The role of university linkages in the performance of actors in Innovation Ecosystems: the case of Italy

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Abstract

Framing of the research. *In the last 15 years the EU has set the development of innovation ecosystems as a pillar for its development plans. Nevertheless, some countries have still not improved their innovation performance over time, as in the case of Italy.*

Purpose of the paper. *The study analyzes this issue by exploring the relational dynamics of the Italian innovation ecosystem and whether the university can enable the growth of early-stage innovative firms.*

Methodology*. We use panel data methodology to compare the performance in terms of sales growth of 244 Italian university spin-offs (USO) and 1487 Italian innovative start-ups (IIS) from 2014 to 2016.*

Results*. Our results show that in Italy universities are not enabling the growth of early-stage innovative firms, on average. Indeed, companies which are not related to the university show a better performance, and most of all the ecosystem-level variables related to the academia are not correlated to sales growth in most cases.*

Research limitations. *The sampling criteria reduced our sample size by more than 50%. Also, our study is a quantitative one, and it lacks many qualitative insights that could enrich our analysis. Finally, since the study is carried out in Italy, this may hinder easy generalizability in other contexts.*

Managerial implications. *The study provides interesting insights for policymakers and start-up and university administrators with data on the effectiveness of the linkages between universities and early-stage innovative firms.*

Originality of the paper. *Previous literature neither did address the comparison between IISs and USOs in Italy, nor the comparison between these two types of firms and USOs that are classified as IISs. Moreover, it is among the first studies to provide insights on the current linkages in the Italian innovation ecosystem.*

Key words: innovation ecosystem; university spin-off; innovative startup; early-stage; panel data.

1. Introduction

Since its foundation, the European Union (EU) has been a convergence machine, directing investments and actions towards the achievement of economic and social growth in all its member states. In following this

purpose, the development of research and innovation (R&I) has always played a central role.

Especially, parallel to the emergence of the knowledge economy and exponential technologies, in the last ten years one of the main goals of the EU has been that of making the generation and commercialization of innovations a continuous and self-sustaining process (González Fernández et al, 2019). Starting from 2014, indeed, EU policies begun to show a larger investment focus in the development of national and local innovation ecosystems across its countries and give early-stage innovative firms a major role in this concern. In the last two decades, after all, the new frameworks of innovation (Adner, 2006; Carayannis and Campbell, 2009; Gomes *et al.*, 2018; Oh *et al.*, 2016) and entrepreneurial ecosystems (Acs *et al.*, 2017; Spigel, 2017; Stam, 2015) have been developed by academics precisely as a result of an effort to improve our knowledge of the mechanisms of innovation and high growth entrepreneurship development.

Despite this new level of knowledge and EU's efforts, however, if we look at the innovation performance of its member states we can notice how fragmented and poorly conducive to innovation the European environment is[1]. Countries which together constitute the largest market in the world, are performing and investing less than others in terms of innovation, and among them Italy represents a notable case. It is the eighth economic power globally[2] and still performs as a moderate innovator (Hollanders *et al.*, 2012; 2014; 2016; 2019; Hollanders and Es-Sadki, 2017), lagging behind other member states both in the public – in terms of public expenditure in R&D, use of structural funds for R&I activities, cooperation between public and private actors, bureaucracy, and the growth rate of doctorate students – and the private sector – in terms of venture capital investments and private co-financing for R&D activities (European Commission - JRC, 2017; Hollanders *et al.*, 2020).

Analyzing this case under the lens of the innovation ecosystem framework can help us comprehend why this happens, and how to fill the existing gaps both in the literature and the practice. The construct, indeed, has the potential to explain the processes of value creation at the regional and national level, and can be used to understand how the relations between actors involved in R&I activities may affect the overall economic and innovation performance (Granstrand and Holgersson, 2020; Gomes *et al.*, 2018; Brown and Mason, 2017; Autio and Thomas, 2014; Carayannis and Campbell, 2009; Granstrand and Holgersson, 2020; Adner, 2006). Innovation ecosystems, after all, build their success not only on the quality of their actors, activities, and artifacts, but most of all on the interdependent relations between them. Thus, to get a wider picture of the issue, an analysis of whether and how the interactions between these attributes create value, and enable the development of innovation and technology, becomes necessary (Jackson, 2011; Gomes *et al.*, 2018).

Among all the actors that live in an ecosystem (Carayannis and Campbell, 2009), in Italy, as well as in all Europe, universities have the

[1] https://www.europarl.europa.eu/factsheets/en/sheet/67/innovation-policy

[2] https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?most_recent_value_desc=true

potential to fulfill a central role as ecosystem "enablers" (Heaton *et al.*, 2019; Reichert, 2019), with their impact on the ecosystem dimensions of talent, culture, and support, and their potential for being catalysts for network building (Gonzales *et al.*, 2018). In the European context this means that, apparently, universities also have the capability to lead the shift to a better innovation performance throughout the EU. Indeed, as in other parts of the world, over the years universities have started to invest more heavily in operations related to their 'third mission', like the creation of their own innovative firms (the so called 'University Spin-Off Firms – USOs), pushed both by the increasingly challenging global competitive landscape and by the growing European focus on early-stage innovative firms.

After all, the contribute of early-stage firms – and, most of all, innovative ones – to regional development has been widely acknowledged by academics. Early-stage innovative firms, indeed, positively impact economic growth, job creation (Bormans *et al.*, 2019; Humala, 2015; Colombo and Delmastro 2002), R&I activities, and collaboration between actors (Rocha *et al.*, 2019; Witte *et al.*, 2018; Spender *et al.*, 2017; Mustar *et al.*, 2008). In addition, they contribute to the diffusion of a culture of entrepreneurship and innovation, and the execution of value-capture activities in ecosystems (Hoffecker, 2019). It is not a case that, in Italy, these firms have been the subjects of policy interventions thought to create a more dynamic and innovative business environment (i.e., Law 297/1999, Ministerial Decree 593/2000, Law 221/2012, Decree 147/2013, Startup Act), especially with the definition of a new category of firms called "Innovative start-ups", which have their own registry and requirements.

Nevertheless, when it comes to USOs and their performance, the debate is still open. On the one side, in fact, multiple studies show their positive impact on both the economy (Meoli *et al.*, 2013; Rasmussen *et al.*, 2006; Walter *et al.*, 2006) and the society as a whole (Fini *et al.*, 2018; Fontes, 2005), and associate them with higher performance when compared to similar firms (Francois and Belarouci, 2021; Czarnitzki *et al.*, 2014; Zhang, 2009; Rothaermel and Thursby, 2005). On the other side, instead, evidence has been provided that USOs show a worse financial performance (Salvador, 2011; Wennberg *et al.*, 2011; Bonardo *et al.*, 2010, 2011; Ensley and Hmieleski, 2005) if compared with corporate spin-offs, thus leaving room for questions regarding the actual causes of such diversity of results, and the effectiveness of European universities in enabling innovative entrepreneurial endeavors.

While previous literature reports insights on universities' contribution to regional and ecosystemic growth (Carree *et al.*, 2014; Heaton *et al.*, 2019; Ierapetritis, 2019) and the growth of USOs, if compared with new ventures in general (Bigliardi *et al.*, 2013), on the low impact of Italian universities' context on USOs' performance (Corsi *et al.*, 2017), and on USOs' performance in general (Bigliardi *et al.*, 2013; Calvo *et al.*, 2013; Fini *et al.*, 2017; Rodríguez-Gulías *et al.*, 2018), the analysis of how and whether in Italy the direct linkage with a university actually enhances the growth of different types of innovative firms in their early stages remains unexplored, and still can give us a better understanding of the causes of the performance of the Italian innovation ecosystem.

Thus, to address this literature gap and provide both the theory and the practice with new insights on the phenomenon, our study intends to compare the performance in terms of sales growth of early-stage innovative firms having a direct link with Italian universities (USOs), with the ones who do not have it (i.e., innovative start-ups). Moreover, when USOs have the characteristics requested by the Italian law, they can be classified as innovative start-ups for the Italian government. Thus, our investigation is extended to this hybrid type of firm, too, and we make three different analyses to compare the performance in terms of sales growth of both USOs, IISs, and USOs that are classified as IISs.

That being said, in this context, we formulate the following research questions:

R1) In Italy, how do university spin-off firms (USO) perform compared to innovative start-ups (IIS)?

R2) In Italy, how do USOs classified as IISs perform, compared to innovative start-ups or USOs separately?

In both of our research questions, we seek to understand if universities are actually exploiting their potential to be enablers in the innovation ecosystem - which is among the main goals of their third mission - starting from the impact they have on the growth of their spin-off firms, which benefit of a privileged channel of information flow. In particular, we compare USOs with innovative start-ups, which are a novel element of the Italian innovation ecosystem and share many characteristics with USOs. We carry out our analysis on a unique panel dataset comprising of 149 Italian USOs, 1392 IISs and 95 USOs classified as IISs, too, all born between 2014 and 2016. Panel data methodology, indeed, helped us produce more reliable findings regarding the differences in the sales growth performance between these types of firms.

Our results show that in Italy, on average, universities are not enabling their spin-off firms to grow faster than non-academic innovative organizations at an early stage of development. This difference only fades when a firm is both a USO and an IIS. Despite the access to cutting-edge resources not available in the marketplace (Bierly *et al.*, 2009) and the assistance that universities extend to spin-offs - due to their significance in fulfilling a university's third mission and as a means of generating value (Pitsakis *et al.*, 2015) -, then, fledgling university spin-offs (USOs) are still not able to outcompete non-academic early-stage innovative enterprises.

This study offers an understanding of how USOs and IISs operate in Italy and the impact of the interaction of early-stage innovative firms with universities, in the Italian context. Also, it gives a launchpad for academics to explore the connections between innovators in Italy. It provides valuable information to start-up and university supervisors on the success of the association between universities and early-stage innovative firms, which could be considered when making strategic and financial decisions linked to universities' engagement in entrepreneurial initiatives and regional innovation ecosystems. Finally, it allows policymakers to comprehend the type of investments needed to support and foster the innovation ecosystems in Italy.

This paper is structured in the following way: Section 2 explores the literature background and lays out the research queries; Section 3 discloses the data and the chosen variables and gives the econometric model applied to further explore the research queries; Section 4, then, offers the results of the empiric investigations; finally, Section 5 gives suggestions for practitioners and further studies.

2. Literature background

2.1 The Innovation ecosystem framework

In the past two decades, a new field of research regarding entrepreneurial and innovative ecosystems has raised relevance among academics and policymakers, thanks to the growing urge to spur innovation development processes at the local level. Different studies explored the concept of innovation ecosystems (Granstrand and Holgersson, 2020; Autio and Thomas, 2014; Jackson, 2011; Carayannis and Campbell, 2009; Adner, 2006), and also enriched the literature by both differentiating the concept of 'innovation ecosystem' from the traditional idea of 'innovation system', and introducing new conceptual frameworks and fresh perspectives (Oh *et al.*, 2016; Gomes *et al.*, 2018; Scaringella and Radziwon, 2018, Thomas and Autio, 2019, Granstrand and Holgersson, 2020).

In particular, apparently all the different definitions point to a concept lately developed by Granstrand and Holgersson (2020), who define an innovation ecosystem as "[..] the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors [..]".

It is clear, then, that the the focus of such ecosystems is that of enabling innovation and technology development, and value creation processes (Jackson, 2011; Gomes *et al.*, 2018) at the local level. However, if we want to add clarity to that definition, we should look more deeply at their evolutionary character, the co-existence of multiple actors and resources, and the fact that innovation ecosystems share actors, dimensions and resources with entrepreneurial ecosystems .

First, innovation and entrepreneurial ecosystems evolve through different phases (Moore, 1993; Cantner *et al.*, 2020) such as: birth, growth, maturity, decline, and re-emergence. This is also why a clear path and strategy for growth should be defined and followed (Moore, 1993; Rabelo and Bernus, 2015) as the ecosystem evolve, in order to reach success. Along an ecosystem's lifecycle, furthermore, actors as well as dimensions take on different roles and relevance. Thus, agents such as universities find themselves in the position of exploiting their potential in different ways, based on the specific phase the ecosystem is going through (Heaton et al, 2019), but always maintaining their role of catalysts for growth over time.

Speaking of the actors that characterize an innovation ecosystem, then, the Quadruple Helix approach (Carayannis and Campbell, 2009) offers the most appropriate framework. Based on Etzkowitz and Leydesdorff's (2000) work and with the addition of a new helix, it identifies four types of actors:

academia/universities, industry, state/government, and media-based and culture-based public. A view which is also confirmed in other studies, such as that of Jackson (2011), and Malerba and McKelvey (2020), which also agree on the central role of universities as enablers of innovation production, firm growth, and so forth in a region, together with other actors.

In this study, since we are interested in firm growth and the value creation process in Italy, among the various actors we focus on universities, which play a central role in European innovation ecosystems (Reichert, 2019). In fact, on the one hand, universities are crucial for talent development. They produce knowledge, skills, and abilities for competitiveness (Goldstein and Drucker, 2006), attract and raise human capital (Huffman and Quigley, 2002), contribute to territory level education (Heinonen and Hytti, 2010), and educate students in diverse roles in future academic, professional, and leadership careers (Reichert, 2019) by also creating innovation and entrepreneurship centers (Schiuma and Carlucci, 2018). On the other hand, they play a vital role in driving innovation and technology development through their research activities and commercialization efforts (Thomas *et al.*, 2021; Rothaermel *et al.*, 2007; Rogers *et al.*, 2001). By creating new knowledge, advancing technologies and managing innovation appropriability, moreover, universities contribute significantly to the growth of various industries (Thomas *et al.*, 2021; Malerba and McKelvey, 2020). Finally, they serve as key players in orchestrating innovation ecosystems, too, by fostering collaborations with other actors in the ecosystem (Reichert, 2019; Heinonen & Hytti, 2010) to promote knowledge sharing and value co-creation.

For the same reasons, we are interested in early-stage innovative firms, in the forms of university spin-offs and innovative start-ups, as they are considered fundamental actors of innovation ecosystems, especially in Italy. Therefore, we discuss about them in the following paragraphs.

2.2 Early-stage innovative firms

Early-stage innovative firms - otherwise known as innovative start-ups - can be described as new firms that commercialize innovative products or services, with a great propensity for growth (Fiorentino *et al.*, 2020; Colombelli *et al.*, 2016; Ali and Shah, 2015) and knowledge production (Fritsch, 2011). Based on the particular innovation they are developing, they can rapidly switch their status of microenterprise to that of high-performing SMEs or big companies (Kantis *et al.*, 2020), as in the case of the so-called 'gazelles' and 'unicorns', and to expand swiftly through industries and geographies.

Possibilities, those, that sometimes come in contrast with the fact that their innovativeness can often hamper their capacity to grow and survive, which mostly depends on their culture, access to quality human capital, and absorptive capacity, other than on financial measures (Hyytinen *et al.*, 2015). Indeed, survival rates in innovative start-ups are usually low, also because of the uncertainty connected to their innovative product or service, the lack of access to proper support, and funding, and the ability

of the surrounding entrepreneurial and innovation ecosystem to foster their growth. These firms, in fact, generally benefit from their presence in successful ecosystems, and capture value from them by taking advantage of the high-quality talent, professional networks, infrastructures, policies, and capital available (Audretsch *et al.*, 2020).

At the same time, however, such firms are acknowledged for their contribution to fostering the growth of innovation and entrepreneurial ecosystems, as they usually create value by spreading a culture of innovation and entrepreneurship, creating jobs, developing new knowledge (Malerba and McKelvey, 2020), and fostering competition and collaboration among ecosystem actors (Colombelli *et al.*, 2016; Witte *et al.*, 2018; Rocha *et al.*, 2019) at the local level.

Given their contribution to economic growth, job creation, and ecosystem development, and their need of support (Wilson, 2015), thus, in recent decades policymakers and academics have grown their concern about the widening gap between Europe and the rest of the world regarding the development of innovative endeavors. Accordingly, while Europe is the biggest market in the world and has long been acknowledged as a global leader in the production of top-tier research, it has also often struggled to translate this expertise into technological innovation.

Keeping in view these facts, the EU Commission has recently increased its efforts in entrepreneurship and ecosystem development activities by reinforcing the policies towards capable innovators, starting with the introduction of the concept of Young Innovative Companies (YIC - Mas-Tur and Simón Moya, 2015; Czarnitziki and Delanote, 2013). In line with this, in 2012 the Italian government introduced a law (i.e., Law 221/2012) to define and support new early-stage innovative firms, too. This law classifies as Innovative Start-ups (that for our purpose we call Italian ISs - IISs) all the new businesses designed to create, build, and sell products or services of a high technological value (Scattoni *et al.*, 2019; Del Bosco *et al.*, 2021), and sustains them with tax credits, flexible labor arrangements, and easier access to financial resources. IISs must be based either in Italy or in another European Union country (but, in this case, with a branch in Italy), and must comply with characteristics regarding the R&D expense, the education level of the workforce, and the presence of patents (Matricano, 2020).

While these innovative start-ups are small in proportion among other start-ups, research shows that in Italy these start-ups grow more than their non-innovative peers on average (Fiorentino *et al.*, 2020), and try to locate near universities to benefit from knowledge spillovers (Calcagnini *et al.*, 2014) thus resulting to be relevant for the growth of innovation ecosystems at the regional and national level, as they seem to be more ready to actively participate in the ecosystem.

2.3 University spin-off firms

As in the case of YICs and IISs, university spin-offs (USOs) have been gaining attention in recent decades, as a consequence of the need for more performing innovative ecosystems, previously described.

The development of USOs, indeed, is embedded in universities' third mission (Rogers *et al.*, 2001) as a means to transform research results into commercial applications (Pattnaik and Pandey, 2016; Rasmussen *et al.*, 2014; Swamidass, 2013; Van Burg *et al.*, 2008; Rasmussen, 2008) and provide benefits to the surrounding environment. USOs are instrumental in driving technological advancement (Akram *et al.*, 2018), in part due to the unique resources that universities can offer and have also been found to be particularly beneficial in terms of collaboration between universities and businesses. Their ability to create a platform for collaboration between academic and industry partners, in fact, can lead to joint research projects, joint-venture companies and even innovative products, helping universities in diversifying their research and teaching, and helping businesses to access new knowledge and expertise (Tohidi *et al.*, 2020).

The linkage with the university and the commercial world, and the ability to increase the absorptive ability of a region through the indirect dissemination of new technology at the local level (Fini *et al.*, 2018; Criaco *et al.*, 2014; Clausen and Rasmussen, 2013; Vincett, 2010; Fontes, 2005; Hindle and Yencken, 2004; McQueen and Wallmark, 1982), then, make USOs highly valuable actors of any innovation and entrepreneurial ecosystem. This, moreover, is particularly true if we think that, when in their early-stages, USOs can be seen as another form of early-stage innovative firms.

In addition to this university spin-offs are twice as likely to succeed as non-university start-ups and are typically more likely to be provided with the necessary financial, structural, and mentoring support to ensure robust growth. But these results are only possible if they live in an enabling environment, created by universities that develop the right capabilities to transfer knowledge to commercial markets[3]. Indeed, despite their potential to generate innovation, USOs share the same challenges of early-stage innovative firms, that can prevent them from growing quickly and producing innovative products and services (Pfeffer *et al.*, 2016). In addition to that, USOs often struggle to transition from being research-oriented to being market-oriented (Kortum and Lerner, 1999), posing questions on the ability of universities to provide them with the right environment, resources, and support.

That is why, over the years, policies have been developed to encourage universities to invest in technology transfer and the development of these companies (Bolzani *et al.*, 2014; Grimaldi *et al.*, 2011; Rappert *et al.*, 1999). This process has increased the linkages between academia and industry, allowing potentially high-growth firms to be established with a significant innovative and economic influence (Vincett, 2010; Lawton Smith and Ho, 2006). In parallel with this, and long before the IISs case, policies (such as the Law 297/1999 and the Ministerial Decree 593/2000) have been created to foster the development of USOs in Italy, too, thanks to a regulatory framework that allowed Universities to decide and oversee their internal policies regarding the employment status of academic entrepreneurs,

[3] https://www.iblforum.org/knowledge-bank/investment-in-university-spin-offs-exploring-the-differences-between-university-and-non-university-start-ups/

intellectual property rights, and conflict of interest matters. (Salvador, 2009).

3. Data and Methodology

The research in hand aims to provide a comprehensive analysis of University Spin-offs (USOs) and Innovative Start-ups (IISs) in the context of Italy. By studying these two kinds of firms, this research aims to provide insights into how Italy can improve its overall innovation performance and innovation ecosystems. USOs and IISs are both significant actors in the innovation ecosystem, as they have the potential to generate new ideas, products that further contribute to economic development. The ultimate objective of this research work is to provide policy makers, researchers, and other stakeholders with a better understanding of the role of USOs and IISs in the context of Italian Innovation ecosystem.

To meet the objective, this research uses multiple databases to retrieve desired data. The first database is provided by Netval, contained information on 1949 Italian USOs, including the company name, foundation date, ATECO code (the Italian classification of economic activities), parent university, location, and VAT number. The database lacks some information, primarily non-sensitive information. However, the authors were able to fill in most of the missing data, including ATECO codes and VAT numbers, through a secondary source. The second database, provided by the Italian Registro Imprese, contained data on 11,620 Italian innovative start-ups (as defined by the DL 18 ottobre 2012, n. 179, and enlisted in a special section of the Registro Imprese) registered between 2013 and 2020. This data includes the company name, foundation date, ATECO code, location, legal requirements, and website. However, this database lacks data regarding websites of some companies.

Furthermore, to integrate these two databases, we used financial data from the Aida-BvD database and secondary data from various sources, such as EU reports, the "Ministero dell'Istruzione dell'Universita e della Ricerca", and the websites of the Italian "Regitro Imprese" and Italian Contamination Lab Network". Overall, we used multiple sources of data to gather comprehensive information on USOs and IISs in Italy, which allowed us to conduct a detailed comparative analysis of different types of startups.

3.1 Exclusion criteria

Based on the main databases and additional sources as mentioned above, we apply exclusion criteria to obtain three different samples of firms. The first sample includes companies that were founded between 2014 and 2016 and have at least three years of financial data available, with a valid VAT number. This criterion helps ensure that the companies are at a similar stage of the company lifecycle and comply with the legal requirements (IISs were defined in Italy by law for the first time back in 2012). Companies founded outside this time frame are excluded due to the lack of comparable financial data.

The second exclusion criterion is to exclude cooperatives, consortia, social or agricultural companies, and companies that are in or have been in bankruptcy (i.e., "in liquidazione" or "in scioglimento"). This helps to eliminate companies with non-profit objectives and those that may not be in a stable financial condition, which could affect the results of the analysis.

After applying the exclusion criteria, we extracted a first sample comprising 149 USOs and a second sample containing 1392 IISs. The third sample is a cross-search of the first two "clean" datasets and contains 95 IISs that are also USOs.

We then integrated the obtained data with an average Regional Innovation Score for the years 2012-2019, retrieved from EU reports (Hollanders *et al.*, 2012; 2014; 2016; 2019; Hollanders and Es-Sadki, 2017), which provides information on the innovation level of every region in Italy. Finally, the financial data was retrieved from the Aida-BvD platform, which allows us to analyze the financial performance of the selected startups.

3.2 Dependent variable

We select firm growth as our dependent variable to examine how USOs and IISs performed differently in their first years in Italy. Growth is a good performance indicator in the context of this study because, despite the fact that innovation ecosystems' primary objective is to promote innovation and technology development in a specific area, they also improve innovative firms' growth potential (Feng *et al.*, 2021). Also, according to Zhou and de Wit (2009), a firm's ability to grow is directly correlated with its age, hence firm growth is an appropriate performance indicator since we only consider the first three years (due to dataset limitations).

Sales and employee growth appear to be the most often utilized indicators for measuring company growth (Wiklund *et al.*, 2009). To measure firm growth, we focus on growth in terms of sales. We use the natural logarithm of the differences in the sales of the firm between year t and year t-1. This approach is consistent with the previous studies by Wennberg *et al.*, and Rodriguez-Gulias *et al.*, (2018).

3.3 Independent Variables

The study in hand takes into account different independent variables (Table 1). First, we consider dummy variable that indicates whether a firm is a start-up, a university spin-off firm, or both. This is a categorical variable that takes on one of three possible values: start-up, university spin-off or both. This variable allow us to compare these types of firms to each other. Then, we consider firm specific dimensions such as financial - tangible assets (log_tot_tan_assets), intangible assets (log_tot_int_assets), shareholder equity (log_shar_equity) and number of employees (log_ employess) by following previous studies (Garnsey *et al.*, 2006; Rauch *et al.*, 2005; and Shalit and Sankar, 1977). After that, in line with previous studies (i.e., Díaz-Santamaría and Bulchand-Gidumal, 2021; Zhou and de Wit, 2009; Coad and Rao, 2008; Gibcus *et al.*, 2006) which highlight

the importance of external environment on firm growth, we use the OECD Taxonomy of economic activities based on R&D intensity ('Rdint' - Galindo-Rueda & Verger, 2016) and variables associated to local context, particulary those linked to universities and innovative start-ups. Following (Varum *et al.*, 2020; Reichert, 2019; Tripathi and Oivo, 2020; and Fini *et al.*, 2017) we, then, also consider the regional specific variables such as number of universities (log_uni_nuts), the number of university students in a given region (log_stud_nuts), the number of contamination labs (log_clab_nuts), and the number of accelerators / incubators in a region (log_inc_nuts).

Tab. 1: Type of variables, description, name, and sources

Type of Variables	Description	Variable name	Sources
Dependent			
Financial	Growth in Sales	Growth	Wennberg *et al.*, 2011 Rodríguez-Gulías *et al.*, 2018
Independent			
Type	Type of company: USO, Startup, USO & Startup	Firm	-
Financial	Tangible Assets	log_tan_assets	Garnsey *et al.*, 2006
	Intangible Assets	log_tot_int_ assets	Garnsey *et al.*, 2006
	Number of Employees	log_employees	Garnsey *et al.*, 2006 Rauch *et al.*, 2005
	Shareholders' Equity	log_shar_equity	Shalit and Sankar, 1977
Industry	R&D Intensity in the sector (and sector classification based on this)	rdint	Díaz-Santamaría and Bulchand-Gidumal, 2021 Zhou and de Wit, 2009 Coad and Rao, 2008 Gibcus *et al.*, 2006
Regional	N° of universities in the region	log_uni_nuts	Varum *et al.*, 2020
	N° of university students in the region	log_stud_nuts	Reichert, 2019
	Regional innovation score	log_ris	Hollanders *et al.*, 2012-2016 Hollanders and Es-Sadki, 2017
	Number of Contamination Labs	log_clab_nuts	Reichert, 2019
	Number of incubators/ accelerators	log_inc_nuts	Tripathi and Oivo, 2020

Source: our elaboration

3.4 Control Variables

To ensure the validity and accuracy of our findings, we have taken into account various industry-related variables, such as the sector type based on the Italian ATECO classification (ateco), as well as regional innovation ecosystem factors like geographical location and Regional Innovation Score (log_ris). Additionally, we have also considered macroeconomic shocks over time by controlling for year.

For what is about the control on geographical location, however, considering that we had to reduce the initial sample by more than 50%, we found it suitable to carry out the analysis based on the NUTS1 territorial

classification[4], which helps us in keeping the number of companies high enough for a proper analysis. For the same reason, the variables related to the Regional Innovation Score, the number of Incubators, Universities, Contamination Labs[5] (Secundo *et al.*, 2020), and Students are respectively the average and the total (per year) of each variable in the respective NUTS1 region.

3.5 Empirical methodology

The empirical approach is based on a panel data estimation of the afore mentioned sample data. The advantage of using a panel dataset is that it allows us to control for unobserved heterogeneity across firms that may affect their sales growth performance. In order to account for heteroscedasticity and autocorrelation in panel data, as we also work with financial data (where the variance may change over time or across different firms), we run a GLS regression. In fact, using standard OLS regression would result in biased estimates if the variance of error terms differred across firms or over time periods. Moreover, we opted for a random-effects model because multicollinearity concerns prevented us from using a fixed-effects model.

In particular, our panel data structure allows us to control for time-invariant and unobserved factors specific to each firm. The estimated model is saturated by time and industry-specific effects, using dummy variables. Then, we estimate a baseline, unbalanced panel model, including only financial indicators as predictors, along with industry, time, and region information as controls:

$$\Delta GROWTH_{i,t} = \alpha + \sum_{j=1}^{k} \delta_j X_{i,t} + \varphi_{i,k} + \gamma D_{industry} + \delta D_{year\ t} + \mu D_{region} + FIRM + \varepsilon_{i,n,t}$$

where:

X (i,t) = the vector of variables representing firm-specific characteristics for firm i, operating in year t

D_industry = industry dummies to control for industry specific effects

D_year t = yearly time dummies to control for time-specific effects

D_region = regional dummies to control for ecosystem-specific effects

ε(i,t) = the error term for firm i in year t

The dummy variable FIRM determines whether a firm is a USO, an IIS, or a USO that was born as an IIS. Keeping in view this model, we run a regression analysis on companies founded between 2014 and 2016 in the first three years of their lifecycle.

[4] NUTS stands for "Nomenclature of Territorial Units for Statistics" and is a geographical classification that divides the EU territory. The NUTS1 include major socio-economic regions. https://ec.europa.eu/eurostat/web/nuts/background

[5] Contamination Labs are "[..] promising Entrepreneurship Education Centres which create programmes to develop an entrepreneurial mindset in students with different educational backgrounds and levels." (Secundo et al., 2020, p. 1)

4. Results

The primary objective of this study is to analyze and compare the performance of university spin-offs (USOs) and innovative start-ups (IISs) in Italy. Additionally, we aim to investigate whether there is a correlation between early-stage innovative firms' growth rates (sales) and their relationship with a university as a parent organization. We use the same model for both research questions as explained in section 3. The dependent variable used in the analysis is sales growth, which is measured as the natural logarithm of the difference in sales between year t and year t-1. The independent variables and controls used in the analysis are time-specific, firm-specific, industry-specific, and ecosystem-specific indicators, including R&D intensity level (rdint), ATECO code (ateco), and total intangible assets. The standard error is adjusted for the different five macro-regions of Italy such as 'Centro', 'Isole', 'Nord-est', 'Nord-ovest', 'Sud'.

The variable FIRM of our regression equation effectively explains the performance in terms of sale growth when we compare IISs to USOs, as shown in Table 2. The study in hand finds that IISs in Italy outperform USOs in terms of sale growth. However, the other variables used in the analysis do not show significant results in explaining the difference in growth rates between the two types of firms. The only variable that is explanatory in this regard is the total value of intangible assets. When comparing USOs and IISs with USOs that are also IISs, the results are not as promising. The difference in the potential growth rates of sales between USO/IISs and USOs that are IISs is not explained by the variable FIRM, as demonstrated in Table 3.

Both the first and second analyses' results could have a variety of causes. In our first analysis, if we consider how a firm's type and relationship with academia may affect that firm's growth, it appears that the academia "parenting" relationship with USOs does not guarantee better performance when compared to other innovative firms, such as IISs. We, therefore, follow Leyden and Link (2013) that the propensity for innovation and the relationship with academia do not directly result in higher economic performance, in spite of the fact that the greater tendency for R&D activities (especially due to composition of the workforce; Ranga and Etzkowitz, 2013) and access to research that is not yet commercially available should result in higher growth rates.

It is important to consider a range of factors when assessing a firm's economic performance, and not solely rely on measures of innovation or academic affiliation. While innovative firms outperform their non-innovative counterparts, they nonetheless confront several challenges and difficulties in their early phases due to their infancy and small size (Audretsch *et al.*, 2020). Therefore, higher performance does not depend only on the R&D until and unless accompanied by founding team's entrepreneurial, strategic, and commercial skills, new business development methodologies, a favorable environment, and a strong network of partners (Daz-Santamara and Bulchand-Gidumal, 2021; Iazzolino *et al.*, 2019).

Tab. 2: Results of a random-effects GLS regression that compares innovative start-up companies to university spin-off firms, all born between 2014 and 2016, with data from year 1 to year 3 of their business life cycle. The dependent variable is 'growth', at the top of the table

Growth	Coefficient	P>z
Firm		
Startup	24.75635	0.000
Year		
2016	2.010249	0.898
2017	-31.56854	0.309
2018	-39.28827	0.227
Rdint		
Low R&D	2.230406	0.795
Medium R&D	1.767358	0.843
Medium-High R&D	6.510788	0.382
Medium-Low R&D	-.3470887	0.926
Ateco	-.0238594	0.720
log_shar_equity	-1.040812	0.693
log_tot_tan_assets	-1.382591	0.211
log_tot_int_assets	2.5086	0.045
log_employees	-2.679912	0.334
log_ris	12.64022	0.413
log_clab_nuts	2.452275	0.905
log_inc_nuts	3.369878	0.877
log_stud_nuts	-1.956994	0.959
log_uni_nuts	-4.741227	0.853
_cons	-21.51	0.943
sigma_u	0	
sigma_e	128.21245	
Rho	0	

Source: our elaboration

As per as our second research question is concern, instead, the findings shown in Table 3 lead to different conclusions. First, both in the confrontation with IISs and USOs, the firm's type does not explain alone the differences in growth between them and USOs that are also IISs. This can be explained as that having innovative firms' characteristics does not guarantee firm's higher performance. While policy interventions aimed at fostering innovation and entrepreneurship are important, simply recognizing a firm as innovative does not guarantee its success or growth trajectory. Therefore, policies and support programs need to be designed to address not only the initial recognition and support of early-stage innovative firms, but also their longer-term growth and success by addressing a range of internal and external factors that can impact their performance.

Tab. 3: Results of a random effects GLS regression, that compares innovative start-ups and university spin-offs to university spin-offs that are also innovative start-ups, all born between 2014 and 2016, with data from year 1 to year 3 of their business life cycle. The dependent variable is 'growth', at the top of the table

	IISs		USOs	
Growth	Coefficient	P>z	Coefficient	P>z
Firm				
Uso&Startup	-5.345357	0.272	5.777906	0.229
Year				
2016	-4.154902	0.932	-6.354571	0.181
2017	-42.9123	0.186	-13.3557	0.167
2018	-50.12202	0.130	-19.83343	0.164
Rdint				
Low R&D	1.688326	0.842	-3.73013	0.286
Medium R&D	2.710009	0.789	-3.129683	0.433
Medium-High R&D	7.550741	0.324	7.831438	0.302
Medium-Low R&D	-1.337312	0.723	.2344194	0.887
Ateco	-.0346356	0.616	-.0287173	0.209
log_shar_equity	-1.299865	0.612	-.827714	0.614
log_tot_tan_assets	-1.429029	0.210	.3817737	0.553
log_tot_int_assets	2.640432	0.026	.1821816	0.862
log_employees	-2.739235	0.326	1.161115	0.001
log_ris	9.273611	0.478	13.15648	0.068
log_clab_nuts	3.519914	0.880	4.735828	0.230
log_inc_nuts	6.198298	0.800	6.748216	0.083
log_stud_nuts	-4.833318	0.910	-17.20481	0.000
log_uni_nuts	-6.609435	0.822	-7.640144	0.006
_cons	44.16233	0.898	62.04734	0.185
sigma_u	0		0	
sigma_e	131.57285		26.241361	
Rho	0		0	

Source: our elaboration.

Following this, we examine the impact of the regional innovation ecosystem on an early-stage innovative firm's performance. In both the comparison between USOs and IISs, and that between IISs and USOs that are also IISs, the results show that the Regional Innovation Score, contamination labs, universities, students, and incubators do not explain alone the differences in growth between the selected firms. This is not the case when we compare USOs to USOs that are also IISs. In this regard, the presence of incubators and a high Regional Innovation Score are positively associated with the growth rate of USOs that are also IISs. However, the number of students and universities in a region has a negative association with the growth rate of such firms in a NUTS 1 region. This leads to dual interpretation of the results. On the one side, in Italy, a region's innovation level, as well as the number of students, universities, contamination labs, and incubators, have less of an impact on innovative start-ups. This is due to the possibility that these firms are less integrated into the local innovation ecosystem and may also be more autonomous in their early life. In fact, the success of innovation ecosystem in promoting the growth of firms depends on the quality of connections between the ecosystem's actors, actions, and artifacts, rather than just the presence of supportive infrastructures, high-skilled human capital, and academia.

On the other side, USOs might be more positively influenced by the Regional Innovation Score and by the presence of incubators because of a closer linkage to the regional innovation ecosystem, and because they might be more likely to benefit from the help of an incubator. Generally speaking, these conditions demonstrate the potential ineffectiveness of policy interventions that prioritize the quantity of support and actions over their quality, which is in line with the previous studies (Audretsch *et al.*, 2020; Colombelli *et al.*, 2016). Also, they confirm that a deeper exploration of the relationships between ecosystem actors, artifacts, and actions is necessary in order to be able to understand the causes of the low performance of the overall ecosystem.

5. Conclusions

This paper aims to enrich the conversation on the dynamics and issues of Italy's innovation ecosystem by comparing its two most acknowledged types of early-stage innovative firms, and analyzing the impact that the linkage with a university has on their growth.

The European Union has made significant efforts to develop an innovation ecosystem and provide funding for its member states. However, there remains a substantial gap in innovation performance among the countries. Italy is a major economy, but still lags behind other member states as a moderate innovator. To address this issue, this paper aims to explore the effectiveness of interactions between universities and early-stage innovative firms in Italy by providing theoretical and empirical insights into the performance of university spin-offs and innovative start-ups.

Starting from two datasets of USOs and IISs in Italy, we carry out a panel data regression that allows us to compare the performances of these two types of early-stage innovative firms, measured by sales growth. On the one side, we find out that Italian innovative start-up firms perform better than Italian university spin-offs on average. The parenting relationship of universities with USOs, then, does not lead to higher financial results. On the other side, although not promising, the findings show how the simple characterization as an innovative start-up does not explain an increase in the firm's growth, on average. Instead, if we compare USOs to USOs that are IISs, this difference in sales growth is positively associated with the Regional Innovation Score and the presence of incubators, and negatively associated with the number of students, contamination labs and universities.

However, these results should be considered with caution, as multiple limitations affected our analysis. First, our study is a quantitative one, and it lacks important qualitative measures such as: the innovativeness of a firm; the quality of ecosystem actors, support infrastructures, and the relations among them. Moreover, we miss data on other ecosystem dimensions, such as funding, cultural base, and number of non-institutional supports. Also, the exclusion criteria necessary for the success of the study reduced our sample size by more than 50%, making it difficult to expand the analysis to

a longer time range. Finally, as innovation ecosystems vary across regions, nations, and continents, and since the study is carried out in Italy, this may hinder easy generalizability in other contexts.

Still, despite these limitations, the paper offers interesting theoretical and practical insights. From a theoretical point of view, indeed, the study reinforces the definition of innovation ecosystem and advances the body of knowledge on the relations between the actors of the Italian innovation ecosystem. Moreover, it tests and proves the association of a few ecosystem-related variables to the increase in sales growth. Also, it confirms what other authors say about the lower performance of USOs compared to other companies more connected to the commercial world.

From a practical point of view, it gives interesting insights for entrepreneurs and university administrators, with data on the effectiveness of "parenting" in the case of the relationship between universities and early-stage innovative firms. University administrators should direct more investments into: transforming the organizational structure in order to make it more entrepreneurship-oriented; improving their entrepreneurship & innovation (E&I) development programs (such as Contamination Labs); helping their spin-off firms transition from being research-oriented to being market-oriented; better supporting them with a strong network of mentors and partners; creating new educational programs in line with the current needs of high-growth innovative firms; improving their strategic connections with other ecosystem actors, and especially with innovative start-ups. Founders of early-stage innovative companies, instead, could use this to make strategic decisions on both the definition of their company's organizational structure and the external collaborations. First, they should ponder and improve the strategic connections they develop with other ecosystem actors involved in R&I activities. Second, they should consider that the linkage with universities with poor E&I programs might not provide benefits for their growth.

Finally, on the policy front it provides policymakers with a deeper understanding of the performance of innovative firms in Italy. Especially, it shows if an ecosystem variable subject to policy intervention is strongly or poorly associated with the growth of early-stage innovative firms. Policymakers could use these insights to understand if and whether the regional investments in innovation are leading to successful results.

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