Scopus

Documents

Prencipe, A.[a] , Corsi, C.[a] , Rodríguez-Gulías, M.J.[b] , Fernández-López, S.[c] , Rodeiro-Pazos, D.[c]

Influence of the regional entrepreneurial ecosystem and its knowledge spillovers in developing successful university spin-offs
(2020) *Socio-Economic Planning Sciences*, 72, art. no. 100814, .

DOI: 10.1016/j.seps.2020.100814

[a] Università degli Studi di Teramo, Italy
[b] Universidade da Coruña, Spain
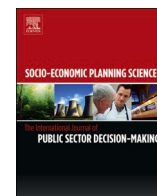[c] Universidade de Santiago de Compostela, Spain

ELSEVIER

RELX Group™

Influence of the regional entrepreneurial ecosystem and its knowledge spillovers in developing successful university spin-offs

Antonio Prencipe [a], Christian Corsi [a], María Jesús Rodríguez-Gulías [b], Sara Fernández-López [c], David Rodeiro-Pazos [c,*]

[a] *Università degli Studi di Teramo, Italy*
[b] *Universidade da Coruña, Spain*
[c] *Universidade de Santiago de Compostela, Spain*

A R T I C L E   I N F O

A B S T R A C T

University Spin-Offs (USOs) are dynamically involved in the knowledge spillover process and incorporated in the regional entrepreneurial ecosystem. Drawing on the knowledge spillovers related concepts and entrepreneurial ecosystem approach, the paper aims to explore the hypothesis that the regional context may partially determine the USOs' growth via a cross-national analysis and using an 'interactionist' approach. Two samples of Spanish and Italian USOs (516 and 904 firms, respectively) over the period 2005–2013 were used and it was applied the multilevel modelling to empirically test the hypotheses. The findings show that regional context affects firm's growth only for Spanish USOs, while for the Italian USOs the evidences seem to suggest a not significant determining influence. The paper provides evidence that the region is a critical contextual dimension and an influential factor in building a more explicative research agenda on entrepreneurial universities.

1. Introduction

Public policies at national and international levels progressively consider University as having a significant role to play in economic development (Smith [1]; Sandström et al. [2]), especially within the interdependence of players and system-level institutional, informational, and socioeconomic environments that form the entrepreneurial ecosystems (Audretsch and Belitski [3]). In particular, the formation of University Spin-Offs (USOs) are considered central pillars of an entrepreneurial ecosystem since they have become a common way to create value from research and to transfer technology, commercializing academic research results and intellectual property (IP) (Guerrero et al. [4]). Indeed, USOs have been raised the attention of public policies because of their potential capability to spread scientific knowledge and to contribute to regional socio-economic growth (Audretsch et al. [5]; Smith and Bagchi-Sen [6]), expanding relations with industry (Benghozi and Salvador [7]), and creating job opportunities for both academics and students (Rizzo [8]).

However, because of their technological/knowledge bases, USOs combine the typical problems of new technology-based firms with the traditional difficulties for start-ups (Oakey et al. [9]). Particularly in Europe, several scholars highlighted that most USOs tend to remain small and seem to be lifestyle firms rather than high-growth companies (Harrison and Leitch [10]). In this regard, the stimulation of USOs' growth is becoming a critical issue for universities and governments (Hess and Siegwart [11]; Schaeffer and Matt [12]).

Several scholars call for a more understanding of the growth-enhancing factors for USOs, too (Galati et al. [13]; Hayter [14]; Wennberg et al. [15]). In particular, some recent firm growth studies, also in the entrepreneurial university context, argue the benefit of applying an 'interactionist' approach by using hierarchical or multilevel modelling, with the purpose of concurrently investigating the firm and the context-levels (Boshuizen et al. [16]; Van Oort et al. [17]; Rodríguez-Gulías et al. [18]; Chang et al. [19]). Such empirical approach becomes pivotal in the study of USOs, because of the role played by the context where the firm is located and the knowledge spillovers, jointly with the firm's intrinsic characteristics.

Studies have shown the regional impact of universities on new business creation and knowledge transfer (Vohora et al. [20]; Etzkowitz and Klofsten [21]; Horta et al. [22]) and the impact of the university's

---

entrepreneurial activity on regional competitiveness (Guerrero et al. [23]) but, to the best of our knowledge, no studies have focused on the other side of the coin, that is, the impact of regional context on USOs' growth.

The regional context may represent an important source of knowledge spillovers for the USOs' growth perspectives due to the constant and growing contacts and the reciprocal trades between universities and external local actors (Rodríguez-Gulías et al. [18]). Even there are different knowledge spillovers all of them are impacted by the context of the environment (Ferreira et al. [24]). Also, it becomes critical to consider the entrepreneurial ecosystem approach because it includes the regional elements that are essential to knowledge spillover entrepreneurship (Spigel [25]; Stam [26]), systematically addressing the central factors that facilitate regional entrepreneurial activity (Qian [27]), particularly for innovative or high-growth firms (Qian [28]) such as USOs.

We therefore pose the following research question: may the knowledge spillovers of the regional context and the different factors in the regional entrepreneurial ecosystem in which a USO is launched partly determine its growth? In order to explore this question, we build on the Knowledge Spillover Theory of Entrepreneurship (Acs et al. [29]), the entrepreneurial ecosystems framework (Spigel [25]; Spigel and Harrison [30]) and the Resource-Based View theory (Penrose [31]; Sirmon et al. [32]) proposing that expertise and resources, both physical and intangible, in a regional geographical area may potentially impact the growth dynamics of the university ventures.

We rely on a panel dataset comprising 516 and 904 Spanish and Italian USOs, respectively, over the period 2005–2013 and located in 36 administrative regions. A multilevel analysis is applied. Our study makes several contributions to the literature on contextual determinants of the USO's growth. First, whereas several studies have looked at the link between contextual determinants and the growth of USOs, this study simultaneously disentangles the effects of the regional and the firm-level factors on the USOs' growth dynamics by using multilevel modelling. Second, by analysing the emerging and critical role of knowledge spillovers linked to the regional context and the related entrepreneurial ecosystems approach, this study adds new lights about the relational dynamics among regions and growth of USOs. In this regard, since USOs stem from universities to commercialise research outputs, they might benefit from regional knowledge spillovers, as well as from the interaction with individual entrepreneurs and the social and economic environments constituting the entrepreneurial ecosystem to a greater extent than other firms. This is central to well recognise the dynamic stream of knowledge spillovers in the regional context. Third, most datasets of USOs involve a single country and usually rely on cross-sectional research designs. As this study matches the majority of USOs across two different national contexts over an 9-years period, we extend the understanding of the within- and the between-country effects on the USOs' growth.

The remainder of this paper is organised as follows: Section 2 introduces the literature review and presents the positioning of this paper; in Section 3, the data are described while Section 4 discusses the model used for the empirical analysis; Section 5 and 6 give the results, and finally Section 7 summarises the main findings and provides the implications for research and practice.

2. Theoretical framework

2.1. Multilevel analysis and university spin-off growth

The studies on entrepreneurial context are dominated by single-level approaches, mostly concentrating on the individual or on the company as (single) unit of study (Davidsson and Wiklund [33]). Nevertheless, in recent years there has been a rising acknowledgement that multilevel modelling generates a more comprehensive understanding of the firm's growth dynamics (Morales and Holtschlag [34]; Wright and Stigliani [35]; Van Oort et al. [17]) by hierarchically considering individual and contextual factors.

Up to now, the studies exploring growth drivers within and across different levels of analysis are not so diffuse in the literature on firm's growth. The need to go further a single level of analysis becomes a cornerstone in the entrepreneurial university literature. Thus, at a micro-level of analysis and following the Resource-Based View of the Firm (RBV), USOs' growth is closely related to the financial, human, cognitive and organizational resources of the venture (Berbegal-Mirabent et al. [36]). Also, external resources are critical sources of competitive advantage and growth opportunities for USOs (Raspe and Van Oort [37]; Rodríguez-Gulías et al. [18]), given that they have an urgent need of improving their initial resource endowment (Brush et al. [38]; Mustar et al. [39]) through interaction with other players in the entrepreneurial ecosystem. For instance, academic entrepreneurs need to improve their managerial credibility and entrepreneurial capability to gain access to outside resource providers and, here, the parent university can play both a fostering and an assisting pivotal role (Rasmussen et al. [40]; Rasmussen and Wright [41]). Thus, some studies call for reflection on the ways in which external (contextual) resources of USOs, especially those referred to the regional knowledge spillovers (Rodríguez-Gulías et al. [42]), and internal ones, when simultaneously considered, leverage the USO's growth (Rasmussen et al. [40]; Raspe and Van Oort [37]).

Though different levels of analysis have been considered in the USO literature, these levels have usually been explored in a separate way (Lockett et al. [43]; Rothaermel Agung and Jiang [44]). Thus, the ways through which the context affects USOs' growth remain still ambiguous. Given that regional knowledge infrastructure and technology policy are crucial for a firm's growth performance and innovation (Beugelsdijk [45]), our study aims at bridging the gap between the firm- and the regional-level in the case of USOs.

Drawing on previous arguments we address such a question by using multilevel analysis which allows us to simultaneously considering the available resources of USO at firm-level and at regional-level. Moreover, the use of the multilevel modelling allows pondering the firm-specific characteristics as critical 'controls' to isolate the effects of the regional variables (Raspe and Van Oort [37]). In so doing, we not only counterbalance the trend to overemphasizing the contextual resources in USOs' growth to the detriment of firm resources (Dicken and Malmberg [46]), but also acknowledge that the effects of regional knowledge spillovers may differ across USOs, mainly depending on their resource endowment and capabilities. Consequently, we propose the following hypothesis:

H1. Multilevel analysis is a more appropriate methodology to test the existence of a regional effect on the USOs' growth than that of the single-level analysis.

2.2. The region-level focus in the entrepreneurial ecosystem approach

Basically, the entrepreneurial ecosystem approach postulates that certain circumstances occurring outside the boundaries of a firm but within a spatial area contribute to the development of the organization. Thus, entrepreneurial ecosystems can be defined as a set of interdependent players and system-level informational, institutional and socioeconomic settings (Audretsch and Belitski [3]) spatially bounded. In this regard, several scholars acknowledge the critical role of the geographical dimension and the proximity in understanding the growth dynamics and firm performance (Grillitsch and Nilsson [47]; Molina-Morales et al. [48]). More specifically, the region has been mostly chosen as the spatial unit of study under the entrepreneurial ecosystem approach. In this regard, Mathisen and Rasmussen [49] point out that USOs are embedded in a surrounding regional ecosystem that is built by an idiosyncratic history, embracing composite relations among universities, public authorities, industry, financiers, and the human

resource capital. USOs are seen as pioneers in shaping the business environment in their regional entrepreneurial ecosystem; however, regional factors also impact the conditions affecting the creation and subsequent growth of USOs. Additionally, Fini et al. [50] using multi-level analysis and analysing the institutional determinants (at both national and university levels) of USOs quantity and quality, remark that regional-level factors may also impact on spin-off establishment and growth.

The regional context has been accepted as a central argument for knowledge generation, not only concerning firm's growth (Fallah et al. [51]; Duschl et al. [52]) but also the USOs (Autio et al. [53]; Sternberg [54]; Rodríguez-Gulías et al. [18]).

In this view, the Knowledge Spillover Theory of Entrepreneurship (KSTE) posits that knowledge created by incumbent firms and research centres (Utterback [55]) spills over to knowledge and technology-based firms, such as USOs, which are primarily qualified to absorb such knowledge and integrate it with the knowledge created in-house (Caiazza et al. [56]). In fact, USO are considered one the most tailored agent to gain positive spillovers for the regional context, since the analytical or synthetic knowledge base characterizing them is quite affected (with different degrees) by geographic boundaries (Klepper [57]; Asheim et al. [58]).

Knowledge is indicated as a definite strategic resource and the fundamental basis for generating competitive advantage according to knowledge-based view (Nagano [59]). The knowledge needed for USOs' growth may be gained from a mixture of internal and external sources, such those related the regional context. Strategic entrepreneurship, grounded in the RBV of the firm, identifies the prominence of accessing the resources and capabilities needed to support opportunity seeking behaviour targeted at realizing competitive advantage and growth (Caiazza et al. [60]). Understating the sources of these resources and capabilities related to regional context and its entrepreneurial ecosystem is fundamental in the understating of the knowledge spillovers effect of regions on USOs' growth (Liu et al. [61]). Our focus on RBV and KSTE highlights the role of the resources and capabilities embodied in the regional knowledge and entrepreneurial ecosystem in adding competitive advantage and growth for USOs. Therefore, these two approaches complement each other by underlining that critical resources/knowledge for growth may be beyond firm boundaries and so USOs may benefit from regional knowledge spillovers.

The regional knowledge infrastructure, understood as a combination of R&D employees and expenses, has become a cornerstone of the regional innovation policies for which the region's firms can also benefit (Grillitsch and Nilsson [47]; Fini et al. [62]). Thus, the regional knowledge infrastructure has been proved to boost long-term innovative investments that reinforce the growth patterns of firms (Beugelsdijk [45]; He et al. [63]) in general, and USOs in particular (Rasmussen et al. [64]; Sternberg [54]). Similarly, the region might be a critical source of human capital spillovers for knowledge and technology-based firms, such as USOs (Sanso-Navarro et al. [65]). Given that knowledgeable human capital has high capabilities to absorb and exploit knowledge, it represents a strategic component of the regional knowledge economy and of the firm's growth patterns (Raspe and van Oort [66]). Actually, the USOs' needs of highly skilled R&D workers require them to recruit the most brilliant human capital in the region, favouring the growth of the firm (Rodríguez-Gulías et al. [42]).

Furthermore, in order to alleviate the financial constraints, public programs provided at regional level may foster the generation and the development of new technology-based firms. In this regard, the function of venture capital funding is well acknowledged by academics and policy makers (Colombelli et al. [67]; Chemmanur et al. [68]; Dutta and Folta [69]), especially with regard to new small ventures, high-tech sectors (Grilli and Murtinu [70]) and also USOs (Rodríguez-Gulías et al. [71]; Bock et al. [72]). Frequently, the funding programs are launched through local administrations and regional funding with the purpose of providing financial and non-financial support to stimulate

the technology transfer from the university to the industry (Lockett et al. [73]) but also specifically directed to USOs (Sternberg [54]), in the form of public incubators and science parks, too (Kochenkova et al. [74]).

Finally, regional context may provide firms with other resources related to spatial externalities (Guerini and Rossi-Lamastra [75]; Casper [76]; Colombelli [77]). Indeed, firms face critical junctures in their growth process. They need to gain definite resources and skills to be capable to develop to the subsequent stage (Vohora et al. [20]). These resources and links can generally only be gained outside the firm, in its local context. The university ventures are usually determined by a technological idea rather than a definite market demand. In this regard, the knowledge and the technologies, enclosed in this idea, face some constraints to suit a market need (Mosey and Wright [78]). Thus, the local industry setting may potentially stimulate the business development of USOs by being dynamically involved in several relational interchanges with universities (Etzkowitz [79]; Perkmann et al. [80]). Due to the lack of business and commercial experience, the academic entrepreneur usually needs the support, the resources and other externalities of the agents from outside the university context (Rasmussen et al. [40]; Rasmussen et al. [64]).

Stemming from previous arguments, we propose the following approach:

H2. The regional context in which a USO is launched may partly determine its growth.

3. The data and sample

In the past fifteen years, we have assisted to a considerable increase in the number of USOs set up in Spain and Italy. In spite of this, a major obstacle for empirical research on USOs has traditionally been the lack of a common definition (Pirnay et al. [81]). Since this research cover two different countries, this point was crucial to guarantee the comparability of results. Therefore, we previously agreed in considering as USOs those firms created to exploit university knowledge but not necessarily founded by university staff. This definition of USO also seems to be the most widely used among researchers (Zhang [82]).

According to this definition, the study sample initially included 531 Spanish USOs, observed from 2001 to 2013, and 952 Italian USOs, observed from 2005 to 2014. In order to have a common period of analysis, the period 2005–2013 was selected, which led us to discard 63 USOs. Therefore, the final sample consisted of 1,420 USOs located in 16 Spanish and 20 Italian regions over the period 2005–2013. Table 1 shows the geographical distribution of USOs across Spanish and Italian

Table 1
Distribution of USOs in regions (by country).

Spain Region	Nº USOs	Italy Region	Nº USOs
Catalonia	132	Piedmont	107
Andalusia	82	Lombardy	106
Valencian Community	71	Tuscany	102
Madrid	68	Emilia-Romagna	96
Galicia	48	Apulia	70
Basque Country	39	Veneto	61
Aragon	12	Lazio	56
Canary Islands	11	Friuli-Venezia Giulia	53
Asturias	10	Marche	48
Castile and Leon	10	Liguria	36
Murcia	9	Sardinia	32
Navarre	7	Umbria	30
Castile-La Mancha	5	Calabria	24
Extremadura	5	Campania	24
Cantabria	4	Abruzzo	15
Balearic Islands	3	Sicily	15
		Trentino-South Tyrol	15
		Molise	8
		Basilicata	5
		Aosta Valley	1
Total	**516**	**Total**	**904**

regions.

Table 1 reveals that USOs vary substantially across regions. While more than 55% of Spanish USOs are located in only three regions, the three Italian regions with more USOs concentrate slightly less than 35% of the total. Furthermore, 25% of the Spanish regions have hosted five or fewer USOs, but this percentage is 10% in the Italian case. Accordingly, the concentration of USOs by region seems to be rather higher in Spain than in Italy.

4. Model specification

Testing the H1 actually means answering the question of whether using multilevel modelling is a more appropriate methodology than using single-level analysis in which contextual variables can also be introduced. More specifically, we tested whether a three-level model fits the data significantly better than a single-level model without super-cluster and cluster effects (Leckie [83]). In so doing, the simplest three-level model that decomposes the total response variance into level specific variance components (Leckie [83]) was considered:

$$\text{GROWTH}_{ijk} = \beta_0 + v_k + u_j + e_{ijk} \text{ [Model 1]}$$

$$v_k \sim N(0, \sigma^2_v)$$

$$u_j \sim N(0, \sigma^2_u)$$

$$e_{ijk} \sim N(0, \Omega_e)$$

where GROWTH_{ijk} is the observed growth for occasion i in USO j in region k, β_0 is the mean response across all occasions, v_k is the effect of the region, u_j is the effect of USO j within region k, and e_{ijk} is the residual error term.[1] Then, it was performed a likelihood ratio test (*LR*) comparing the empty three-level model with the empty single-level model (Leckie [83]).

$$LR = -2 \, lnL_1 - (-2\log L_2)$$

where L_1 is the likelihood value of the single-level model, L_2 is the likelihood value of the multilevel model and 'ln' refers to the natural logarithm.

After validating the H1, we properly tested whether USO's growth is partly determined by the region where USOs are located (H2). More specifically, we compared the three-level model (Model 1) with the following two-level occasions-within-USO model (Model 2) (Leckie [83]; Rabe-Hesketh and Skrondal [84])[2] by performing again the LR test[3]:

$$\text{GROWTH}_{ij} = \beta_0 + u_j + e_{ij} \text{ [Model 2]}$$

$$u_j \sim N(0, \sigma^2_u)$$

$$e_{ij} \sim N(0, \Omega_e)$$

---

[1] The random effects are assumed to be independent of one another and normally distributed with zero means and constant variances. For the residual errors, it was assumed that they have a first-order autoregressive correlation structure, AR (1) (Rabe-Hesketh and Skrondal [84]; Steele [89]). Under an AR (1) model $var(e_{ijk}) = \sigma^2_e$ (constant) for all occasions i and $cov(e_{ijk}, e_{i'jk}) = \sigma^2_e \, \rho^{|i - i'|}$, so $corr(e_{ijk}, e_{i'jk}) = \rho^{|i - i'|}$. Thus, the correlation between the responses at occasions i and i' depends on the length of time between them, and is smaller the further apart occasions i and i' are (Steele [89]).

[2] It should be noted that the value of L_1 is now the likelihood value for the two-level occasions-within-USO (Model 2) and differs to that used in the previous *LR* test. The value of L_2, on the other hand, is the same. As suggested by Rabe-Hesketh and Skrondal [84], it divide the p-value by two for testing one variance when another uncorrelated random effect is in the model.

[3] In this case, we are testing the null hypothesis that there are no supercluster effects (H_0: $\sigma^2_v = 0$).

5. Descriptive analysis

5.1. The dependent variable: USO's growth

Firm's growth is considered an important indicator of performance in newly established ventures, with employment and sales being the most extended measures of growth (Wennberg et al. [15]). Consequently, in this work, separate complementary models were estimated for both measures of growth. Following Wennberg et al. [15], growth rates were calculated as the $\ln(\text{size}_{i,t}/\text{size}_{i,t-1})$. Table 2 shows the average annual growth rates of the USOs for the period 2005–2013.

Whereas the little difference in the average annual growth rate of employment between Spanish USOs' (24.3%) and Italian ones (21.3%) is not statistically significant, when the analysis is done year per year significant differences are found.

5.2. The independent variable: regional context

In both countries, USOs' growth rates vary across regions over the period 2005–2013. Fig. 1 illustrates the average annual growth rates of both employment and sales in the Spanish and Italian USOs.

The average annual employment growth rates were positive in 14 of the 16 Spanish regions (87.5%). Similarly, the Spanish USOs showed positive sales growth rates in most of the regions (75%). In the Italian case, slightly more than half (55%) of the regions have positive average annual employment growth rates in their USOs. In contrast, only about the 25% of them showed positive values in the average annual growth rates of their USOs' sales. Hence, the proportion of regions with positive annual mean values of growth (employment and sales) is higher in Spain than in Italy.

6. Multivariate analysis

The results of the estimations of the three and two-level variance component models [Model 1 and Model 2] to USOs' employment growth in the Spanish and Italian cases are showed in Table 3.

The estimations show that the USOs random effects (σ^2_u) values for three- and two-level models [Model 1 and 2 respectively] are very low in both Spain and Italy when we analyse the employment growth. The three-level region random effects (σ^2_v) values are low but not as much as the USOs random effects (σ^2_u), and the one-level occasion random effects (σ^2_e) are the highest in the two countries. Also, in both countries LR tests are significant when comparing multilevel three-level model [Model 1] and a simplest linear regression (with $p < 0.1$). Hence the results confirm that multilevel modelling is a more appropriate approach than single-level analysis in the study of the region effect on USO employment growth (H1).

However, LR test rejects the null hypothesis that there are no supercluster effects (H_0: $\sigma^2_v = 0$) in the Spanish case. Hence Spanish USOs located in the same region are more homogeneous in terms of employment growth than Spanish USOs situated in a different region, but there is no evidence for Italian USOs. Our findings only support the H2 in the Spanish case, the region effect on the employment growth was found in Spain but not in Italy.

In the same way, Table 4 presents the results of identical estimations for sales growth. Again, H1 is validated to both countries, while H2 is supported only for Spain, reinforcing the results obtained for employment growth.

Finally, Table 5 presents a summary of the empirical findings.

7. Result discussion and conclusions

Nowadays entrepreneurial universities have become key actors in regional entrepreneurship agendas due to their technology transfer activities, especially through the creation of USOs. In this respect, the growth rates of such firms are at the heart of academic debate and public

Table 2
Annual growth rates of the USOs for the period 2005–2013 (by country).

Variable		Italy		Spain		*t*-test	
	Year	Mean	(Std. Dev)	Mean	(Std. Dev)	t	P
EMPLOYMENT	**2005–2013**	0.213	2.130	0.243	0.760	−0.577	0.564
	2006	0.078	0.212	0.424	1.003	−1.239	0.217
	2007	0.090	0.441	0.379	0.801	−2.110**	0.036
	2008	0.470	2.597	0.561	1.095	−0.397	0.691
	2009	0.663	6.064	0.273	0.831	1.062	0.289
	2010	0.004	0.876	0.201	0.654	−2.468**	0.014
	2011	0.231	0.963	0.189	0.598	0.529	0.597
	2012	0.175	0.660	0.074	0.620	1.901*	0.058
	2013	0.137	0.664	0.057	0.393	1.702*	0.089
SALES	**2005–2013**	3.244	89.066	1.371	9.713	0.994	0.320
	2006	0.387	0.899	1.708	6.715	−1.985**	0.048
	2007	0.327	0.796	2.728	12.533	−2.343**	0.020
	2008	2.755	13.689	1.804	5.843	0.988	0.324
	2009	2.608	29.072	2.256	17.650	0.188	0.851
	2010	13.042	229.772	1.020	5.585	0.971	0.332
	2011	1.372	9.038	1.407	11.865	−0.048	0.962
	2012	1.340	6.162	0.282	1.567	3.043***	0.002
	2013	1.103	9.822	0.348	3.020	1.247	0.213

Notes: ***, ** and * indicate significance at 0.1%, 1% and 5% level, respectively. The table also shows the difference of means for the annual growth rates between Italian and Spanish USOs. The t statistic is used to test the equality of means.

policies. With the rising interest in the field, new questions have been posed such as whether the regional entrepreneurial ecosystem, in which the university venture runs, may potentially be growth-enhancing.

This paper aimed to study the impact of the regional context on the USO's growth by applying multilevel analysis. Indeed, it develops a cross-national analysis based on a panel sample of 516 Spanish and 904 Italian USOs, over the period 2005–2013 and located in 36 administrative regions. By using multilevel modelling and mainly drawing on the KSTE, the findings confirm that the regional context is a significant and actual dimension for clarifying USOs' growth. This result is in accordance with those obtained by Rodríguez-Gulías et al. [42], pointing out that multilevel modelling is a more appropriate approach than single-level analysis in the study of the region impact on USOs' growth.

Furthermore, the findings remark that the regional context explains the firm's growth only for Spanish USOs, both in terms of employment and sales, while the region seems to not produce effects on Italian USOs. In other words, substantial changes at the region-level partly determine the growth at firm-level in the Spanish USOs, whereas the same does not hold for the Italian ones. Hence, only the Spanish USOs can benefit of being located in certain regions instead of in others. As remarked by Aparicio et al. [85], we suggest that regional conditions can may not have an automatic effect on firm's growth; hence, specific mechanisms (in the forms of infrastructural, funding and networking support, at local and national level) are required to serve as a conduit to entrepreneurial successful activity that impacts on firm creation and subsequent economic growth.

The different effect of the region across countries suggests that in Spain the knowledge spillovers of the regional entrepreneurial ecosystem and the other linked spatial externalities are more effective in fostering university ventures compared to those of the Italian context. This does not mean that the Italian USOs have less growing performance than the Spanish ones (in this regard we found mixed patterns of growth for Spanish and Italian USOs in the period of analysis), but only that the promoting actions and the environmental setting at regional-level do not reach the university entrepreneurial context. The reasons about the emerging weak role of Italian regions in partially determining the growth of Italian USOs might be related to low proactivity of Italian universities, with more than 40% of them without a Technology Transfer Office (TTO) by the end of 2005 (Baldini et al. [86]). Further, the decrease of regional public spending, as well as the cut of public funds for the Italian universities and TTOs established by the 2010′ Italian University Reform (law n. 240/2010) have been reduced the

likelihood of success in the creation and growth of USOs (Algieri et al. [87]). In addition, although Italy's innovation policies at national and regional level have been improved in terms of coherence, persistent lack of resources, fragmentation in various sectors, discontinuities over time and the lack of an ex-post assessment of interventions has created redundant, unproductive and unclear policies for potential beneficiaries (Donatiello and Gherardini [88]).

The paper has some remarkable implications. The evidence about the role of the region in determining the USO's growth represents a critical contextual dimension and influential factor in building a more explicative research agenda on the university ventures. Hence, using a multilevel approach, this study makes a significant methodological and theoretical contribution to the literature. Additionally, in view of the fact that the regional context has a substantial role in fostering USOs' growth in Spain, but not in Italy, a more effective regional policy agenda in supporting the development of USOs is required, both in the Spanish regions, which lack of proactive, coordinated and diffuse fostering actions of university entrepreneurship, both in Italy. Because also if Italian USOs seem to be not sensitive to regional-level dimensions of growth, the recognised role of regions and its entrepreneurial ecosystem as one of the main drives of knowledge spillover and other technology-based externalities and resources may suggest that the planning of a shared and stimulating milieu. In addition, a higher engagement of the regional agents (both public and private) in the spin-out process is a critical prerequisite to foster USOs' growth. Ever from a policy perspective, a further suggestion of the paper is that the growth prospects of USOs should be a factor in the eminence of its regional socio-economic context. The university ventures located in superior quality regional entrepreneurial ecosystem with effectively knowledge spillover process should have higher growth potentials compared to similar ventures in lower regional contexts in terms of quality of their basic resources of knowledge and innovative system.

Further, in the regions where the entrepreneurial ecosystem does not have a positive impact on USOs' growth, universities should invest in producing in-house support mechanisms. In detail, universities would be better off pursuing incremental investments in the establishment of internal dedicated funding tools (specific to USOs creation and development) and putting further efforts into fine-tuning existing ones.

The weak effect of regions on USOs in Italy could be offset by a relevant rise of private funds and a reinforcement of collaboration activities with industry which, though, strictly depend on the efficiency of the TTOs strategies and practices.
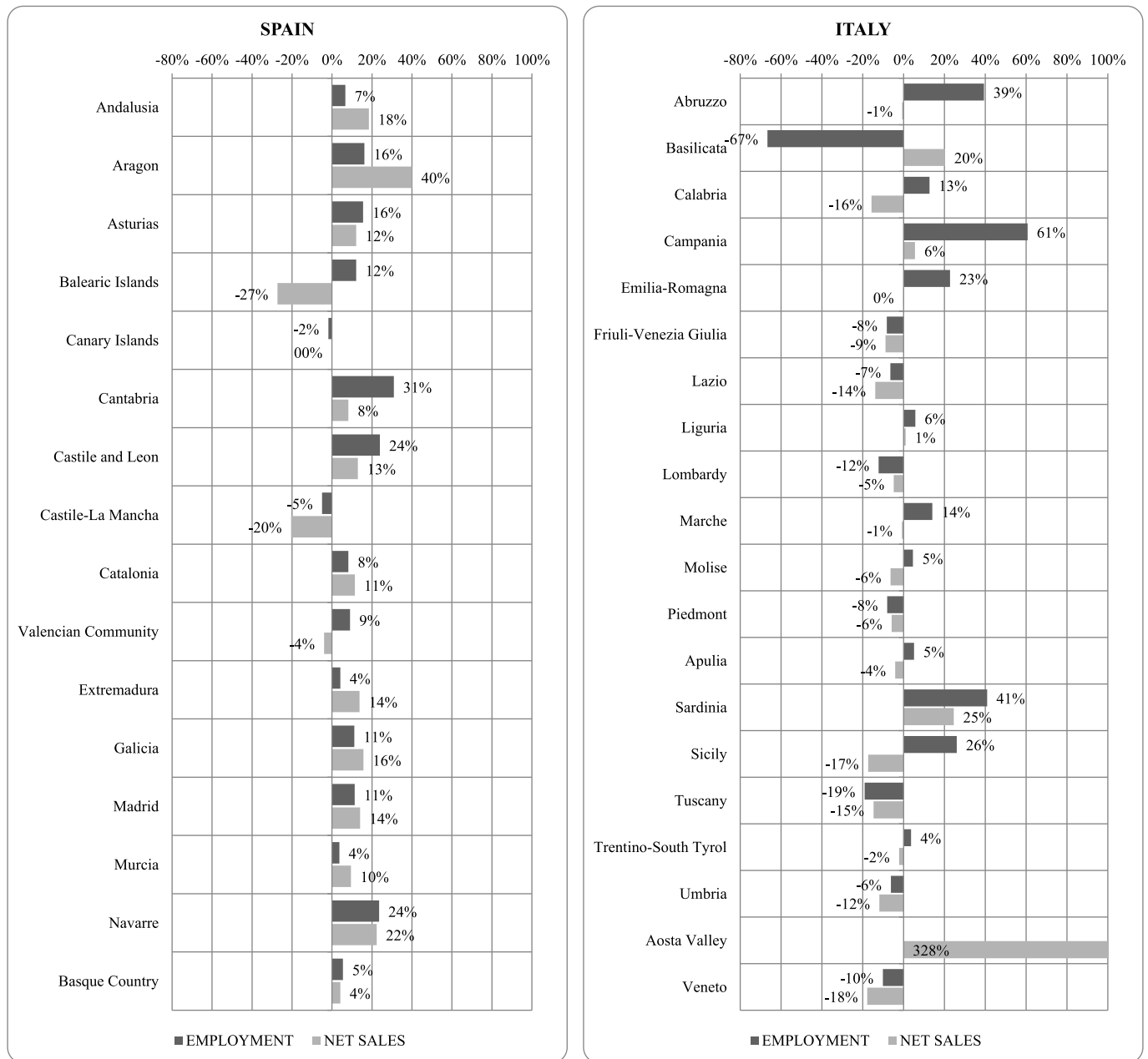
Fig. 1. Average annual growth rates of the USOs for the period 2005–2013 (by region).

We acknowledge that our study is not without limitations, which can be addressed in further research. First, while we analysed similar countries with differences in their regional effects in fostering USOs' growth, a further research is required to explore whether our evidences hold for other countries or whether there are additional differences. Second, while our focus was on regional-level differences, another remarkable aspect might be to control the existence of further institutions involved in the knowledge and technology transfers in the regional entrepreneurial ecosystem, with the aim to assess whether the potential and consequential competition drives the growth performance or rather decreases it. Third, although the panel data help to capture the quantitative effects of regional and firm variations, a complementary and in-depth qualitative analysis of differences in the growth of USOs in different countries is also needed. Additionally, we considered USOs' growth in terms of employment and sales, which can underestimate the development status of USOs, since a large number of USOs do not generate sales for several years, if at all, and accounting data are only

partial for a substantial proportion of our initial sample not least because small firms have exceptions from reporting financial data. As a result, future research could benefit from considering further indicators of USOs' growth, such as those related to innovation outcomes, as well as asset-based ones. In fact, it is well recognised that high-tech, knowledge-based firms, such as USOs, are more sensitive to asset measures of growth.

CRediT authorship contribution statement

Antonio Prencipe: Conceptualization, Investigation, Writing - original draft, Writing - review & editing, Project administration. **Christian Corsi:** Investigation, Writing - original draft, Writing - review & editing, Supervision. **María Jesús Rodríguez-Gulías:** Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. **Sara Fernández-López:** Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review

Table 3

Three and two-level variance component models: employment growth (by country).

	Spain		Italy	
	3-level	2-level	3-level	2-level
	[Model 1]	[Model 2]	[Model 1]	[Model 2]
Constant	0.108***	0.097***	0.094***	0.095***
	(0.018)	(0.011)	(0.018)	(0.015)
Radom effects				
σ^2_v	0.002		0.001	
σ^2_u	2.2E-14	2.9E-20	4.4E-19	3.3E-13
σ^2_e	0.224	0.226	0.264	0.265
ρ	0.038	0.046	−0.171	−0.162
Nº observations	2,064	2,064	949	949
Nº superclusters (Regions)	16		19	
Nº clusters (USOs)	454	454	351	351
Log likelihood	−1,390.11	−1,393.71	−708.90	−709.65
LR TEST (n-level to 1-level model)				
χ^2	9.79	2.61	14.52	13.03
p-value	0.0204	0.2718	0.0023	0.0015
LR TEST (3-level to 2-level model)				
χ^2		7.19		1.50
p-value		0.0275		0.2207
p-value (divide by 2)		0.0138		0.1104

Notes: ***, ** and * indicate significance at 0.1%, 1% and 5% level, respectively. Standard errors in brackets.

Table 4

Three and two-level variance component models: sales growth (by country).

	Spain		Italy	
	3-level	2-level	3-level	2-level
	[Model 1]	[Model 2]	[Model 1]	[Model 2]
Constant	0.157***	0.149***	0.182***	0.177***
	(0.030)	(0.018)	(0.018)	(0.015)
Radom effects				
σ^2_v	0.005		0.001	
σ^2_u	2.6E-14	2.4E-13	2.0E-18	3.7E-17
σ^2_e	0.883	0.888	1.026	1.027
ρ	−0.135	−0.127	−0.274	−0.273
Nº observations	2,254	2,254	3,007	3,007
Nº superclusters (Regions)	16		20	
Nº clusters (USOs)	470	470	691	691
Log likelihood	−3,046.21	−3,050.38	−4,218.14	−4,218.60
LR TEST (n-level to 1-level model)				
χ^2	29.79	21.45	126.11	125.18
p-value	0.0000	0.0000	0.0000	0.0000
LR TEST (3-level to 2-level model)				
χ^2		8.34		0.93
p-value		0.0800		0.9205
p-value (divide by 2)		0.0400		0.4603

Notes: ***, ** and * indicate significance at 0.1%, 1% and 5% level, respectively. Standard errors in brackets.

Table 5

Summary of the empirical results.

	Spain		Italy	
	Employment	Sales	Employment	Sales
H1. *Multilevel analysis is a more appropriate methodology to test the existence of a region effect than that of the single-level analysis.*	Yes	Yes	Yes	Yes
H2. *The regional context in which a USO is launched may partly determine its growth.*	Yes	Yes	No	No

& editing. **David Rodeiro-Pazos:** Conceptualization, Investigation, Writing - original draft, Writing - review & editing, Supervision, Project administration.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.seps.2020.100814.

References

[1] Smith HL. Universities, innovation, and territorial development: a review of the evidence. Environ Plann C Govern Pol 2007;25(1):98–114. https://doi.org/10.1068/c0561.

[2] Sandström C, Wennberg K, Wallin MW, Zherlygina Y. Public policy for academic entrepreneurship initiatives: a review and critical discussion. J Technol Tran 2018;43(5):1232–56. https://doi.org/10.1007/s10961-016-9536-x.

[3] Audretsch DB, Belitski M. Entrepreneurial ecosystems in cities: establishing the framework conditions. J Technol Tran 2017;42(5):1030–51. https://doi.org/10.1007/s10961-016-9473-8.

[4] Guerrero M, Urbano D, Fayolle A, Klofsten M, Mian S. Entrepreneurial universities: emerging models in the new social and economic landscape. Small Bus Econ 2016;47(3):551–63. https://doi.org/10.1007/s11187-016-9755-4.

[5] Audretsch DB, Belitski M, Desai S. Entrepreneurship and economic development in cities. Ann Reg Sci 2015;55(1):33–60. https://doi.org/10.1007/s00168-015-0685-x.

[6] Smith HL, Bagchi-Sen S. The research university, entrepreneurship and regional development: research propositions and current evidence. Enterpren Reg Dev 2012;24(5–6):383–404. https://doi.org/10.1080/08985626.2011.592547.

[7] Benghozi PJ, Salvador E. Are traditional industrial partnerships so strategic for research spin-off development? Some evidence from the Italian case. Enterpren Reg Dev 2014;26(1–2):47–79. https://doi.org/10.1080/08985626.2013.860194.

[8] Rizzo U. Why do scientists create academic spin-offs? The influence of the context. J Technol Tran 2015;40(2):198–226. https://doi.org/10.1007/s10961-014-9334-2.

[9] Oakey RP, Hare PG, Balazs K. Strategies for the exploitation of intelligence capital: evidence from Hungarian research institutes. R D Manag 1996;26(1):67–82. https://doi.org/10.1111/j.1467-9310.1996.tb00930.x.

[10] Harrison RT, Leitch C. Voodoo institution or entrepreneurial university? Spin-off companies, the entrepreneurial system and regional development in the UK. Reg Stud 2010;44(9):1241–62. https://doi.org/10.1080/00343400903167912.

[11] Hess S, Siegwart RY. R&D Venture: proposition of a technology transfer concept for breakthrough technologies with R&D cooperation: a case study in the energy sector. J Technol Tran 2013;38(2):153–79. https://doi.org/10.1007/s10961-012-9249-8.

[12] Schaeffer V, Matt M. Development of academic entrepreneurship in a non-mature context: the role of the university as a hub-organisation. Enterpren Reg Dev 2016:1–22. https://doi.org/10.1080/08985626.2016.1247915.

[13] Galati F, Bigliardi B, Petroni A, Marolla G. Which factors are perceived as obstacles for the growth of Italian academic spin-offs? Technol Anal Strat Manag 2017;29(1):84–104. https://doi.org/10.1080/09537325.2016.1199853.

[14] Hayter CS. A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem. Small Bus Econ 2016;47(3):633–56. https://doi.org/10.1007/s11187-016-9756-3.

[15] Wennberg K, Wiklund J, Wright M. The effectiveness of university knowledge spillovers: performance differences between university spinoffs and corporate spinoffs. Res Pol 2011;40(8):1128–43. https://doi.org/10.1016/j.respol.2011.05.014.

[16] Boshuizen J, Geurts, Van Der Veen A. Regional social networks as conduits for knowledge spillovers: explaining performance of high-tech firms. Tijdschr Econ Soc Geogr 2009;100(2):183–97. https://doi.org/10.1111/j.1467-9663.2009.00528.x.

[17] Van Oort FG, Burger MJ, Knoben J, Raspe O. Multilevel approaches and the firm-agglomeration ambiguity in economic growth studies. J Econ Surv 2012;26(3):468–91. https://doi.org/10.1111/j.1467-6419.2012.00723.x.

[18] Rodríguez-Gulías MJ, Rodeiro-Pazos D, Fernández-López S. The effect of university and regional knowledge spillovers on firms' performance: an analysis of the Spanish USOs. Int Enterpren Manag J 2017;13(1):191–209. https://doi.org/10.1007/s11365-016-0399-2.

[19] Chang YC, Yang PY, Martin BR, Chi HR, Tsai-Lin TF. Entrepreneurial universities and research ambidexterity: a multilevel analysis. Technovation 2016;54:7–21. https://doi.org/10.1016/j.technovation.2016.02.006.

[20] Vohora A, Wright M, Lockett A. Critical junctures in the development of university high-tech spinout companies. Res Pol 2004;33(1):147–75. https://doi.org/10.1016/S0048-7333(03)00107-0.

[21] Etzkowitz H, Klofsten M. The innovating region: toward a theory of knowledge-based regional development. R D Manag 2005;35(3):243–55. https://doi.org/10.1111/j.1467-9310.2005.00387.x.

[22] Horta H, Meoli M, Vismara S. Skilled unemployment and the creation of academic spin-offs: a recession-push hypothesis. J Technol Tran 2016;41(4):798–817. https://doi.org/10.1007/s10961-015-9405-z.

[23] Guerrero M, Urbano D, Fayolle A. Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities. J Technol Tran 2016;41(1):105–31. https://doi.org/10.1007/s10961-014-9377-4.

[24] Ferreira JJ, Ratten V, Dana LP. Knowledge spillover-based strategic entrepreneurship. Int Enterpren Manag J 2017;13(1):161–7. https://doi.org/10.1007/s11365-016-0415-6.

[25] Spigel B. The relational organization of entrepreneurial ecosystems. Enterpren Theor Pract 2017;41(1):49–72. https://doi.org/10.1111/etap.12167.

[26] Stam E. Entrepreneurial ecosystems and regional policy: a sympathetic critique. Eur Plann Stud 2015;23(9):1759–69. https://doi.org/10.1080/09654313.2015.1061484.

[27] Qian H. Diversity versus tolerance: the social drivers of innovation and entrepreneurship in US cities. Urban Stud 2013;50(13):2718–35. https://doi.org/10.1177/0042098013477703.

[28] Qian H. Knowledge-based regional economic development: a synthetic review of knowledge spillovers, entrepreneurship, and entrepreneurial ecosystems. Econ Dev Q 2018;32(2):163–76. https://doi.org/10.1177/0891242418760981.

[29] Acs ZJ, Audretsch DB, Lehmann EE. The knowledge spillover theory of entrepreneurship. Small Bus Econ 2013;41(4):757–74. https://doi.org/10.1007/s11187-008-9157-3.

[30] Spigel B, Harrison R. Toward a process theory of entrepreneurial ecosystems. Strat. Enterpren.J 2018;12(1):151–68. https://doi.org/10.1002/sej.1268.

[31] Penrose E. The theory of the firm. New York: John Wiley & Sons; 1959.

[32] Sirmon DG, Hitt MA, Ireland RD. Managing firm resources in dynamic environments to create value: looking inside the black box. Acad Manag Rev 2007;32(1):273–92. https://doi.org/10.5465/AMR.2007.23466005.

[33] Davidsson P, Wiklund J. Levels of analysis in entrepreneurship research: current research practice and suggestions for the future. Enterpren Theor Pract 2001;25(4):81–100. https://doi.org/10.1007/978-3-540-48543-8_12.

[34] Morales CE, Holtschlag C. Post materialist values and entrepreneurship: a multilevel approach. Int. J. Entrep.Behav. Res. 2013;19(3):266–82. https://doi.org/10.1108/13552551311330174.

[35] Wright M, Stigliani I. Entrepreneurship and growth. Int Small Bus J 2013;31(1):3–22. https://doi.org/10.1177/0266242612467359.

[36] Berbegal-Mirabent J, Ribeiro-Soriano DE, García JLS. Can a magic recipe foster university spin-off creation? J Bus Res 2015;68(11):2272–8. https://doi.org/10.1016/j.jbusres.2015.06.010.

[37] Raspe O, Van Oort F. Localized knowledge externalities and firms: an intrinsic multilevel issue, Firb-Risc Conference Research and entrepreneurship in the knowledge-based economy, September 7-8, 2009, KITeS-Cespri. Milan, Italy: Bocconi University; 2009.

[38] Brush CG, Greene PG, Hart MM. From initial idea to unique advantage: the entrepreneurial challenge of constructing a resource base. Acad Manag Exec 2001;15(1):64–78. https://doi.org/10.5465/AME.2001.4251394.

[39] Mustar P, Renault M, Colombo MG, Piva E, Fontes M, Lockett A, Moray N. Conceptualising the heterogeneity of research-based spin-offs: a multi- dimensional taxonomy. Res Pol 2006;35(2):289–308. https://doi.org/10.1016/j.respol.2005.11.001.

[40] Rasmussen E, Mosey S, Wright M. The evolution of entrepreneurial competencies: a longitudinal study of university spin-off venture emergence. J Manag Stud 2011;48(6):1314–45. https://doi.org/10.1111/j.1467-6486.2010.00995.x.

[41] Rasmussen E, Wright M. How can universities facilitate academic spin-offs? An entrepreneurial competency perspective. J Technol Tran 2015;40(5):782–99. https://doi.org/10.1007/s10961-014-9386-3.

[42] Rodríguez-Gulías MJ, Rodeiro-Pazos D, Fernández-López S. The regional effect on the innovative performance of university spin-offs: a multilevel approach. J.Knowl. Econ. 2016;7(4):869–89. https://doi.org/10.1007/s13132-015-0287-y.

[43] Lockett A, Siegel D, Wright M, Ensley MD. The creation of spin-off firms at public research institutions: managerial and policy implications. Res Pol 2005;34(7):981–93. https://doi.org/10.1016/j.respol.2005.05.010.

[44] Rothaermel FT, Agung SD, Jiang L. University entrepreneurship: a taxonomy of the literature. Ind Corp Change 2007;16(4):691–791. https://doi.org/10.1093/icc/dtm023.

[45] Beugelsdijk S. The regional environment and a firm's innovative performance: a plea for a multilevel interactionist approach. Econ Geogr 2007;83(2):181–99. https://doi.org/10.1111/j.1944-8287.2007.tb00342.x.

[46] Dicken P, Malmberg A. Firms in territories: a relational perspective. Econ Geogr 2001;77(4):345–63. https://doi.org/10.1111/j.1944-8287.2001.tb00169.x.

[47] Grillitsch M, Nilsson M. Firm performance in the periphery: on the relation between firm-internal knowledge and local knowledge spillovers. Reg Stud 2016:1–13. https://doi.org/10.1080/00343404.2016.1175554.

[48] Molina-Morales FX, García-Villaverde PM, Parra-Requena G. Geographical and cognitive proximity effects on innovation performance in SMEs: a way through knowledge acquisition. Int Enterpren Manag J 2014;10(2):231–51. https://doi.org/10.1007/s11365-011-0214-z.

[49] Mathisen MT, Rasmussen E. The development, growth, and performance of university spin-offs: a critical review. J Technol Tran 2019;44(6):1891–938. https://doi.org/10.1007/s10961-018-09714-9.

[50] Fini R, Fu K, Mathisen MT, Rasmussen E, Wright M. Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study. Small Bus Econ 2017;48(2):361–91. https://doi.org/10.1007/s11187-016-9779-9.

[51] Fallah B, Partridge MD, Rickman DS. Geography and high-tech employment growth in US counties. J Econ Geogr 2014;14(4):683–720. https://doi.org/10.1093/jeg/lbt030.

[52] Duschl M, Schimke A, Brenner T, Luxen D. Firm growth and the spatial impact of geolocated external factors. Jahrb Natl Stat 2014;234(2–3):234–56. https://doi.org/10.1515/jbnst-2014-2-308.

[53] Autio E, Kenney M, Mustar P, Siegel D, Wright M. Entrepreneurial innovation: the importance of context. Res Pol 2014;43(7):1097–108. https://doi.org/10.1016/j.respol.2014.01.015.

[54] Sternberg R. Success factors of university-spin-offs: regional government support programs versus regional environment. Technovation 2014;34(3):137–48. https://doi.org/10.1016/j.technovation.2013.11.003.

[55] Utterback J. Mastering the dynamics of innovation: how companies can seize opportunities in the face of technological change. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship; 1994.

[56] Caiazza R, Belitski M, Audretsch DB. From latent to emergent entrepreneurship: the knowledge spillover construction circle. J Technol Tran 2019:1–11. https://doi.org/10.1007/s10961-019-09719-y.

[57] Klepper S. Employee startups in high-tech industries. Ind Corp Change 2001;10(3):639–74. https://doi.org/10.1093/icc/10.3.639.

[58] Asheim B, Coenen L, Vang J. Face-to-face, buzz, and knowledge bases: sociospatial implications for learning, innovation, and innovation policy. Environ Plann C Govern Pol 2007;25(5):655–70. https://doi.org/10.1068/c0648.

[59] Nagano H. The growth of knowledge through the resource-based view. Manag Decis 2019;58(1):98–111. https://doi.org/10.1108/MD-11-2016-0798.

[60] Caiazza R, Richardson A, Audretsch D. Knowledge effects on competitiveness: from firms to regional advantage. J Technol Tran 2015;40(6):899–909. https://doi.org/10.1007/s10961-015-9425-8.

[61] Liu X, Wright M, Filatotchev I, Dai O, Lu J. Human mobility and international knowledge spillovers: evidence from high-tech small and medium enterprises in an emerging market. Strat.Enterpren.J 2010;4(4):340–55. https://doi.org/10.1002/sej.100.

[62] Fini R, Grimaldi R, Santoni S, Sobrero M. Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. Res Pol 2011;40(8):1113–27. https://doi.org/10.1016/j.respol.2011.05.013.

[63] He H, Chen Y, Schramm R. Technological spillovers in space and firm productivity: evidence from China's electric apparatus industry. Urban Stud 2018;55(11):2522–41. https://doi.org/10.1177/0042098017720338.

[64] Rasmussen E, Mosey S, Wright M. The transformation of network ties to develop entrepreneurial competencies for university spin-offs. Enterpren Reg Dev 2015;27(7–8):430–57. https://doi.org/10.1080/08985626.2015.1070536.

[65] Sanso-Navarro M, Vera-Cabello M, Ximénez-De-Embún DP. Human capital spillovers and regional development. J Appl Econom 2017;32(4):923–30. https://doi.org/10.1002/jae.2541.

[66] Raspe O, van Oort F. Growth of new firms and spatially bounded knowledge externalities. Ann Reg Sci 2011;46(3):495–518. https://doi.org/10.1007/s00168-009-0357-9.

[67] Colombelli A, Krafft J, Vivarelli M. To be born is not enough: the key role of innovative start-ups. Small Bus Econ 2016:1–15. https://doi.org/10.1007/s11187-016-9716-y.

[68] Chemmanur TJ, Loutskina E, Tian X. Corporate venture capital, value creation, and innovation. Rev Financ Stud 2014;27(8):2434–73. https://doi.org/10.1093/rfs/hhu033.

[69] Dutta S, Folta TB. A comparison of the effect of angels and venture capitalists on innovation and value creation. J Bus Ventur 2016;31(1):39–54. https://doi.org/10.1016/j.jbusvent.2015.08.003.

[70] Grilli L, Murtinu S. New technology-based firms in Europe: market penetration, public venture capital, and timing of investment. Ind Corp Change 2015;24(5):1109–48. https://doi.org/10.1093/icc/dtu025.

[71] Rodríguez-Gulías MJ, Rodeiro-Pazos D, Fernández-López S, Corsi C, Prencipe A. The role of venture capitalist to enhance the growth of Spanish and Italian university spin-offs. Int Enterpren Manag J 2018;14(4):1111–30. https://doi.org/10.1007/s11365-017-0489-9.

[72] Bock C, Huber A, Jarchow S. Growth factors of research-based spin-offs and the role of venture capital investing. J Technol Tran 2018;43(5):1375–409. https://doi.org/10.1007/s10961-017-9635-3.

[73] Lockett A, Wright M, Franklin S. Technology transfer and universities' spin-out strategies. Small Bus Econ 2003;20(2):185–200. https://doi.org/10.1023/A:1022202216972.

[74] Kochenkova A, Grimaldi R, Munari F. Public policy measures in support of knowledge transfer activities: a review of academic literature. J Technol Tran 2016;41(3):407–29. https://doi.org/10.1007/s10961-015-9416-9.

[75] Guerini M, Rossi-Lamastra C. How university and industry knowledge interact to determine local entrepreneurship. Appl Econ Lett 2014;21(8):513–6. https://doi.org/10.1080/13504851.2013.864031.

[76] Casper S. The spill-over theory reversed: the impact of regional economies on the commercialization of university science. Res Pol 2013;42(8):1313–24. https://doi.org/10.1016/j.respol.2013.04.005.

[77] Colombelli A. The impact of local knowledge bases on the creation of innovative start-ups in Italy. Small Bus Econ 2016:1–14. https://doi.org/10.1007/s11187-016-9722-0.

[78] Mosey S, Wright M. From human capital to social capital: a longitudinal study of technology–based academic entrepreneurs. Enterpren Theor Pract 2007;31(6):909–35. https://doi.org/10.1111/j.1540-6520.2007.00203.x.

[79] Etzkowitz H. Triple helix clusters: boundary permeability at university—industry—government interfaces as a regional innovation strategy. Environ Plann C Govern Pol 2012;30(5):766–79. https://doi.org/10.1068/c1182.

[80] Perkmann M, Tartari V, McKelvey M, Autio E, Broström A, D'Este P, Krabel S. Academic engagement and commercialisation: a review of the literature on university–industry relations. Res Pol 2013;42(2):423–42. https://doi.org/10.1016/j.respol.2012.09.007.

[81] Pirnay F, Surlemont B, Nlemvo F. Towards a typology of university spin-offs. Small Bus Econ 2003;21(4):355–69. https://doi.org/10.1023/A:1026167105153.

[82] Zhang J. The performance of university spin-offs: an exploratory analysis using venture capital data. J Technol Tran 2009;34(3):255–85. https://doi.org/10.1007/s10961-008-9088-9.

[83] Leckie G. Three-level multilevel models – Concepts. LEMMA VLE Module 2013;11:1–47. http://www.bristol.ac.uk/cmm/learning/course.html. [Accessed 15 October 2015].

[84] Rabe-Hesketh S, Skrondal A. Multilevel and longitudinal modelling using Stata. third ed., I+II. College Station, TX: Stata Press; 2012.

[85] Aparicio S, Urbano D, Audretsch D. Institutional factors, opportunity entrepreneurship and economic growth: panel data evidence. Technol Forecast Soc Change 2016;102:45–61. https://doi.org/10.1016/j.techfore.2015.04.006.

[86] Baldini N, Fini R, Grimaldi R. The transition towards entrepreneurial universities: an assessment of academic entrepreneurship in Italy. In: Link A, Siegel D, Wright M, editors. Handbook of university technology transfer. Chicago: University of Chicago Press; 2014.

[87] Algieri B, Aquino A, Succurro M. Technology transfer offices and academic spin-off creation: the case of Italy. J Technol Tran 2013;38(4):382–400. https://doi.org/10.1007/s10961-011-9241-8.

[88] Donatiello D, Gherardini A. All that glitters is not gold: the surrogate use of university spin-offs. Insights from Italy. High Educ Pol 2019;32(2):203–26. https://doi.org/10.1057/s41307-017-0079-z.

[89] Steele F. Multilevel modelling of repeated measures data. LEMMA VLE Module 2014;15:1–62. http://www.bristol.ac.uk/cmm/learning/course.html. [Accessed 10 November 2015].

Antonio Prencipe is research fellow in business economics at the Università degli Studi di Teramo, Italy. He is member of the board of directors and manager of the university spin-off CISREM. His research is focus on technology transfer, university spin-off, governance and innovation of small firms. Recently, he has published in different journals as Industry and Innovation, International Entrepreneurship and Management Journal, Journal of Small Business and Enterprise Development, Journal of Management Development and Journal of the Knowledge Economy.

Christian Corsi is associate professor in business economics at the Università degli Studi di Teramo, Italy. He is dean of the Communication Sciences Faculty at the Università degli Studi di Teramo and President of the university spin-off CISREM. His research interests focuses on technology transfer, university spin-offs, governance and innovation of small firms. Recently, he has published in different journals as Industry and Innovation, International Entrepreneurship and Management Journal, Journal of Small Business and Enterprise Development, Journal of Management Development, Journal of Intellectual Capital and Journal of the Knowledge Economy.

María Jesús Rodríguez Gulías joined the Universidade da Coruña (Spain) as lecturer in 2015. Previously, she combined her work as technician in the Technology Transfer Office of Universidade de Santiago de Compostela (Spain) and the development of her PhD and worked for Universidade de Vigo. Dissertation on university spin-offs, defended in January 2014. Her research interests are in two main areas: intellectual property valuation and academic entrepreneurship. Recently, she has published in different journals as Information Systems, Science and Public Policy, Technovation, Journal of Knowledge Management, Service Industries Journal, International Entrepreneurship and Management Journal, Technology Analysis & Strategic Management or International Entrepreneurship and Management Journal, all of them included in JCR.

Sara Fernández López joined the Universidade de Santiago de Compostela (Spain) as associate professor in 2006, after 11 years of working as a lecturer and researcher. She is the Secretary of the Committee of Ph. D. Programme in Economics and Business since 2013. Her research interests are in two main areas: household finance and academic entrepreneurship. She has around 80 internationally refereed papers. Recently, she has published in the journals Business Services, European Journal of Finance, Feminist Economist, Spanish Journal of Finance and Accounting or Academia Revista Latinoamericana de Administración, all of them included in JCR.

David Rodeiro Pazos joined Universidade de Santiago de Compostela (Spain) as associate professor in 2009, after 7 years of working as a lecturer and researcher. He has his PhD. from the University of Santiago in 2008. His research interests are academic entrepreneurship, university spin-offs, technology transfer and venture capital. He is author and co-author of several books on entrepreneurship. He has around 70 internationally refereed papers published in journal as Technology Analysis & Strategic Management, Journal of the Knowledge Economy, Journal of Management Development or Service Business, included in JCR. Recently, he and has been involve in European projects "Citizenergy", "LACES" and "FAN-BEST".