Higher Education
https://doi.org/10.1007/s10734-026-01750-x

The impact of parent universities and institutional quality on academic spin-off companies: a longitudinal perspective

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Received: 23 July 2025 / Accepted: 10 August 2026

Abstract
This article contributes to the literature on the explanatory factors which influence the various stages of academic spin-off (ASO) companies over time. In particular, the analysis offers a retrospective long-term overview of the role of parent universities and the quality of local institutions, in both launch- and growth-stage of ASOs. To do so, it examines a sample of 945 ASOs, established between 2004 and 2018, in 63 Italian public universities, drawing on a unique database which was built using the most comprehensive data available. Findings reveal two different scenarios linked to the launch- and growth-stage. As regards ASO creation, the initiatives and services provided by the parent university are important, while the quality of local institutions and the context play a marginal role. However, institutional quality and financial development are key determinants for the growth-stage, whereas university characteristics do not seem so important. Although ASOs have become a policy-driven target and it has long been argued that universities should further promote the growth of ASOs by investing increasing human and financial resources in them, much of this appears to be true only for a limited time frame of the ASO life cycle. Instead, a certain level of coordination and complementarity of efforts of parent universities and local institutions in both stages, as well as better understanding of the specific needs ASOs have in diverse moments of their life, could have more impact.

Keywords Academic entrepreneurship · Innovation · Institutional quality · Spin-off · University policy

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Published online: 20 August 2026

Introduction

Academic spin-off companies (ASOs) have been increasingly recognised as an important enabler for transforming research outcomes into commercial ventures, promoting entrepreneurship within universities (Fuster et al., 2019). However, they have perhaps been over-credited with being the most direct channel through which academia contributes to technological progress, increasing employment and strengthening economic development (Messeni Petruzzelli & Murgia, 2022). Indeed, ASOs have become a policy-driven target (Caputo et al., 2022) which reflects a fascination for well-known ecosystems, like Silicon Valley, with governments and universities investing considerable resources to create the conditions for establishing ASOs (Audretsch, 2021).

Previous research frequently assumed there was a direct and uniform link between this institutional support and the performance of ASOs. Nevertheless, it is still unclear how the interaction between different institutional factors, including university organisational support and regional conditions, influence the formation and growth of ASOs (Fini et al., 2011; Opizzi et al., 2025). This is important since many ASOs are said to exhibit very limited growth or to be inactive for years (Meoli & Vismara, 2016). Ndonzuau et al. (2002) laid the foundation in this field of study by pinpointing the critical contextual factors that shape the venture process of any ASO, which includes generating a business idea, finalising a business project, creating a firm and producing value. The ASO launch- and growth- stages are particularly complex (Calcagnini et al., 2016) because they require collaboration between various actors, such as the universities, firms, incubators, science parks and governments, embedded in the ecosystem (Öberg & Grundström, 2024).

While several studies (Fuster et al., 2019; Öberg & Grundström, 2024; Prokop, 2021b) have examined the relationship between entrepreneurial, university or innovation ecosystems, and ASOs, there is still limited evidence as to what extent the venturing process is a combination of the role played by the parent university and local institutions (Dabić et al., 2022; Fini et al., 2011; Prokop, 2021a). Except for a few studies that simultaneously investigated both the creation and growth of ASOs (Fini et al., 2017; Mathisen & Rasmussen, 2019) or bridged university-level and local institutional conditions (Corsi & Prencipe, 2016; Fini et al., 2011), there is limited understanding of how the interaction between parent universities, local institutions, and the quality of their support services influence both the formation and growth of ASOs. Further examination is needed to contribute to informing policies for enhancing the effectiveness of support systems for ASOs and so allocating resources more efficiently (Mathisen & Rasmussen, 2019).

This article contributes to the literature on the explanatory factors which influence the various stages of ASOs over time (Dabić et al., 2022; Fini et al., 2011; Fini et al., 2017; Mathisen & Rasmussen, 2019), by offering a retrospective long-term overview of the contribution of parent universities, local institutions and the quality of their support services in both the creation and growth of ASOs. The following research questions are addressed:

i) to what extent do parent universities and the quality of public institutions influence the formation of ASOs?
ii) to what extent is the growth of ASOs influenced by parent universities and by the quality of public institutions?

From a methodological standpoint, we examine a sample of 945 ASOs, established between 2004 and 2018, in 63 Italian public universities. We use a negative binomial regression estimation model to investigate the determinants of ASO launch-stage. Then, we involve a logit model to analyse ASO growth-stage. The findings reveal two different scenarios. As regards the launch-stage, the activities and the services provided by the parent university show a positive relation with ASO creation, while the quality of local institutions and the context play a marginal role. Regarding the growth-stage, university characteristics do not seem to be as important when compared to institutional quality and financial development which emerge as key determinants. Although the analysis draws on a unique database, it is worth noting that data on firm-level characteristics such as R&D investments, and access to venture funding, were not available. This hindered a deeper assessment of ASO heterogeneity and financial constraints, which may influence both the creation and growth of firms.

This article is structured as follows: Sect. 2 presents the literature background. Section 3 describes the research design. Results and discussion follow. The final section presents the conclusion and suggests a selection of policy implications.

Literature background

ASOs are knowledge-based companies established to commercially leverage intellectual property and facilitate the transfer of knowledge and technology from universities. These firms include at least one academic founder and are primarily oriented toward utilising scientific outputs (Opizzi et al., 2025). However, while ASOs usually show a high propensity to patent, they often reflect academic values and workflows, which are difficult to reconcile with market objectives and logics (Colombo & Piva, 2012).

The literature has demonstrated that the creation and growth of ASOs is a complex process involving diverse actors and multiple interacting factors (Calcagnini et al., 2016). Indeed, Ndonzuau et al. (2002) conceptualised the ASO multi-stage process of transformation of research results into economic value, which includes idea generation, project finalisation, ASO launch, and the creation of economic value. This model encompasses those institutional factors, such as university policies, resource availability and the quality of local institutions, that critically influence each stage of this process. Then, Mustar et al. (2006) introduced a multi-dimensional taxonomy for ASOs to account for the variations in how these firms are established, and evolve. Along with key dimensions, such as resource endowments and business models, the authors observe that the institutional context, links and organisational environment may play an important role in shaping the characteristics and growth trajectories of ASOs. The relationship between ASOs, their parent universities and other anchor institutions includes, among others, formal ties, such as licensing agreements and equity positions of the university; informal interactions, for example collaboration and knowledge exchange; governance structures and organisational support; and the role of intermediaries such as Technology Transfer Offices (TTOs), incubators and science parks.

Most research has focused on the launch-stage of ASOs, with comparatively less attention paid to their subsequent performance over time. Previous studies examined how the parent university, through direct links, strategic support, and physical context, influences the number of academic ventures established. The availability of both tangible and intangible resources provided, or facilitated, by the parent university is important, as scholars

usually have to deal with a lack of the financial resources, laboratories, equipment, skills and industrial experience, required to transform scientific outputs into marketable products or services (Colombo & Piva, 2012). Previous research has demonstrated a positive and significant relationship between the presence and size of a university TTO and the formation of ASOs (Ramaciotti & Rizzo, 2015). Indeed, TTO staff offer support for scholars on business plan drafting, market analysis, the protection of intellectual property rights, and participation in competitive calls for business funding (Micozzi et al., 2021). Furthermore, the nature and quality of the knowledge generated by universities may well favour the formation of ASOs. Top-tier research universities, with higher levels of scientific productivity and citations, usually have higher rates of ASO creation (Hossinger et al., 2020). Moreover, supportive university policies for venture creation, patenting, and consulting research, also affect business launch (Fini et al., 2011; Mustar et al., 2006). Also, the availability of public seed funding is a significant predictor of ASO formation (Bahuleyan et al., 2024).

Regarding the growth-stage of ASOs, i.e. their expansion after establishment, further attention should be paid to the quality of the broader institutional environment in which an ASO operates. Institutional quality is frequently assessed using single proxies, such as legislation, yet the broader concept, which also encompasses norms, informal rules, enforcement mechanisms, and culture, is seldom captured in a comprehensive manner (Ramos et al., 2026). Ndonzuau et al. (2002) argue that ASOs usually encounter issues related to infrastructures, the recruitment of skilled collaborators, and accessing the funding needed both to sustain and, more importantly, to accelerate their development. However, ASOs originate in universities and are not a uniform group because of their differences in resource endowment and institutional links (Mustar et al., 2006). This means they require a set of further interacting factors which enable productive entrepreneurship over time. Among the key factors, local institutions should enact regulations for supporting new ventures, public R&D spending, and incubators (Fini et al., 2011). Public institutions should promote both an entrepreneurial culture and offer support through contracted research (Muscio et al., 2016) and also access to venture capital funding (Fini et al., 2017).

ASOs seem to grow less in geographical areas with low quality institutions, an excessive number of regulations (Chambers & Munemo, 2017), and/or, with high levels of corruption (Oliveira et al., 2022). Galati et al. (2017) emphasised the detrimental effects of excessive government bureaucracy and strict regulations on access to investment and human capital for universities, which negatively impacts the performance of ASOs. As for Italy, adopting clear regulations for academic entrepreneurship has positively influenced the academic venture process, facilitating both access to monetary incentives and to the management of entrepreneurial risk (Muscio et al., 2016). The growth-stage can also be affected by the design and enactment of intellectual property regulations (Fini et al., 2017), which determine the ownership of scholars' inventions and their orientation towards entrepreneurship.

Fini et al. (2011) examined the combined effect of University-Level Support Mechanisms (ULSMs) and Local-Context Support Mechanisms (LCSMs) in promoting the creation of ASOs. The authors investigated whether and to what degree ULSMs and LCSMs serve as complements offering differentiated institutional support, or as substitutes that inefficiently replicate resources. From the conceptual standpoint, ULSMs are defined as «the set of policies and instruments that can be put in place by universities to support academic spin-offs» (Fini et al., 2011, p. 1114) whose variation depends on the phase of intervention,

subjects targeted, type of support provided, nature and type of resources allocated, and the institutional setting in which ASOs operate. LCSMs are conceptualised as support mechanisms emerging from «the business environment within which universities operate» (Fini et al., 2011, p. 1115) which can provide important resources for the establishment and growth of ASOs. The region in which a new venture operates offers both tangible resources, including physical infrastructure and R&D laboratories, as well as intangible resources such as human capital. Using longitudinal data on 404 Italian ASOs established between 2000 and 2007, the authors revealed that ULSMs complement legislative support for high-tech entrepreneurship; *ceteris paribus*, a higher marginal productivity of legislative support increases the marginal productivity of ULSMs. Instead, ULSMs act as substitutes for regional-level factors, including social capital, financial development, public R&D expenditure, the presence of business incubators, and overall innovative performance.

Corsi and Prencipe (2016) investigated how university and regional contextual factors influence the innovation performance of ASOs. Drawing on a sample of 621 Italian ASOs over the period 2004–2012, this study showed that university context plays a more central and significant role than regional context in fostering ASO innovation. In particular, university-affiliated business incubators and university science parks exert a strong positive and statistically significant effect on the innovation performance of ASO. Whereas, regional factors, such as R&D expenditure, R&D staff, human resources and patenting activity, have a marginal or vague role in fostering innovation efforts of academic ventures.

Fini et al. (2017) explored how institutional determinants at both university-level and national-level affect ASO creation and their quality as measured by their ability to attract venture capital financing. Using data on 2323 ASOs from three European countries over the period 2000–2012, the study demonstrated a trade-off between quantity and quality. Indeed, institutional framework changes have a positive effect on the number of ASOs established but a negative effect on the quality of these firms. These results suggest that the implementation of new institutional frameworks appears to be «more symbolic than substantive» (Fini et al., 2017, p. 361) in economic impact. The response within universities is a significant increase in the number of ASO created, while the potential economic impact of these firms seems to be more modest.

More recently, Mathisen and Rasmussen (2019) proposed a multi-level conceptual framework examining how various levels, individual, firm, institutional, and ecosystem, affect the development, growth, and performance of ASOs. The framework recognises that ASOs are heterogeneous firms whose success depends on factors operating across all these interconnected levels. At the individual level, ASOs usually start with deep academic knowledge and strong research networks. However, they typically possess low levels of business expertise and have limited networks beyond the academic environment. Further key individual factors include the inventor's skills, their network with venture capitalists, and a well-functioning multidisciplinary team. Regarding firm-level determinants, ASOs focus on internal organisational factors which are critical to their success. For example, key determinants encompass technology assets and their conversion into market applications, development processes and adaptation to critical events, and partnerships. At the institutional and ecosystem level, external support structures and broader environmental contexts shape ASO growth trajectories. In particular, important factors include policies and support programmes, the relationship between ASOs and their parent universities, and the regional context.

Overall, these studies suggest that research on ASOs has evolved towards greater theoretical sophistication and broader thematic diversity. However, except for a few articles that simultaneously examined both the creation and the growth of ASOs (Fini et al., 2017; Mathisen & Rasmussen, 2019) or both university-level and local institutional conditions (Corsi & Prencipe, 2016; Fini et al., 2011), little research explored how the interaction between parent universities, local institutions, and the quality of their support services impacts both the formation and the development of ASOs. Given the growing focus on these issues by policymakers in the EU and globally, a systematic evaluation of how university and institutions support academic entrepreneurship seems both timely and important. Thus, this article addresses this gap by offering a retrospective long-term overview of the role of parent universities, local institutions and the quality of their support services in both the creation and growth of ASOs.

Research design

Sample, context, and descriptive statistics

Our analysis deals with a sample of 945 ASOs created between 2004 and 2018 in 63 Italian public universities, drawing on a unique database which was built using the most comprehensive data available. Data on ASOs are drawn from the Italian Network of Technology Transfer Offices of Universities and Public Research Organisations (NETVAL) and, the Bureau van Dijk-Aida database. Data on universities are from the Ministry of University and Research (MUR), while the quality of local institutions was retrieved from the Institutional Quality Index (IQI) database by Nifo and Vecchione (2014, 2015) (see Appendix).

Several factors make the Italian context an interesting case for studying the role of parent universities and local institutions, and the quality of their support services, when creating and promoting the growth of an ASO. First, following a nationwide reform in university technology transfer regulations, there has been a considerable increase in the number of ASOs over the past two decades (Muscio et al., 2016). Second, ASOs pose challenges for national policy-makers since universities have to somehow balance their traditional teaching and research missions with the role of academic entrepreneurship in knowledge transfer and commercialisation, as emphasised by the report *The Future of European Competitiveness* (Draghi, 2025). Third, in Italy, there is a high degree of heterogeneity in the quality of institutions at the local level (Agostino et al., 2020; Corradini, 2021), which has limited university-industry connections, and created a weak venture capital market (Hahn et al., 2024).

As regards the university context, Table 1 reports the geographical distribution of Italian public universities both by size and by its NUTS-1 geographical area[1]. Almost 46% of all mega universities and half of the big universities are in the North of Italy. The Centre and the South of Italy account for the largest share of small universities: almost 80% of the total. Overall, universities show a considerable degree of heterogeneity both in terms of size and of geographical distribution. Figure 1 shows that the kernel density distribution of the

[1] NUTS (Nomenclature of Territorial Units for Statistics) is the standard geocode, adopted by the European Union, for referencing country subdivision for statistical purposes. The analysis also considers Italian NUTS-3 regions which correspond to administrative provinces (average population of 600,000 residents). In 2026, there are 110 NUTS 3 regions: 82 ordinary provinces, 2 autonomous provinces, 4 regional decentralisation entities, 6 free municipal consortia, and 15 metropolitan cities and the Aosta Valley region (also province): https://www.istat.it/classificazione/codici-dei-comuni-delle-province-e-delle-regioni/.

Table 1 Geographical distribution of universities by size

University size	NUTS-1 geographical area				
	North-West	North-East	Centre	South	Total
Mega	33.3	13.3	26.7	26.7	100.0
Big	25.0	25.0	8.3	41.7	100.0
Medium	7.7	38.5	23.1	30.8	100.0
Small	16.7	4.2	33.3	45.8	100.0
Average	20.3	17.2	25.0	37.5	100.0

University size - total number of academic researchers ≥ 1,500 (Mega); between 1,000 and 1,499 (Big); between 500 and 999 (Medium); ≤499 (Small)

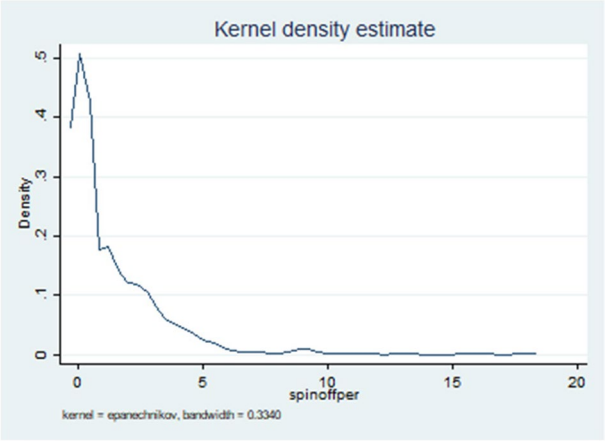


Fig. 1 Kernel density distribution of the number of ASOs per 1,000 academic researchers (headcount). Source: Authors' elaboration.

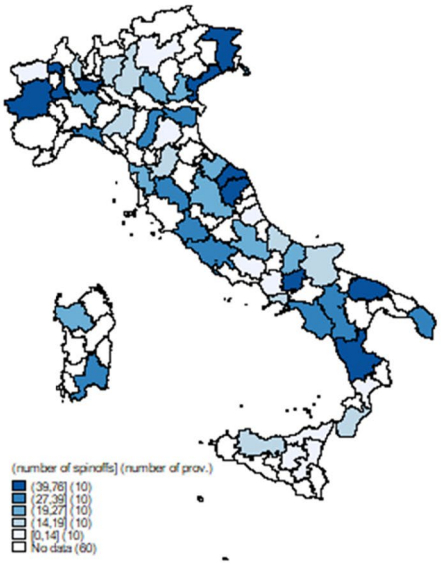
number of ASOs per 1,000 researchers in Italy is positively skewed, with many universities with zero ASOs.

Figure 2 shows the geographical distribution of ASOs (panel a), and of their parent universities (panel b), while Fig. 3 shows the quality of institutions at the provincial level[2]. As regards the ASO launch-stage, figures reveal a heterogeneous spatial distribution of both ASOs and parent universities, indicating that academic ventures are distributed across a wide range of provinces rather than being concentrated in a limited number of areas. There is also a marked difference between provinces in the North, and those in the South, of the country in the quality of local institutions. Almost all Northern provinces show very high values, while Southern provinces, including the Islands, show much lower values for the quality of institutions. Furthermore, the IQI has low variability: the overall standard deviation of the panel data set is 0.25, the between-standard deviation is 0.24, while the within-standard deviation of the IQI is 0.05. In general, there is little spatial correlation between high-quality institutions and the formation of ASOs. Furthermore, the correlation matrix is reported in the Appendix (Table 1B and Table 2B).

Table 2 shows the descriptive statistics. Regarding the dependent variable, which is the number of new ASOs per 1,000 academic researchers per year, there is a mean of 1.32 academic ventures created annually per Italian public university. However, the standard deviation reveals wide variations in ASO formation. Indeed, universities behave very differently when creating ASOs: ranging from zero to 18.02 new firms established per

[2] The distribution of universities by NUTS-3 regions (Italian provinces) is also shown in Fig. 1B in the Appendix.

a) Total number of ASOs.



b) Total number of parent universities.

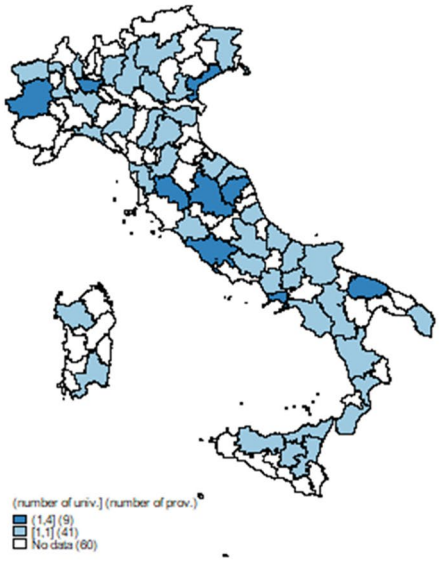


Fig. 2 Geographical distribution at NUTS-3 provincial level (2004–2018). *Notes*: darker areas denote higher values while lighter areas denote lower values. *Source*: Authors' elaboration

year. On a 0–1 scale, the IQI reveals considerable heterogeneity across Italian provinces. Turning to the university framework, control variables show wide variations among higher education institutions, especially concerning scientific publications and academic patents. Furthermore, not all universities have a TTO or dedicated staff to support academic entrepreneurship and ASO creation. Regarding the industry and local context, descriptive statistics reveal marked differences in both the growth of per-capita real value added and the number of university-educated residents. Overall, the provinces exhibit a high degree of heterogeneity.

As for the growth-stage, Fig. 4 shows the distribution of sales of active ASOs by class size calculated over different periods, i.e., 3, 6, and 9 years after the companies were established. The total number of ASOs is 822, as we have not included those established in 2017 and 2018: economic and financial information were still not available 3 years after they had been set up. The majority of active ASOs (i.e., 806) struggle to grow. For instance, 3 years after their creation, about 58% of them had sales below 50,000 € while less than 2.5% had sales over 500,000 €. Growth also remains a problem for the ASOs that were still active 6 years after they were formed (i.e., 376 ASOs): the sales of more than 45% of these remain below 50,000 €. It is worth noting that, of the ASOs established before 2010, only 151 of them were still operating 9 years after they were founded. Of these companies, more than 40% had failed to develop their activities and their sales were less than 50,000 €. However, the percentage of ASOs with sales above 500,000 € had increased to more than 13%. Moreover, 3, 6 and 9 years after these firms were launched, the median values were

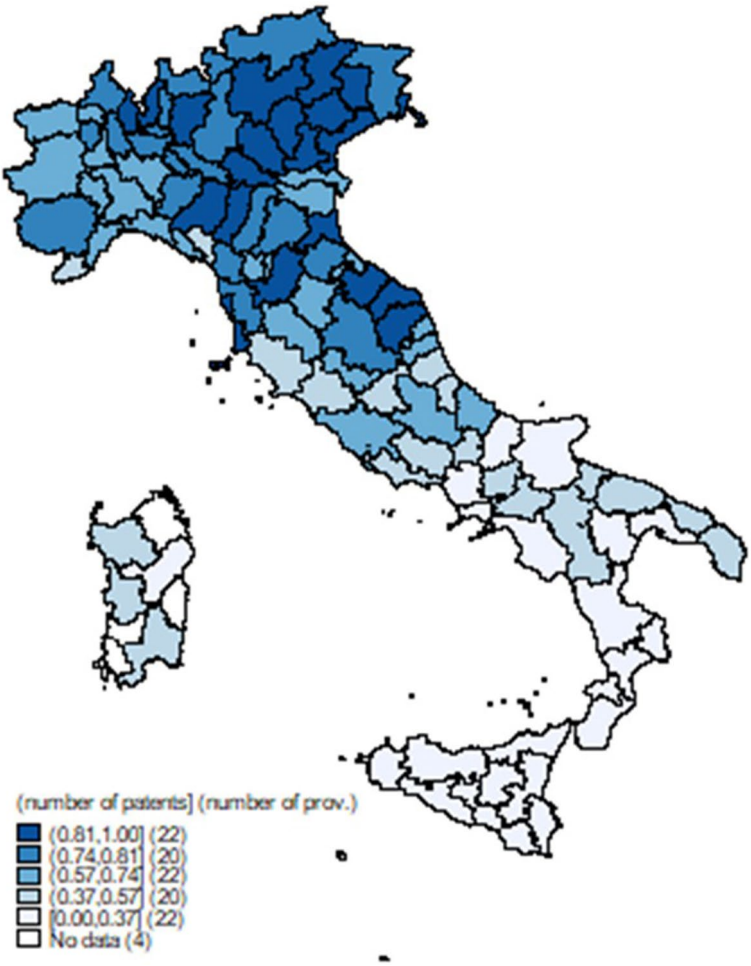


Fig. 3 Institutional Quality Index (IQI). *Notes*: darker areas denote higher values while lighter areas denote lower values. *Source*: Authors' elaboration

respectively 32, 62, and 88,000 €, while the mean values were, respectively, 92, 173 and 290 thousand €. Despite heterogeneous performances, ASO mortality rates seem low: only 143 ASOs ceased activities between 2004 and 2018, i.e., about 17.3% of the total. Furthermore, only 11 ASOs (1.3% of the total active) ceased activities within the first 3 years, 68 ASOs (15.3%) stopped operating between 4 and 6 years after their creation, and 64 ASOs (29.7%) had closed between 7 and 9 years after they had been set up.

Then, Table 3 shows the main descriptive statistics of ASOs 3, 6, and 9 years after they were established. Mean and median values are also displayed for ASOs with non-zero sales,

Table 2 Descriptive statistics

	mean	p50	min	Max	sd
Academic spin-off companies (ASOs)	1.32	0.64	0.00	18.02	1.96
Institutional Quality Index (IQI)	0.57	0.66	0.01	1.00	0.25
Size and quality of university					
Dummy presence of Technology Transfer Office (TTO)	0.67	1.00	0.00	1.00	0.47
Personnel in TTO	3.16	2.50	0.00	18.00	3.04
Univ. publications	1.16	1.17	0.00	2.63	0.59
Univ. research quality	1.52	1.23	0.07	6.25	1.30
Academic patents	2.64	0.00	0.00	40.21	4.81
University commercial income	4.46	4.18	0.78	16.61	1.81
University type	0.76	1.00	0.00	1.00	0.43
Local context					
Accessibility index	5.14	4.91	0.87	10.00	2.06
Per-capita Value Added	26.04	25.64	11.52	50.02	8.27
Population density	0.50	0.24	0.04	2.65	0.70
Per-capita patents	0.13	0.13	0.00	0.50	0.10
Bank loans	1.16	1.04	0.50	2.73	0.46
Firm survival	64.43	64.43	50.58	72.71	4.19
People with a university degree	7.22	6.74	0.00	24.28	3.90
ASO characteristics					
Dummy innovation	0.13	0.00	0.00	1.00	0.34
Number of ASO owners	5.75	5.00	1.00	30.00	3.75
University as owner	0.28	0.00	0.00	1.00	0.45
Firm as owner	0.54	1.00	0.00	1.00	0.50

for the unit of measures, see Table 4

Authors' elaboration

which were around 80% of the total. The percentage of innovative ASOs[3] was instead relatively modest, between 12% and 18% of all ASOs[4].

Variables

ASO launch-stage

We used the number of newly created ASOs as dependent variable in the first empirical analysis which investigated the extent to which parent universities and the quality of pub-

[3] Italian Law n. 221/2012 defines ASOs that can be converted into innovative start-ups as companies (including cooperatives or European companies with tax residence in Italy) focused on producing, developing, and marketing highly innovative services or products. Key requirements include being a new company (or established no more than 5 years before) with an annual turnover less than 5 million €. Furthermore, the firm must have at least one of the following characteristics: R&D and innovation expenses equal to at least 15% of turnover or production costs; a highly qualified workforce (at least 1/3 PhD holders, PhD candidates, or researchers, or 2/3 with a Master's degree); or ownership/license of at least one patent, or registered software.

[4] The Appendix shows the kernel distributions of ASO sales (Fig. 2B).

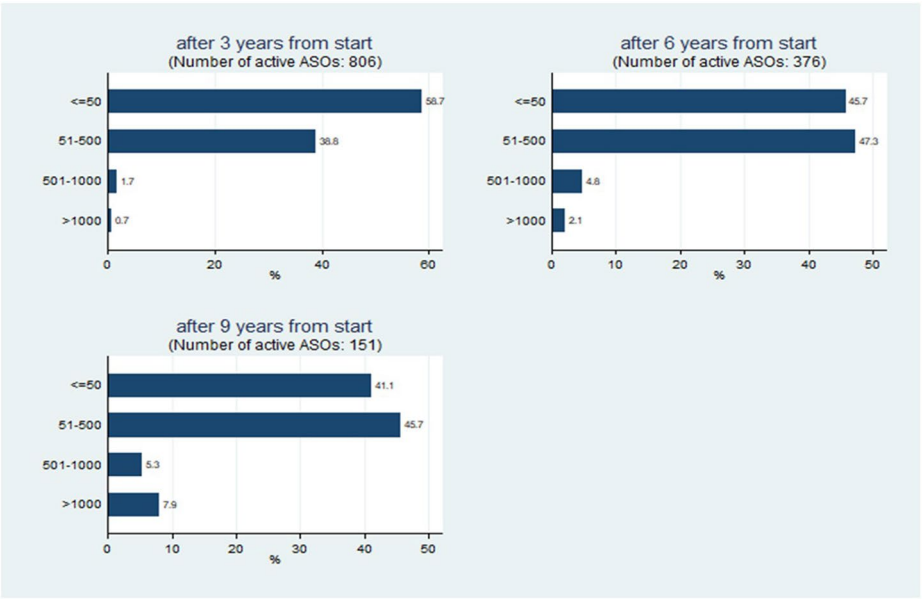


Fig. 4 Distribution of active ASOs' sales (thousands of €), by class size, 3, 6 and 9 years after being launched. Source Authors' elaboration

Table 3 ASOs' sales 3, 6, and 9 years after their launch, percentage of ASOs with non-zero sales and percentage of innovative ASOs

	Sales *		With non-zero sales			Innovative
	mean	median	%	mean *	median *	%
3 years	92	32	79.8	112	49	12.1
6 years	173	62	82.8	206	83	18.5
9 years	290	88	81.3	343	118	18.1

*Thousands of €. *Thousands of €.*Source*: Authors' elaboration

lic institutions had influenced the formation of ASOs (RQ1). The number of academic researchers was used to assess university size[5]. Researchers were full professors, associate professors, assistant professors, and research fellows[6]. In general, the higher the number of scholars and support staff, the greater the likelihood that academic knowledge will be transferred to the market, through the establishment of new ventures (Fini et al., 2017).

The main independent variable is the Institutional Quality Index (IQI) by Nifo and Vecchione (2014, 2015). This is a composite index elaborated at NUTS-3 provincial level that considers multiple aspects of institutional quality. This index is aligned with other initiatives

[5] The total number of enrolled students was used as an alternative measure for university size (ISTAT, 2019). Class sizes are as follows: total number of students > 40 thousand (Mega University); between 20 thousand and 39.9 thousand students (Big University); between 19.9 thousand and 10 thousand students (Medium University); less than 10 thousand students (Small University). The correlation with our university size measure is above 0.98. Empirical results do not differ to any great extent.

[6] Data on the type of contract (part-time vs. full-time) are not available. We consider both permanent and temporary positions as the latter are a relatively large proportion of total researchers within Italian universities (almost 30% of the total) and they offer an important contribution to teaching and research.

for broader geographical contexts such as the European Quality of Government Index (EQI) by Charron et al. (2015) or the World Governance Indicator (WGI) proposed by Kaufmann et al. (2009, 2010). However, the IQI only shares the architecture of the WGI. Indeed, it considers five measures rather than six, in which each index is drawn up by aggregating the sub-indices; it is based on statistical data and not on perception surveys; it measures institutional quality at both the regional and provincial level; and it involves different procedures for weighting, normalisation and aggregation of indices. Drawing on Friedman (2011), we used five dimensions of the IQI: (i) *control and corruption*, (ii) *government effectiveness*, (iii) *regulatory quality*, (iv) *rule of law*, and (v) *voice*, i.e., *influence*, *and accountability* (see the Appendix).

We included two sets of independent variables that may have had an impact on the formation of ASOs, which have been documented in the studies reviewed. The first set comprises those independent variables that account for the size and the quality of the parent universities. These variables are: the presence of a TTO and its size, measured by the number of staff units; two indicators that measure the research quality of each university, i.e., the number of scientific publications and the final Indicator of University Research (IRFS2), which is a measure related to the research quality evaluation of each institution, carried out by the Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR); the number of academic patents; the amount of university income received for commercial purposes; and a dummy variable that accounts for the type of university, i.e., whether the Science, Technology, Engineering, and Mathematics (STEM) disciplines are more, or less, prevalent than the Social Sciences and Humanities (SSH) in each university. We used this dummy to check for the specific orientation of those universities within ASO activities.

The second set of independent variables includes those variables that are related to the characteristics of the local context: the per-capita real value-added; population density, i.e., a measure of agglomeration economies; and the number of residents with a university degree (Meoli et al., 2017).

ASO growth-stage

The second empirical analysis aimed to investigate the extent to which parent universities and the quality of public institutions influence the growth of ASOs (RQ2). The dependent variable is the amount of ASOs' sales 3 years after the firms had been established[7]. To test the determinants of ASO growth we also considered a longer period, i.e., 6 and 9 years after the firms were launched. The reason why we chose these time spans is because the status of ASO, and the formal or informal incubation period within the university, is granted (by Italian law) for a limited period, usually 3 to 6 years. During this period the parent university provides ASOs with the opportunity to take advantage of special conditions regarding the use of physical and virtual spaces, laboratories, equipment, and professional advice (Iacobucci et al., 2011). However, in some cases, growth should be measured over a longer period, especially when considering sectors such as biotech and pharma which have longer incubation periods. The dependent variable is a dummy that equals to 1 if sales of active ASOs are higher than the median value, and it is equal to zero elsewhere. For robustness, we also used the mean values.

[7] The number of employees can be used as an alternative measure of growth; however, these data are only available for a limited number of ASOs.

Regarding the independent variables, we included variables relevant to firm growth. For the local context, along with per-capita value added and population density, we checked for physical infrastructure accessibility, financial development (proxied by bank loan amounts), and the percentage of firms surviving 3 years after their creation. We also took province size into account using population and, for provincial innovativeness, we used patents. For university size and quality, we used the same independent variables as in the launch-stage model. In addition, we considered a selection of ASO characteristics, using a dummy variable (1 if the ASO is defined as innovative, 0 otherwise). We also accounted for the number of founders at an ASO establishment, the presence of a university or private company among the share owners (dummy variable = 1) and the number of ASOs belonging to the same university so as to measure university venture development capacity. Table 4 summarises the selected variables.

Empirical strategy

In order to explore the determinants of ASO launch-stage we estimated the following model:

$$spinoffs_{i,t} = a_i + \beta_1 IQI_{p,t-1} + \beta_k \sum_{k=1}^{N} X_{k,t-1} + \delta_t + \vartheta_r + \epsilon_{i,t} \quad (1)$$

where $spinoffs$ is the number of ASOs per 1,000 academic researchers (based on headcount); IQI is the Institutional Quality Index; X_k is the vector of the k independent variables defined in the previous section; δ_t are year dummies that aim to capture the effects of business cycles; ϑ_r are regional fixed effects; and $\epsilon_{i,t}$ is the error term. Subscripts: t denotes the time period (2004–2018), i denotes university, p indicates NUTS-3 areas (provinces), and r denotes NUTS-2 areas (regions). The independent variables are lagged one period to alleviate the endogeneity problem.

Our dataset is a longitudinal panel aggregated at university level. The model was estimated with a fixed effects negative binomial regression (NBR)[8] - as in previous studies (Fini et al., 2011; Meoli & Vismara, 2016; Meoli et al., 2017) - for several reasons. First, given the large number of zeros in the dependent variable, an NBR is more appropriate than an ordinary least square (OLS). Indeed, the ASO distribution is positively skewed and this might not fit well into the OLS linear regression model, because the data are unlikely to satisfy the assumption of normality of the residuals. Second, we chose an NBR rather than a Poisson regression model because the latter assumes that the distribution contains a single parameter, where the conditional mean equals the conditional variance. To test this assumption, we performed a Wald test which showed that using a negative binomial model is preferable to a Poisson model in all cases. Third, the NBR can also be estimated in the case of a non-integer dependent variable, providing that the dependent variable has positive values (Wooldridge, 2010). Fourth, the NBR estimation model is preferable when dealing with some observations that, structurally, are not zeros, like for instance the case of the zero-inflated negative binomial.[9] Even though the structure of the data is hierarchical, there are only a few universities that are within the same NUTS-3 area, so there is no need to estimate the relationship between ASO formation and its determinants using a mixed random effect model.

[8] We used the *xtnbreg* command in STATA.

[9] AIC and BIC statistics showed that the NBR model fits better than the zero-inflation NBR.

Table 4 Variables

Variables	Definitions	Source	Year	Unit of measure
Academic spin-off companies (ASOs)	Number of ASOs	NETVAL	2004–2018	Per 1,000 academic researchers*
Institutional Quality Index (IQI)	Index of institutional quality	Nifo and Vecchione (2014)	2004–2018	Index (0–1)
Size and quality of university				
Dummy presence of Technology Transfer Office (TTO)	Dummy = 1 if university has a TTO, 0 otherwise	NETVAL	2004–2018	0 or 1
Personnel in TTO	Number of staff in the TTO	NETVAL	2004–2018	Headcount
Univ. publications	Total number of publications per academic researcher	SCOPUS	2004–2018	Number
Univ. research quality	IRFS2: Indicator of final assessment of the research quality of the institution	ANVUR MUR	2004–2018	Index
Academic patents	Total number of academic patents per academic researcher	NETVAL	2004–2018	Per 1,000 academic researchers
University commercial income	Research income earned by the university for commercial purposes	MUR	2007–2015	Per university personnel (10,000 €)
University type	Dummy = 1 whether the number of STEM researchers is higher than the number of researchers in the SSHs, 0 otherwise	MUR	2004–2018	0 or 1
Local context				
Per-capita value added	Per-capita real Value Added	ISTAT	2004–2018	10,000 € per capita
Population density	Inverse of population density	ISTAT	2004–2018	Square kilometre over number of inhabitants
Residents with a university degree	Proportion of residents with a first cycle and second cycle degree	MUR	2004–2018	Per 1,000 inhabitants
For the growth-stage model				
Accessibility index	Motorway and railway potential accessibility index		2007	0–10
Per-capita patents	Registered patents at the European Patent Office (EPO)t	REGPAT	2004–2018	Per 1,000 university personnel
Bank loans	Amount of loans to households and firms	Bank of Italy and ISTAT	2004–2018	As a share of value added
Firm survival	Firm survival rate 3 years after launch	ISTAT	2004–2018	As a percentage of total firms
Spin-offs	Number of cumulative ASOs	NETVAL	2004–2018	Per 1,000 academic researchers
ASO characteristics				

Table 4 (continued)

Variables	Definitions	Source	Year	Unit of measure
Dummy Innovation	Dummy = 1 if ASO is innovative, 0 otherwise	NETVAL	2004–2018	0 or 1
Number of ASO owners	Number of ASO owners	Authors' elaboration on Bureau van Dijk-Aida data	2004–2018	Headcount
University as owner	Dummy = 1 if University owns shares in the ASO, 0 otherwise	Authors' elaboration on Bureau van Dijk-Aida data	2004–2018	0 or 1
Firm as owner	Dummy = 1 if there is a shareholding firm in the ASO, 0 otherwise	Authors' elaboration on Bureau van Dijk-Aida data	2004–2018	0 or 1

* Researchers are full professors, associate professors, assistant professors and research fellows. Authors' elaboration

To analyse ASO growth-stage, we regressed the following fixed effects logit model:

$$growth_{i,t} = a_i + \beta_1 IQI_{p,t-1} + \beta_k \sum_{k=1}^{N} X_{k,t-1} + \vartheta_r + \epsilon_{i,t} \quad (2)$$

where *growth* is a dummy equal to 1 if sales of active ASOs are higher than the median values 3, 6 and 9 years after the companies were established, *IQI* is the Institutional Quality Index; X_k is the vector of *k* independent variables as defined in the previous section; ϑ_r are regional fixed effects; and $\epsilon_{i,t}$ is the error term. The subscript *t* denotes the period, i.e., at 3, 6, and 9 years after the firm's foundation, *t-1* means that the independent variables are taken at the previous period, *i* denotes university, *p* denotes NUTS-3 areas (Italian provinces), and *r* denotes NUTS-2 areas (Italian regions). Model [2] is estimated with a logit fixed effects regression.[10]

Results and discussion

Tables 5 and 6 report the results for the NBRs. Table 5 includes the IQI in its aggregated form, while Table 6 adds the five sub-dimensions of the IQI.[11]

Table 5 reports the set of independent variables in sequence. In Column 1 the model is estimated with only the IQI variable; Column 2 also includes the independent variables that account for the size and the quality of university; Column 3 adds those variables that depict the characteristics of industry and the local context. In Table 5, it is important to note that the coefficient of *IQI* is not statistically significant in any columns. The coefficient of *university publications* is statistically significant at the 1% level. Scientific publications do

[10] We used the logit command in STATA.

[11] We also estimated the model considering the legal status of innovative ASOs. The results, reported in the Appendix, are qualitatively similar to those of the baseline.

Table 5 Negative binomial regression (NBR) - Dependent variable: number of ASOs per 1,000 academic researchers (2004–2018)

	(1)	(2)	(3)	(4)
	NBR	NBR	NBR	NBR
	b/se	b/se	b/se	b/se
Institutional Quality Index (IQI)	0.705	0.720	0.844	0.945
	(0.783)	(0.632)	(0.636)	(0.699)
Size and quality of university				
Dummy presence TTO		0.772***	0.759***	0.714***
		(0.138)	(0.139)	(0.165)
Personnel in TTO		0.041**	0.047***	0.004
		(0.016)	(0.016)	(0.018)
Univ. publications		0.539***	0.515***	0.445**
		(0.161)	(0.164)	(0.203)
Univ. research quality		0.110***	0.150***	0.173***
		(0.042)	(0.046)	(0.043)
Academic patents		0.007	0.010	0.002
		(0.008)	(0.009)	(0.010)
University type		0.091	0.096	0.065
		(0.192)	(0.190)	(0.200)
Local context				
Per-capita value added			−0.007	−0.006
			(0.014)	(0.015)
Population density			−0.018	−0.134
			(0.121)	(0.141)
Residents with a univ. degree			−0.031*	−0.045**
			(0.018)	(0.018)
Univ. comm. income				0.611***
				(0.157)
Constant	−0.290	−2.351***	−2.096***	−2.001***
	(0.671)	(0.512)	(0.566)	(0.737)
Number of observations	882	882	882	544
Number of universities	63	63	63	61
AIC	2468	2394	2395	1589
BIC	2640	2595	2611	1761
Wald test (Chisq)	106.177	5.667	2.762	0.009

clustered errors at NUTS-3 level are in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$. Authors' elaboration

exert a positive effect on the formation of ASOs. Publications are the outcomes of both basic and applied research, also carried out within industrial doctoral programmes. Publications conceptualise innovative ideas and prototypes which can be exploited better commercially by establishing an ASO.

In Table 5 the coefficient of the *Dummy presence TTO* is statistically significant at the 1% level. As was found by Micozzi et al. (2021), the creation of a TTO in a university does have a positive impact on the formation of ASOs. TTOs contribute to making research more

Table 6 Negative binomial regression (NBR) – IQI sub-dimensions - Dependent variable: number of ASOs per 1,000 academic researchers (2004–2018)

	(1)	(2)	(3)	(4)	(5)
	NBR	NBR	NBR	NBR	NBR
	b/se	b/se	b/se	b/se	b/se
Control and corruption	0.898				
	(0.659)				
Government effectiveness		0.320			
		(0.441)			
Regulatory quality			0.282		
			(0.375)		
Rule of law				0.535	
				(0.549)	
Voice and accountability					−0.192
					(0.474)
Size and quality of university					
Dummy presence TTO	0.763***	0.769***	0.756***	0.765***	0.773***
	(0.141)	(0.140)	(0.141)	(0.140)	(0.142)
Personnel in TTO	0.044***	0.046***	0.046***	0.046***	0.046***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Univ. publications	0.509***	0.534***	0.544***	0.526***	0.541***
	(0.166)	(0.164)	(0.165)	(0.165)	(0.164)
Univ. research quality	0.153***	0.147***	0.153***	0.155***	0.151***
	(0.047)	(0.046)	(0.047)	(0.047)	(0.047)
Academic patents	0.009	0.009	0.009	0.010	0.009
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
University type	0.127	0.089	0.072	0.078	0.077
	(0.196)	(0.191)	(0.194)	(0.192)	(0.193)
Local context					
Per-capita value added	−0.010	−0.004	−0.006	−0.000	−0.001
	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
Population density	0.136	−0.054	−0.023	−0.023	−0.040
	(0.177)	(0.123)	(0.124)	(0.122)	(0.122)
Residents with a univ. degree	−0.030*	−0.033*	−0.031*	−0.031*	−0.032*
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	−2.374***	−1.763***	−1.779***	−2.124***	−1.653***
	(0.695)	(0.498)	(0.501)	(0.645)	(0.526)
Number of observations	882	882	882	882	882
Number of universities	63	63	63	63	63
AIC	2395	2397	2397	2396	2397
BIC	2611	2612	2612	2611	2612
Wald test (Chisq)	3.729	2.889	3.468	3.096	3.234

clustered errors at NUTS-3 level are in parentheses, $^{*}p<0.10$, $^{**}p<0.05$, $^{***}p<0.01$. Authors' elaboration

visible and to promoting its economic valorisation by stimulating the transfer of knowledge (or co-creation) from academia both to the market and to society at large. TTOs provide knowledge and support-services to scholars who may not have the required entrepreneurial skills. Adding staff units to a TTO seems positively related to the creation of ASOs. It could well be that, simply by increasing the number of personnel involved, TTOs are able to cover

a wider portfolio of support services. Our findings are in line with previous research regarding the association between a university's research profile and academic entrepreneurship (Meoli et al. 2017), indicating that ASO formation is often not related to the *type of university* variable. As regards the *university research quality* and the *university commercial income* variables, the coefficients are statistically significant and positive.

As regards the local context, including per-capita value added, population density and people with a university degree, Table 5 (Column 3) and Table 6 (Column 3) show that such characteristics do not play an important role in explaining an/the ASO launch-stage. Furthermore, the coefficients of the sub-dimensions of the *IQI*, are not statistically significant for ASO creation. Overall, the characteristics of each university are the most important determinants for the launch-stage; the quality of institutions and the local context play a very marginal role in the creation of ASOs.

As regards the second empirical analysis, which seeks to examine what determines the growth of an ASO, Table 7 presents the results of this estimation model in Eq. [2]. Columns 1–3 show the estimation results where the dependent variable is a dummy equal to 1 if sales of active ASOs are above the median value 3, 6 and 9 years after the companies were established. For robustness purposes, we also used the mean sales values. Columns 4–6, show the results for 3, 6 and 9 years after the firms were launched.

The *IQI* is statistically significant with a positive sign in the case of 3 and 6 years. At 9 years, however, the *IQI* does not have a statistically significant effect on the firm's performance. This might suggest that in the early stage of growth ASOs benefit more from interaction with local institutions while, in the longer term, their development is more affected by other characteristics of the local context, such as accessible physical and digital infrastructures and easier access to finance[12]. The coefficients of these variables become positive and statistically significant 9 years after the ASOs were established. Furthermore, operating in more densely populated provinces, but not in provinces with large populations, is positive for ASO growth. Being innovative also matters.

If universities are involved in ownership this can exert a negative impact on ASO development over time. This finding is in line with previous results (Ferretti et al., 2020), which suggested that parent universities rarely have a culture based on a managerial approach. However, the joint presence of a university and a venture capitalist is perceived by banks as a strong signal of the entrepreneurial project's quality, thus enhancing ASO credibility and making the firm a more trustworthy borrower (Del Sarto et al., 2025). However, the joint presence of universities and private shareholders, may increase bureaucratic procedures and so reduce flexibility in decision-making processes. Results also show that if ASOs are created within a big or mega university, this may positively affect their growth. While *university research quality* plays an important role in the launch-stage, it does have a nega-

[12] We also estimated the model considering the IQI sub-dimensions. Results are reported in the Appendix. In general, results are confirmed for the case of Government effectiveness and the Rule of law sub-dimensions. The coefficient of Control of corruption is also statistically significant at 9 years. However, for the Regulatory quality and for the Voice and accountability dimensions the coefficients are not statistically significant in any of the cases. These results may suggest that ASO growth is more sensitive to aspects related to safeguarding the business environment, or to the degree with which laws are enforced at the local level rather than to aspects concerning economic and political life, or to the implementation of sound policies and regulations.

Table 7 Growth regressions - Dependent variable: growth of firm sales (2009–2018)

	(1)	(2)	(3)	(4)	(5)	(6)
	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT
	b/se	b/se	b/se	b/se	b/se	b/se
Institutional Quality Index (IQI)	3.288**	3.048*	−7.341	3.177**	4.528*	−6.666
	(1.340)	(1.608)	(6.130)	(1.519)	(2.583)	(9.610)
Local context						
Accessibility index	−0.028	0.173	1.096**	0.015	0.276	0.108
	(0.089)	(0.143)	(0.431)	(0.138)	(0.246)	(0.371)
Per-capita patents	0.754	5.176	−11.784	5.455**	9.379**	51.178***
	(2.041)	(3.259)	(16.958)	(2.626)	(4.751)	(14.558)
Per-capita value added	−0.015	−0.089**	−1.071***	−0.070*	−0.247***	−0.369**
	(0.034)	(0.038)	(0.337)	(0.041)	(0.075)	(0.172)
Population density	0.191	0.453	−0.707	0.859**	1.098**	−0.569
	(0.226)	(0.310)	(0.813)	(0.347)	(0.502)	(1.401)
Population	−0.011	−0.695**	−1.392**	−0.053	−0.043	0.998
	(0.158)	(0.301)	(0.705)	(0.261)	(0.388)	(0.956)
Bank loans	−0.105	2.002**	35.611***	−0.393	1.132*	−4.163
	(0.263)	(1.002)	(12.437)	(0.430)	(0.688)	(7.977)
Firm survival	0.003	0.025	0.272	−0.017	0.031	−0.767**
	(0.041)	(0.069)	(0.257)	(0.040)	(0.123)	(0.309)
Spin-offs	−0.085*	0.082	0.599***	0.036	0.130	1.086***
	(0.047)	(0.062)	(0.148)	(0.060)	(0.116)	(0.381)
ASO characteristics						
Dummy innovation	0.337	0.479	2.702***	0.624**	0.156	1.183
	(0.259)	(0.381)	(0.815)	(0.258)	(0.565)	(1.045)
Number of ASO owners	−0.027	−0.027	−0.226*	−0.020	−0.035	0.091
	(0.026)	(0.035)	(0.125)	(0.026)	(0.041)	(0.219)
University as owner	−0.205	−0.738*	1.551	−0.395	−1.148***	−1.261
	(0.262)	(0.435)	(1.286)	(0.282)	(0.434)	(1.947)
Firm as owner	−0.081	0.243	0.819	0.177	0.946***	2.454**
	(0.174)	(0.437)	(0.867)	(0.222)	(0.338)	(1.105)
Size and quality of university						
University size	0.379	0.615**	6.437***	0.009	2.162**	9.038***
	(0.288)	(0.247)	(1.614)	(0.276)	(0.861)	(2.710)
Univ. research quality	−0.236	−0.366**	−3.719***	−0.002	−1.784***	−4.838***
	(0.202)	(0.180)	(1.178)	(0.212)	(0.671)	(1.712)
Dummy presence TTO	−0.355	−1.032**	−6.112***	−0.047	0.322	−2.245
	(0.374)	(0.410)	(1.848)	(0.541)	(1.017)	(1.583)
Personnel in TTO	0.056	0.065	−0.019	0.030	0.013	−0.224
	(0.041)	(0.066)	(0.170)	(0.040)	(0.101)	(0.208)
University type	−0.237	−0.652	−2.389**	−0.476	−1.003	−2.528
	(0.237)	(0.451)	(1.067)	(0.388)	(0.648)	(2.183)
Constant	−1.324	−15.322***	−8.551	−14.171***	−15.470**	48.865*
	(3.345)	(4.941)	(17.013)	(2.812)	(7.773)	(25.267)
Number of observations	709	314	127	702	287	107
Number of universities	55	48	40	54	45	35
Number of NUTS-3 provinces	47	41	33	46	38	28
Regional FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 7 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT
	b/se	b/se	b/se	b/se	b/se	b/se
Industry FE	YES	YES	YES	YES	YES	YES
AIC	1009	451	171	857	351	120
BIC	1219	601	262	1062	482	192

in Columns 1–3, the dependent variable is equal to 1 if ASO sales are above the median value 3, 6, and 9 years after the companies were established, and it is equal to zero elsewhere. In Columns 4–6, the dependent variable is equal to 1 if ASO sales are above the mean value 3, 6, and 9 years after the companies were established, and it is equal to zero elsewhere. The median values are 32, 62, and 88 thousand €, 3, 6, and 9 years after the firms were launched respectively. The mean values are 92, 173, and 290 thousand €, 3, 6, and 9 years after respectively. Clustered errors at NUTS-3 level are in parentheses, * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Authors' elaboration

tive impact on ASO growth.[13] It may be that a "surrogate use" of ASOs is common among scholars since, rather than growing in terms of sales, such firms seem more connected to the need to adopt flexible tools for recruiting researchers, continuing research projects and managing contracted research, thus overcoming the administrative constraints that sometimes affect academia (Donatiello & Gherardini, 2019).

Overall, logit estimation indicates that the *IQI* is a key determinant for ASO growth, at least in the early phase of ASO development, while other characteristics of the local context seem to be more important in the more advanced phases[14].

Conclusion and policy implications

This article has sought to contribute to the literature on the explanatory factors which influence the various stages of ASOs over time (Dabić et al., 2022; Fini et al., 2011; Fini et al., 2017; Mathisen & Rasmussen, 2019). Unlike previous studies that simultaneously investigated both the creation and growth of ASOs (Fini et al., 2017; Mathisen & Rasmussen, 2019) or bridged university-level and local institutional conditions (Corsi & Prencipe, 2016; Fini et al., 2011), this article offers a retrospective, long-term, overview of the role of parent universities, and of the quality of institutions, in both the launch and the growth trajectories of ASOs. The analysis has considered a sample of 945 academic ventures, established between 2004 and 2018, in 63 Italian public universities.

Although local institutions have sought to improve the quality of their services to support entrepreneurship (Agostino et al., 2020), neither the presence, nor the size, of a university ensure the creation and successful development of ASOs in a given geographical area. There

[13] To further investigate the results obtained at the 9-year horizon (Columns 3 and 6), we conducted an additional robustness check based on a balanced panel. Specifically, we re-estimated growth model [2] using a sample restricted to firms observed over the full time span, thus ensuring the same set of firms across horizons. Consistent with the baseline specification, we used the median and mean values as cutoffs, as in Table 7. This approach allows us to assess whether the determinants of sales growth remain stable when focusing on a common sample of surviving firms and comparing outcomes at 3 and 6 years after establishment. The results, shown in the Appendix, indicate that the positive effect of institutional quality at shorter horizons does not persist when the analysis is restricted to a balanced sample, likely due to the selection bias introduced by focusing on surviving firms.

[14] For robustness, we estimate the model using the logarithm of sales as the dependent variable. The results, which are reported in the Appendix, confirm the main findings.

is insufficient, inconsistent, evidence to explain why ASOs grow much more when established in some universities, than they do in others (Dabić et al., 2022). Indeed, the literature has mainly focused on anecdotal single cases of high-growth ASOs (Caputo, 2022). This restricts, impedes, understanding of ASO performance, growth trajectories, and of the long-term effects of institutional support (Ramos et al., 2026).

Our findings reveal two different scenarios, linked to two key stages conceptualised by Ndonzuau et al. (2002). For the launch-stage of ASOs, the support activities and services provided by the parent university seem to play a positive role, though we are aware of how difficult it is to assess, to perceive, a causal relation between the two, as the rise in the number of ASOs could encourage development of support services. Furthermore, the quality of local institutions and the context play a seemingly marginal role. Institutional quality and financial development are, however, key determinants for the growth-stage, but university characteristics do not seem to be so important. Although it has been argued that universities should do more to promote the growth of ASOs by investing more in human and financial resources, much of this seems to be true only for a limited period within the time frame of ASO life cycles. Instead, a certain level of coordination and complementarity of efforts of parent universities and local institutions in the two stages, as well as better understanding of the different needs ASOs have in these stages, could have a bigger impact. Universities should specifically support ASO creation, while local institutions could act, and do more to support, ASO growth. A selection of policy interventions, based on the results obtained from the analysis, is suggested below.

In the launch-stage, universities should ensure there are the resources, both intangible and tangible, which are fundamental for ASOs, by educating talents, nurturing an entrepreneurial mindset and developing applied research infrastructures, such as efficient TTOs or other support services to guide the venturing process. Universities could also promote wider industry-academic cooperation, leveraging on training talents through industrial doctorates to close the gap between academic and industrial research (Compagnucci et al., 2025). Those resources and policies, could facilitate the process of turning research outcomes into ideas for both commercial and social purposes, thus encouraging the creation of ASOs. In the growth-stage, ASO development seems problematic, especially in terms of profitability and market penetration: the median value of sales 3 years after being established, was about 32,000 € and only a negligible share of ASOs had reached a level of sales above 50,000 €. Along with the role played by parent universities during the early stage of the venturing process, it seems that ASOs can only grow when the main dimensions of institutional quality are strengthened: control and corruption, government effectiveness, regulatory quality, rule of law, and voice, i.e., influence, and accountability. In this case, the supportive role of public institutions and policy-makers becomes even more important. Newly created firms need to operate in a context that favours entrepreneurial action and encourages business dynamics.

Furthermore, the findings suggest a selection of insights building on previous articles that emphasised the need to design and implement more effective programmes, measures, and institutions in order to better support the evolution of ASOs over time (Caldera & Debande, 2010; Ramos et al., 2026). Previous research has argued that there is no single model for supporting ASO creation within universities (Ramos et al., 2026). When promoting ASOs, isolated initiatives tend to be ineffective; instead, coordinated actions across different areas of the university are essential (Caldera & Debande, 2010). Based on our findings, we can

say that areas where policy-makers consider it a priority to leverage on university R&I capacity to promote entrepreneurial development, a mix of actions could be implemented. To encourage ASO launch, maximum support should be offered to universities, for example by co-financing the recruitment of staff for TTOs or industrial doctorates. Policies that seek to improve the conditions for businesses and the quality of local institutions also appear to be important for the growth-stage of an ASO. The balance between support from universities for business launch (short-run), and attention to the quality of institutions (long-term), seems to contribute most to ASO growth. This means that tailored support policies and programmes are required to address diverse contexts and to meet the needs of ASOs at different stages.

This article does have some limitations which should be considered in order to guide future research. The empirical analysis is constrained by data availability. Information on the full-time equivalent number of researchers, firm-level characteristics such as R&D investments, and access to venture funding is not available. These data limitations prevent a deeper assessment of research intensity, firm heterogeneity, and financial constraints, all of which may influence both the creation and growth of ASOs. The findings should be interpreted within the scope of the adopted empirical framework, acknowledging that institutional and contextual factors beyond those included in the analysis may also have influenced the estimated relationships. Moreover, although we perform a range of robustness checks, future research could benefit from complementary approaches, including qualitative methods that capture the perspective of academic entrepreneurs. In-depth interviews with ASO founders could help identify the key determinants of firm creation and growth more accurately. Given the complexity of ASO development processes, future studies should adopt multi-level analytical frameworks to better understand the interaction between individual characteristics, organisational support structures, and the broader institutional environment. Policy measures could be crafted by comparing STEM- and SSH-oriented institutions; big vs. medium vs. small universities; and urban campuses vs. campuses located in areas that have not, as yet, been involved. Finally, since this study focuses on Italy, comparative analyses across different institutional and geographical contexts would be valuable to assess the external validity of the findings and to inform more tailored policy interventions.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10734-026-01750-x.

Acknowledgements Donato Iacobucci and Francesco Perugini acknowledge that this research is part of the 101120390 - USE IPM - HORIZON-WIDERA-2022-TALENTS-03-01 project, funded by the European Union. Views and opinions expressed are, however, those of the authors only and do not necessarily reflect those of the European Union or the European Research Executive Agency. Neither the European Union nor the European Research Executive Agency can be held responsible for them.
Lorenzo Compagnucci and Francesca Spigarelli acknowledge that "This study is included in the project "Innovation and Vulnerability. Legal issues and remedies" of the Department of Law, University of Macerata (funded by the Ministry of University and Research, programme Departments of Excellence 2023–2027)".

Author's contribution Lorenzo Compagnucci: conceptualisation; methodology; formal analysis; investigation; visualisation; data curation; writing - original draft; writing - review & editing;· Donato Iacobucci: resources; supervision; writing - original draft; writing - review & editing· Francesco Perugini: methodology; formal analysis; investigation; visualisation; data curation; writing - original draft; writing- review & editing· Francesca Spigarelli: resources; supervision; writing- original draft; writing - review & editing

Funding See the acknowledgements.

Declarations

Ethics approval and consent to participate Not Applicable.

Competing interests the authors report that there are no competing interests to declare.

References

Agostino, M., Nifo, A., Trivieri, F., & Vecchione, G. (2020). Rule of law and regulatory quality as drivers of entrepreneurship. *Regional Studies, 54*(6), 814–826. https://doi.org/10.1080/00343404.2019.1648785

Audretsch, D.B. (2021). Have we oversold the Silicon Valley model of entrepreneurship? *Small Business Economics, 56*, 849–856 (2021). https://doi.org/10.1007/s11187-019-00272-4

Bahuleyan, A., Chavan, M., Krzeminska, A., & Chirico, F. (2024). Process and variance research: Integrating research on university spinoff evolution. *Technovation, 130*. https://doi.org/10.1016/j.technovation.2023.102920

Calcagnini, G., Favaretto, I., Giombini, G., Perugini, F., & Rombaldoni, R. (2016). The role of universities in the location of innovative start-ups. *The Journal Technology Transfer, 41*(4), 670–693. https://doi.org/10.1007/s10961-015-9396-9

Caldera, A., & Debande, O. (2010). Performance of Spanish universities in technology transfer: An empirical analysis. *Research P*olicy, 39(9), 1160–1173. https://doi.org/10.1016/j.respol.2010.05.016

Caputo, A., Charles, D., & Fiorentino, R. (2022). University spinoffs: Entrepreneurship, growth and regional development. *Studies in Higher Education, 47*(10), 1999–2006. https://doi.org/10.1080/03075079.2022.2122655

Chambers, D., & Munemo, J. (2017). *The impact of regulations and institutional quality on entrepreneurship* (Mercatus Working Paper). Mercatus Center at George Mason University, Arlington, VA.

Charron, N., Dijkstra, L., & Lapuente, V. (2015). Mapping the regional divide in Europe: A measure for assessing quality of government in 206 European regions. *Social Indicators Research, 122*(2), 315–346. https://doi.org/10.1007/s11205-014-0702-y

Colombo, M.G., & Piva, E. (2012). Firms' genetic characteristics and competence-enlarging strategies: A comparison between academic and non-academic high-tech start-ups. *Research Policy, 41*(1), 79–92. https://doi.org/10.1016/j.respol.2011.08.010

Compagnucci, L., Spigarelli, F., Perugini, F., & Iacobucci, D. (2025). Industrial doctorates for regional development: The case of Le Marche Region. *Higher Education, 90*, 1591–1611. https://doi.org/10.1007/s10734-024-01394-9

Corradini, C. (2021). Local institutional quality and economic growth: A panel-VAR analysis of Italian NUTS-3 regions. *Economic Letters, 198*, 109659. https://doi.org/10.1016/j.econlet.2020.109659

Corsi, C., & Prencipe, A. (2016). Improving innovation in university spin-offs: The fostering role of university and region. *Journal of Technology Management & Innovation*, 11(2), 13–21. https://doi.org/10.4067/S0718-27242016000200002.

Dabić, M., Vlačić, B., Guerrero, M., & Daim, T.U. (2022). University spin-offs: the past, the present, and the future. *Studies in Higher Education, 47*(10), 2007–2021. https://doi.org/10.1080/03075079.2022.2122656

Del Sarto, N., Bocchialini, E., Gai, L., & Ielasi, F. (2025). The influence of venture capital and university ownership on spin-off's bank loan access: a synergistic effect. *Small Business Economics, 65*, 427–449. https://doi.org/10.1007/s11187-024-00995-z

Donatiello, D., & Gherardini, A. (2019). All that glitters is not gold: The surrogate use of university spin-offs. Insights from Italy. *Higher Education Policy, 32*, 203–226. https://doi.org/10.1057/s41307-017-0079-z

Draghi, M. (2025). *The future of European competitiveness. Part B In-depth analysis and recommendations*. Publications Office of the European Union.

Ferretti, M., Ferri, S., Fiorentino, R., Parmentola, A., & Sapio, A. (2020). What drives the growth of academic spin-offs? Matching academics, universities, and non-research organizations. *International Entrepreneurship and Management Journal, 16*, 137–163. https://doi.org/10.1007/s11365-018-0497-4

Fini, R., Fu, K., Mathisen, M.T., Rasmussen, E., & Wright, M. (2017). Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study. *Small Business Economics, 48*(2), 361–391. https://doi.org/10.1007/s11187-016-9779-9

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

Friedman, B.A. (2011). The relationship between governance effectiveness and entrepreneurship. *International Journal of Humanities and Social Science, 1*(17), 221–225.

Fuster, E., Padilla-Meléndez, A., Lockett, N., & del-Águila-Obra, A.R. (2019). The emerging role of university spin-off companies in developing regional entrepreneurial university ecosystems: The case of Andalusia. *Technological Forecasting and Social Change, 141*(C), 219–231. https://doi.org/10.1016/j.techfore.2018.10.020

Galati, F., Bigliardi, B., Petroni, A., & Marolla, G. (2017). Which factors are perceived as obstacles for the growth of Italian academic spin-offs? *Technology Analysis & Strategic Management, 29*(1), 84–104. https://doi.org/10.1080/09537325.2016.1199853

Hahn, D., Minola, T., Vismara, S., & Agyare, D. (2024). Do exploration and exploitation in university research drive early-stage equity financing of university spin-offs? *Small Business Economics, 63*, 627–653. https://doi.org/10.1007/s11187-023-00862-3

Hossinger, S.M., Chen, X., & Werner, A. (2020). Drivers, barriers and success factors of academic spin-offs: A systematic literature review. *Management Review Quarterly, 70*(1), 97–134. https://doi.org/10.1007/s11301-019-00161-w

Iacobucci, D., Iacopini, A., Micozzi, A., & Orsini, S. (2011). Fostering entrepreneurship in academic spin-offs. *International Journal of Entrepreneurship and Small Business, 12*(4), 513–533. https://doi.org/10.1504/IJESB.2011.039689

ISTAT (2019). Studenti e bacini universitari. Available at: https://www.istat.it/it/files/2016/11/Studenti-e-bacini-universitari.pdf

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2009). Governance matters VIII: Aggregate and individual governance indicators 1996–2008. *World Bank Policy Research Working Paper, 4978*. https://ssrn.com/abstract=1424591

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The worldwide governance indicators: Methodology and analytical issues. *Policy Research Working Paper Series*, 5430. https://openknowledge.worldbank.org/handle/10986/3913

Mathisen, M.T., & Rasmussen, E. (2019). The development, growth, and performance of university spin-offs: a critical review. *The Journal Technology Transfer, 44*, 1891–938. https://doi.org/10.1007/s10961-018-09714-9

Meoli, M., & Vismara, S. (2016). University support and the creation of technology and non-technology academic spin-offs. *Small Business Economics, 47*, 345–362. https://doi.org/10.1007/s11187-016-9721-1

Meoli, M., Pierucci, E., & Vismara, S. (2017). The effects of public policies in fostering university spinoffs in Italy. *Economics of Innovation and New Technology, 27*(5–6), 479–492. https://doi.org/10.1080/10438599.2017.1374048

Messeni Petruzzelli, A., & Murgia, G. (2022). The regional impact of spin-offs' innovative activity: Unveiling the effect of scientific knowledge and parent university's specialization. *Studies in Higher Education, 47*(10), 2088–2100. https://doi.org/10.1080/03075079.2022.2122661

Micozzi, A., Iacobucci, D., Martelli, I., & Piccaluga, A. (2021). Engines need transmission belts: The importance of people in technology transfer offices. *The Journal of Technology Transfer, 46*, 1551–1583. https://doi.org/10.1007/s10961-021-09844-7

Muscio, A., Quaglione, D., & Ramaciotti, L. (2016). The effects of university rules on spinoff creation: The case of academia in Italy. *Research Policy, 45*(7), 1386–1396. https://doi.org/10.1016/j.respol.2016.04.011

Mustar, P., Renault, M., Colombo, M-G., Piva, E., Fontes, M., Lockett, A., Wright, M., Clarysse, B., & Moray, N. (2006). Conceptualising the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy. *Research Policy, 35*(2), 289–308. https://doi.org/10.1016/j.respol.2005.11.001

Ndonzuau, F.N., Pirnay, F., & Surlemont, B. (2002). A stage model of academic spin-off creation. *Technovation, 22*(5), 281–289. https://doi.org/10.1016/s0166-4972(01)00019-0

Nifo, A., & Vecchione, G. (2015). Measuring institutional quality in Italy. *Rivista Economica del Mezzogiorno 1–2*, 157–181. https://doi.org/10.1432/80447

Nifo, A., & Vecchione, G. (2014). Do institutions play a role in skilled migration? The case of Italy. *Regional Studies, 48*(10), 1628–1649. https://doi.org/10.1080/00343404.2013.835799

Öberg, C., & Grundström, C. (2024). Exploring the co-creation-innovativeness paradox: Distance as an ecosystem characteristic of university spin-offs. *Journal of Innovation and Entrepreneurship, 13*. https://doi.org/10.1186/s13731-024-00440-1

Oliveira, A., Carvalho, F., & Reis, N.R. (2022). Institutions and firms' performance: A bibliometric analysis and future research avenues. *Publications 10*(8). https://doi.org/10.3390/publications10010008

Opizzi, M., Loi, M., & Lamine, W. (2025). Academic spin-off emergence as an organization-embedded dynamic: Synthesis and research questions from a systematic literature review. *Technovation*, 146, https://doi.org/10.1016/j.technovation.2025.103296

Prokop, D. (2021a). The academic spinoff theory of the firm. *International Journal of Entrepreneurhsip and Innovation*. https://doi.org/10.1177/1465750321106601 .

Prokop, D. (2021b). University entrepreneurial ecosystems and spinoff companies: Configurations, developments and outcomes. *Technovation 107*, 102286. https://doi.org/10.1016/j.technovation.2021.102286

Ramaciotti, L., & Rizzo, U. (2015). The determinants of academic spin-off creation by Italian universities. *R & D Management, 45*(5), 501–514. https://doi.org/10.1111/radm.12105

Ramos, V., Françozo, R. V., Leandro, E., & Silva, V. (2026). Systematic review on academic spin-offs: Challenges, impacts, and success factors. *Administrative Sciences, 16*(2), Article 66. https://doi.org/10.3390/admsci16020066

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT Press.