# Do University Incubators Stimulate Innovation of University Spin - Offs? An Analysis of Italian Firms

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## Abstract

*The paper aims to study the impact of university incubators on the innovation of university spin-offs. In particular, and starting from the existing theoretical arguments and empirical evidences, it was hypothesized that incubation facilities promoted and located within the university may potentially act as effective mechanism in order to bridge the gap between the resources possessed by researchers and financial, administrative and managerial resources needed to growth and innovative. Based on a sample of 621 Italian university spin-offs over the period 2004-2012, the results suggest that incubations services of university have and effective and pivotal role in stimulating the innovative activities in university ventures. The papers contribute to the literature debate about the fostering mechanisms at different level of analyses of university entrepreneurship, in particular for those focusing on the innovation dynamics of the university spin-offs.*

**Keywords:** university spin-off; university incubator; innovation; Italy.

## *1. Introduction*

Both academicians and practitioners have even more a growing interest in the development and fostering of entrepreneurial university as well as in stimulating the elements of creation of knowledge-based economies, especially through university spin-offs (Guerrero et al., 2016; Markuerkiaga et al., 2016; Sternberg, 2014; Rodríguez-Gulías et al., 2016; Rasmussen et al., 2015). In this regard, the mechanisms linked to their generation and growths are considered critical into the programs aimed to improve the innovative capabilities at regional and national level (Colombelli et al., 2016; Lockett et al., 2005). Without a doubt, one of the most important purpose of the university spin-offs is the commercialization of knowledge and technology developed in the university context, integrated part of the technology transfer mission (Breznitz and Etzkowitz, 2016; Palumbo, 2010).

Hence, a key contribution of university spin-offs to the knowledge environment is their capability to create innovation (Rodríguez-Gulías et al., 2015; Wong et al., 2007). Several scholars highlight that university spin-offs typically denote superior innovation performance compared to non-university spin-offs and other new technology-based firms (NTBFs), mainly in term of patents (Lejpras, 2014), potentially due to the particular environmental context that characterized academia, rich of a promising research output ready to disseminate also by means of new ventures. However, the understanding of factors and mechanisms related to the innovative activities of university spin-off are not well explored, and only recently some scholars have focalize on this core aspect of the spinning process output by investigating the determinants at various level of analyses, both at micro, meso and macro one (Rodríguez-Gulías et al., 2015; Lejpras 2014).

Resource-based view (RBV) theory is extensively used in studies about the generation and development of university spin-offs (Van Geenhuizen and Soetanto, 2009; Mustar et al., 2006). According to the RBV, a pivotal role in the effective and successful exploitation of the technology/knowledge generated by university ventures and, consequently, their growth, is played by resources, competencies and promoting mechanisms of parent university (Rasmussen et al., 2014),

Taking into account the resource-based view theory applied to the university spin-offs context (Rodeiro-Pazos et. al, 2012; Vinig and Van Rijsbergen, 2010),it is to remarks the resources, capabilities and fostering mechanisms of university origin (Rasmussen et al., 2014), jointly with the features, the composition and the interactions of the regional context in which the university spin-off is located (Sternberg, 2014; Rodríguez-Gulías et al., 2015) in supporting entrepreneurship activities, such as innovative ones. In this regard, it is to note as one the major fostering mechanism of the university entrepreneurial activities is the university incubator (Stal et al., 2016; Lockett et al., 2005). Indeed, university incubators pursue to eliminate the bridge the gap among the resources and capabilities of academicians and financial, organisational and managerial resources necessary to set up in adequate way the new business (Rasmussen, 2011; Berbegal-Mirabent et al., 2015). Additionally, incubators have the ability to draw talent researchers and nascent promising entrepreneurs, technologies and expertise, targeting to improve the entrepreneurial essence within the university context (Soetanot and van Geenhuizen, 2007). This is may be a critical approach to endorse the dissemination of new knowledge and the generation of innovative outcome (Mian, 1996; Vedovello and Godinho, 2003).

This paper aims to contribute to the better understating of the innovation patterns and performance of university spin-off by exploring the fostering role of university incubators that may potentially expand the innovation prospective of university spin-offs. To this end, the paper empirically investigates a sample of 621 Italian USOs over the period 2004-2012. Indeed, in Italy the spin-off phenomenon is rising quite fast in the last ten years (Fini et al., 2011; Iacobucci and Micozzi, 2015), as also remarked by the Netval report[1].

The paper aims to contribute to the literature debate about the fostering mechanisms at different level of analyses of university entrepreneurship, in particular for those focusing on the innovation pattern and growth dynamics of the academic ventures. In addition, the paper could be a source of important and basic guideline for the setting and planning of the policy actions stimulating entrepreneurship and innovation at university level.

## *2. Literature Background*

With the aim to improve the transfer of knowledge and technology to industries, fostering innovation and entrepreneurship, universities have taken several initiatives comprising launching university incubators (Ranga and Etzkowitz, 2013; Markman et al., 2005).Universities are a one of the crucial actor of economic players to success the competition of growth through their dynamic involvement in running incubators, research and development, innovation, commercialization and development of entrepreneurs in both developed and developing socio-economic contexts (Mian, 1996; Rasmussen et al., 2014). Also OECD (2010) stimulated the incubator manager to engage with universities in order to improve the fostering role of research commercialization for the optimal value of the society. In particular, university incubators constitutes a pivotal ad effective infrastructural support in the growing processes of university spin-offs, stimulating and adding itself the value generation form the nascent firms (O'Shea et al., 2005; Berbegal-Mirabent et al., 2015). In this regard, scholars point out the critical and fostering role of university incubators in improve the entrepreneurial capabilities of the university start-ups, in particular during the early phase of their existence (Grimaldi and Grandi, 2005).

According to Rothaermel and Thursby (2005), the incubator can be defined as a facilitator or a direct supplier of essential resources and capabilities without substantial expenses. Since they are actually placed within the context of university research, the incubators permits university spin-offs to run faster in the business development process inside a motivating setting and to have outstanding visibility and improved reputation (Von Zedtwitz and Grimaldi, 2006). The physical closeness between academics, financiers, entrepreneurs and executives, along with the sharing of research laboratory, spaces and facilities are suitable to speed up both the transfer of technologies/know ledges generated in academia, the competitive advantages of the new university ventures and, afterwards, the attractiveness of the close socio-economic context (McAdam and Marlow, 2008; McAdam and McAdam, 2008).

The geographical closeness of companies may potentially activate a natural and constant process of assimilation among technical-scientific and business capability, hence endorsing the growth and improvement of several types of innovation (Lindelöf and Löfsten, 2004; Fritsch and Slavtchev, 2007; Minguillo and Thelwall, 2015).

[1]At 31.12.2015, the spin-offs, by a public research surveyed in Italy are 1.254, an increase in the average number of spin-offs created in 2014, from 1.9 to 2.4(Netval, 2016).

Therefore, university incubators may effective and optimally foster the knowledge and technologies dissemination from the spin-offs firms, especially thanks to the superior qualified skills and competences in the form of human capital, assistant set-up to the nascent business, better linkages between university context and industry context, superior ability to recognize the competitive opportunity in order to run fast as they can in the innovation race (Etzkowitz, 2002). More in detail, the university incubators may support the academic entrepreneur to reduce the managerial and marketing obstacles with the aim to better enhance the innovative outcome of the university spin-off (Vinig and Van Rijsbergen, 2010). Some empirical findings could help to validate and clarify these arguments.

In their study, Chandra et al. (2012) noted that university backed incubators have solid historical view with the provision of setting, human know-how, capital source, fostering innovation and commercialization. Additionally, Somsuk et al. (2012) categorized the vital resources for university incubators to foster new ventures, basically refers to financial, human, technological and organizational ones. In the same way, Salem (2014) recognized university incubators as one of the most effective kind of incubators among all and young entrepreneurs may gain benefit from university incubators in order to establish relations with industry for run their own companies. Also, Chindaprasert and Puapatanakul (2006) indicate university incubators as a suitable mechanism to endorse research and development, innovative and commercialization activities, as well as developing entrepreneurs. More recently, Soetanto and Jack (2016), using a sample of spin-offs from the United Kingdom, the Netherlands and Norway, have been investigated the potential moderating effect of incubation support (networking and entrepreneurial support) on innovation strategy effectiveness. Their empirical findings validate the effective role of university incubators in the exploitation of technology from spin-offs to the market.

Hence, in view of the above considerations it can be argue the following:

*H1: University incubators positive improve the innovation of university spin-offs.*

## 3. Method

### *3.1. Sample*

With the aim to empirical validate the positive effect off university incubators in improving the innovation of university spin-offs, it was investigated a panel sample of 621 Italian university spin-offs extracted from Netval database at 31 December 2014, a database part of the project "Spin-off Italia" and run in collaboration with Netval, Università Politecnica delle Marche and Scuola Superiore Sant´Anna – Istituto di Management, which collect updated information about the full population of active spin-off in Italy; while data cover a period from 2004 to 2012. In addition, financial information about university spin-offs was extracted from Aida BdV database, an Italian subset of ORBIS database, which containing historical financial, biographical and merchandise data of about 700,000 Italian active companies. In detail, financial information is provided by Honyvem who acquire and reprocesses all official accounts deposited with the Italian Chambers of Commerce. Data regarding business Incubators University and research funding, were collected from institutional websites of universities, MIUR (Ministry of Education, University and Research) and regional authorities. Additional information about the patent activity of universities was extracted from PATIRIS database.

### 3.2. Variable definition

#### 3.2.1. Dependent variable

The dependent variable used in this paper, the innovation of university spin-off, was measured by a dummy variable taking the value 1 if the firm has innovations (in every form, product, process and organizational innovation) and 0 otherwise (*Dummy* i*nnovation*).

#### 3.2.2. Independent variables

With the aim to predict the potential effects of university incubators on innovation of university spin-offs, in accordance with Berbegal-Mirabent et al. (2015), it was used the number of university-affiliated business incubators (*University Incubators*).

#### 3.2.3. Control variables

The study control primarily, in line with Sørensen and Stuart (2000), for firm age measured by the number of years the university spin-off has been established (*Age*), as well as for firm size, determined by the number of university spin-offs' personnel (*Size*), in accordance with De Cleyn and Braet (2012).

Firm performance is also recognised to impact on innovative activities (Hoskisson et al., 2002). In this regard, it was control for accounting performance by means of two profitability ratio, namely return on assets (*ROA*) and return on sales (*ROS*). Each measure was computed by dividing net income to total assets and operating profit to net sales. Additionally, following Fini et al. (2011), we use university financial resources for research and development activities by coding the amount of public research fund that is part of the ordinary financing (FFO), a public financing that represents the main source of economic income for Italian universities (*University R&D*). Indeed, in accordance with Becker and Dietz (2004) and Nieto and Santamaría (2007), R&D expenditure is at the base of innovative activities and help to explain the generation of innovations.

Finally, as the innovation directions of university spin-offs may be related to the patenting activities and success of parent university (O'Shea et al., 2005), it was control for the stock of patents for each university in the last 10 years (*University* p*atent*).

### 3.3. Econometric approach

In order to test research hypothesis it has been used a binary probit GLM in the estimation of parameters, which is extremely useful in case of dichotomous dependent variables (Pardo and Pardo, 2008). The use of ordinary least square (OLS) regression is inappropriate for this type of dependent variables because the possible range of values is confined to two sides of the interval [0-1] (Kieschnick and McCullough, 2003). Additionally, this statistical method is designed for a maximum-likelihood estimation of the number of rates of non-negative counts.Finally, university spin-off *i*'s innovation function can be described as:

$$Dummy\ innovation_i = {}_{\beta_1} University\ incubator_i + \beta_2 Age_i + \beta_3 \mathrm{Size}_{it} + \beta_4 \mathrm{ROA}_{it} + \beta_5 \mathrm{ROS}_{it} + \beta_6 University\ R\&D_{it} + \beta_7 University\ patent_{it} + \varepsilon_{it}$$

Where i indexes universities and *t* indexes years. In addition, $\approx_t$is the time effect and $\varepsilon_{it}$ is the error term.

## *4. Results*

### 4.1. Descriptive statistics

Table 1 shows the descriptive statistics of the variables used in the study. The results point out that the sampled university spin-offs with innovation are about 13.9%, with moderate dispersion in the sample (S.D. = 34.57). This evidence reveals that the university ventures in Italy show a not diffuse and pervasive innovative orientation, especially compared to the U.S. or U.K. context. This may represent a limit in the effectiveness of technology transfer from university.

Referring to the sample mean of university incubators for each university spin-offs analysed, this is less than one, revealing that the Italian university system is characterized by a low presence of business incubators affiliated with academic institution. This may potentially affect the growth pattern of university spin-offs, since the lack of an important, basic and critical infrastructural support, especially in term of innovative activities and performance. Additionally, the relative low dispersion in the sample related to his variable (S.D. = 0.922), point out that there is a diffuse and persistent deficiency of incubation facilities in the Italian universities, confirming and exasperate the emerging situation previously outlined.

Table 2 and Table 3 reports the frequency statistics of the innovation of university spin-off and number of university incubators, respectively, while Figure 1 and Figure 2 reports the frequency histograms with normal curve both for innovation and university incubators variables. In particular, it could be note that spin-off located in university without affiliated incubator are about 44.1% of the sample, following by 36.3% with one university incubator, 11.4% with two university incubators and 8.1% with three university incubators (Table 3).

### 4.2. Binary probit GLM estimation

Table 4 shows the outcomes of the binary probit GLM in the estimation of the model predicting the impact of university incubators on innovation of university spin-offs. The regression analyses are performed in a step-wise manner. Column 1 includes all the control variables; Column 2 refers to the full model. In the column 1, the estimated coefficient on A*ge* is positive and statistically significant (coeff. = 0.510, $p < 0.001$), similar consideration for the estimated on S*ize* (coeff. = 0.296, $p < 0.05$). The estimated coefficient on firm performance measured by *ROA* and *ROS* are respectively negative and positive, but in the both case they are not statically significant.

Furthermore, the estimated coefficient on *University* p*atent* results negative and statically significant (coeff. = -0.21, p< 0.001). Analogous findings for the estimated coefficient on *University R&D*, although their practical power is very low (coeff. = -0.001, p< 0.05).

H1 remarks a positive relationship between university incubators and the innovation of university spin-offs. In the column 2, the estimated coefficient on *University incubator* is positive and statistically significant (coeff. = 3.203, p< 0.05), thus confirming H1. This evidence supporting the theoretical and practical arguments related to the promoting role of university incubators in the innovative activities of university spin-offs.

## *5. Conclusion*

### 5.1. Findings discussion

The paper aimed to investigate the impact of university incubators on the innovation of university spin-offs. In particular, and starting from the existing theoretical arguments and empirical evidences, it was stated that incubation facilities structured, promoted and located within the university may potentially act as effective mechanism in order to bridge the gap between the resources possessed by researchers and financial, administrative and managerial resources needed to growth and innovative. To this end, a sample of 621 Italian USOs was analysed during the period 2004-2012. The results show the effective and pivotal role of business incubators in stimulating the innovative activities in university ventures, acting as key actors for their development and future growth. This findings is in line with those of obtained by previous studies, highlighting that the infrastructural support and the business accelerating role of parent university is a critical base for the full development of the innovation trajectories in the university spin-off.

### 5.2. Practical and policy implications

The paper has some remarkable practical and policy implications. The Italian university context is characterized by a lack of diffuse incubation services developed internally, as well as the majority of the university spin-offs firms denoting a scarce innovation. However, since the positive and effective fostering role of university-affiliated incubators in the innovation of university ventures, both university managers and policy makers at regional and national level are call to better implement a prominent and dynamic long term strategy to introduce superior form of business facilities at university level, the first point of contact and reference for the nascent academic ventures. Additionally, the incubation services and the related activities need to better integrated and aligned to those embodies the growth perspectives of university spin-offs, especially in term of innovation expectations.

### 5.3. Limitations and future directions

The paper is not free of limitations. The empirical study is based only on a dichotomous measure of innovation, related to the existence or not of innovation in university spin-offs firms. However, future studies may take advantages from a better understating of innovative activities in the university spin-off by using innovation performance measures, such those associated with patents counts and patent data (Acs and Audretsch, 1989; Dachs and Pyka, 2010). Additionally, also innovation efforts of university spin-off explored by using input measures of innovation such as R&D expenditures and staff may represents an interesting approach in studying the effect of university incubators. Furthermore, the combination of the methods above - innovation performance and innovation efforts - may potentially better clarify the actual fostering effect of incubation services at university level in order to better design corrective actions in different emerging situational context and growing phases of the university spin-off.

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**Table 1: Descriptive statistics**

| | N | Min. | Max | Mean | S. D. |
|---|---|---|---|---|---|
| Innovation | 5580 | 0.000 | 1.000 | 0.139 | 0.346 |
| University incubator | 5589 | 0.000 | 3.000 | 0.834 | 0.922 |
| Age | 5589 | 2.000 | 78.000 | 8.594 | 6.520 |
| Size | 2417 | 0.000 | 308.000 | 5.126 | 22.120 |
| ROS | 2399 | -51.380 | 29.970 | 4.216 | 11.700 |
| ROA | 2830 | -428.760 | 88.250 | 2.661 | 25.455 |
| University patent | 5580 | 0.000 | 375.000 | 78.198 | 83.145 |
| University R&D | 909 | 3397941.000 | 26149760.000 | 13161974.277 | 8837940.901 |

**Table 2: Frequency table for innovation in university spin-offs**

| Innovation in university spin-offs (dummy) | Frequency | % | % valid | % cumulate |
|---|---|---|---|---|
| 0 | 4,806 | 85.9 | 86.1 | 86.1 |
| 1 | 774 | 13.8 | 13.9 | 100.0 |
| Total | 5,580 | 99.7 | 100.0 | |

**Table 3: Frequency table for university incubators**

| No. university incubators | Frequency | % | % valid | % cumulate |
|---|---|---|---|---|
| 0 | 2,466 | 44.1 | 44.1 | 44.1 |
| 1 | 2,034 | 36.3 | 36.4 | 80.5 |
| 2 | 639 | 11.4 | 11.4 | 91.9 |
| 3 | 450 | 8.0 | 8.1 | 100.0 |
| Total | 5,589 | 99.8 | 100.0 | |

**Figure 1: Frequency histograms with normal curve for innovation in university spin-offs**

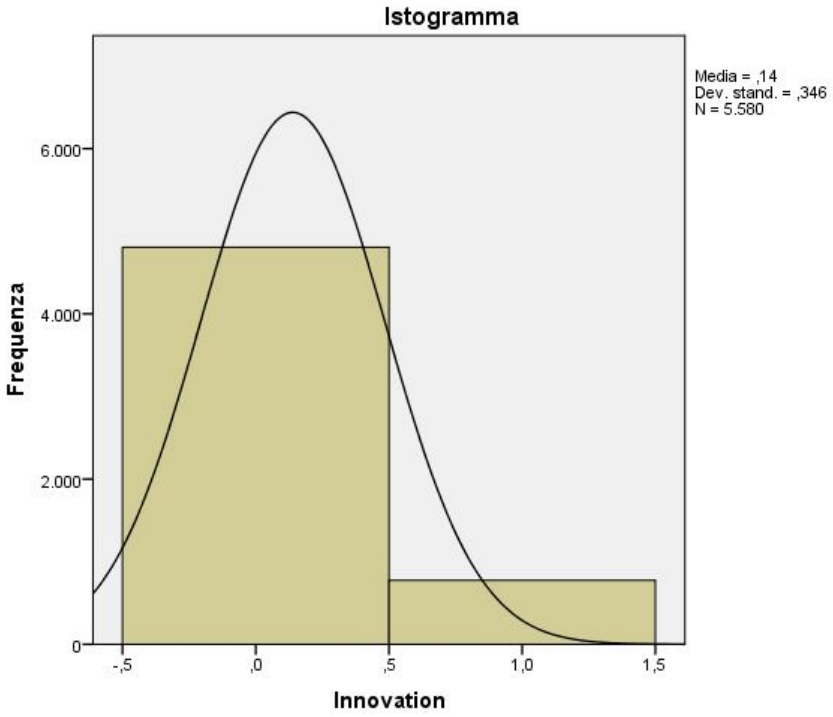

**Figure 2: Frequency histograms with normal curve for university incubators**

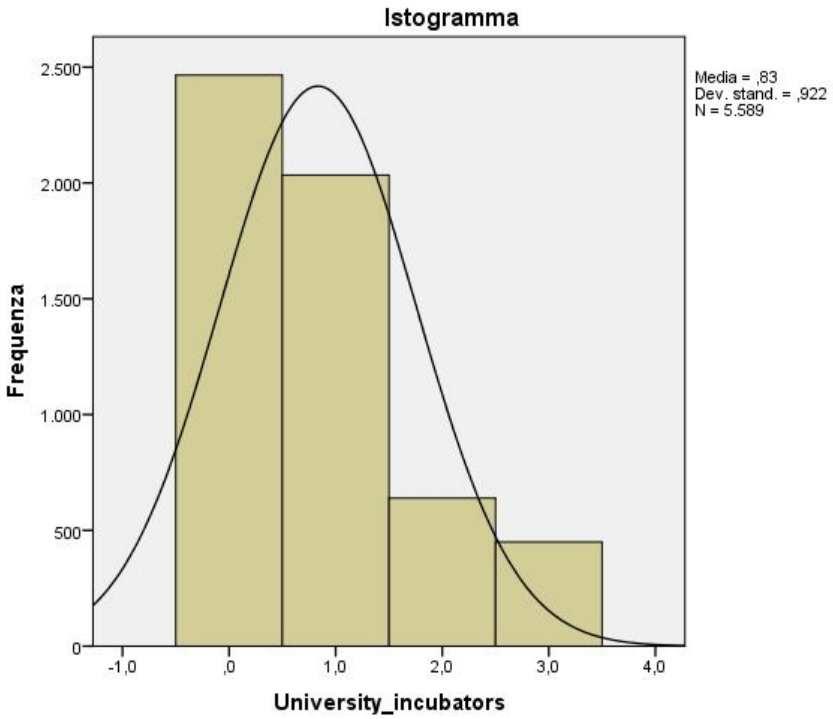


**Table 4: Binary probit GLM estimates about the impact of university incubators on innovation of university spin-offs**

| ***Dependent variable : Innovation*** | | |
|---|---|---|
| ***Estimator*** | ***Binary probit GLM*** | ***Binary probit GLM*** |
| | **(1)** | **(2)** |
| **University incubators** | - | **3.203**** **(1.5257)** |
| Age | 0.510*** (0.0930) | 0.518*** (0.0952) |
| Size | 0.296** (0.1068) | 0.300** (0.1079) |
| ROS | 0.014 (0.0109) | 0.015 (0.0110) |
| ROA | -0.004 (0.0038) | -0.004 (0.0037) |
| University patent | -0.021*** (0.0054) | -0.026*** (0.0071) |
| University R&D | -0.001** (0.001) | -0.001 (0.001) |
| Likelihood-ratio chi-square | 69.043*** | 69.513 |
| DF | 6 | 7 |

**Notes:** Standard errors in parenthesis. DF stands for degrees of freedom.
* 10% significance level for which the null hypothesis is rejected.
** 5% significance level for which the null hypothesis is rejected.
*** 1% significance level for which the null hypothesis is rejected