University Regulations, Spinoff Characteristics, and External Financing: A Signaling Perspective on Academic Spinoffs

Abstract

We study the role of university regulations and spinoff characteristics in influencing the ability of academic spinoffs (ASOs) to secure external financing. Using a panel of 1,070 Italian ASOs from 2000 to 2023, we analyse how university-level signals, such as institutional policies, research quality, and technology transfer mechanisms, interact with firm-level signals, including founder credibility and patent activity, to shape investment decisions. We employ Probit and Tobit models to distinguish between the extensive margin (probability of receiving funding) and the intensive margin (amount of funding secured). Our findings suggest that university regulations, particularly those requiring academic founders to retain equity, enhance the likelihood of funding by signalling commitment and reducing information asymmetry. However, these policies do not influence the amount invested, which depends more on spinoff-level characteristics. Strong founders and patent activity serve as key signals that not only increase the probability of funding but also affect investment size. These results highlight the importance of both institutional and firm-level signals in shaping spinoff financing outcomes.

1. Introduction

Over the past two decades, universities have played an increasingly prominent role in the commercialization of technology across most industrialized countries. Academic spinoffs (ASOs) have emerged as a key mechanism for transforming research into commercial ventures, facilitating technology transfer, and attracting significant scholarly attention in the study of academic entrepreneurship (Baldini, 2010; Gomez Gras et al., 2008; Muscio et al., 2016). While spinoffs represent a promising avenue for knowledge transfer, they remain an underutilized mechanism in some cases (Harrison and Leitch, 2010). Promoting ASOs fosters greater engagement between academia and the private sector, creates new revenue streams for universities, and enhances employment opportunities, particularly for post-doctoral researchers and graduates (Nosella and Grimaldi, 2009; Rizzo, 2015).

Despite Italy being classified as a "moderate innovator" by the European Innovation Scoreboard—underperforming in key areas such as public sector R&D investment and venture capital activity—academic entrepreneurship in the country has been thriving. According to NETVAL data, the number of spinoffs established by the 65 Italian universities monitored by the network grew from 32 in 2000 to 133 in 2021, peaking at 162 in 2018 (NETVAL, 2024). Several factors contributed to this expansion, including changes in government funding policies and intellectual property regulations. Notably, reforms in 2012 and 2015, alongside the introduction of the "patent box" legislation in 2015, spurred universities to strengthen their technology transfer and licensing activities. However, while spinoff activity has occurred nationwide, it remains highly concentrated in a select group of universities, such as the Polytechnic of Milan, the University of Bologna, the University of Pisa, and the University of Padua. This suggests that certain conditions emphasized in the literature—such as research excellence, an entrepreneurial culture, and local institutional support—are critical in facilitating technology commercialization.

Universities vary significantly in the level of support they provide for ASOs. Institutional policies and strategies strongly influence spinoff creation, but approaches differ in terms of contractual arrangements, the role of intermediaries such as technology transfer offices, and the extent of entrepreneurial assistance offered (Clarysse et al., 2005; Geuna and Muscio, 2009; Rasmussen et al., 2014). As a result, many studies have examined how university practices and regulations shape ASO formation and broader academic entrepreneurship activities (Galán-Muros et al., 2015; Muscio et al., 2015, 2016; Rasmussen and Borch, 2010; Siegel and Wright, 2015). The design of effective internal policies is particularly crucial in contexts where universities operate with significant autonomy, as differences in institutional regulations can lead to disparities in spin-off creation and technology transfer success. Ultimately, faculty members' willingness to engage in knowledge transfer and launch spinoffs is influenced by their assessment of the incentives and constraints embedded in university policies.

While establishing ASOs is a crucial step in translating academic research into commercial applications, their long-term sustainability and growth hinge on securing adequate financing. As newly formed entities, ASOs often face the "liabilities of newness," lacking an established track record that would allow external investors and partners to accurately assess their potential. This creates an information gap that can hinder their ability to attract funding. Signaling theory (Spence, 1974) posits that when one party has more information than another, it can convey its quality through

signals that are costly and difficult to replicate. Strong signals are widely recognized as instrumental in reducing information asymmetries, a concept explored extensively in financial contexts such as initial public offerings (Colombo et al., 2019; Pollock et al., 2010), venture capital investment (Higgins & Gulati, 2006), and entrepreneurial finance, including crowdfunding (Kleinert et al., 2020). Existing research has investigated how these signals mitigate information asymmetry in the evaluation of new firms, thereby facilitating access to external resources.

This study builds on signaling theory and academic entrepreneurship literature, analyzing a panel of 1,070 Italian academic spinoffs from 2000 to 2023. It explores the impact of two types of ASOs key characteristics—spinoff-level and university-level factors— which acts as signals on the likelihood of securing external financing from government sources or venture capitalists (VCs). University-level factors include policies related to spinoffs, academic quality, and innovation capacity, while spinoff-level factors focus on founder credibility and patents. To our knowledge, this is the first empirical study to examine how these signals influence investment decisions, distinguishing between firm-level and university-level factors.

The remainder of this paper is structured as follows. Section 2 provides a brief review of selected empirical literature on three interrelated factors—individual, institutional, and contextual—that influence new venture creation and spinoff funding. Section 3 outlines the data and methodology used. Section 4 presents the results, and Section 5 concludes.

2. Theoretical background and research hypotheses

The literature on ASOs has long recognized their role in fostering the growth of entrepreneurial ecosystems. Like other high-potential ventures, ASOs have the potential to drive employment, innovation, and economic growth. They are innovative and often operate in high-tech sectors, and these characteristics also make them likely to suffer from financial constraints, hindering their growth (Berger and Udell 1998; Carpenter and Petersen, 2002). Therefore, securing adequate financing remains a critical factor for their success. Thus, it is important not only to examine the factors influencing the creation of academic spinoffs but also to focus on the conditions required to ensure their success and enable university spinoffs (ASOs) to generate substantial wealth.

University spinoffs can be financed through both internal and external sources, each with distinct advantages and limitations. Internal financing is typically provided by the university or affiliated institutions in the form of grants, research funding, endowments, alumni contributions, internal venture funds, or revenues generated from licensing intellectual property (IP). These sources are particularly valuable during the early stages, as they provide essential funding without requiring equity dilution. However, their scale is often insufficient to meet the financial needs of spinoffs as they grow and expand.

In contrast, external financing offers access to larger pools of capital, which are critical for scaling operations and commercialization. These sources include government grants and subsidies, angel investors, venture capital (VC) firms, corporate partnerships, crowdfunding platforms, and debt-based financing from banks. External funding often comes with additional benefits, such as industry expertise, mentorship, and access to extensive networks. However, it also presents challenges. Equity-based funding, such as venture capital, may require founders to relinquish significant ownership and control. Moreover, corporate partnerships and VCs may prioritize short-term returns, which can

conflict with the long-term research and development goals of ASOs. Given the high complexity and uncertainty surrounding ASOs, external funders face higher monitoring costs, especially in the early stages of development (Prokop, 2021; Prokop et al., 2019; Lockett et al., 2002). As ASOs mature, they often transition towards more instrumental networks that provide specific resources for growth (Prokop et al., 2019). The extent of external financing and investment in academic start-ups largely depends on the quality of signals they receive from the spinoff. The literature highlights the signalling value of various firm-specific characteristics—such as the top management team, ownership structure, partnerships, alliances, and founder involvement—as well as university-specific factors, including institutional reputation, academic support, university investments, access to resources during the start-up stage, and patenting activity.

2.1 Parent university characteristics - regulation, innovative capability, and reputation

Several studies emphasize the important role of university policies in facilitating academic spinoffs' access to external financing (Caldera & Debande, 2010; Fini et al., 2011). While many European universities have fostered environments conducive to spinoff creation (Nosella & Grimaldi, 2009), research exploring how institutional policies directly impact the ability of spinoffs to secure funding is still limited. Muscio et al. (2016) identify key institutional factors such as monetary incentives, equity allocation, and entrepreneurial risk regulations that influence spinoff creation, but their direct effect on financing remains underexplored. Signalling theory suggests that university policies serve as signals to reduce information asymmetry between spinoffs and investors. For example, allowing academic founders a larger equity share can indicate higher commitment and greater involvement, increasing the likelihood of attracting external financing. Moreover, clear and structured policies related to intellectual property, equity participation, and risk management signal that the university has addressed governance and legal concerns, thus reducing uncertainty for potential investors. This regulatory framework not only enhances the credibility of the spinoff but also acts as a certification mechanism, reassuring investors about the venture's scientific and commercial potential. By providing such signals, universities help mitigate information asymmetry, making spinoffs more attractive to external financiers. Ultimately, universities with formal spinoff regulations and policies are better positioned to help their spinoffs secure funding, as these policies improve the trustworthiness of the venture and reduce the perceived risks for investors.

Hypothesis 1. Academic spinoffs established by universities with a dedicated regulatory framework are more likely to be funded.

Another aspect of the university institutional environment that plays a significant role in attracting external funding is the university's technology transfer ecosystem. This includes the availability of well-functioning incubation infrastructures and services such as Technology Transfer Offices (TTOs) and science parks. These ecosystems are designed to foster the transformation of research results into commercial products and to support the creation and financing of academic start-ups (Algieri et al., 2013; Gómez-Gras et al., 2008; Caldera and Debande, 2010).

Evidence suggests that TTOs and incubation services can help reduce start-up costs (Pazos et al., 2012), mitigate market risks (Prokop et al., 2019), develop spinoffs (Montiel-Campos, 2018; Pazos et al., 2012), and enhance their overall performance (Nosella and Grimaldi, 2009). Furthermore, TTOs provide a valuable mechanism for communicating the credibility of academic spinoffs to

potential investors. A study by Gubitta et al. (2016) specifically highlights the role of TTOs in attracting venture capital by offering credible signals of a spinoff's quality.

Hypothesis 2. Academic spinoffs established by more prestigious and innovative universities are more likely to achieve a higher funding.

2.2 Spinoff characteristics - Human capital and technological potential (aggiungere qui)

The literature on academic spinoffs highlights the importance of specific internal characteristics, such as patents and founder expertise, as key factors influencing both the formation and funding of spinoffs (Perkmann et al., 2013; Mathisen & Rasmussen, 2019). Patents are widely recognized as a strong signal to investors, indicating the technological potential and uniqueness of a spinoff. Studies have shown that academic spinoffs with patents are more likely to secure venture capital (VC) financing or achieve a successful exit, as patents enhance the perceived value and credibility of the venture (Clarysse et al., 2007; Miozzo & DiVito, 2016; Mueller et al., 2012).

Similarly, the educational background and industry experience of the founders serve as important internal signals to investors. Founders with strong academic credentials and relevant work experience are often seen as more capable of successfully translating research into a viable business, increasing the likelihood of securing external funding (D'Este & Perkmann, 2011). These internal factors act as signals of quality and reduce uncertainty for investors, who rely on such cues to assess the spinoff's potential for success.

Hypothesis 3. Academic spinoffs with patents are more likely to be funded.

Hypothesis 4. Academic spinoffs led by founders with strong educational backgrounds and relevant work experience are more likely to be funded.

2.3 Other spinoff and university characteristics and contextual factors

In our analysis, we also control for other spinoff characteristics and contextual factors that may influence variations in spinoff financing. While intrinsic characteristics of spinoffs, such as patents, founder expertise, and regulatory frameworks, play a significant role in their ability to attract funding, the heterogeneity in terms of sector and technology type also has a considerable impact. Different industries can exhibit varying levels of investor interest, market potential, and perceived risks, all of which affect financing outcomes (Munari & Toschi, 2011; Zerbinati et al., 2012). The perceived or actual riskiness of the technology underlying a spinoff can also have an important mediating effect on the impact of both the spinoff and university signals. When investors evaluate academic spinoffs, they consider not only the internal signals—such as patents, founder expertise, and regulatory frameworks—but also the inherent risk associated with the technology being commercialized. Technologies perceived as high-risk, such as those in biotech or cutting-edge engineering, may require stronger signals from both the spinoff and the university to mitigate investor concerns and enhance funding prospects. In contrast, technologies that are perceived as lower-risk, such as those in established sectors with more predictable outcomes, may rely less on signaling and more on proven market potential. Therefore, the effectiveness of the spinoff and university signals may vary depending on how risky the underlying technology is perceived to be. For high-risk technologies, investors may place more weight on strong university involvement, clear intellectual property

frameworks, and the expertise of the founders to reduce uncertainties and increase confidence in the venture's potential for success.

Large attention has been devoted at investigating the influence of university's characteristics on both the creation and the financing of academic spinoffs. Scholars have focused on the effect of institution type (Rajhi, 2014), university size (e.g., Fini et al., 2017; Horta et al., 2016; Powers and McDougall, 2005), university reputation (Bruneel et al., 2020; Fini et al., 2017), university age (Civera et al., 2020), university patenting activities, and university human capital (Meoli and Vismara, 2016). Several studies have found that as universities have more and better human capital, they have greater potential to initiate ventures, especially in high-tech sectors (e.g. Meoli and Vismara, 2016). University patenting activities (measured by number of patents granted per year per university or measured by total number of universities owned patents) might also increase the likelihood of being funded. As universities obtain more patents, they are more like to nurture competent academic start-ups because of their accumulated knowledge (Acs and Audretsch, 1988), and this might have positive effect on their funding.

The relationship between university characteristics and the financing of academic spinoffs is also shaped by the geographical, institutional, and cultural context in which these spinoffs operate. Literature suggests that the creation and financing of academic spinoffs depend not only on internal university-level mechanisms but also on the broader regional entrepreneurial environment and public support systems (Guerrero et al., 2008; Fini et al., 2011; Grimm & Jaenicke, 2012; Davey et al., 2016; Ghio et al., 2016; Kroll, 2009). The presence of agglomeration economies can play a key role in enhancing the formation of spinoffs and their ability to secure funding. Geographic proximity to VC hubs reduces information asymmetries, facilitates screening, and supports post-investment monitoring (Cumming & Dai, 2010; Chen et al., 2010). Fini et al. (2011) examined the combined impact of university-level support mechanisms (ULSMs) and local-context support mechanisms (LCSMs) on the creation of university spinoffs. Their findings suggest that these factors significantly influence spinoff creation, with the effectiveness of ULSMs being enhanced when the regional context is supportive of high-tech entrepreneurship.

3 Empirical strategy

3.1 The empirical specification

We test our hypothesis by examining both the extensive margin (whether a spinoff receives financing) and the intensive margin (the amount of financing received). Additionally, we distinguish between the first investment secured after launch and subsequent investments.

We then first estimate a Probit specification to asses the effect of ASOs' and parent universities' characteristics on the probability that the spinoff receives fundings (either public grants and venture capital). In this specification the dependent variable is a binary variable "funding" is observed and indicates whether a university spinoff receives the funding or not (=0 if the university spinoff does not receive funding, =1 if the university spinoff does receive funding). The probit regression model takes the following form:

$$Y_{ijt}^{*} = \beta_1 X_{1jt} + \beta_2 X_{2it} + \beta_3 Z_{1jt} + \beta_4 Z_{2it} + \beta_5 Z_{3t} + \epsilon_{ijt}$$

$$Y_{ijt} = 1 \; if \; Y_{ijt}^{*} > 0$$

$$Y_{ijt} = 0 \; otherwise$$

where i is the spinoff, j is the parent university and t is the year in which the spinoff receive the financing. X_{1j} are the characteristics of the university such as the presence of specific rules governing spinoff creation (Hypothesis 1), the presence of a TTO department (Hypothesis 2), and the quality of the university in term of research rating and number of patents (Hypothesis 3). X_{2j} are the characteristics of the individual spinoff which signal the quality of the venture, i.e. the presence of a strong funder (Hypothesis 4) and the ASO's number of patents (Hypothesis 5). We also include a set of controls at University level (Z_{1j}), ASO's level (Z_{2j}), and at province (NUTS 3 territorial classification) level (Z_3).

In the second specification, we estimate the effect of the same covariates on the amount of financing received by the ASOs. As a large part of the ASOs does not receive any form of funding, our dependent variable is partly continuous with a positive and large probability mass at zero. Hence, we model such a response variable in order to account for the presence of a corner solution outcome. Denote by Y_{ijt} the amount of funding received at time t, the Tobit model is:

$$Y^*_{ijt} = \beta_1 X_{1jt} + \beta_2 X_{2it} + \beta_3 Z_{1jt} + \beta_4 Z_{2it} + \beta_5 Z_{3t} + \epsilon_{ijt}$$

$$Y_{ijt} = Y^*_{ijt} \; if \; Y^*_{ijt} > 0$$

$$Y_{ijt} = 0 \; otherwise$$

All the specifications include a set of dummies for the ASO's launch year and provinces. Finally, we cluster standard errors based on university-time cells to adjust standard for possible serial correlation within cells arising from the fact that ASOs are nested within a parent university, and spinoff regulation is measured at the University level.

3.2 The data

Our sample consists of 1,078 academic spinoffs from Italy created between 2000 and 2023 by 63 public universities in Italy. Data were collected from Dealroom, which contains longitudinal information on start-ups and spinoffs located in Europe, including their complete investment history. The database was recast and complemented with further information from the Italian Ministry of Universities and Research (MIUR) Spinoff Italia database, which provides the name, year of establishment, sector, geographic location and parent university of each spinoff (Civera et al., 2020). We also merged these data with those of Muscio et al. (2016), which provides detailed information on rules in 63 Italian public universities. The information was extracted from the "regolamento spinoff" which are publicly available documents available on the websites of universities. We updated the database developed by Muscio et al. (2016), containing the most relevant features of university rules and policies in support of academic entrepreneurship, with the most recent information. The original database took the first steps in exploring the heterogeneity in university policies. A second wave of reviews carried out in Spring 2024 of university policy documents allowed a revision and update of the original database. It considered three sets of institutional variables: general rules and procedures; rules regulating monetary incentives; and rules affecting the entrepreneurial risk. With regard to general rules and procedures, it considered the following design features: pro-forma for the business plan available at the parent university (format b plan); obligation to avoid business activity

in contrast with the mission and activity of the university (conflict interests); universities can establish their own "technical committee" (committee) to evaluate spinoff proposals and, at the same time, to reduce potential negative impact on their reputation deriving from inappropriate/unsuccessful spinoff initiatives (Van Burg et al., 2008). When looking at the monetary incentives, Muscio et al. (2016) considered the following design features: minimum equity stake in spinoff firms (limit uni partic) and guidelines for the dual employment of scientist-entrepreneur (forced part time). As the authors state, this is because university regulations and policies that allow the allocation of a higher share in the equity to the academic founder are expected to result in higher involvement of faculty in spinoff activity. Regarding the institutional rules related to the entrepreneurial risk, the authors considered two features: whether the university is not liable for any losses incurred by the spinoff, which means that the whole risk is absorbed by other partners (part losses), and the duration of incubation period (limit incub). We identify three sets of control variables as predictors of spinoff ability to raise external finance. The first category contains firm-level characteristics with firm size dummies, sector dummies, and founding year dummies indicating the year of establishment of each spinoff. The second category include university-level control variables such as university size measured as the total faculty (postdoc students, assistant, associate and full professors), university reputation defined as the research rating based on the evaluation of research output (VQR) carried out over the period 2004-2019, and dummy variable TTO for those universities with a technology transfer department. The third category of contextual factors comprises measures identifying the features of the entrepreneurial ecosystem as provincial VC investments (amount of VC investments per province in the year of investment), share of value added over population at province level, dummy variable incubator for provinces with a certified incubator, and the number of bank branches at provincial level.

Table 1 Variable descriptions

Variable	Definition	Source	
Panel A: Dependent variables			
Funded	Dummy variable equal to 1 if academic spinoff has been funded	Dealroom	
Amount invested	Amount invested	Dealroom	
Panel B: University regulation			
Reg so	Specific regulation on spinoff creation. Dummy variable.	University regulation	official
format b plan	Presence of a pro-forma of the business plan. Dummy variable equal to 1 if the university provides a pro-forma and to 0 if not.	University regulation	official
conflict interests	Participants cannot carry out activities in conflict with their parent university. Dummy variable.	University regulation	official
committee	The parent university has a committee evaluating spin-outs proposals. Dummy variable.	University regulation	official
limit uni partic	Minimum share of the spinoff equity held by academic participants. Dummy variable.	University regulation	official
forced part time	Whether academic spin-out founders are forced to a part-time regime. Dummy variable.	University regulation	official
part losses	If the university is ready or able to take up any losses of the spinoff. Dummy variable.	University regulation	official
limit incub	Time limit on spin-off incubation in university facilities. Dummy variable.	University regulation	official
Panel C: University characteristics			
TTOs	Presence of a technology transfer department	NETVAL	
University patents	Number of patents	NETVAL	

University rating	Research rating published by MIUR based on VQR.	VQR, MIUR
University size	Total number of researchers (full professors, associate, assistant professors, and researchers) and PhD students	CINECA
Panel D: Spinoff characteristics		
strong founder	=1 if the founder has a proven track record for success, e.g. she/he may have founded another successful startup, held a high position and/or has a strong educational background	Dealroom
ASOs patents	number of patents at the spinoff level	Dealroom
size (employees)	Categories of employees, where category boundaries are: 1 employee; 2-10 employees; 11-50 employees; 51-200 employees	Dealroom+Orbis
sector	10 categories of sectors	Spinoff Italia
launch year	Year of foundation	Dealroom
Panel E: Contextual variables		
va_prov	Value added per capita in the province (NUTS3) where the university is located.	Eurostat
vc_prov	Venture capital per capita in the province (NUTS3) where the university is located.	Dealroom.co
Certified incubators	Presence of certified incubators at the province (NUTS3) level	Infocamere
Bank branches	Number of bank branches at the province (NUTS3) level	ISTAT

3.3 Descriptive statistics

Academic entrepreneurship and spinoff creation are a powerful channel technology transfer and research commercialization. The number of spinoffs vary considerably across university systems and universities. In Italy, Politecnico di Torino (with 140 academic spinoffs), Politecnico di Milano (with 108 academic spinoffs), University of Padua (95), University of Bologna (81.5), University of Pisa (81.5), and have the highest share of spinoffs over the period 2000-2023 (source: Netval). According to the Dealroom database, Politecnico of Milano created on average 7 new start-ups every year over the period 2000-2023, whereas University of Macerata, University of Cassino and University of Molise rarely generated spinoffs over the same time period. In terms of sectors, the most important sectors include ICT, energy, health, and services for innovation.

Figure 1 Concentration of academic spinoffs and amount of finance raised by Italian university cities, 2000-2023 (left hand side), and average amount invested at university city level (right hand side)

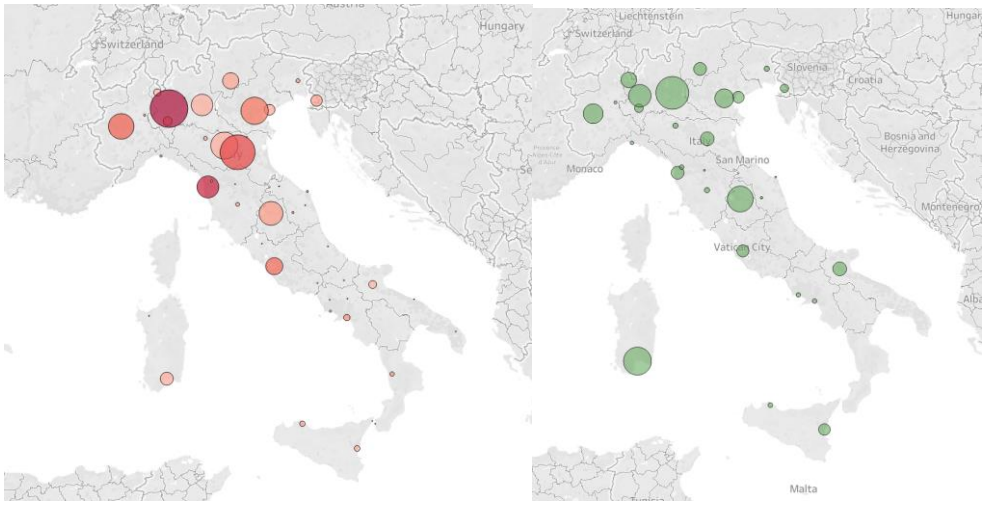


Table 2 reports the descriptive statistics. Over 22.9% of Italian academic spinoffs are financed through further rounds of finance, and receive on average around 269 thousand EUR. Around 20% of academic spinoffs have patents and an extremely low percentage (around 5%) are led by successful (in terms of education and work experience) managers. They have an average age of less than 8 years, and hire on average between 2 to 10 employees. The vast majority of them are in the health sector. Academic spinoffs are established in public universities with over 2000 researchers (professors and researchers) on average, and these universities produce on average 5 patents per year. Regarding institutional policy support, the vast majority of public universities have adopted different rules which could potentially affect spinoff's ability to raise funding. Around 14% of these universities reported a pro-forma for the business plan, 57% could not carry out spinoff activity in contrast with the mission and the activity of the university. The vast majority (over 84%) have a committee evaluating the commercialization of the university technology. Only 6.9% have a minimum equity stake to take in new start-ups, and around 18% have the obligation for scientists to move from full-time to part-time position. 52% report that the potential losses of the new start-ups are taken up by the university, and few universities have a time limit on spinoff incubation in university facilities. Finally, focusing on provincial controls, spinoffs are located in provinces with more than one million inhabitants, and 597 bank branches on average.

Table 2 Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) s.d.	(4) min	(5) max
Panel A: Dependent variables					
Funded	1,202	0.229	0.420	0	1
Amount invested (first) , thousands	137	820.4	2531.07	2.50	2.30 e+03
Amount invested (overall), thousands	275	1177.99	2766.54	0	2.30 e+03
Panel B: University regulation					
Reg so	1,202	0.930	0.255	0	1
format b plan	1,202	0.143	0.351	0	1
conflict interests	1,202	0.574	0.495	0	1
Committee	1,202	0.844	0.363	0	1
limit uni partic	1,202	0.069	0.254	0	1
forced part time	1,202	0.176	0.381	0	1
part losses	1,202	0.520	0.500	0	1
limit incub	1,202	0.144	0.351	0	1
Panel C: University characteristics					
TTO	1,202	0.936	0.245	0	1
University patenting	1,202	5.353	7.599	0	37
University rating	1,202	2.428	1.603	0.080	6.250
University size	1,202	2,033	1,371	29	7,520
Panel D: Spinoff characteristics					
Strong founder	1,202	0.051	0.220	0	1
Patents count	1,202	0.202	0.998	0	16
Employees	1,202	11.02	14.93	2	170
Panel E: Contextual variables					
va_prov	1,108	42,073	49,558	3,995	173,737
pop, thousands	1,175	1.321e+03	1.141e+03	166.58	4.356e+03
vc_prov, thousands	1,202	1.38e+04	4.88e+04	0	2.89e+05
Certified incubators	1,202	0.478	0.500	0	1
Bank branches	1,202	597.4	502.7	76	2,614

4 Results

Table 3 and Table 4 reports the results of the Probit and the Tobit regressions. Table 3 focuses on the first financing received by ASOs . The specific regulation on spinoff is statistically significant in the probit regression when considered alone (column 1) suggesting that universities with a specific regulation for spinoff increase the chance of receiving at least one funding for their spinoffs. This result is in line with Hypothesis 1, thought the presence of spinoff regulation does not to have any affect on the amount of funding that the spinoff receives (Column 3). Going more in details of regulatory norms (columns 3 and 4), Table 3 shows that the presence of a minimum requirement on the equity stake from academic participants (so_lim_min_soc_uni) increases the probability of the spinoff to receive fundings. The effect is still positive on the amount of founding, thought less precisely estimated. This may signal their commitment to the venture, aligning their incentives with long-term success. Investors tend to interpret this as a sign of confidence in the technology and business potential, reducing concerns about opportunistic behavior or lack of dedication. Moreover, retaining a meaningful equity stake ensures that academic founders remain actively involved in the development and commercialization process, which is particularly valuable in deep-tech and knowledge-intensive sectors where the expertise of the original inventors is crucial. This reduces the perceived risk associated with investing in early-stage spinoffs and makes them more attractive to external financiers, including venture capitalists, angel investors, and public funding agencies. When the university spinoff regulation provides rule spinoff participants from engaging in activities that conflict with their parent university (so_confl_int_so) negatively affect their ability to secure external funding. If on the one side, this rule may signal a stronger alignment between technologies and expertise developed by the spinoff and the University's mission, on the other this could be seen as a limit to strategic flexibility, restricting partnerships or business models that enhance growth.. It can also signal excessive university control, raising concerns about bureaucratic interference and reduced autonomy in decision-making. In line with Hypothesis 2, the presence of a TTO at the parent university has a positive and significant effect on spinoff funding, confirming that TTOs provide a valuable mechanism for communicating the credibility of academic spinoffs to potential investors. Finally, while the university patent performance affect neither the probability of receiving funding nor their amount, academic research performance (vqr) has a positive impact on the probability of receiving fundings. This last result supports hypothesis 3 and implies that university reputation may act as a signal of the quality of the spinoff.

Regarding the effect of spinoffs' characteristics, the presence of a strong founders (both in terms of education and work experience) and the ASOs' ability to innovate proxied by the patent performance affect positively the ability to attract investment both at the intensive and extensive margins. These results confirm both Hypothesis 4 and 5. A strong founder with both academic and entrepreneurial experience reassures investors of the firm's ability to execute its business plan, while patents serve as tangible indicators of innovation, increasing the perceived value and growth potential of the venture.

Interestingly, university characteristics, such as spinoff rules and reputation, primarily influence a spinoff's ability to secure initial financing by reducing information asymmetry and enhancing credibility. A well-regarded university signals quality and institutional support, increasing investor confidence in backing a venture. However, these factors do not necessarily determine the amount of

funding received, as investment size depends more on the specific potential of the spinoff itself. In contrast, spinoff-level characteristics, such as a strong founder and innovative performance, affect both the likelihood of receiving funding and the amount secured. Since investors allocate capital based on expected returns and risk, these firm-specific signals directly impact both access to financing and the scale of investment.

At the context level, the probability of receiving the first investment and the amount of the first investment is positively influenced by the provincial availability of venture capital. The probability of receiving the first investment is also positively affected by local wellbeing, and the presence of incubators, whereas it is negatively influenced by the presence of a relatively large number of bank branches. Such finding can be interpreted with the presence of a substitution effect in investment decisions for venture capitalists and banks.

Table 3: First Investment round

VARIABLES	(1) Probit (dy/dx)	(2) Probit (dy/dx)	(3) Tobit	(4) Tobit
Spinoffs characteristics				
strong_founder	0.203***	0.235***	4.227***	4.212***
	(0.0470)	(0.0486)	(1.249)	(1.242)
patents_count	0.0207***	0.0195***	0.187*	0.181*
	(0.00714)	(0.00716)	(0.111)	(0.109)
University regulation and research reputation				
Reg so	0.135*	0.243**	-0.0666	-0.105
	(0.0747)	(0.108)	(0.302)	(0.480)
so_confl_int_so		-0.109**		0.438
		(0.0428)		(0.306)
so_comm_valut		-0.0171		-0.0251
		(0.0990)		(0.416)
so_format_bp		0.00702		-0.202
		(0.0708)		(0.363)
so_obb_tempo_def		0.0359		-0.257
		(0.0643)		(0.318)
so_part_perdite_uni		0.0103		-0.167
		(0.0519)		(0.334)
so_lim_durata_incub		0.00909		-0.502
		(0.0629)		(0.349)
so_lim_min_soc_uni		0.177**		0.420
		(0.0850)		(0.377)
TTO			0.742***	0.780***
			(0.231)	(0.235)
uni_patent_activity (log)	0.00282	0.0133	0.200	0.147
	(0.0153)	(0.0149)	(0.150)	(0.159)
vqr	0.0737**	0.106***	0.0820	0.0654
	(0.0301)	(0.0406)	(0.165)	(0.192)
Other spinoff and university controls				
uni_staff (log)	-0.142**	-0.224***	-0.313	-0.101
	(0.0595)	(0.0767)	(0.322)	(0.343)
grant			6.169***	6.164***
			(0.610)	(0.610)

Polytechnic	0.117**	0.0626	-0.0736	0.0151
	(0.0545)	(0.0824)	(0.379)	(0.432)
2 to 10 employees	0.0932***	0.0877***	0.605***	0.587***
	(0.0158)	(0.0151)	(0.119)	(0.122)
11 to 50 employees	0.168***	0.169***	1.191***	1.171***
	(0.0316)	(0.0330)	(0.287)	(0.284)
51 + employees	0.0380	0.0106	-0.596	-0.627
	(0.0690)	(0.0560)	(0.888)	(0.893)
1 employee (base category)				
Contextual variables				
incubators_prov	0.0835**	0.109***	-0.0431	-0.00238
	(0.0393)	(0.0399)	(0.251)	(0.260)
lsportelli_prov	-1.311***	-1.321***	1.174	1.522
	(0.186)	(0.195)	(1.326)	(1.331)
lva	0.663**	0.545*	3.092	2.811
	(0.276)	(0.288)	(2.556)	(2.648)
lVC_amount_prov	0.0162***	0.0157***	0.0325**	0.0338**
	(0.00285)	(0.00297)	(0.0143)	(0.0146)
Sector FE	Included	Included	Included	Included
NUTS 3 FE	Included	Included	Included	Included
Lunch year FE	Included	Included	Included	Included
Year of investment FE			Included	Included
Observations	852	852	1,050	1,048

Standard errors in parentheses clustered at university-time. *** p<0.01, ** p<0.05, * p<0.1. All the specifications include Sectors. Provinces and years FE. Sectors are Aerospace, Industrial Automation, Biomedical, Electronics, Energy and Environment, ICT, Life Sciences, Nanotech, Innovation Services, Cultural Heritage.

Table 4 results on the overall amount of founding collected in several investment funds confirm the results found in the previous regressions. ASOs from universities that have adopted a regulatory regime for their spinoff activity (Reg) have a higher probability of obtaining funding whereas it does not play a role in explaining in the amount of funding received. Again the probability of being funded is influenced positively by the rule that sets a minimum limit on university staff participation in spinoff capital (limit min soc uni), and also by the rule that set a limit on spinoff incubation in university facilities (so_lim_durata_incub). In the Tobit regression, the only significant institutional variable affecting the amount of finance is the dummy variable forced part-time, which takes the value of 1 if academics have to go part time when they choose to start a spinoff. This finding can be interpreted as universities exercising higher control over entrepreneurial decisions and human capital raise less external finance for their spinoffs. Among the key signals from the parent university, we find that spinoffs belonging more prestigious universities are more likely to be funded, indicating that investors use the prestige or reputation of the university as a signal or indicator of quality when investing in academic spinoffs. Among the key signals from spinoff characteristics, we find that academic spinoffs with more patents, and those led by stronger founders have a higher probability of raising finance and attract more capital. Smaller and younger academic spinoffs are also more likely to raise finance and attract money.

Table 4: All investment rounds

VARIABLES	(1) Probit (dy/dx)	(2) Probit (dy/dx)	(3) Tobit	(4) Tobit
Spinoffs characteristics				
strong_founder	0.183***	0.201***	2.137**	2.189**
	(0.0365)	(0.0408)	(0.994)	(0.995)
patents_count	0.0168**	0.0153**	0.269**	0.264**
	(0.00685)	(0.00661)	(0.110)	(0.108)
University regulation and research reputation				
Reg so	0.226***	0.363***	0.188	-0.324
	(0.0726)	(0.0894)	(0.367)	(0.561)
so_confl_int_so		-0.0530		0.160
		(0.0344)		(0.359)
so_comm_valut		-0.0522		0.467
		(0.0715)		(0.461)
so_format_bp		0.00335		-0.0715
		(0.0699)		(0.408)
so_obb_tempo_def		-0.0263		-0.740**
		(0.0504)		(0.351)
so_part_perdite_uni		-0.0176		0.473
		(0.0434)		(0.389)
so_lim_durata_incub		0.0854*		-0.236
		(0.0510)		(0.393)
so_lim_min_soc_uni		0.160***		0.107
		(0.0585)		(0.426)
TTO			0.704**	0.695**
			(0.280)	(0.275)
uni_patent_activity (log)	0.001	0.016	0.148	0.124
	(0.0143)	(0.0127)	(0.162)	(0.168)
vqr	0.0600**	0.0769**	0.171	0.00618
	(0.0299)	(0.0362)	(0.200)	(0.232)
Other spinoff and university controls				
grant			4.483***	4.491***
			(0.530)	(0.533)
debt			1.438	1.419
			(0.995)	(0.983)
past financing (acc)			0.258***	0.251***
			(0.0557)	(0.0554)
uni_staff (log)	-0.142**	-0.224***	-0.313	-0.101
	(0.0595)	(0.0767)	(0.322)	(0.343)
Polytechnic	0.111**	0.0551	0.166	0.277
	(0.0510)	(0.0732)	(0.452)	(0.493)
2 to 10 employees	0.0868***	0.0812***	0.766***	0.761***
	(0.0155)	(0.0146)	(0.149)	(0.153)
11 to 50 employees	0.152***	0.133***	1.729***	1.674***
	(0.0295)	(0.0266)	(0.309)	(0.305)
51 + employees	0.0220	0.000950	-0.371	-0.337
	(0.0490)	(0.0401)	(0.955)	(0.945)
1 employee (base category)				
Contextual variables				
incubators_prov	0.107***	0.0921**	0.0281	-0.0556
	(0.0353)	(0.0370)	(0.299)	(0.304)
lsportelli_prov	-1.764***	-1.769***	0.743	1.099

	(0.192)	(0.196)	(1.647)	(1.645)
lva	0.808***	0.858***	5.089	5.594*
	(0.227)	(0.235)	(3.111)	(3.154)
lVC_amount_prov	0.0151***	0.0153***	0.0409**	0.0419**
	(0.00279)	(0.00281)	(0.0169)	(0.0174)
Sector FE	Included	Included	Included	Included
NUTS 3 FE	Included	Included	Included	Included
Lunch year FE	Included	Included	Included	Included
Year of investment FE			Included	Included
Observations	852	852	1,050	1,048

Standard errors in parentheses clustered at university-time. *** p<0.01, ** p<0.05, * p<0.1. All the specifications include Sectors. Provinces and years FE. Sectors are Aerospace, Industrial Automation, Biomedical, Electronics, Energy and Environment, ICT, Life Sciences, Nanotech, Innovation Services, Cultural Heritage.

5 The role of risk and financing rounds in the signalling channel

To further validate the signalling hypothesis, we conduct robustness checks to examine whether the effectiveness of quality signals varies with the risk profile of academic spinoffs and across different rounds of financing. The underlying assumption is that in environments with higher uncertainty, credible signals become more valuable in reducing information asymmetries between spinoffs and potential investors. Additionally, if our signalling hypothesis holds, we expect the effect of signals to weaken in later financing rounds, as investors acquire more information about the firm's quality over time.

5.1 Signalling Effect and Spinoff Risk Exposure

The classification of high-risk spinoffs follows established literature on entrepreneurial risk, venture financing, and industry-specific challenges faced by early-stage firms (Gompers & Lerner, 2001; Colombo & Piva, 2008). We define a spinoff as high-risk if it operates in an industry characterized by technological complexity and long development cycles, employs innovative or emerging technologies, or operates in a market with high levels of uncertainty. Accordingly, three dimensions of risk are considered: (i) Industry Classification, where robotics, semiconductors, and space technologies are identified as high-risk due to their capital intensity and regulatory hurdles (Murray & Lott, 1995); (ii) Technological Characteristics, where spinoffs developing deep technology, machine learning, artificial intelligence, robotics, or computer vision face high levels of uncertainty and high R&D investment needs (Teece, 1986; Autio & Yli-Renko, 1998); and (iii) Market Uncertainty, where spinoffs focusing on niche applications such as medical devices, energy storage, and recognition technologies encounter significant commercialization risks (Hsu, 2007).[1]

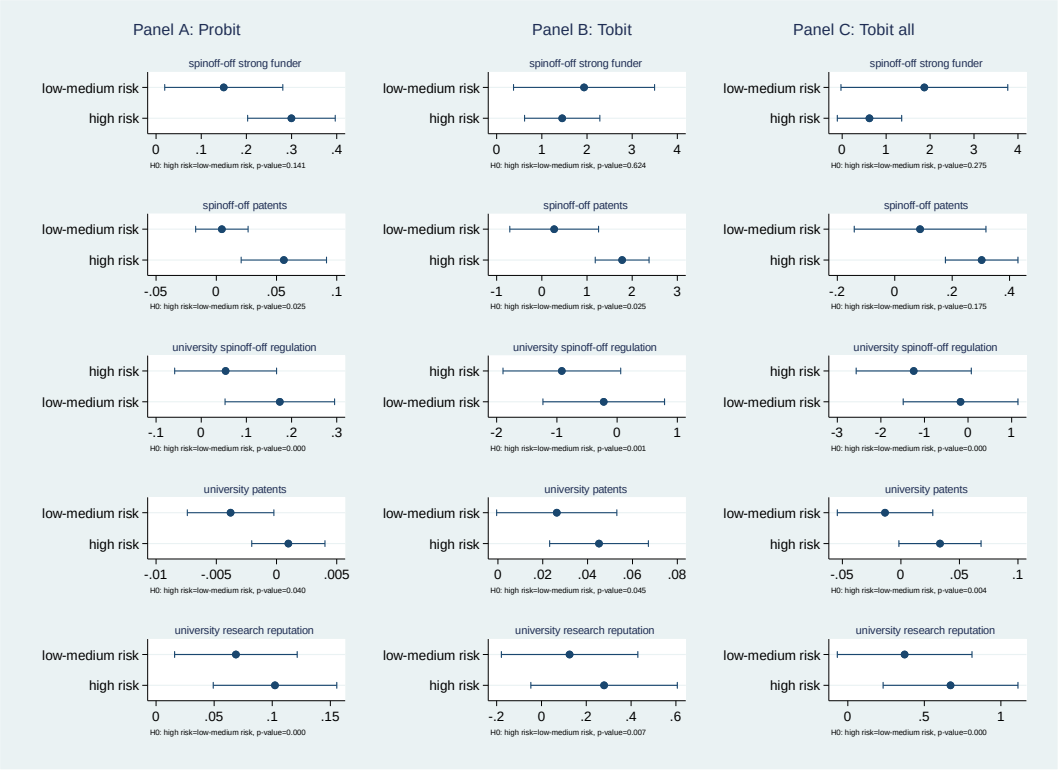
According to our classification, 112 spinoffs operate in a high-risk industry, 114 spinoffs develop high-risk technologies, and 31 spinoffs focus on niche applications. A spinoff is classified as high-risk if it meets at least one of these criteria. Accordingly, we identify 209 high-risk spinoffs, 81 of which have received at least one round of financing during the period considered.

[1] The classification of spinoff relies on quality information contained in first-industry, technologies and sub-industries fields in the Dealroom dataset.

To assess whether the signalling effect is stronger for high-risk spinoffs, we interact our key signalling variables introduced in the previous sections (e.g., strong founder presence, intellectual property, or parent university characteristics) with the risk index. A positive and significant coefficient on these interaction terms would suggest that quality signals play a more critical role in financing decisions for spinoffs operating in riskier environments.

Figure 2 reports the coefficients of the signalling variables on the first financing received by ASOs (both the intensive and extensive margin) estimated for high- and low-medium-risk spinoffs separately. In all the case the effect is consistently higher and more statistically significant for riskier ASOs, and the null hypothesis of equal impact is generally rejected.[2] The results remain similar when we extend the analysis to all financing, as shown in Panel C. These results provide additional robustness to our main findings, supporting the theory that the signalling mechanism is particularly important in contexts where investors face greater challenges in assessing firm quality.

Figure 2: Signal effects for different spinoffs' risk exposure



5.2 Signalling effect at different financing rounds

In a second robustness check, we examine whether the effect of quality signals weakens in later financing rounds. If signals serve as a mechanism to reduce initial information asymmetries, their impact should be strongest in early-stage financing and diminish in subsequent rounds as investors acquire more direct evidence of firm performance (Gompers, 1995; Kaplan & Strömberg, 2003). This expectation aligns with empirical findings that early-stage investors rely more on intangible

[2] The results remain robust when we narrow the set of spinoffs labeled as risky to those classified in the Dealroom database as operating with Deeptech technologies (165 spinoffs). Deeptech technologies are defined as those based on significant scientific or engineering innovations, often involving complex research and development processes.

indicators, whereas later-stage investors prioritize financial performance and growth potential (Gompers, Kovner, Lerner, & Scharfstein, 2010).
To test this, we define three financing stages: first round (151 ASOs), second round (55 ASOs), and subsequent rounds (27 ASO).
To examine the likelihood of a spinoff securing funding across successive financing rounds, we estimate an ordered probit model where the dependent variable reflects the highest financing round reached. In particular, we investigate how various signals—such as patent ownership, founder background, or university regulation—correlate with the probability of reaching more advanced stages of financing. [3]This approach allows us to evaluate how intrinsic and institutional signals affect investor decisions at different stages of the financing cycle.

In the second specification, we employ a Tobit model to examine how different signals affect the amount of investment received by academic spinoffs across successive financing rounds. We estimate separate coefficients for each round by introducing interaction terms between key signals and round indicators. A declining coefficient on the signal variables across rounds supports the hypothesis that signalling effects are strongest in the initial stage and weaken over time (Hsu, 2004; Bottazzi, Da Rin, & Hellmann, 2008). Figure 3 presents the estimated marginal effects from the ordered probit model, while Figure 4 displays the marginal effects of the key signal variables on the amount of financing in each round.
From Figure 3, we observe that—consistent with the results in the previous sections—all variables of interest significantly affect the probability of receiving financing, and do not exhibit any differential effects across subsequent rounds. This supports our hypothesis that signals matter primarily for the likelihood of being financed, rather than for distinguishing between different stages of investment.
In line with these firs set of results, the Tobit marginal effects in Figure 4 reveal that both spinoff-level and university-level characteristics are statistically significant in the first financing round, with their impact declining in subsequent rounds. Moreover, the signalling effect in the first round is statistically different from those in later stages for all variables considered, except for the presence of spinoff patents. These findings further support the idea that signalling is most influential in early financing stages, when information asymmetries are greatest. The declining coefficients suggest that as spinoffs develop a track record, investors increasingly rely on firm-specific performance data rather than initial signals. Intellectual property, however, continues to play a significant role even in later rounds, as it provides a basis for competitive advantage and long-term value creation (Haeussler, Harhoff, & Müller, 2014).

[3] This framework captures the ordered nature of funding progression while accounting for the fact that many spinoffs receive no external financing. The model assumes a latent propensity to receive funding, influenced by observed characteristics, which is translated into discrete outcomes through estimated thresholds. As in the previous pecification, estimation is performed using maximum likelihood, with standard errors clustered at the university-year level to address potential within-group correlation.

Figure 3 – Order probit regressions

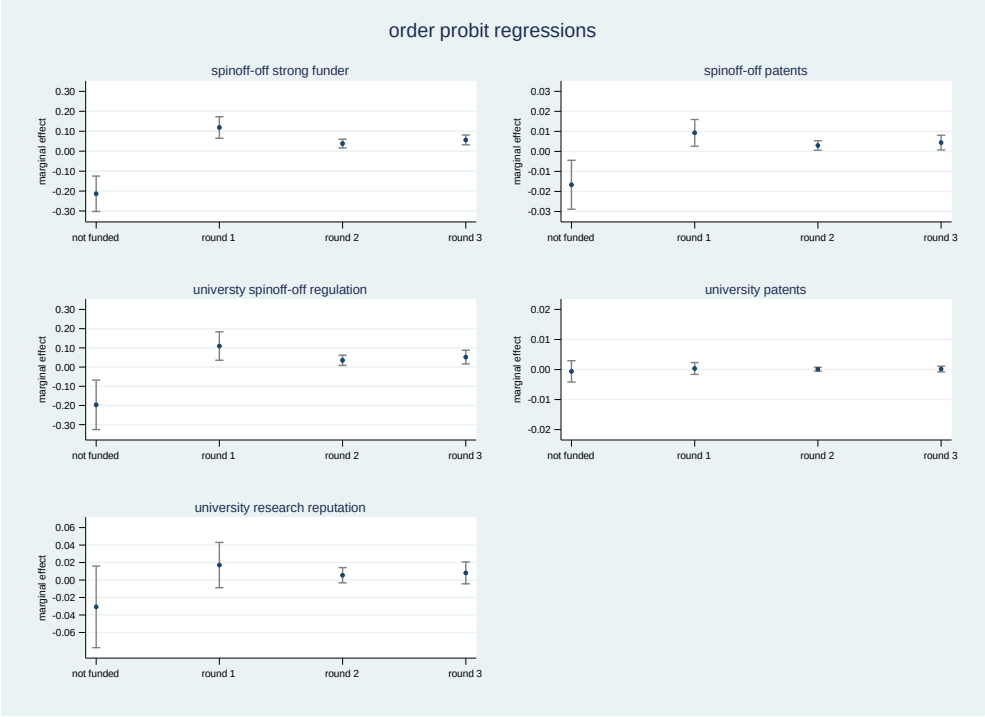
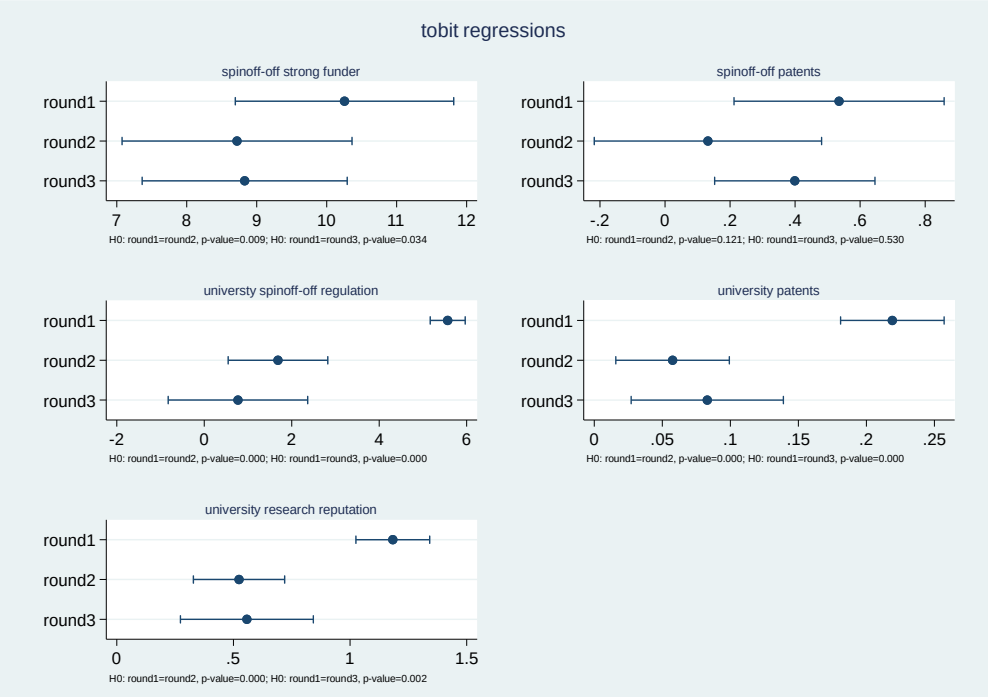


Figure 4 – Tobit regressions



6. Conclusions

This study contributes to the literature on academic entrepreneurship by demonstrating how university regulations and spinoff characteristics influence external financing through signaling mechanisms. Our findings suggest that while university-level signals, such as regulatory frameworks and institutional prestige, enhance a spinoff's likelihood of receiving funding, they do not affect the amount invested. Instead, firm-level characteristics, particularly founder strength and patent activity, serve as more direct signals to investors, influencing both funding access and investment size.

The results have important policy implications. Universities seeking to support their spinoffs should design regulatory frameworks that enhance transparency and reduce information asymmetries while allowing sufficient entrepreneurial flexibility. Policies that require academic founders to retain equity can reinforce investor confidence, but excessive restrictions, such as rigid conflict-of-interest rules, may hinder a spinoff's ability to attract funding. Moreover, strengthening technology transfer offices and fostering an environment that supports innovation, and experienced entrepreneurial leadership can further enhance spinoff financing prospects.

Future research could explore the impact of different investor types—such as government grants, corporate investors, and venture capitalists—on financing outcomes and assess how these actors weigh university and firm-level signals differently.

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