

University incubator as catalyst of resources for academic spin-offs. The case of ARCA Consortium.

FEDERICA PALUMBO
Department of Management
“Sapienza” University of Rome
Via del Castro Laurenziano 9, 00161, Roma
ITALY
federica.palumbo@uniroma1.it

GANDOLFO DOMINICI
Department S.E.A.S.
University of Palermo
Viale delle Scienze, edificio 13, 80128, Palermo
ITALY
gandolfo.dominici@libero.it - <http://www.unipa.it/gandolfodominici>

Abstract: - Today we can observe an increasing proliferation of new academic spin-off initiatives aimed to transfer knowledge from the university to the market. Due to their strategic role in enhancing the development of technological innovation, academic spin-offs can attain high levels of social performance and consonance with their environment. At the same time, they must overcome many difficulties if they are to achieve a high level of financial performance and growth. They are often considered to be mere vehicles for the transmission of knowledge, implying that their entrepreneurial potential is not fully exploited. According to the Resource Based View (RBV) the competitive disadvantage of an academic spin-off is due to a lack of resources. This paper will join this stream of research in order to analyze the financial performance of academic spin-offs. We examine the case of Arca Consortium’s incubator, established by the University of Palermo, and of the academic spin-offs it has supported and continues to assist. The empirical analysis, based on two linear regression models, is performed based on 19 case studies of spin-offs created between 2007 and 2009 by academicians of the University of Palermo.

Key-Words: - Academic Spin-off, University Incubator, ARCA Consortium, University of Palermo.

1 Introduction and theoretical background

In the actual era of “knowledge economy” [1], knowledge is conceived as the driving force of innovation, entrepreneurship and economic development [2]. According to Rullani [3], the production of new knowledge and the dissemination of available knowledge are the “fuel” for the “engine-growth”. The knowledge economy has empowered the role of the University in society, causing what has been called the Second Academic Revolution¹. University has added a third mission to its traditional functions of teaching and research: transferring the knowledge created in its laboratories to the market. The emergence of the “entrepreneurial university” is described by theory of “Triple Helix” formulated by Etzkowitz and

Leydersdoff [4][5]. According to these authors in the knowledge economy the engine of economic development is powered by a “Triple Helix” composed by University, Industry and Government and by the synergic relationships between them [5][6].

Technology transfer process from universities to the market can take place mainly through the grant of patents or through the creation of new ventures promoted by academicians and researchers, called “academic spin-offs”. Piccaluga & Baldieri [7] defined academic spin-offs as firms which operate in hi-tech industries and are composed by at least one academician. Pirnay, Surlemont & Nlemvo [8] defined spin-offs as “new firms created to exploit commercially some knowledge, technology, or research results developed within a university”. In such schemes they emerge as a connective tissue between the world of research and the world of production that is responsible of promoting innovation in business. The academic spin-off has

¹ The First Academic Revolution happened during the late nineteenth and early twentieth century. It has added the mission of the research next to the traditional mission of teaching.

become a viable and effective alternative to the patent, especially when the knowledge embedded inside the technology is tacit. This happens for the following reasons:

- the spin-off involves directly and intensely the researcher, who can choose to leave the university and work only for the new venture or to work for both [9][10][11][12][13][14][15]. Most of the studies and surveys show, however, that only in very few cases academics abandon their workplace at the university to devote completely to the uncertain business activities. They would rather prefer to deal with technical activities that allow them to develop the knowledge capital and delegate the tasks relating to the business activities to a staff of young graduates [11][16]. On the other hand, even if universities have become more entrepreneurial and encourage the creation of spin-offs, they do not usually encourage researchers to neglect their academic duties to devote themselves to business activities [11];
- the spin-off continues to maintain a close link with the academic world even after the establishment of the company. This means that university research results feed continuously spin-off skills, increasing their competitiveness.

The majority of the work performed in this field has focused on the role that academic spin-offs play in enhancing and accelerating the development and transfer of technological innovation [17][18][19], and in sustaining regional economic growth [20][21][22][23]. Yet very little has been done to understand how academic spin-offs perform in terms of growth and value creation. Even though spin-offs are the most effective form of technological transfer between universities and industry, their startup process is more complex than that of traditional firms. Spin-offs need a strong support to achieve the minimal level of financial performance indispensable to long-term survival, particularly during the establishment and growth phases of their development. The study of Mustar [24] demonstrated that academic spin-offs typically remain small in scale and have low added value. Similarly, George Zahra & Wood [25] found that science-based spin-offs tend to be more innovative, but do not necessarily show greater financial performance. Some explanations for this lack of growth refer to macro-structural and cultural factors, while other studies refer to the resource endowment of such academic spin-offs. RBV is widely used in studies about the creation and development of academic spin-offs [26][27]. According to the RBV, the rise of a new venture can be considered as a

process of acquisition and recombination of resources and expertise [28]. This implies that to exploit a business opportunity the enterprise must have an endowment of tangible and intangible resources [29]. Several empirical studies [30][31][32][33][34][35] investigated the role played by different types of initial resources endowments for the processes of creation and development of spin-offs, such as personal features of founders, technology or financial resources. Other empirical studies [26][32][36][37] have shown that there is a gap between the resources held by researchers and those required to start up and success, which concerns the following aspects:

- Financial resources.
- Managerial skills.
- Marketing and selling skills.
- Reputation and credibility.

This strong lack of resources implies that spin-offs are highly dependent by the external environment. Therefore, spin-offs can only arise if the University and the other actors in the environment create a cultural background that favors the spread of entrepreneurial values. One of the main tools to support the creation of spin-offs is represented by university incubators. University incubators are structures promoted and located within the University that act as mechanisms to support the creation of spin-offs. University incubators seek to bridge the gap between the resources possessed by researchers and financial, administrative and managerial resources needed to start a business. Incubators attract talent, technologies, capital and know-how, aiming to enhance the entrepreneurial spirit within the academia; this is an important way to promote the creation of innovative enterprises and to accelerate the commercialization of research [38]. According to Rothaermel & Thursby [39] the incubator can be considered as a mediator or a direct provider of resources without significant costs. Being physically located within the structures of university research, the incubator allows spin-offs to grow in a stimulating environment and to have excellent visibility. The physical proximity among researchers, entrepreneurs and managers as well as the sharing of spaces, facilities and laboratories are useful to accelerate both the transfer of technologies developed in universities, the competitiveness of the established spin-offs and, subsequently, the competitiveness of the surrounding territory. The geographical proximity of firms can trigger a spontaneous and continuous process of integration between technical-scientific and entrepreneurial experience, thus promoting the rise and development of different forms of innovation.

The incubator becomes a catalyst of resources for the spin-off, an intermediary between the start-up and the following external bearers of resources:

- Financers.
- University.
- Local business system.
- Other companies incubated.

In this study we combine the qualitative methodology of case study, based on the principles of theoretical sampling [40], with an empirical analysis based on two linear regression econometric models. The case study selected is ARCA Consortium and its academic spin-offs. ARCA Consortium manages an academic incubator established in 2005 by University of Palermo inside the University campus (Parco d'Orlèans) in order to assist innovative business initiatives in the start-up phase promoted by academics. Until now Arca Consortium has hosted 30 academic spin-offs. We collected data from these spin-offs and, by means of two statistical models, we investigated the impact of the presence of the incubator on their performance, observed for a period of 3 years (from 2007 to 2009). We conclude that academic spin-offs which are supported by a business incubator increase over time their competitive capabilities and their performance.

The remainder of the paper is organized as follows. Section 2 explains the research question that has inspired this study and the research methodology adopted. In section 3 the case study of ARCA Consortium is introduced. Section 4 presents the dataset, the variables and the two linear regression models adopted. The findings and the discussion of our empirical analysis are provided in section 5. Finally, section 6 presents some concluding remarks, limitations of the study and further research.

2 Research Methods

The research question that inspires this study is, "Are academic spin-offs able to fill the gaps in resources that hamper their development, and to achieve a high level of financial performance through the help of university incubators and their related services and networks?"

In order to answer to the research question and to better understand the phenomenon under inspection we use the qualitative methodology of case study, based on the principles of theoretical sampling [40]. According to the theoretical sampling, the case study should be selected based on its theoretical relevance in order to reply to the research question and to adapt to the theoretical model and not for statistical reasons [41][42].

To investigate the phenomenon we selected the case study of ARCA Consortium and its academic spin-offs. ARCA Consortium has provided a rich context within which to collect detailed information about particular issues and to gather primary data from the relevant academic spin-offs that we have observed. We have chosen this case study because it is a virtuous example of incubator established in an underdeveloped economic area (Sicily-Italy).

3 ARCA Consortium's incubator case

In June 2003, ARCA Consortium was established by the University of Palermo (Italy) together with the association "Sintesi", the regional state-owned company "Sviluppo Italia – Sicilia" and the private company "Easy Integrazione sistemi s.r.l."

The founders of ARCA are an example of synergy between the private and the public sectors.

Sintesi is an association established in 1991 by the Sicilian Universities of Catania, Messina and Palermo. The scope of the association is to promote the cooperation between universities and private businesses in Sicily in the fields of education, innovation and technological transfer.

Sviluppo Italia Sicilia focuses its activities in Sicily aiming to endorse the resources of the region. The firm operates with strong links with the regional government supplying services to attract investments and to improve the regional bureaucracy.

Easy Integrazione di Sistemi is a private firm established in 1996 as a spin-off of the Department of Physics of University of Palermo. Its scope is to develop technologies for knowledge management and to develop innovative organizational models based on distance collaboration.

In 2005, thanks to a aid of €1.8 millions given by the Italian Ministry of Economic Development, the ARCA Consortium started a business incubator inside the campus of the University of Palermo.

The ARCA incubator supplies services to help innovative entrepreneurial initiative to overcome the so called "death valley" phase [43] and to become competitive in the market.

The ARCA incubator delivers: business planning services, equipped offices, marketing, organizational and financial consulting. The incubator also acts as a hub to link the research spin-offs with potential stakeholders.

The incubator is open also to firms that already have their own offices and that are not interested to stay inside the incubator but to just take advantage of the business innovation network of ARCA through "virtual incubation".

Virtual incubation includes the same services of real incubation except the office space. This kind of incubation allows firms to take advantage with a minimum cost of all the common service of the incubator and of ARCA business network; in particular these firms are usually interested in the financial network.

In about 10 years of activity the ARCA incubator assisted 30 research spin-offs. Some of these ventures have been in “virtual incubation”, others in real incubation and then on the market, still others first on real incubation then in virtual incubation.

The ARCA incubator supported in the pre-incubation phase several entrepreneurial initiative participating to the “START CUP” contest which is part of the Italian National Prize for Innovation.

The “START CUP” award is a local contest among innovative business ideas coming from scientific laboratories. The award was established in Palermo in 2005; winners of the competition are accepted to participate to the National Prize for Innovation.

Today 13 incubated firms have already finished the incubation period, 11 of which have been successful and able to stand alone in the business environment and only two didn't reach the goal.

Other 17 start-up are currently under incubation process.

Table 1 (in Appendix) shows the main characteristics of start-ups that have been incubated by ARCA.

Many spin-offs that have already finished their period of incubation have chosen to remain inside the structures of ARCA incubator to maintain synergic relationships with other spin-offs incubated and with incubator's network of external partner. This decision shows their willingness to seek a harmonious relationship with the context also at the end of incubation.

Academic spin-offs, due to their features of highly innovative enterprises, have always a positive impact on the surrounding area. This implies that ARCA spin-offs' activity usually converges with supra-systems' aims. For example patents help to increase the innovative capacity of the area, creates new workplaces that contribute to reduce the problem of unemployment and the turnover helps to enhance the overall wealth of the area.

4 An empirical analysis on academic spin-offs performance

The aim of this empirical analysis is to demonstrate that spin-offs which have been hosted in the incubator of ARCA Consortium, at the end of the process of incubation are able to achieve high level

of financial performance and bridge their lack of resources. Many studies have demonstrated that incubators are able to increase the competitiveness and performance of academic spin-offs [38][44][45]. In this analysis we have considered the turnover as a proxy of financial performance and value creation of firms. Using the econometric software Stata we have analyzed data related to firms incubated in ARCA from 2007 to 2009. Data were collected through phone interviews and surveys sent by e-mail to the 19 firms of the sample. We have estimated two econometric models, considering turnover as dependent variable. The following table shows the explanatory variables and the hypothesis of the models.

Table 2 - Independent variables of the empirical model

Explanatory variable	Description	Expected correlation with performance
<i>dincubation</i>	Dummy variable that can assume values: 1 - if the firm was incubated in the year of observation 0 - in the opposite case	(+)
<i>incubationperiod</i>	Number of years of incubation until the time of observation	(+)
<i>dresearcher</i>	Dummy variable that can assume values: 1 - if the administrator is a researcher or an academician 0 - in the opposite case	(-)
<i>patents</i>	Number of patents registered by the firm in the year of observation	(+)
<i>pubfin</i>	amount of public funding received	(+)
<i>members</i>	Number of members of the firm	(+)
<i>capital</i>	Amount of share capital of the firm	(+)
<i>startcupranking</i>	Start Cup Palermo rank. This variable can assume values: 3 - Top rated 2 - second in the standings 1 - third in the standings 0 - no participation or cup victory to Start palermo.	(+)
<i>life</i>	Number of years of the firm at the time of observation	(+)

The two econometric models are based on two different estimators:

- Pooled OLS estimator

$$\text{turnover}_{it} = C_0 + \beta_1 \text{dincubation}_{it} + \beta_2 \text{incubationperiod}_{it} + \beta_3 \text{dresearcher}_{it} + \beta_4 \text{patents}_{it} + \beta_5 \text{pubfin}_{it} + \beta_6 \text{members}_{it} + \beta_7 \text{capital}_{it} + \beta_8 \text{startcupranking}_{it} + \beta_9 \text{life}_{it} + \varepsilon_{it}$$

- Random effects estimator

$$\text{turnover}_{it} = u_i + \beta_1 \text{dincubation}_{it} + \beta_2 \text{incubationperiod}_{it} + \beta_3 \text{dresearcher}_{it} + \beta_4 \text{patents}_{it} + \beta_5 \text{pubfin}_{it} + \beta_6 \text{members}_{it} + \beta_7 \text{capital}_{it} + \beta_8 \text{startcupranking}_{it} + \beta_9 \text{life}_{it} + \varepsilon_{it}$$

5 Results and discussion

Results of the models are reported in table 3 (in Appendix).

We consider only statistically significant results (p value less than 10%).

The results are confirmed both in the case of the pooled estimator that in the case of random effects estimator.

The variable “dincubation” is significantly (p-value equal to 0) and positively correlated with the turnover, as required by the hypothesis. A company that was incubated is better able to create value than a similar firm does not incubated (between €80,000 and €90,000 more).

The variable “incubationperiod” is inversely related to turnover (7.8% in the OLS model and 0.7% in RE). This result is contrary to our hypothesis, according to which a company becomes increasingly more competitive during the incubation period. This result is probably due to the fact that firms which need to be incubated longer are those which need more support because they are not yet ready to survive alone on the market. Mosaicoon for example, the most successful spin-off company of ARCA Consortium, has been never incubated. This result, coupled with the previous one, shows that the incubation has surely a positive effect on financial performance if it is a way to start up the new venture, but if it becomes a sort of continued assistance essential for the survival of the firm, it becomes a factor of weakness.

The variable “dresearcher”, although in the random effects model is negatively associated with turnover, such as required by research hypothesis, it is not significant, as well as the number of “patents”.

On the contrary, the amount of public funding received by the company is positively associated with turnover and statistically significant. As a consequence, if the new venture is highly innovative, an initial help from the Government may therefore be useful to start the business and to disseminate the results to the rest of society. This result is in line with our hypothesis and with the prevailing literature, including the Triple Helix model, which states that the innovative capacity of a country or of a local system depends on the synergic interactions between State, the research system and the productive sector.

The number of members is negatively related to turnover, contrary to our hypothesis. According to

our expectations, in fact, a greater number of heterogeneous subjects engaged and involved in the enterprise would have to ensure the best results. However, this result could be due to the fact that a large number of members may increase conflict within the enterprise and slow decision making activities.

More capitalized companies show the highest levels of turnover, and, as expected in our hypothesis, the correlation coefficient between the two variables is positively and significantly positive. Hence, an increasing of share capital has a positive effect on turnover.

The ranking of Start Cup Palermo competition, contrary to our hypothesis, is negatively related to turnover. This negative result, however, could be related to the fact that the ideas are particularly innovative, award-winning in a business plan competition, are less profitable in the short term, whereas less innovative ideas and better accepted by the public or customers may have a stronger impact on turnover. Adding more periods to our observations could provide more information about this relationship.

The variable “life” is relative to the age of the company. The coefficient of this variable is significant and positively related to turnover. As a consequence, although spin-off companies start their activities facing several obstacles and are usually unable to approach the market, during the time and thanks to the support of the team and consultants of the incubator ARCA, become competitive on the market. This result is consistent with the model of Ndonzuau et al. [44] according to which, after the incubation period, the company becomes able to transfer and strengthen its market value.

6 Limitations of the study and further research

We analyzed the academic spin-offs that have been incubated by the ARCA Consortium’s incubator at the University of Palermo (Italy), in order to answer to the research question: “Are academic spin-offs able to fill the gaps in resources that hamper their development, and to achieve a high level of financial performance through the help of university incubators and their related services and networks?”.

Combining a qualitative and quantitative approaches we conducted an analysis that has been very useful to answer to the research question but also to better understand the benefits of the incubation service for academic spin-offs.

We found that, in spite of the economically depressed context (Sicily is one of the poorest and less industrialized regions in EU), these firms are able to reach a state of financial performance after incubation under certain conditions.

As a consequence, we are able to maintain that the added value of ARCA incubator is its laboratory function that supports the transformation of ideas into actions in a situation of low risk. In addition, due to the underdevelopment and structural deficiencies that characterize the environment in which it and the incubated firms operate, ARCA acts as a greenhouse in the desert. A greenhouse that gathers people and innovative ideas and allows them to confront and interact in a fruitful way. As a result, entrepreneurs are able to overcome the isolation that typifies undeveloped contexts and they sustain each other rising their chances to become successful. ARCA challenge is to combine and integrate the different pieces of knowledge pertaining both the incubated firms and ARCA's consultants in order to stimulate cross fertilization.

However this study has different limitations. The main limitation is that the observation time interval is too short. In addition, financial performance is a multidimensional aspect that should be investigated from several point of views in addition to turnover. These limits are also the reason why we plan to develop further research on this topic in order to find out if the financial performance is kept also in the medium-long range period (after 5-6 years). We also propose to make a comparison with other incubators located in different contexts.

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APPENDIX

Table 1 – Academic spin-offs incubated in ARCA from 2003 to 2013.

Trade name	Year of establishment	Sector of activity	Currently under incubation	Finished Incubation
BIONAT	2003	Biotech	-	X
IN.TR.AM.	2005	Transport	-	X
WINGS	2005	ICT	-	X
WISNET ENGINEERING	2006	Diagnostic equipment	-	Virtual incubation
OPERA	2006	Architecture	-	Virtual incubation
IDRAMBIENTE	2006	Environment	-	X
DOCTOR GREEN	2006	Environment	-	X
IRRIWORKS	2006	Environment	-	Virtual incubation
SIN	2006	Diagnostic equipment	-	X
SECURPROJECT	2007	ICT	-	X
SOFTENERGY	2007	Environment	-	X
CYCLOPUS CAD	2007	Biomed	-	X
MOSAICOON	2008	ICT	Never incubated	
BIOSURVEY	2008	Environment	Under virtual incubation	-
DIASIS	2008	Architecture	Under incubation	-
I-LABS	2008	Energy	Under virtual incubation	-
YAM	2009	Nautical	Under virtual incubation	-
Gè	2009	Environment	Under incubation	-
E.LAB	2009	Environment	Under incubation	-
INFORMAMUSE	2009	ICT	Under incubation	-
ABIEL	2010	Biotech	Under incubation	-
SNAP	2010	Design	Under incubation	-
FMOM	2010	Fashion	Under incubation	-
KINEO	2010	Meccatronic	Under virtual incubation	-
LYMPHA	2010	Environment	Under virtual incubation	-
GEON	2010	Energy	Under virtual incubation	-
LAB CP	2010	Culture	Under virtual incubation	-
CR MOBILITY SOLUTIONS	2010	Energy	Under virtual incubation	-
MOBILITÀ PALERMO	2012	Environment	Under virtual incubation	-
MARCELLO MANCINI	2012	ICT	Under virtual incubation	-

Table 3 – Results of the econometric models.

Explained variable:	<i>turnover</i>	<i>turnover</i>
Estimation procedure	OLS	Panel RE
Legend	coef. ^(significance level) Robust Std. Err.	coef. ^(significance level) Robust Std. Err.
<i>dincubation</i>	90689.23 ** (28338.46)	82355.9 *** (23126.67)
<i>incubationperiod</i>	-53673.2 * (29519.11)	-58095.55 *** (21480.67)
<i>dresearcher</i>	705.5 (27851.75)	-28697.2 (37244.38)
<i>patents</i>	29864.47 (38450.12)	28824.49 (44381.09)
<i>pubfin</i>	.2005687 *** (.0490311)	.1753365 *** (.0455496)
<i>members</i>	-13534.19 ** (6356.604)	-15795.4 ** (7730.855)
<i>capital</i>	1.760777 * (1.0097419)	2.963105 *** (.8913496)
<i>startcupranking</i>	-29650.65 *** (11963.64)	-35289.24 *** (13672)
<i>life</i>	90613.91 *** (31791.43)	80956.74 *** (20228.24)
<i>_cons</i>	-4785.322 (47803.68)	18650.89 (68572.04)
N	44	44
Cluster	19	19
	F (9, 34) = 44 Prob>F = 0.0000 R-squared = 0.6445 Root MSE = 80725	Obs per group: min = 1 avg = 2.3 max = 3 R-sq: within = 0.6895 between = 0.5462 overall = 0.5904 Wald chi2 = 67.35 Prob > chi2 = 0.0000