



The effects of university rules on spinoff creation: The case of academia in Italy



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ABSTRACT

The economics literature provides rich evidence on the convergence between the institutional factors and individual-level characteristics influencing the involvement of academia in knowledge transfer activities and spinoff creation. However, little is known about the effects of internal university regulations on academic entrepreneurship. In the last ten years, spinoff activity from academia in Italy has been intensive and most academic institutions have policies related to the regulation of academic entrepreneurship practices, known as 'Regolamento Spinoff'. This paper investigates the impact of the set of university rules governing the creation of spinoffs, on institutional capability to generate new ventures. Based on panel-data analysis using detailed university-level data on academic spinoffs, we identify three classes of institutionally-defined rules that can motivate faculty members to establish a spinoff company. These are: general rules and procedures; rules regulating monetary incentives; rules related to the entrepreneurial risk. We find that at least some rules pertaining to each of these three classes have some effect on spinoff creation. In particular, we find that monetary incentives play a significant role in promoting academic spinoff activity, and that overly-restrictive university rules regarding contract research have a negative effect on spinoff creation.

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1. Introduction

University spinoffs have become a popular way to obtain value from research and to transfer technology and are attracting increased interest from scholars studying the commercialization of academic research results (Baldini, 2010; Clarysse et al., 2005; Gomez Gras et al., 2008). Spinoffs are regarded as a potentially important, but so far under-exploited technology transfer option (Lockett et al., 2003; Harrison and Leitch, 2010). Encouraging academic spinoffs increases interactions with the private sector, creating job opportunities for both academics and graduates (Nosella and Grimaldi, 2009; Friedman and Silberman, 2003; Rizzo, 2015).

The support offered by universities for academic spin-off activity, varies greatly. There are huge differences in central university policies, in contractual practices and in the level of support offered by university Technology Transfer Offices (TTOs) (Rasmussen et al.,

2014; Clarysse et al., 2005). Spinoff creation can be a challenging, risky and time-consuming means of knowledge transfer, which puts additional pressure on academics and university offices (Rasmussen et al., 2014). It follows that university policies can play a crucial role in influencing spinoff creation.

Several studies examine university practices and university rules in order to gain some insight into their impact on spinoff creation and academic entrepreneurial activities generally (Debackere and Veugelers, 2005; Di Gregorio and Shane, 2003; Galán-Muros et al., 2015; Nosella and Grimaldi, 2009; Rasmussen and Borch, 2010; Siegel and Wright, 2015; Siegel et al., 2007, 2004, 2003). However, the design of internal university policies seems to be considered less important. The design of policy and regulations is of particular relevance in contexts where universities have substantial autonomy; different performance in relation to spinoff creation might depend on the adoption by the university of different rules which affect the conditions related to the establishment of spinoff firms by academics (and technology transfer activities more generally). Thus, the choice to create an academic spinoff (and to transfer knowledge from university to industry more generally) might, to some extent, be the result of the faculty member's rational response to the conditions (i.e. opportunities and boundaries, incentives and

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constraints) set by the university's policies and their overall consistency.

In Italy, legislative interventions,¹ have increased the autonomy of universities to set rules and to create conditions conducive to knowledge transfer activities including spinoff creation. Many Italian universities have reacted by establishing norms for university-industry interaction, with particular reference to spinoff firms, via the so-called 'Regolamento Spinoff', and norms for contract research via the 'Regolamento Contoterzi' (Muscio et al., 2013). While several authors argue that different university policies or strategies for technology transfer can encourage or inhibit spinoff activity (Di Gregorio and Shane, 2003; Gomez Gras et al., 2008), there are no studies that empirically assess the impact of internal university regulations on the rate of spinoff creation and especially, from a country level perspective. Building on the emerging debate (Caldera and Debande, 2010; Muscio et al., 2015; Rasmussen et al., 2014) on the influence of university policies and strategies on knowledge transfer activities, our study contributes in several ways. We focus on the design of university policies/internal regulations, based on detailed information on the rules chosen by universities to frame spinoff creation and motivate faculty members (and other possible stakeholders such as venture capitalists or private partners) to start new ventures. We provide a quantitative assessment of the impact of these rules on academic spinoff activity. In line with the idea that the decision to create an academic spinoff is a rational response to the set of boundaries to and incentives for knowledge transfer activity as a whole² we control for the impact of internal rules related to contract research and patenting, on spinoff creation.

The paper is organized as follows. Section 2 sets the theoretical background to academic entrepreneurship. Section 3 presents our empirical results on the effects of academic regulation on spinoff creation. Section 4 discusses the results and their implications for policy.

2. University policies for spinoff creation

There continue to be huge differences among universities in both the USA and in Europe, in terms of spinoff creation performance, (Rasmussen and Wright, 2015). The literature tends to focus on the identification of the determinants of different academic spinoff creation performance, at various levels. Early studies mostly lacked any underlying theoretical perspectives and focused on describing the phenomenon (Rothaermel et al., 2007), or took an inductive approach aimed at assessing the existence of certain relationships, but with no consistent general framing (O'shea et al., 2007). Other studies, based on a variety of theoretical and conceptual grounds, try to identify the antecedents to academic entrepreneurship. From the perspective of a resource-based view (Lockett and Wright, 2005; O'shea et al., 2005; Powers and McDougall, 2005; Rasmussen and Wright, 2015), the resources most important for academic entrepreneurial activity fall into four categories: financial, physical, human capital and organizational. Other approaches emphasize the importance of university support mechanisms for academic entrepreneurship, at both the strategic and operational levels (Galán-Muros et al., 2015). These include the regulatory and working environment (Caldera and Debande, 2010; Muscio et al., 2015), the reward and promotion systems that shape

the monetary and non-monetary incentives for researchers (Siegel et al., 2003; Yencken et al., 2005), and a well-defined and clear spinoff strategy (Lach and Schankerman, 2008; Phan and Siegel, 2006; Rasmussen and Borch, 2010). Also, the role played by wider social, regulatory and organizational forces has been investigated (Fini et al., 2011; Ranga et al., 2003; Shane, 2004; Van Looy et al., 2003).

Generally, the promotion of academic entrepreneurship activity and university spinoff creation in particular, is complex. It involves both the individual and institutional levels and also (Muscio and Pozzali, 2013; O'shea et al., 2005; Powers and McDougall, 2005; Ramaciotti and Rizzo, 2014) external factors such as the local socio-economic conditions and access to technological, human and financial resources. In addition, several studies highlight that academic entrepreneurial activities, including spinoff creation, occur on a significant scale only if there is a clear university strategy in place (Van Looy et al., 2011). This implies that an institutional-level entrepreneurial orientation, which can be recognized and understood by all potential stakeholders (Siegel et al., 2003), is as important as the policy measures through which it is operationalized.

Although many European universities have made efforts to create the institutional conditions conducive to the transfer of their research results (Nosella and Grimaldi, 2009), there are very few studies of internal university policies related to the systematic commercial exploitation of academic research (Siegel et al., 2007). This paper contributes to the stream of literature on the effects of the academic institutional level on academic entrepreneurship (Caldera and Debande, 2010; Degroof and Roberts, 2004; Feldman et al., 2002; Fini et al., 2011; Muscio et al., 2015; Nosella and Grimaldi, 2009). While there are several university-level factors that may be promoting universities' more active involvement in creating the opportunities for exploiting research results (Baldini et al., 2007), in this article we focus on university's internal policies/regulations which motivate faculty members to engage in spinoff creation, and promote managed knowledge transfer activity. We identify three classes of institutionally-defined rules framing spinoff creation and incentivizing faculty members to engage in this activity: general rules and procedures; rules regulating monetary incentives; rules affecting the entrepreneurial risk.

- General rules and procedures

Universities can define a set of rules framing spinoff creation (Caldera and Debande, 2010). First, the existence of such rules is a signal of the university's strategic entrepreneurial orientation, which legitimates spinoff activity as part of the academic cultural framework (Phan and Siegel, 2006; Rasmussen and Borch, 2010; Van Looy et al., 2011). This points also to the importance of internal rules about other knowledge transfer channels to support the importance placed by the university on interaction with industry. Second, regulation makes the relation between the spinoff promoter and the university clearer and less ambiguous, and formalizes the conditions under which academics may pursue an entrepreneurial venture (Rasmussen and Borch, 2010). It clarifies also how other stakeholders might participate in the technology transfer activity (Siegel et al., 2003). As Lockett et al. (2003) emphasize, clear and well-defined strategies on the formation and management of spinoffs are characteristic of better performing universities.

Internal rules can streamline the procedures involved in the preparation of proposals for spinoff initiatives (e.g., business plans) and their approval (e.g. establishment of an ad hoc committee to evaluate proposals), and the management of potential conflicts of interest between the university and the spinoff.

¹ Law 168/1989, Law 537/1993, Law 297/1999, Law 593/00, Law 30/2005, Law 240/2010.

² Romme and Endenburg (2006) Romme and Endenburg (2006: 288) state that: 'An individual design rule can typically not be applied independently from other rules. Given the integrated nature of organisations and their designs, design rules are therefore developed and presented as part of a coherent set of related rules'.

The first dimension of a university spinoff-specific policy is related to how support is provided to researchers in the invention to company start-up process (Debackere and Veugelers, 2005). For instance, while the technical aspects and commercial potential of an invention may have been identified clearly, drafting the spinoff project proposal and business plan may be an activity that is unfamiliar to researcher-inventors. A lack of the required capabilities (Lockett and Wright, 2005) could be perceived as an obstacle to spinoff activity. Some universities have put in place structures to support these processes (TTOs, business incubators). However, it is important to note that these facilities develop their supporting activities based on the procedures and routines specified in the relevant university policy.

Universities may also set rules to reduce potential negative impact on their reputation deriving from inappropriate/unsuccessful spinoff initiatives (Van Burg et al., 2008). One way to guard against reputation damage is for the university to set up a committee to vet and select proposals. A dedicated committee generally will pass an opinion on whether or not the new venture should be endorsed by the parent institution (e.g., via the right to use the university's logo), and on its long-term sustainability.

According to the literature, the rules on conflicts of interest between the university and the spinoff play a significant role (Van Burg et al., 2008). Evidence for Spain shows that appropriate internal rules regulating the participation of researchers in external activities are important for university spinoff creation (Caldera and Debande, 2010). Well-defined rules on conflicts of interest and, in particular, on the compatibility of such activity with a researcher's multiple roles in fulfilment of the university's missions, have a positive impact on performance. Rules on conflicts of interest also influence other university knowledge transfer activities such as research contracts and consultancies (Caldera and Debande, 2010; Muscio et al., 2015). It is interesting that the scientific literature tends to focus on conflicts of interest on the researcher's side (e.g., focusing on the time spent on research/teaching and third mission activities) while paying scant attention to the rules governing possible conflicts of interest between the spinoff's activities and the parent university's (scientific or economic) interests and missions (Rasmussen and Borch, 2010 make brief mention of this issue).

- Monetary incentives

Very little research has been done on how university monetary incentive schemes shape the propensity of researchers to start new ventures. Caldera and Debande (2010) claim that the design of both incentive and risk-sharing schemes for the parties involved in the commercial exploitation of research is a crucial component of an effective technology transfer strategy.

Reward for technology transfer activity is an important driver of faculty members' involvement in research commercialization or spinoff creation (Geuna and Muscio, 2009). These rewards can take several forms, such as being granted a share of the licensing or equity ownership (Link and Siegel, 2005). In particular, the monetary incentives for spinoff creation (i.e. the distribution of eventual profits and capital gains in the case of spinoff success) are related strictly to how the equity is distributed among the participants. 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. Some authors (Di Gregorio and Shane, 2003; Gomez Gras et al., 2008; Markman et al., 2005) show that the distribution of royalty payments between researchers and the university, is fundamental for determining the university's spinoff creation performance. Inventors can receive revenue from their inventions via royalties paid by licensees, or from the profits accruing from the commercialization of their technology. In relation to commercialization activities more

generally, there is some evidence that universities that allocate higher royalty shares to researchers show better technology transfer activity performance (Siegel et al., 2003; Phan and Siegel, 2006). Also, as Friedman and Silberman (2003) and Lach and Schankerman (2004) suggest, organizational incentives for university technology transfer appear to be an important determinant of success.

On the other hand, there is also evidence suggesting that monetary aspects play a minor or even irrelevant role and that other motivations may be more significant and more decisive in driving researchers' commercial endeavours (Lam, 2011). These include indirect and alternative rewards (Baldini et al., 2007) such as reputation and recognition (Göktepe-Hulten and Mahagaonkar, 2010).

It has been underlined also that rules which include monetary incentives act more as signalling devices. In other words, what is important is their existence and the consistent signals they embody, rather than the financial incentives or disincentives for researchers to engage in technology transfer activities (Krueger et al., 2000). Rules embedding conditions that are perceived as unjustified and unfair (e.g., an overly high share of the revenue retained by the university, which is more than is justified by central administration) will undermine researchers' commitment and trust in the administration (Yencken et al., 2005). In addition, these negative effects could percolate through knowledge transfer channels.

- Entrepreneurial risk

Institutionally-defined rules related to the entrepreneurial risk involved in spinoff creation can motivate faculty members to engage in academic entrepreneurial activities, despite not granting direct monetary benefits. Some universities allow academic entrepreneurs to access university R&D laboratories, scientific facilities and academic incubators. These possibilities can be particularly relevant for spinoffs unable to afford the initial investment required for capital equipment (Fini et al., 2011). Therefore, university incubators that support early stage start up through the provision of services and facilities (e.g., access to and the use of expensive instrumentation, or access to toxic substances disposal, and animal facilities) to support production up to commercial distribution, can be very effective tools.

Several studies highlight the difficulties experienced by spinoffs in accessing capital (Lockett and Wright, 2005) and the consequent importance of university venture capital funding to secure the initial development phase (Caldera and Debande, 2010; Croce et al., 2014; Di Gregorio and Shane, 2003). This highlights the importance of internal university rules about possible monetary contributions in the form of equity ownership (Di Gregorio and Shane, 2003; Gompers and Lerner, 2004).

At the same time, universities rules can increase the entrepreneurial risk for researchers. This can occur if the university tries to limit possible opportunistic behaviours from spinoff founders, or to select spinoffs driven by a 'real' entrepreneurial spirit, or simply if it tries to minimize the financial impact on the university of unsuccessful spinoff creation. Thus, a limit to the number of research contracts which the parent university can grant to the spinoff is often included in the internal regulation. This can be especially effective for reducing the risk that the opportunity to create a spinoff, which seldom is supported by direct and indirect forms of government funding, is exploited in order to employ junior temporary academic staff (PhD students, research officers, etc.) who continue to be paid by the parent academic institution.

Finally, responsibility for financial losses is a strong deterrent to spinoff creation. Some universities state that, while they encourage academic entrepreneurship and demand a share of the spinoff

equity, they will not be liable for any losses incurred by the spinoff, which means that the other partners bear the whole risk.

2.1. Other determinants of spinoff activity

It is clear that academic spinoff activity is not dependent solely on internal university regulation. The literature identifies a number of other factors which can have direct or indirect effects on the propensity of a university to engage in spinoff activity.

For example, universities with a tradition and history of spinoff creation are (O'shea et al., 2005) able to benefit from the knowledge and experience accumulated over the years (Rasmussen and Borch, 2010). Many universities have dedicated offices to manage links with industry, licensing, patenting, spinoff creation, contract research and consulting activity. The TTO is probably the most common university-level initiatives to formalize the university's commitment to knowledge transfer (Siegel et al., 2003; Bonaccorsi et al., 2013). The role of the TTO in spinoff creation has been analysed by several authors. O'shea et al. (2005) find evidence of a positive correlation between TTO size and the rate of spinoff creation while Caldera and Debande (2010), Powers and McDougall (2005), Lockett and Wright (2005) and O'shea et al. (2005) show that TTO size significantly affects spinoff activity. In many cases TTOs support the diffusion of technology from academia to industry (Siegel et al., 2003) and contribute experience in writing business plans, obtaining financial resources, and negotiating with potential partners. Several works stress the role of TTOs in increasing the value of university intellectual property (Meseri and Maital, 2001; O'shea et al., 2008), and managing the rules for its legal protection and commercial potential (Vohora et al., 2004).

The relationship between spinoff creation and other types of technology transfer activities has also been discussed with some authors suggesting that academic involvement in contract research and consulting activities is indicative of greater spinoff activity (Landry et al., 2006). Contract research and consulting might also accompany academic entrepreneurship, for instance, in the case of an academic who started a spinoff company but continues to collaborate with the parent university (Perkmann et al., 2013; Meyer, 2003). Van Looy et al. (2011) find no evidence of any trade-offs between different technology transfer mechanisms. In particular, spinoff and patenting seem unrelated, while contract research and spin off emerge as positively and significantly related, suggesting that 'contract research could be instrumental for creating spin off companies. Indeed, engaging in contract research might result in a better understanding of market potential and in the development of adequate business models. As such, contract research might act in a number of cases as an 'incubation' device, leading to spin off creation' (Van Looy et al., 2011; Van Looy et al., 2011: 560). Some authors explore these relationships from the perspective of research funding. According to Di Gregorio and Shane (2003), there are many reasons why industry-funded research promotes spinoff activity. For instance, private companies are more likely than governments to fund commercially-oriented research, and the commercial orientation will have a positive impact on academic entrepreneurship. With some exceptions (Ramaciotti and Rizzo, 2014), most studies show that receiving funding from contract research and consultancy activities leads to a greater number of spinoffs.

The economic literature provides evidence of several other determinants of spinoff creation. It has been argued that university research performance positively affects academic involvement in technology transfer activities (Renault, 2006; Perkmann et al., 2013; Cohen et al., 2002; Rasmussen et al., 2014). There is also some empirical evidence showing that universities with higher levels of research productivity generate a higher number of new ventures (Di Gregorio and Shane, 2003; Powers and McDougall, 2005).

Finally, the influence of the external context on spinoff creation has been highlighted (Friedman and Silberman, 2003). O'shea et al. (2005) argue that the region's knowledge infrastructure and industry composition are important factors influencing spinoff activity, while, according to Feldman and Desrochers (2004), universities located in contexts with a weak entrepreneurial infrastructure find it more difficult to promote academic spinoffs. Baldini (2010) suggests that a fertile economic environment is positively related to university spinoff activity, and that the spinoff process benefits more from high regional levels of innovation than from the activities of the parent university. Supporting this, Di Gregorio and Shane (2003) argue that universities located in regions that are rich in sources of venture capital will be more likely to generate spinoffs given the easier access to finance.

3. Empirical analysis

3.1. Data and methodology

The empirical analysis consists of an econometric exercise to determine the relevance of academic regulation for stimulating academic spinoff creation. The analysis is based on three main sources of data. First, the Netval database, which includes information on the number of spinoffs generated by each Italian university. Netval administers an annual questionnaire to collect information on technology transfer activity to the Chancellors or Technology Transfer Managers of Italian universities. The results of the survey are published in an annual report.³ On average, 62 universities respond to the survey, accounting for 80% of the total number of students and 80.6% of professors. Data quality is high; as part of the Netval activities, all technology transfer managers and staff from the universities in the Netval network participate in a Summer School where the data collection process is validated. The second data source is an original database created by the authors, which collects detailed information on current and past spinoff creation and contract research rules in place in 65 Italian public universities. The information was extracted from the *regolamento spinoff* and the *regolamento contoterzi*, which are publicly available documents available on the websites of most universities,⁴ that set the rules for academics setting up and managing university spinoffs or engaging in contract research and consultancy;

The third data source is a publicly available database that provides detailed information on the amounts and sources of academic funding, the composition of university research staff and the availability of support infrastructures such as TTOs. These data are collected annually by the Italian Ministry of University and Research (MIUR) and are available for the period 2005–2012.

We use an index of research quality, created by MIUR as part of a government effort to measure research performance in Italy, based on an evaluation of research output conducted in 2001–03. We also exploit a NUTS III-level geographical indicator of value added, obtained from the Italian National Statistical Institute (ISTAT).

Table 1 presents information on the variables used in the analysis. The dependent variable is the number of spinoff companies generated each year by each university during the period 2005–12.

Since the dependent variable is based on count data and the distribution of spinoffs is very skewed, we apply a negative binomial regression model to a panel data structure.⁵ Consistent with the

³ Available at: <http://www.netval.it>

⁴ Where not available online (6 cases), the authors instigated phone requests for copies of the documentation.

⁵ Our dependent variable is based on count data. A test (Long and Freese, 2014) comparing the fit of the count model Poisson, negative binomial, zero-inflated Poisson and zero-inflated negative binomial models confirms that, in our case, the

Table 1
Data source and definitions.

Variable	Definition	Data source
Dependent Variable spinoff	Number of new spin-off companies from each university (per year)	NETVAL
Independent Variables		
University regulation – General Rules and Procedures		
reg_SO	Specific regulation on spinoff creation (y/n)	University official regulation
reg_CR	Specific regulation on contract research and consultancies (y/n)	Web survey
format_b_plan	Availability of a predefined format for business plans at the parent university (y/n)	University official regulation
confl_interests	Spinoffs cannot carry out activities in conflict with their parent university (y/n)	University official regulation
committee	Presence at the parent university of a Committee evaluating spinoff proposals (0 no Committee; 1 Committee with internal members; 2 Committee with internal and external members)	University official regulation
– Monetary Incentives		
limit_uni_partic	Minimum share of the spinoff equity held by academic participants (y/n)	University official regulation
contr_res_withholding	Share of revenues from contract research and consultancies withheld by the university	Web survey
forced_part_time	Academic spinoff promoters are forced to a part time regime (y/n)	University official regulation
patent_withholding	Amount withheld by the university in case of sale of a patent (y/n)	Web survey
– Entrepreneurial risk		
limit_contracts	Maximum limit on research contracts from parent university to the spin-off (y/n)	University official regulation
part_losses	The university is not liable to fund any losses of the spinoff (y/n)	University official regulation
limit_incub	Time limit on spin-off incubation in university facilities (y/n)	University official regulation
Control variables		
spinoff_cumul	Cumulative amount of spinoffs units (t-1)	NETVAL
patents	Number of patents (t-1) (ln)	NETVAL
f_contract_research	Total funding from research contracts and consultancies from public and private organisations (t-1) (ln, 2005–12)	MIUR
f_gov	Total government research funding (t-1) (ln, 2005–12)	MIUR
tto	Presence at the university of a Technology Transfer Office (TTO) (y/n)	NETVAL
p_research	Total number of research staff (full professors, associate professors, assistant professors, research officers) and PhD students (t-1) (ln, 2005–12)	MIUR
polytech	Polytechnic university (4 in Italy)	University website
rating	Research rating published by MIUR in 2007, based on the evaluation of research output carried out over the period 2001–03. This composite indicator takes into account peer review evaluations of research activity carried out at academic institutions (patents, impact factor of journal articles, etc.)	CIVR VTR (MIUR, 2007)
va_prov	Value added of the province (NUTS III) where the university is located (ln)	ISTAT

background presented above, our independent variables include the set of rules defined in the internal university regulations concerning or otherwise affecting the setting up of academic spinoff firms. We control also for several characteristics of academic institutions which might influence academic capacity to create spinoffs.

y_{it} denotes university i 's spinoff companies generated at time t ; the negative binomial panel model with unobserved university effects is expressed as:

$$y_{it}^* = z_{it}'\beta + x_{it}'\delta + c_a + c_t + u_{it}, i = 1, \dots, N, t = 1, \dots, T \quad (1)$$

$$y_{it} = \max(0, y_{it}^*)$$

where z_{it} is a set of indicators for university spinoff regulation, x_{it} is a set of controls for university-specific characteristics, c_a is the scientific area effect, c_t is the year effect, and u_{it} is the error term. Year effects are included to account for cyclical variations in the university's capacity to generate spinoffs.⁶ The vector x_{it} contains a set of

covariates, which might be correlated to the university's capability to engage in spinoff activity, such as the cumulative number of spinoffs created, university size (measured as number of research staff), university structural characteristics, research quality, (1-year lagged) number of patents, (1-year lagged) research funding from public and private sources, and economic performance in the area in which the parent institution is located.

Table 2 presents some statistical information on the implementation of general rules and procedures, monetary incentives and the norms concerning entrepreneurial risk. While the majority of academic institutions has implemented spinoff or research contract policies, there are wide differences in the types of norms applied to frame spinoff creation. If we extend our analysis to other forms of technology transfer, the most frequent rules are related to regulation of monetary incentives, but there are differences among these rules. Most institutions have set a committee to evaluate spinoff proposals and regulate conflicts of interests for academics deciding to start a new venture; however, only a few provide a procedural support (such as a format for the business plan). Few institutions force academics to go part time if they choose to start a spinoff, but the majority regulate monetary incentives by applying some sort of withholding on the sales of patents or on contract research. The rules vary also in the area of abatement of entrepreneurial risk.

negative binomial model shows the best fit of differences between observed and average estimated probabilities for each count.

⁶ See Tables 1 and 2 for more detail on the controls used in the model, and some summary statistics.

Table 2
Adoption of regulations and rules (n. = 55).

Regulations and rules			n.	%
General Rules and Procedures	reg.SO	Specific regulation on spinoff creation	50	90.9%
	reg.CR	Specific regulation on contract research and consultancies	52	94.5%
	format.b.plan	Availability of a predefined format for business plans at the parent university	8	14.5%
	confl.interests	Spinoffs cannot carry out activities in conflict with their parent university	39	70.9%
	committee	Presence at the parent university of a Committee evaluating spinoff proposals	43	78.2%
Monetary Incentives	limit.uni.partic	Minimum share of the spinoff equity held by academic participants	9	16.4%
	forced.part.time	Academic spinoff promoters are forced to a part time regime	11	20.0%
	contr.res.withholding	Share of revenues from contract research and consultancies withheld by the university	49	89.1%
Entrepreneurial risk	patent.withholding	Amount withheld by the university in case of sale of a patent	33	60.0%
	limit.contracts	Maximum limit on research contracts from parent university to the spin-off	4	7.3%
	part.losses	The university is not liable to fund any losses of the spinoff	20	36.4%
	limit.incub	Time limit on spin-off incubation in university facilities	38	69.1%

Note: In relation to this picture, a few changes have occurred during the considered period. In particular, three universities have removed their rule on participation to spinoff losses (part.losses), while two universities have modified their strategy in terms of provision of predefined formats for business plans (format.b.plan, one has started providing a business plan format, the other has stopped).

Table 3
Summary statistics.

VARIABLE	Obs	Mean	Std. Dev	Min	Max
Dependent variable					
spinoff	521	1.501	1.764	0.000	10.000
Independent variables					
University regulation					
- General Rules and Procedures					
reg.SO	534	0.702	0.458	0.000	1.000
reg.CR	550	0.875	0.332	0.000	1.000
format.b.plan	534	0.103	0.304	0.000	1.000
confl.interests	534	0.506	0.500	0.000	1.000
committee	534	0.730	0.644	0.000	2.000
- Monetary Incentives					
limit.uni.partic	534	0.081	0.272	0.000	1.000
forced.part.time	534	0.174	0.380	0.000	1.000
contr.res.withholding	497	0.179	0.165	0.000	0.860
patent.withholding	550	0.522	0.500	0.000	1.000
- Entrepreneurial risk					
limit.contracts	534	0.097	0.297	0.000	1.000
part.losses	534	0.270	0.444	0.000	1.000
limit.incub	534	0.532	0.499	0.000	1.000
Control variables					
spinoff.cumul	521	1.987	1.031	0.000	4.263
patents	613	1.999	1.665	0.000	5.894
f.contract.research	531	7.080	2.428	0.000	10.629
f.gov	531	7.868	2.128	0.000	11.144
tto	536	0.862	0.345	0.000	1.000
p.research	531	5.943	1.875	0.000	85.97
polytech	598	0.054	0.225	0.000	1.000
rating	550	0.998	0.066	0.830	1.150
va.prov	606	9.895	1.082	8.142	11.886
Natural sciences	614	0.853	0.354	0.000	1.000
Engineering and technology	614	0.821	0.384	0.000	1.000
Medical sciences	614	0.648	0.478	0.000	1.000
Agricultural sciences	614	0.474	0.500	0.000	1.000
Social sciences	614	0.891	0.312	0.000	1.000
Humanities	614	0.853	0.354	0.000	1.000

While it is a common practice to limit the duration of business incubation and, to a lesser extent, to remove responsibility for any eventual financial loss, very few universities set a maximum limit on the number of research contracts that the parent institution can grant to its spinoffs. This last might be a sign of caution by the university over spinoffs supplying research services. It might be that spinoff creation is seen as a way of keeping post-graduates and non-tenured researchers close to the parent institution, but employed by the spin off. They are enabled to continue with their research and to be paid by the university via a research contract with the spinoff. This problem is increasing as a result of the budget con-

straints on universities. Table 3 presents the summary statistics of the variables included in the regressions.

3.2. Econometric analysis

Fig. 1 shows recent trends in academic spinoff creation in Italy. According to the Netval (2014) survey, most academic spinoffs

⁷ The Netval surveys identify 1102 spin offs in 69 academic institutions over the period 1979–2013. In our exercise we analysed spinoff data in those academic

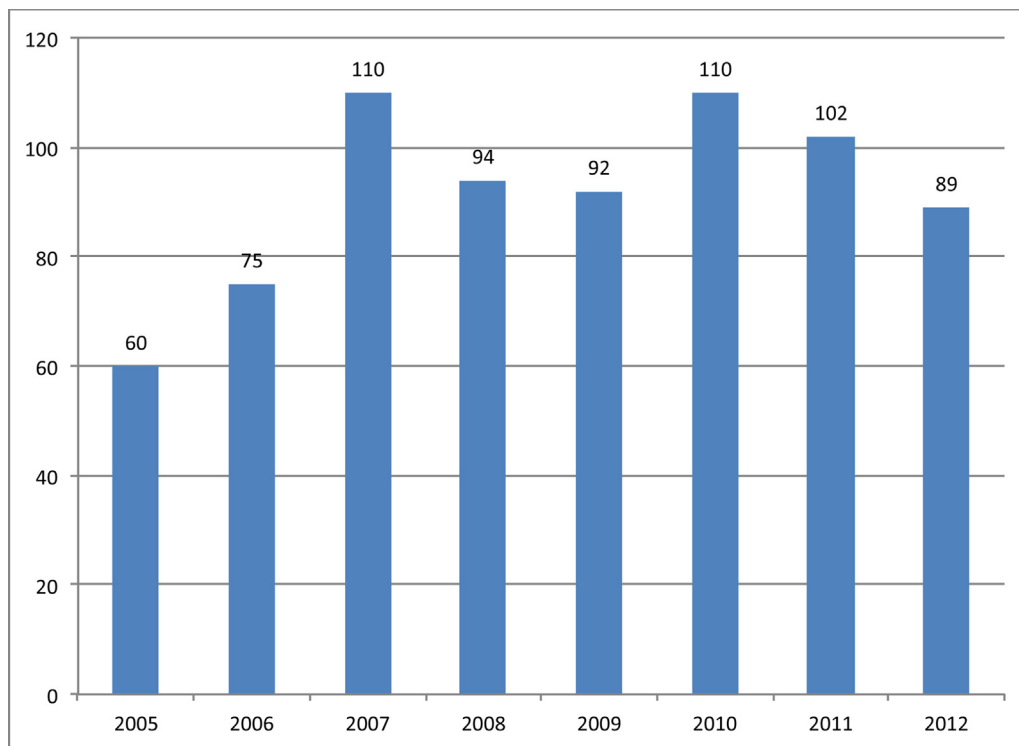


Fig. 1. Spin-off creation in Italian universities (2005–12, Total 732).

Source: Authors' calculation based on NETVAL data.

in Italy are service firms whose market entry costs are relatively low. Only some 15% of all active spinoffs in Italy are in the life sciences sector with a further 8% engaged in activities related to the biomedical industry (Netval, 2014).

Approximately 87% of the 1102 spinoff enterprises identified and active in the Italy were established after 2005, including 140 established in 2012 (corresponding to 12.7% of spinoffs created over the period 2005–12). While the survival rate is generally high, the sharpest year-to-year increase in the number of academic spinoffs occurred in 2010 (+46%) (Netval, 2014). At the European level, according to the ninth annual Survey of ProTon Europe (2012), in 2010, the total number of spinoff companies created with the support of European Knowledge Transfer Offices (KTOs) participating in the survey was 579, averaging 1.9 new spinoffs per KTO. The national and European surveys demonstrate that Italian KTOs are progressively developing the ability to support and foster spinoff creation (ProTon Europe, 2012).

Table 3 presents the parameters for the panel data negative binomial regression. This model is used to estimate the impact of regulation on the extent of spinoff activity, measured in terms of number of new spinoffs generated per year by each university. In order to take account of whether the size and statistical significance of any are dependent on the inclusion/exclusion of some of the variables in the regression, we add the independent variables stepwise, one group at the time, with the last model including all the regressors (Table 4).

The results confirm that certain regulatory norms have some effect on the generation of academic spinoff companies. As discussed in Section 2, we identify three classes of institutionally-defined rules framing spinoff activity related to general rules and procedures, monetary incentives and entrepreneurial risk. We find

that some norms in each area have a significant effect on the university's capacity to generate spinoffs.

First, a regulatory framework for spinoff activity (reg.SO) and contract research (reg.CR) have a positive effect on spinoff creation. We find that the sign and level of statistical significance of the variable reg.SO remain relatively stable as the controls are added to the base model. We also find strong evidence of a positive role of the availability of entrepreneurial support in the form of guidelines for business plan preparation (format.b.plan). It seems also that while spinoffs are relative free to exploit academic IP, they cannot act in conflict with the parent university. Note that the Italian Government opted for the inventor's privilege rule (OECD, 2003) rather than the institutional privilege embodied in IP systems aligned to the Bayh-Dole Act. When academic institutions adopt rules governing conflict of interests (confl.interests), spinoff creation decreases. Finally, we find that the presence of a board/committee to evaluate the validity of spinoff proposals reduces the number of spinoffs. However, although beyond the scope of this paper, it could be argued that being more selective about which proposals to support might increase the chances of spinoff survival and generate better performance.

Second, we find that at least some form of monetary incentive for spinoff creation has a positive impact on spinoff creation. Confirming the existing literature on the topic, we find that those universities that set a minimum limit on university staff participation in spinoff capital tend to generate more spinoffs (limit.uni.partic). Arguably, in universities applying this rule, academic founders are required to make a stronger commitment to the management of the new venture and contribute more to the decision-making process. In this case, the monetary incentive increases since, in the event of commercial success, the profits and capital gains from the spinoff which accrue to the researcher are proportional to the researcher's equity shares.

Forcing staff involved in a spinoff to be employed part-time by the university has no statistically significant association with

institutions (58 universities) for which the complete panel dataset for the period 2005–12 was available and a total of 732 spinoffs.

Table 4
Panel data negative binomial regressions.

Variables	(1)	(2)	(3)	(4)
University regulation				
- General Rules and Procedures				
reg_SO	0.414*			0.553**
	[0.225]			[0.219]
reg_CR	0.038			0.570*
	[0.258]			[0.304]
format_b_plan	0.560***			0.516***
	[0.154]			[0.137]
confl_interests	-0.218			-0.341**
	[0.146]			[0.149]
committee	-0.098			-0.198*
	[0.122]			[0.118]
- Monetary Incentives				
limit_uni_partic		0.403**		0.570***
		[0.161]		[0.167]
forced_part_time		-0.02		-0.06
		[0.145]		[0.158]
contr_res_withholding		-1.184**		-1.630***
		[0.489]		[0.519]
patent_withholding		-0.096		-0.198*
		[0.114]		[0.119]
- Entrepreneurial risk				
limit_contracts			-0.602**	-0.727***
			[0.305]	[0.245]
part_losses			0.209	0.086
			[0.138]	[0.127]
limit_incub			0.161	0.028
			[0.146]	[0.151]
Control variables				
spinoff_cumul	0.465***	0.450***	0.415***	0.480***
	[0.088]	[0.075]	[0.100]	[0.075]
patents	0.046	0.025	0.081*	0.023
	[0.040]	[0.038]	[0.043]	[0.037]
f_contract_research	0.122*	0.194***	0.167**	0.128**
	[0.064]	[0.062]	[0.066]	[0.065]
f_gov	-0.014	-0.079	-0.069	-0.015
	[0.077]	[0.074]	[0.079]	[0.078]
tto	0.567***	0.397*	0.530**	0.541**
	[0.215]	[0.224]	[0.220]	[0.218]
p_research	0.161*	0.170**	0.148*	0.193**
	[0.085]	[0.081]	[0.083]	[0.085]
polytech	0.291	0.114	0.412	0.189
	[0.214]	[0.206]	[0.276]	[0.205]
rating	0.278	-0.783	0.462	-1.058
	[1.179]	[1.108]	[1.341]	[1.242]
va_prov	-0.170**	-0.121*	-0.183**	-0.166**
	[0.078]	[0.070]	[0.089]	[0.070]
Constant	-0.002	0.162	0.71	1.053
	[2.001]	[1.261]	[2.428]	[1.926]
Observations	383	365	383	365
Number of idu	58	55	58	55
Area dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Akaike Information Criteria (AIC)	1152.89	1106.60	1158.92	1092.55
WALD Test on joint significance	General Rules and Procedures	Monetary Incentives	Entrepren. Risk	ALL
	chi2(5) = 23.44	chi2(4) = 26.35	chi2(3) = 9.06	chi2(12) = 48.27
	Prob > chi2 = 0.0003	Prob > chi2 = 0.0000	Prob > chi2 = 0.0285	Prob > chi2 = 0.0000

*p < 0.1, ** p < 0.05, *** p < 0.01.

spinoff creation (forced_part_time). The university's choice to retain a proportion of profits from patent sales (patent_withholding) is also a significant driver of spinoff creation. We find that those universities that set a limit on the individual compensation from research contracts and consultancies are less likely to generate spinoffs (contr_res_withholding). Supporting this, [Roberts and Malone \(1996\)](#) and [Di Gregorio and Shane \(2003\)](#) show that the number of university spinoff firms is higher in contexts with more intense industry-university collaboration. Encouragement for

academic staff to engage in research contract activity, results in more spinoff creation activity. This highlights the importance of this rule for signalling the university's entrepreneurial orientation: universities that withhold a large proportion of the revenue from contract research and consultancies⁸ signal a poor orienta-

⁸ The 'negative signalling effect' of this rule is particularly significant in the Italian case since '...Italian universities are facing a decline in public funding which

tion to entrepreneurialism, and discourage their researchers from embarking on spinoff creation.

Third, our results show that entrepreneurial risk is not a primary concern for academic staff. We found no evidence of a significant impact of participation of the parent university on the spinoff's financial losses (*part.losses*), or of a time limitation on the incubation period, on academic spinoff creation (*limit_incubation*). However, we found that the intensity of spinoff creation depends largely on the opportunities available to the spinoff for winning contracts from the parent institution (*limit_contracts*). This is because the parent university is a valuable source of resources for the spinoff's initial activities, which can influence academics' decisions to start their own companies. However, as discussed in Section 2, in some cases the creation of a spinoff can be seen as an opportunity for the university to retain young non-tenured researchers by employing them in the spinoff (Nosella and Grimaldi 2009; Rizzo, 2015). This allows them to continue with their research and to be paid via research contracts from the parent institution which subcontracts the research to the spinoff. Setting rules to reduce this opportunistic behaviour inevitably reduces the university's spinoff creation performance, but also reduces the opportunities to create spinoffs with no real market potential.

According to the estimates for the control variables, which confirm the results obtained by Ramaciotti and Rizzo (2014), those universities with past experience of creating spinoffs, will continue to show better spinoff creation performance. We found evidence also of scale effects, with larger universities being more likely to generate spinoffs. This confirms some of the results in the literature that the asset basis of the parent university can be mobilized to facilitate the launch of a spinoff company (Ndonzuau et al., 2002). Indeed, as Landry et al. (2006) note, large universities have more resources and greater expertise relative to independent laboratories, can call on the services of TTOs (Feldman et al., 2002; Di Gregorio and Shane, 2003) and have more extensive scientific expertise (Zucker et al., 2002), all of which can be mobilized to foster entrepreneurial university research.

While we find no connection between patent performance and spinoff activity, our results are consistent with the literature on the impact of academic funding (Di Gregorio and Shane, 2003; Landry et al., 2006). We found that the probability of spinoff creation is not affected by public research funding and is positively affected by the intensity of contract research and consulting activity. In contrast to other studies (O'shea et al., 2005; Roberts and Malone, 1996; Siegel et al., 2003), we find that the presence of a TTO at the parent university has a positive effect on spinoff creation. Moreover, confirming work by Landry et al. (2006) and Ramaciotti and Rizzo (2014), we find that academic research performance has no impact on spinoff activity. Finally, in relation to the university's geographical location, we found some evidence of convergence effects since universities in those regions with lagging economic conditions tend to perform better at spinoff generation. This is in line with Degroot and Roberts (2004), who show that universities located in weak entrepreneurial contexts tend to adopt proactive and supportive models for spinoff development.

4. Concluding remarks

This paper adds to the literature on the determinants of spinoff creation by providing deeper and more systematic insights into the role played by internal academic regulations on technology transfer activities. In particular, our work provides empirical evidence on the effects on institutional capability to generate new ventures of the set of university rules governing the creation of spinoffs. Our work is based on the assumption that the decision to create a spinoff is the rational response of the academic founder to the boundaries and incentives set by the parent university on knowledge transfer activities. Therefore, our empirical analysis takes into account the impact on spinoff creation of some relevant internal rules pertaining to contract research and patenting activities (in particular those regulating the monetary incentives for researchers), together with a number of other determinants studied widely in the economic literature.

The analysis was based on the Italian context, which is characterized by certain peculiarities compared to the more widely studied US and UK ones. Although the spinoff phenomenon in Italy is relatively new (Netval, 2014), it is growing steadily and is in line with the European average (ProTon Europe, 2012). In contrast to the Anglo-Saxon context (Shane, 2004), only a limited number of spinoffs in Italy are based on patented inventions (Nosella and Grimaldi, 2009; Grimaldi and Grandi, 2003); the majority focus on services (Netval, 2014). This is related in part to the fact that a significant number of academic spinoffs are created by founders as a means of conducting research projects or contract research and consultancy under fewer constraints⁹ than within the university context. Despite these differences, our findings are particularly relevant for those countries where there is substantial university autonomy in the definition of rules to set the conditions for spinoff firm creation.

We identified three classes of institutionally-defined rules that can motivate faculty members to start a spinoff company: general rules and procedures; rules regulating monetary incentives; rules affecting the entrepreneurial risk. Although some rules in each of these categories have some effect on spinoff creation, some of our findings merit special consideration.

First, the existence of specific internal rules on spinoff creation is positively associated with better university performance in generating spinoffs, which underlines the role played by clear-cut procedures and recognizable strategies aimed explicitly at promoting academic entrepreneurship. This suggests that universities keen to increase their spinoff rates should develop clear and specific rules for their academics. These rules should be designed to encourage potential spinoff creators to assess the viability of their entrepreneurial activities and should reduce the time and resources spent negotiating contracts with the university.

Second, we find that potential conflicts of interest between the parent university and the spinoff are a relevant factor in spinoff creation and require careful consideration when designing incentives for academic entrepreneurship. Rules reducing conflicts of interests generally reduce opportunistic behaviour from researchers who create spinoffs primarily to gain more flexibility in the distribution of revenues from external sources. We have shown that setting a limit on the amount of revenue that the spinoff can obtain from

is forcing them to consider external funding options as a way to ensure increase in their financial sustainability. This has led universities to withhold a share of the revenues derived from consulting and research-to-order activities that rely on university facilities (i.e. laboratories and technical and administrative personnel) in order to cover part of the related costs and/or overheads. However, the amounts withheld are often arbitrary and not directly related to the scientific area or university facilities involved [...]. This reduces researchers' incentives to engage in consultancy activities' (Muscio et al., 2015; Muscio et al., 2015:1074).

⁹ According to most indicators, the performance and efficiency of the Public Administration in Italy are poor (Van de Walle, 2005). Revenues from research projects between universities and industry are subject to several constraints concerning how they can be allocated and the expenses that can be covered and accounted for. In such a bureaucratic and burdensome environment, it is understandable that researchers look for alternative ways to pursue research projects and manage the related financial flows more freely.

the parent university is necessary but hampers spinoff creation. However, although such rules may act as a deterrent by reducing access to valuable sources of revenue, especially in contexts characterized by structural difficulties related to accessing funding,¹⁰ it is clear that the lack of career opportunities in Italian academia, generated by cuts in public research funding, are acting as an incentive for spinoff creation in order to create jobs for postdocs and research officers (Nosella and Grimaldi, 2009; Rizzo, 2015) whose salaries are effectively paid from research contracts commissioned by the parent university. In this case, the spinoff earns revenue that otherwise would remain with the relevant academic departments, absorbing research funding.

Third, we found that some but not all of the rules about monetary incentives contribute to explaining universities' performance in spinoff creation. We found a positive relation between new venturing and the involvement of academic founders in the spinoff equity. Universities adopting the 'minimum capital share' rule perform better in terms of spinoff creation because this rule increases stakeholders' engagement, eventually granting researchers involved in the new venture a minimum level of capital gains and profits generated by spinoff activities.

Our results confirm also that there is an interdependence among the various channels of academic knowledge transfer, which highlights the need for a systemic approach to the design of university strategies. We found that restrictive academic regulation on contract research and consulting activities has a negative impact on the intensity of university spinoff creation; universities that withhold a higher share of the revenue from researchers' contracting and consulting show worse performance in new venture establishment.

The results presented in this paper have several implications for future research on the topic. We confirmed that the spinoff phenomenon is greater in those universities with a clear spinoff strategy (Van Looy et al., 2011) and showed that universities differ widely in their capability to generate spinoffs. We showed also that many regulatory aspects, combined with university characteristics and performance, drive spinoff activity. What remains unknown is how spinoff generation influences other aspects of university performance such as research activity and university capability to attract research contracts. We would encourage more exploration of the consequences of variation in spinoff activity on universities over time. Future research also could explore the impact of regulation at the department or individual level, to distinguish among different types of spinoffs (service sector, manufacturing, etc.). This level of analysis was not possible here since it would require disaggregated data on spinoff activity.

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¹⁰ In Italy, the majority of academic spinoffs are based on low levels of capital (Netval, 2014; Ramaciotti and Rizzo, 2014; Salvador, 2006) and often are unable to secure venture capital funding or are simply not interested in seeking it (Salvador, 2006), preferring less risky internal financing modes (Chiesa and Piccaluga, 2000).

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