

The role of venture capitalist to enhance the growth of Spanish and Italian university spin-offs

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Abstract The establishment of spin-offs to commercialise university knowledge/technology is a potential mechanism to promote economic and innovative development. Nevertheless, University Spin-Offs (USOs) are usually resource-constrained, especially in obtaining funding, limiting their growth. Venture Capital (VC) investors play an important role in the financing and the improvement of their managerial skills, which are critical for firm growth. This paper aims to explore both the effect of VC partners on the USOs' growth and the cross-national differences in the role played by them. To study both issues, we empirically analysed 516 Spanish and 904 Italian USOs created by 50 Spanish and 57 Italian universities, respectively, and observed them

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between 2005 and 2013. The results showed different effects in the Spanish and Italian cases. While in Spain the presence of VC partners positively affects the USOs' growth, in Italy there is not a significant effect. This evidence calls for systematic policies by public administrations and universities to foster USO growth.

Keywords University spin-offs · USO · Universities · Venture capital · Firm growth · Cross-country · Panel data · Spain · Italy

Introduction

The commercialization and the exploitation of technology and knowledge assigned from the University has become one of the main goals for academic institutions (Petruzzelli 2011; Grimpe and Hussinger 2013; Shane 2002; Lissoni et al. 2008; OECD 2012; Franco and Haase 2015; Perkmann et al. 2013; Fini et al. 2016). Universities have transmuted their traditional primary role from education providers and scientific knowledge makers towards a more complex “entrepreneurial” university (Etzkowitz et al. 2000; Philpott et al. 2011; Del Giudice et al. 2013; Geoghegan et al. 2015).

Under this role, the creation of firms to commercialise university research has increased the links between science and industry, representing a way to set up potentially high-growth firms with a relevant economic and innovative influence at local and national levels (Henderson et al. 1998; Smith and Ho 2006; Vincett 2010; Di Tommaso and Ramaciotti 2010). These firms, aimed at the diffusion of research results, especially in the form of breakthroughs, have been called University Spin-Offs (USOs) (Thursby et al. 2001; Rasmussen 2008; Van Burg et al. 2008; Swamidass 2013; Nicotra et al. 2014; Rasmussen et al. 2014; Pattnaik and Pandey 2016).

Although there has been a rise in the number of USOs generated in both Europe and the U.S. (Shane 2004; Wright et al. 2007), most of them have shown limited growth (Grimaldi et al. 2011; Mowery 2011). Indeed, technologies/knowledge that are not properly exploited limit the USOs' growth opportunities, as well as the social/innovative returns for the economy (Carayannis and Rakhmatullin 2014; Schuh and Drescher 2014; Ardito et al. 2015). In particular, and mainly in Europe, past research has revealed that several USOs tend to remain small and seem to be lifestyle companies rather than high-growth start-ups (Harrison and Leitch 2010; Fini et al. 2016).

USOs tend to be resource-constrained firms and they usually lack the experience to predict the resources needs to both overcome liabilities and growth (Vohora et al. 2004; Rasmussen et al. 2011). Indeed, USOs denote several constraints in obtaining funding to sustain their growth strategies in the long-term (Tobar 2004; Mustar et al. 2008; Sørheim et al. 2011), since they are sensitive to different types of market failures – chiefly throughout the early phase (Hindle et al. 2011; Gantenbein and Engelhardt 2012). Additionally, academic entrepreneurs often lack critical management capability and skills (Franklin et al. 2001; Oliveira et al. 2013), along with previous experience in the USO industry (Mosey and Wright 2007; Rasmussen and Borch 2010).

In this context, private investors represent pivotal dimensions for full development and growth of USOs. Indeed, previous studies provide evidence that the deficiency of access to external finance is usually behind the low growth of most USOs, making availability of funding one of the most critical elements for USO success (Clarysse

et al. 2007; Miozzo and DiVito 2016). Wright et al. (2006) cite access to Venture Capital (VC) as one of the most important forms to support the USOs' growth strategies. Indeed, VC firms' provision of the capital risk has been considered as a key answer to: bridge over the so-called equity gap for USOs (Wright et al. 2006; Rasmussen and Sørheim 2012); bring the technology/knowledge developed from the university to the market; and increase the USOs' growth opportunities (Rosenbusch et al. 2013; Fini et al. 2016). The entrepreneurship literature has stressed that, in addition to financial resources, VC provides portfolio firms with valuable know-how in developing their business, growth strategy, capabilities (Gorman and Sahlman 1989; Ni et al. 2014), and resilient partnerships with other companies (Ozmel et al. 2013).

In summary, the dynamics associated with the USOs' growth rank high in the agendas of European governments that are worried about fostering innovative firms (Radosevich 1995; Lockett et al. 2005; Botelho and Almeida 2011; Rodríguez-Gulías et al. 2016a), and a more systematic understanding of the factors supporting the USOs' growth is required (Philpott et al. 2011; Rasmussen et al. 2014). At the same time, recent literature underlines a growing interest regarding the impact of VC on firm growth, involving also the entrepreneurial technology/knowledge intensive ventures (Grilli and Murtinu 2014; Colombo et al. 2016; Meglio et al. 2016), such as USOs. While many contributions have addressed the relationship between the presence of VC partners and firm growth, we found an alarming scarcity of studies on USO growth (Becky-Nagy 2013; Rodríguez-Gulías et al. 2016b). Moreover, these studies are primarily descriptive and country-centred.

This paper aims to fill these knowledge gaps by analysing whether the presence of VC affects USO growth in Italy and Spain. In so doing, we relied on a unique panel dataset comprising 531 and 952 Spanish and Italian USOs, respectively, over the period 2005 to 2013. This dataset allowed us to use panel data methodology, which yields more robust findings regarding growth differences between venture-backed and non-venture-backed USOs. As Clarysse et al. (2007), along with Fini and Grimaldi (2016) highlight, a cross-national approach will also add to the literature on VC since the level of VC activity changes across countries, due to the different levels of formal institutional development, incentives and cultural settings (Li and Zahra 2012). In this sense, Italy and Spain represent two European countries showing a rapid and diffuse development of the USO phenomenon in the last few years (Rodeiro-Pazos et al. 2012; Iacobucci and Micozzi 2015), where USOs are usually young. Thus, the study of their growth dynamics is particularly interesting. Also, both belong to the group of European countries with low R&D expenditure.

The paper contributes to the literature on the impact of VC on USO growth in different ways. First, the paper leads to some interesting reflections on the opportunity to leverage the potential benefits provided by VC, which is considered one of the main mechanisms to promote the foundation and development of technology/knowledge oriented ventures (Colombelli et al. 2016). This was also noted by the European Union economic policy agenda (Chemmanur et al. 2014; Dutta and Folta 2016). In so doing, we took a regional perspective with it is needed to build an effective local and national policy action to foster the development of USOs. Second, the majority datasets of USOs comprise a single country and, in most of the cases, rely on cross-sectional research designs. As this paper compares a large number of USOs across two different national contexts over an eight-year period, it extends the knowledge about them within and between the country impacts of VC on the growth of USOs.

The paper is organised as follows: After the “[Introduction](#)” section comes the theoretical framework that outlines the hypotheses to explore in the study. The sample and the econometric models used are introduced in the “[Methodology](#)” section. Next, the “[Results](#)” section provides the outcomes of the empirical and descriptive analyses, while the “[Conclusions and discussion](#)” section discusses the main findings and provides recommendations.

Theoretical framework

In the last few years, literature has paid attention to USO capability to attract VC in order to actively improve firm growth (Lee et al. 2001; Heirman and Clarysse 2004; Clarysse et al. 2007; Rodríguez-Gulías et al. 2017). In this regard, Shane (2004) argues that USOs that have a (potentially) great marketplace, characterised by a solid patent protection, are preferred. In addition, USOs developing technologies that can be applied in many heterogeneous markets and having potentially good entrepreneurial abilities are considered highly appreciated by Venture Capitalists.

Thus, the resource-based view (RBV) of the firm (Penrose 1959) argues that firm performance lies in its ability to collect and deploy their valuable and non-substitutable resources in ways that lead to strong capabilities (Barney 1991). Under this approach, the considerable resource needs for many USOs, especially high-tech ones, constitute a key reason for considering VC as an attractive source not only of funding, but also of managerial expertise and other resources. By investing in USOs, VC partners provide firms with a set of valuable resources and competencies that would be difficult to access in the absence of a VC partner endorsement (Lindsey 2008; Bertoni et al. 2011). Some of the reasons why VC can have a special impact in USOs are:

First, university firms show important cultural dissimilarities with private ones (Wright et al. 2006). Indeed, academic entrepreneurs usually have advanced formal education levels (Siegel et al. 2003), but lack business knowledge and managerial expertise to start a venture (Siegel et al. 2003; Shane 2004; Vohora et al. 2004; Wright et al. 2006). In this sense, the monitoring role (“coach” effect) played by VC investors in the firm’s day-to-day management becomes especially relevant (Colombo and Grilli 2010; Bertoni et al. 2011). Scholars remark that the provision of systematic and deep monitoring services is related with the access of VC to detailed knowledge of their portfolio firms (Lerner 1995; Kaplan and Stromberg 2001; Denis 2004). In turn, the empirical evidence arising from the studies of Ortín-Ángel and Vendrell-Herrero (2010) shows that USOs attract more VC than other high-tech ventures; this is partly due to the lack of managerial skills of academic entrepreneurs, who are more ready and open to receive professional, expert and skilled VC investors to fill these deficiencies.

Second, the effectiveness of VC in fostering the USOs’ growth is related to the specific nature of this kind of firm as well. Thus, similar to other new technology-based firms (NTBFs), USOs usually hold limited tangible assets and are active in the technology transfer process; this is characterised by rapid and continuous change, both at the micro and macro levels (Krugman 1979; Perez and Sánchez 2003; Wright 2014). As remarked by Gompers and Lerner (2001), these issues are mainly challenging for start-ups with a high rate of intangible assets – chiefly related to their innovative and R&D projects, for which the firm’s value is hard to evaluate. According to Bertoni et al. (2011) and Colombo

and Grilli (2010), VCs are especially suitable to fund these high-risk firms since they are exposed, to a lesser extent, (compared with other type of investors) to the adverse selection and moral hazard problems that afflict NTBFs. In so doing, VCs alleviate the USOs' financial restrictions (Colombo and Grilli 2010; Wright et al. 2006) caused by asymmetric information between entrepreneurs and investors (O'Shea et al., 2005, 2008; Czarnitzki et al. 2014; Soetanto and Van Geenhuizen 2015; Fernández-Alles et al. 2015) and help them in obtaining equity (Gompers and Lerner 2001).

The mechanisms, used by VC to overcome the information asymmetry problems, are based on the strong scrutiny of the firms formerly providing the finance ("scout" role), as well as the subsequent and above-mentioned monitoring activity ("monitoring" role). Regarding the scrutiny process, VC investors implement screening and evaluation procedures with the aim of limiting uncertainty and addressing many issues linked with the information asymmetry between the academic entrepreneur and the VC investor (Baeyens et al. 2006; Wright et al. 2006). These procedures are settled primarily for the private sector, and reveal mainly three critical issues for USOs in the VC screening process. First, the commonly soft information of spin-off ventures, such as that related to the communication of early-stage technology, is hard to evaluate, causing adverse selection problems (Freel 2007). Second, risk evaluation is quite problematic in the case of higher levels of uncertainty; this affects the willingness of VCs to finance USOs (see Sørheim et al. 2011). Third, the relatively recent phenomenon of university entrepreneurship may raise negatively the above-mentioned issues (Widding et al. 2009). This "scout" role affects not only the selection of the firm but also its development and growth (Meglio et al. 2016).

Concerning the "monitoring" mechanisms, the most widely used for finance are the syndication with other VC partners, the multi-stage financing of the firm, as well as the involvement on a firm's board of directors. Regarding the first mechanism, scholars maintain that VCs bring in their other investment VCs with the purpose of capitalising in multiple firms and diversifying the company-specific risks. Grilli and Murtinu (2014) claim that syndication between VC partners may have multiple positive effects for portfolio firms, comprising dimensions related to firm growth. Indeed, syndication reduces information asymmetries associated with the screening process (Fried and Hisrich 1994; Abor 2017), minimises the funding concerns. This also enables the transfer of complementary resources, expertise and professional linkages from several VCs (Ferrary 2010; Gu and Lu 2014). Additionally, syndication reduces the number of agency issues with entrepreneurs (Sorenson and Stuart 2001; Cumming et al. 2017), thereby improving the success and quality of the exit strategy (Cumming and Johan 2008).

With regard to the second mechanism (multi-stage firm financing), staged capital infusion represents a fundamental control mechanism for VC (Sahlman 1990; Burchardt et al. 2016; Ragozzino and Blevins 2016). Thus, it keeps the entrepreneur within the right decision-making process in each phase of the firm's growth. Consequently, staged capital infusion increases the financing period and decreases the need of firm re-evaluation. This is because staged capital infusion improves the maturity status of the firm, reducing latent agency problems (Gompers 1995; Gompers and Lerner 2001).

Concerning the third mechanism, the active involvement of the VC partners in the firm's board of directors may have beneficial effects in terms of managerial guidance and backing activity (Gompers and Lerner 2001).

Thirdly, the presence of VC partners generates positive effects in terms of product market outcomes, especially for innovative firms (Gompers and Lerner 2001; Denis 2004), which is the case for the majority of USOs. The empirical study of Hellman and Puri (2000) shows that innovative firms are more likely to be venture-backed, allowing for a quick time to market of their products. The reason behind this effect lies in the VCs' ability to recognise value innovation opportunities and to bring them to market (Denis 2004). This "market gatekeeper" role of VC becomes vital for USOs, which often require effective professional support in transforming the academic research into valuable and marketable innovation outputs.

Fourthly, as observed by Manigart and Sapienza (2000), since VC investors are involved to a greater extent in technology/knowledge intensive ventures than they are in other firms, they often provide venture-backed firms with value-building facilities that have a greater return on investment (Gompers and Lerner 2001; Denis 2004). Thus, VC investors may develop business support services, which provide USOs with physical resources such as reduced rent in business incubators and technology parks ("subsidiser" role). In this view, value-creating facilities from VC represent a great opportunity for the founders and for the growth of the USO overall.

Finally, being venture-backed is often viewed as a signal of firm success ("signalling" effect) since it indicates that the firm has passed the strong scrutiny of VC investors, who evaluate their capability to create substantial prospective economic returns (Lockett et al. 2005; Bertoni et al. 2011). USOs may leverage such acknowledgement to access external resources (i.e., the next round of backing) or to access key interactions with other agents (e.g., business partners, clients, supplies, or other investors, among others). Thus, these agents consider that VC fortifies the firm's competitive advantage, allowing it to make strategic investments in both managerial and innovation activities; this appears to cover the funding requirements throughout all the growth stages of the USO (Heirman and Clarysse 2004). It is noteworthy that an effective signalling effect on venture-backed firms is required (Denis 2004) for the following reasons: (i) the VC investor has reputational capital that would be damaged in the case of an incorrect certification; (ii) the value of the VC's reputational capital exceeds the benefit from an incorrect certification, (iii) the venture-backed firm has to afford a cost to get the VC's participation and therefore their reputation, which increases along with the uncertainty about the firm value.

In view of these arguments (e.g., the "coach," "scout," "market gatekeeper," "subsidiser," and "signaller" roles) for a positive association between VC and the USOs' growth, the following research hypothesis is advanced:

Hypothesis 1: The presence of VC partners positively affects the growth of USOs.

Although VC financing is considered critical and essential for USOs, the empirical evidence studying its impact on firms' growth remains limited. Zhang (2009), using a sample of 704 USOs and 5655 independent American firms over the period 1992 to 2001, shows that the amount of capital raised in the first round of VC has a positive impact on the number of employees. Similarly, Rodríguez-Gulías et al. (2016b), using a longitudinal dataset of 212 Spanish USOs over the period 2001 to 2010, show that VC partners have a positive effect on the USOs' growth in terms of firm sales. Also, Yagüe and March (2011), examining whether the performance of biotechnological USOs in

Spain differs from non-USOs, have included the effect of venture capital in their studies, but they did not find a significant relationship with USO growth.

An additional difficulty with empirically analysing the effect of VC on firm growth is disentangling the “treatment” effect (i.e., the results of the financial and non-financial support provided by VC), from the “selection” effect that results in the capability of the VC to screen high-growth firms and invest mainly in them (Brander et al. 2002; Croce et al. 2013; Bertoni et al. 2013). In this regard, Bertoni et al. (2011), when analysing whether VC investments have a positive treatment effect on the employment and sales growth of the Italian NTBFs, showed that VC does not pick “winners.” This means VCs usually do not invest in firms that would grow without VC partners; but, to the contrary, they seek to “build winners.” This confirms the positive and valuable role of VC in sustaining new and promising ventures, such as USOs, for which the growth and innovative potential would be hampered in the absence of an effective and proactive involvement of specialised professional investors.

As we mentioned, this study covers two different countries. This cross-national approach implies the need for considering in the empirical analysis the differences between the environments in which USOs and VC investors interact. Given that the set of resources differs across countries and regions, the effect of VC on the USOs’ growth can also differ between geographical areas. Therefore, we established the following research hypothesis:

Hypothesis 2: The presence of VC partners affects the growth of USOs differently depending on the country.

Methodology

This section shows the variables considered as well as the methodology. The sample used in our study consisted of 516 Spanish and 904 Italian USOs created by 50 Spanish and 57 Italian universities, respectively, and observed between 2005 and 2013. The respective data collection procedures were mainly the same for both subsamples. First, the basic information (e.g., name, year of foundation, industry classification, etc.) about Spanish and Italian USOs was obtained, respectively, from the Spanish Network of University Knowledge Transfer Offices and the Netval database, which collect updated information about the full population of active USOs in each country. Second, we used the SABI database (in the Spanish case) and the Aida BvD database (in the Italian case) to construct two longitudinal (2005–2013) datasets containing data about firm-specific characteristic and financial performance of USOs. Both databases are provided by Bureau Van Dijk and gather the financial, biographical and merchandise data of firms.

Dependent variable

Regarding performance in new firms, growth has been used as the most common indicator (Wennberg et al. 2011). In this sense, the sales growth is considered a good indicator of the firm’s success in spite of the fact that a firm could grow without having sales in the short-term. That is the case, for example, for technology firms that need a long pre-commercial stage to develop their products.

Following Wennberg et al. (2011), we measured sales growth as the natural logarithm of the difference in the sales of the firm:

$$\text{Growth}_{i,t} = \ln\left(\frac{\text{Sales}_{i,t}}{\text{Sales}_{i,t-1}}\right)$$

Independent and control variables

In this work, just as in Bonardo et al. (2009) and Yagüe and March (2011), the main independent variable (VENT_CAP) was a time-invariant dummy variable that takes the value 1 if the USO had at least one VC partner in its shareholder, and 0 otherwise.

Additionally, a set of control variables was incorporated. In order to approximate firm-specific characteristics, we used the natural logarithms of the firm age (LN_AGE) and the number of employees (LN_EMP). With regard to firm financial performance, we included the return on assets (ROA) and the total asset turnover ratio (TOT_TUR). Finally, we controlled for the firms in high-tech industries (HIGHTECH). Table 1 summarises the measures of independent variables and shows the expected relationships with firm growth.

Model specification

We used panel data methodology in order to analyse if venture-backed USOs grow more than non-venture-backed USOs for the Spanish and the Italian cases. Compared to cross-sections analysis, panel data methodology allows controlling for individual heterogeneity. USOs are presumably heterogeneous, that is, each one has its own individual behaviour. This individual behaviour is very closely related to the decision to admit VC partners in the shareholding, among other aspects. And, more importantly, the effect of being a venture-backed USO on firm growth links strongly to the specificity of each firm. By using panel data methodology, we controlled for this heterogeneity by modelling it as an individual effect, α_i .

More specifically, we applied the random effects GLS (Generalised Least Squares) model. This alternative has been selected based on the fact that the main independent

Table 1 Measures of independent variables and predictions

Variable			Measures
Venture capital	VENT_CAP	(+)	1 if the firm had venture capital funding, and 0 otherwise
Age	LN_AGE	(+)	Natural logarithm of the firm age
Size	LN_EMP	(+)	Natural logarithm of the number of employees
Return on assets	ROA	(+)	Net income divided by total assets
Total asset turnover	TOT_Turnover	(+)	Sales divided by total assets
Industry	HIGHTECH	()	1 for firms in high-tech industries according to the to the Eurostat classification, and 0 otherwise

variable (VENT_CAP) is time-invariant and we could not test the proposed hypotheses if we opted for using an intragroup or fixed effects estimator. The random effects estimator assumes that the individual effects (α_i) are independent (uncorrelated) from the explanatory variables (x_{it}). Thus, the basic specification of the model is as follows:

$$GROWTH_{it} = \beta_1 VENT_CAP_i + \beta_2 LN_AGE_{it} + \beta_3 LN_EMP_{it} + \beta_4 ROA_{it} + \beta_5 TOT_TUR_{it} + \beta_6 HIGHTECH_i + a_i + \lambda_t + \varepsilon_{it}$$

Where α_i is the firm-specific time-invariant effect (unobserved heterogeneity), λ_t incorporates the time-specific effect by time dummy variables allowing us to control for the effects of macroeconomic variables, and ε_{it} is the random disturbance.

Empirical results

Descriptive Analysis

Of the 1420 USOs that constitute the final sample, 76 Spanish USOs and 22 Italian USOs had VC partners. The proportion of firms with VC investors is substantially higher in the Spanish case (15% of the total Spanish USOs) than in the Italian case (2% of the total Italian USOs) (Fig. 1).

Table 2 shows the descriptive statistics for the dependent and independent variables by subsamples: Spain and Italy. At the same time, the information for venture-backed USOs and non-venture-backed USOs is displayed, as well as a test of the mean differences (t-test) between both groups of companies.

Regarding the dependent variable, the mean growth rate of the period in the venture-backed Spanish USOs is higher (177.7%) than in the non-venture-backed ones (129.4%). In Italy the opposite is true (68.8% in venture-backed and 331.8% in non-venture-backed USOs). Nonetheless, the differences are not statistically significant in both cases (Table 2).

More in detail, Fig. 2 shows the mean growth rates of the analysed period in the Spanish USOs distinguishing between venture-backed and non-venture-backed firms. Figure 3 displays the same for the Italian case.

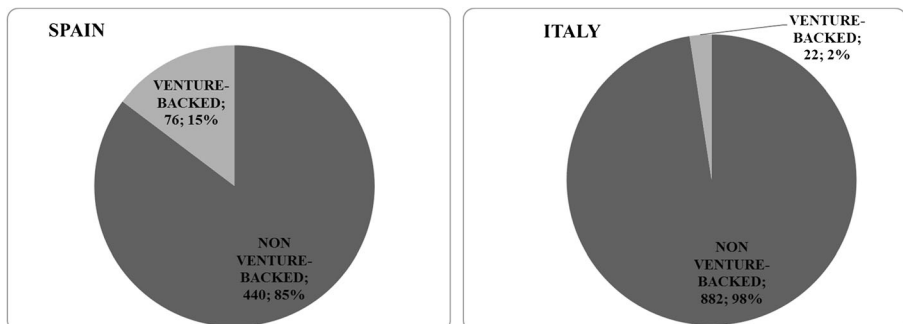


Fig. 1 Spanish/Italian venture-backed USOs

Table 2 Differences between venture-backed and non-venture-backed USOs by country: t-test

	Non-venture-backed		Venture-backed		t-test	
	Obs	Mean	Obs	Mean	t	P > 0
Spain						
G_Sales ^a	1895	1.294	359	1.777	-0.864	0.388
Age ^a	2579	6.215	519	6.397	-1.143	0.253
EMP ^a	2176	7.026	473	15.554	-11.856***	0.000
ROA	2552	-0.073	514	-0.129	1.708*	0.088
TOT_Turnover	2402	1.119	444	0.396	6.706***	0.000
HIGHTECH	2579	0.451	519	0.649	-8.340***	0.000
Italy						
G_Sales ^a	3039	3.318	88	0.688	0.273	0.785
Age ^a	4976	5.157	158	5.766	-1.948*	0.052
EMP ^a	3713	2.602	124	5.290	-2.889***	0.004
ROA	4369	-0.007	138	-0.396	10.839***	0.000
TOT_Turnover	4351	0.799	138	0.252	9.103***	0.000
HIGHTECH	4957	0.626	158	0.797	-4.401***	0.000

^a Variables are not in logs. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The table also shows the difference of means for variables between venture-backed and non-venture-backed USOs. The t statistic is used to test the equality of means

In Spain (Fig. 2), the annual average growth rates was always positive for both venture and non-venture backed USOs, although they had substantially decreased over the period 2006 to 2013. The Italian USOs show smaller growth rates than the Spanish (Fig. 3). Although they have also displayed a decreasing trend since 2008, they have not fallen so drastically. In this case, the growth rates were superior for the non-venture-backed USOs over all the analysed periods.

In the Spanish sub-sample, there were no significant differences in the firms' ages between venture-backed (6.4 years on average) and non-venture-backed USOs (6.2 years on average). However, venture-backed USOs were significantly larger than non-venture-backed USOs (15 and 7 employees on average, respectively), and had a greater presence in high-tech sectors (65% and 45%). On the other hand, the average ROA and the average total asset turnover ratio were significantly higher for the latter (Table 2).

Similar to the Spanish case, the venture-backed Italian USOs operated in high-tech sectors to a greater extent than the non-venture-backed USOs. In the same way, the ROA and the total asset turnover ratio had higher values in the non-venture-backed USOs (Table 2).

Finally, Table 3 shows the correlation matrix of the dependent variable and the independent continuous variables.

Multivariate analysis

Table 4 presents the results for random effects GLS models on sales growth for Spain and Italy.

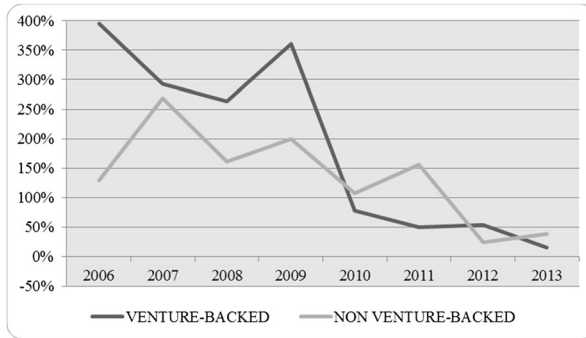


Fig. 2 Mean rates of sales growth in the Spanish USOs (2006–2013)

In the Spanish case, the results show a positive effect for the presence of VC partners on sales growth. However, this effect is not significant in the Italian case. Hence, the *Hypothesis 1*, which referred to the effect of VC partners on the USOs' growth, is strongly supported only for the Spanish case. In turn, the hypothesis stating that the impact of VC on the USOs' growth can differ across countries depending on the differences in the environments (*Hypothesis 2*) is supported.

In addition, in both countries, USO growth is positively determined by firm size and profitability, as well as the firm's efficiency in the use of assets. In contrast, firm age negatively impacts firm growth. In the Spanish case, we also found a positive relationship between operating in high-tech sectors and sales growth.

Conclusions and discussion

The arguments related to the growth dynamics of USOs are currently increasing in the literature, since the understanding of their growth drivers is essential for the development of effective and resilient university entrepreneurship (Visintin and Pittino 2014; Rasmussen and Wright 2015; Scholten et al. 2015; Jelfs 2016). In this regard, the lack of adequate finance and the scarce management expertise of academic entrepreneurs have been often acknowledged as significant obstacles to the full business development and growth of USOs. In this context, VC partners appear to be especially suitable

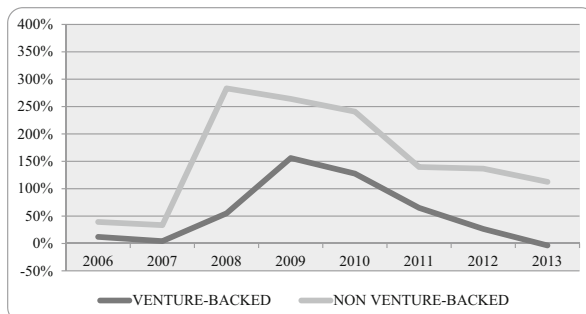


Fig. 3 Mean rates of sales growth in the Italian USOs (2006–2013)

Table 3 Correlation matrix

	G_Sales	LN_AGE	LN_EMP	ROA	TOT_Turnover
G_Sales	1				
LN_AGE	-0.2496*	1			
LN_EMP	0.0348*	0.3419*	1		
ROA	0.1553*	0.0308*	0.0273	1	
TOT_Turnover	0.1249*	0.0420*	-0.0751*	-0.3259*	1

Table shows the Pearson correlation coefficients for the continuous variables considered in the empirical analysis. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

investors for USOs, since VC partners help venture-backed firms in financing and assist with improving their managerial skills and commercial approach. At the same time, they provide venture-backed firms with a solid portfolio of social and organizational ties, which are critical for their growth opportunities.

Stemming from these arguments, the aim of this study was to explore whether VC investors affect the USOs' growth, considering two different countries with the same methodology. To answer this question, we empirically analysed the impact of the presence of VC investors on the growth of 516 Spanish and 904 Italian USOs created by 50 Spanish and 57 Italian universities, respectively, and observed them between 2005 and 2013.

Table 4 Panel regressions for random effects GLS models on sales growth: Spain and Italy

	Spain	Italy
VENT_CAP	0.242*** (0.061)	0.179 (0.122)
LN_AGE	-0.643*** (0.056)	-0.472*** (0.057)
LN_EMP	0.106*** (0.023)	0.103*** (0.025)
ROA	0.318*** (0.092)	0.477* (0.209)
TOT_Turnover	0.158*** (0.034)	0.191*** (0.037)
HIGHTECH	0.108* (0.047)	0.002 (0.045)
YR2006C	-0.053 (0.087)	-0.196* (0.084)
YR2007C	-0.044 (0.076)	-0.083 (0.078)
YR2008C	-0.007 (0.077)	-0.134 (0.077)
YR2009C	-0.205** (0.068)	-0.208** (0.076)
YR2010C	-0.095 (0.058)	-0.069 (0.156)
YR2011C	-0.029 (0.057)	-0.021 (0.066)
YR2012C	-0.096 (0.059)	0.004 (0.078)
_CONS	0.995*** (0.132)	0.804*** (0.126)
Observations	2067	1303
Firms	450	397
Wald χ^2	293.99***	134.90***

Robust standard errors are in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Our results show a different effect in Spanish and Italian contexts. While in Spain VC has a positive effect on sales growth, in Italy there is not a significant effect.

Therefore, for Spanish USOs the support provided by VC investors may be boosting its above-average growth. First, when compared to non-venture-backed USOs, the venture-backed ones operate in high tech sectors to a greater extent. In these sectors, VCs could outperform traditional investors, since VCs benefit from a more accurate valuation of firms who are operating under high levels of uncertainty (“scout” role); and VCs also benefit from their ability to recognise value innovation opportunities and to bring them to market (“market gatekeeper” role). Second, the presence of VC investors could mitigate the lack of managerial skills of the USOs’ academic founders (“coach” role). Thirdly, the venture-backed USOs could be having access to more resources not only directly provided by VC investors (“subsidiser” role), but also by other agents due to the “signalling” effect of being backed by a VC investor.

In contrast, for Italian USOs, although the presence of VC partners might allow them to overcome the constraints hindering firm growth, VC activity may be inadequate – chiefly in bank-based institutional contexts such as Italy. Groh et al. (2010) have calculated composite indices to compare the attractiveness of 27 European countries for institutional investments into the VC and Private Equity (PE) asset class. The findings show that the resulting scores are rather low for Italy.

In line with this finding, the empirical results of this study show that, in the Italian context, the presence of venture-backed USOs is quite limited – especially when compared to the Spanish case. This may represent a cause of the non-significant effect of VC partners on the growth dynamics of USOs. The low involvement of VC partners in Italian USOs simply reflects the scarce diffusion of this type of professional investor in the country, as noted in a recent report by Acevedo et al. (2016). We see that both Spain and Italy – where firms receive VC comprise only 0.018% and 0.005% of GDP, respectively – have the lowest relative share of GDP in comparison with other European countries. In addition, the Italian VC market is significantly less developed and a relatively immature sector, especially with regard to SMEs and NTBFs (Bertoni et al. 2013; Rossi 2015). The causes are related to systematic and simultaneous determining factors mainly related to the cultural context and the emerging socio-economic condition. Indeed, a greater part of the Italian firms, especially small ones, are usually reluctant to open up to outsiders for involvement in their businesses. Furthermore, the negative economic condition led to a significant reduction in the number of new ventures in the last decade (Acevedo et al. 2016). Also, the noticeable and pronounced regional inequalities increase the existing gap between the Italian VC market and the VC markets in other countries (Bertoni et al. 2013; Rossi 2015); this was also noted by the Italian Association for Private Equity and Venture Capital (AIFI). These elements prevent an adequate and active expansion of the VC market in Italy, hampering the roles that VC partners can play in the USOs’ growth where there is an exchange of complementary resources, transfer of managerial and organizational expertise; and where there is also the development of contact networks, monitoring, screening and signalling activity, along with well-developed multi-stage financing activity.

For these reasons, in Italy, other mechanisms, such as public subsidies, may serve as a substitute for VC in promoting the USOs’ growth. A similar conclusion was reached by Colombo and Grilli (2007) in the case of NTBFs. In any case, the above described context leaves open a question which is of great interest in the Italy case: Should VC

investors be supported, or should other complement/substitute mechanisms aimed at promoting the USOS growth be designed?

In view of our results, different policies should be proposed for Spain and Italy. In the Spanish case, policies must be oriented to reinforce the role of VC, as it positively affects the USOs' growth. In this sense, the selection of projects with significant potential could help VC activities. Some specific policies could be:

- Create a common database of Spanish USOs
- Create forums to present projects and get investment rounds

In the case of Italy, policies must first be introduced to promote the participation of VC investors in USOs and enhance the growth of the venture-backed USOs. Based on this, the policies for the Italian case should be applied from the sphere of public administrations and/or universities. Therefore, some of these policies could be:

- Facilitate greater guarantee to VC investors.
- Offer tax advantages to venture capitalists/business angels.
- Create intermediaries to identify potential USOs and investors.

Hence, a review of the policy programs and actions following the domains above is required – especially for Italy. The plan of policy schemes that effectively fosters the activity of VC investors and jointly brings USOs with high-growth potential to look for adequate investors is a critical priority for Spanish and Italian policy makers.

Our study adds to existing research regarding the role of VC in the USOs' growth. First, to the best of our knowledge, no previous study has analysed the presence of VC as a growth driver of USOs from a cross-national approach. However, the empirical results underline the need for adopting a “cross-national approach” in the study of this issue since the role played by VC investors may differ across countries. Indeed, the European concern with having fewer leading innovators than the U.S. has often lead institutions to adopt “one size fits all” policies in their strategies that are geared towards promoting innovation. However, these kinds of policies may have unexpected effects across countries if national differences are ignored. Second, at a scientific level, it was considered a broad period of time, which allowed us to capture the growth dynamics of USOs. Third, using panel data methodology and applying GLS models allowed us to control for firm heterogeneity, which is closely related to the decision of being venture-backed. In so doing, we yielded more robust findings regarding growth differences between venture-backed and non-venture-backed USOs.

The above discussed results provide some novel insights into the function and effectiveness of VC investors in improving the USOs' growth. Nevertheless, we are aware that our paper has some limitations that open new stimulating guidelines for future research. First, the availability of information was the main problem of this work. This was due to the fact that the SABI database, used for the Spanish USOs, does not provide historical information on the composition of the shareholders. Information about the specific date and amount of VC participation would lead to more robust results. Second, the number of venture-backed USOs was quite limited. It could be interesting for future studies to test the hypotheses on a larger sample of venture-backed USOs. Third, since significant dissimilarities among VC investors can be found on the

base of features related to investment familiarity and human capital (Knockaert et al. 2006), jointly with the different typology of VC (corporate VC, independent VC, governmental VC and bank-affiliated VC) (Andrieu and Groh 2012; Brander et al., 2015; Wadhwa et al. 2016), it could be interesting for new studies investigate whether different types of VC investors have different effects on USOs' growth.

Furthermore, future research may benefit from distinguishing the general effect of VC from the specific roles played by VC partners (the “coach,” “scout,” “market gatekeeper,” “subsidiser,” and “signaller” roles), in order to better understand the key factors supporting and spurring the growth dynamics in the USOs. Additionally, the cross-country factors affecting VC behaviour should also be considered in future studies by including country-level variables referred to entrepreneurial culture, institutional setting, micro- and macro-economic conditions, financial market development, and protection of property rights (Bruining and Wright 2002; Carpenter and Petersen 2002; Dushnitsky and Lenox 2005; Bernstein et al. 2016). In this regard, it could be interesting to investigate also the moderating role of the above-mentioned variables in the relationship between VC and USO growth. Finally, the different effects of VC on the USOs' growth between Italy and Spain may also be analysed in terms of internal dynamics of VC partners, such as the financing approach, the organisational model, and the goals and selection strategies of portfolio firms. Hence, the understating of the settings under which VCs play a key role for the USOs' growth will be certainly improved.

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