "knowledge providers", but also if they are really involved and integrated into company management. It could also be useful to enhance the commitment of academic entrepreneurs in science-based companies permitting them to temporarily reduce their institutional commitments.

6. Limitations and further research needs

This study is not free from limitations, first of all, the most recent available financial data for companies were those relating to 2008. Therefore the current analysis was performed without taking into account the year of 2009 financial performance. Unfortunately, in Italy, financial statements related to a specific period are only available for consultation 6-8 months later.

Moreover, some of the graduated companies (20% of the sample), during 2007 were still in the incubator and were just leaving their start-up stage. Further studies should also address the generalization of our findings. The studied sample is all from I3P, an important incubator linked to Turin Polytechnic and then focused on engineering sciences. Future research could extend the analysis to data on incubated companies across different technology incubators.

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