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Investigating the association between universities' corporate governance structure and the knowledge transfer performance outcomes

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Abstract

Purpose – The aim of this paper is to provide evidence of the relationship between the governance structure of universities and the universities' knowledge transfer (KT) performance outcomes measured in terms of university spin-off firms university spin-offs (USOs).

Design/methodology/approach – The universities' board of directors has been analyzed under three profiles: the incidence of internal directors belonging to the STEM (Science, Technology, Engineering and Mathematics) faculties, the incidence of women directors and the incidence of external directors.

Findings – The findings provide evidence of a significant and positive association, for southern Italian state universities, of the presence of university STEM directors and the establishment of university spin-offs (USOs).

Originality/value – The article is original as, to the best of the authors' knowledge, no study, except for the paper by Meoli *et al.* (2019), examined the governance of universities in relation to the establishment of academic spin-offs.

Keywords Universities' corporate governance structure, STEM directors, Women directors, External directors, Knowledge transfer (KT) performance outcomes, Southern Italian state universities

Paper type Research paper

1. Introduction

Recent studies in the literature have focused on the changing role of the university with the move from first mission (teaching) and second mission (research) activities, toward the third mission, meaning a closer connection with society (Edwards, 2013; Hershberg *et al.*, 2007).

Third mission has been recognized in Italy as an institutional mission of universities with the introduction of the system of self-evaluation, periodical evaluation and accreditation and its evaluation has been explicitly included in the next national evaluation of research for the

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2015–2019 period by the Italian National Agency for the Evaluation of the University research system.

Generally, "third mission" activities comprise three dimensions performed by universities in relation to external environments: technology transfer and innovation, continuing education and social engagement (Secundo *et al.*, 2017). Also, at the political level, the European Commission (2003) declared that the main goals for universities must be production, diffusion and knowledge transfer.

In the article we focus on the university performance outcome of technology transfer and innovation, proxied with the creation of university spin-offs (USOs). USOs are a specific type of new technology venture, commercializing research results and scientific knowledge from universities (Mathisen and Rasmussen, 2019). USO could be defined as an autonomous structure of the parent organization (university), which involve stakeholders and resources of both a public and private nature, set up with the ultimate aim to transfer technology and research results to industry within a profit perspective (Hossinger *et al.*, 2020; Gübeli and Doloreux, 2005).

We chose to proxy the knowledge transfer (KT) performance outcome with the establishment of USOs as it is increasingly being used as a performance indicator to evaluate public investments in universities and public research organizations (Meoli *et al.*, 2019).

The main aim of the article is to investigate the association between the universities' board of directors' composition and the strategic decision to establish new university spin-offs (USOs). In our perspective, the board of directors is a key governing body and a central element of the firm's strategy that plays an important role in initiating and organizing innovation projects (Ben Rejeb *et al.*, 2020; Zhong *et al.*, 2021).

The main contribution of the paper thus lies in examining in depth the board's structure and inferring board variables that can provide significant insights for the establishment of spin-offs, a key knowledge strategic decision of the universities' board of directors. Furthermore, the number of academic spin-offs matters to board members as it is one of the parameters used to allocate funding to State universities (Meoli *et al.*, 2018).

The theoretical lens through which we examine this association are the upper echelon theory (UET), which postulates that values, cognitive bases and perceptions of corporate elite (such as board of directors) as well their processes, affect the corporate strategic choices and outcomes (Hambrick and Mason, 1984).

The article is original as, to the best of our knowledge, no study, except for the paper of Meoli *et al.* (2019), examined the governance of universities in relation to the establishment of academic spin-offs. Differently from the Meoli's *et al.* (2019) study, our paper introduced two other ways to examine the board of directors: namely the incidence of internal board members belonging to the STEM (Science, Technology, Engineering and Mathematics) areas and the incidence of women on boards. In this way, our study contributes to fill the research gap, shedding further light on the role played by universities' governance mechanisms in fostering USOs.

The research has been carried out on southern Italian public universities. Italy has been chosen as, since 2000, the phenomenon of USOs has become more significant, when a law (297/1999 Law) authorized universities to allow researchers and professors to be directly involved in the setting up and management of new firms for the industrial exploitation of research results, namely USOs (Iacobucci *et al.*, 2021). Following this legislation, research organizations developed specific regulations to manage the involvement of academics in USOs and better organized the provision of services to support their entrepreneurial activities (Muscio *et al.*, 2016). The evolution of USOs observed in the Italian context therefore is an ideal setting to investigate the relations between universities' corporate governance structure and their outputs in terms of number of USOs (Meoli *et al.*, 2018, 2019).

We decided to focus solely on south of Italy as the Italian southern regions' USOs have been scarcely analyzed in literature (Parmentola and Ferretti, 2018; Sciarelli *et al.*, 2021).

We believe that our findings could shed more light on the context of southern Italy, where universities face higher internal and external barriers than northern universities, providing helpful issues to identify governance factors that facilitate the birth of USO, and give relevant policy implications for universities' boards and regional governments.

The paper is organized as follows: Section 2 provides a review of the literature and posits the research hypotheses; Section 3 presents the methodology (inclusive of the context, the research model, the variables measurement, the sample selection and data source); Section 4 shows the empirical results; Section 5 discusses the main findings; and Section 6 offers some conclusions, together with the main limits of the study, research implications and future research directions.

2. Conceptual framework, literature review and hypotheses development

The section illustrates the conceptual framework behind the paper and the literature review that drove the positing of the research hypotheses.

2.1 The conceptual framework

As regards the conceptual framework we used in the paper, our paper is not included either in the agency theory, according to which the main function of the boards of directors is the monitoring management on behalf of shareholders, or in the resource dependence theory, according to which the provision of resources is the main function of the board of directors. Instead, we focus on the third function recognized to the board, namely the strategic management of the organization (Kemp, 2010). In other words, we start from the consideration that in each kind of organization, and therefore in universities, the board of directors plays a pivotal role in setting and implementing organizational strategies (Beretzinets *et al.*, 2016). The decision to set up new USOs belongs to these strategic decisions, and furthermore, it is a complex one, as USOs are high-technology ventures embedded with innovation (Sciarelli *et al.*, 2021). We employed the UET theoretical framework. The milestone in this field was the work of Hambrick and Mason (1984), which conceptualized the centrality of the "dominant coalition" in defining corporate goals, implementing strategies and achieving predetermined results under the name of UET. According to the UET framework, organizational outcomes are reflections of the personality, characteristics and behavior of the individuals at their apex (Hambrick and Mason, 1984). Since the emergence of Hambrick and Mason's (1984) study, the research has started to focus on the importance of the top management team in guiding the strategy of the firm as well as its influence on organizational performance (Cambrea *et al.*, 2017). As the board of directors is a governance organizational top management team, we decided to apply the UET to investigate how the cognitive structures of board members affect how they collect, filter, interpret and use information in their decision-making activity. The empirical literature also provided evidence of this association: a recent study, for a sample of family firms, highlighted that directors' personal details, behavior, educational backgrounds and work experience in specific professional areas are predictive of organizational strategy and performance (Rossignoli *et al.*, 2021).

Consistently with Midavaine *et al.* (2016), we study the board of directors as a managing decision unit of analysis. As the board of directors decides as a team, based on information to bear collectively, the focus is on the board composition/heterogeneity/diversity. Board heterogeneity, from one hand, may give rise to disagreement and (task-oriented) conflict, among professionals which may prompt active information search and processing, but from the other hand a proper composition of the board of a firm may reduce uncertainty, enhance information exchange between external organizations and the firm, increase access to resources, and aid in the formulation of firm strategy (Hillman and Dalziel, 2003). In the literature there is a twofold position as regards the effectiveness of board diversity in strategic decision-making: a part of

the literature believes that the board human capital diversity is especially able to prompt more complex decisions such as innovative ones as it provides directors with the pool of knowledge essential for creative breakthroughs (Finkelstein *et al.*, 2009), but another part of the literature points out the circumstance that a homogeneous board may end up making decisions quickly and more effectively (Frijins *et al.*, 2016).

In relation to the university context and to our research aim, we focus on three different source of diversity supposed in literature to affect the strategic decisions on innovation. The first source of diversity we focus on is the knowledge background (research discipline) of internal directors, as USOs are mainly innovative start-ups and literature provide evidence of the association between STEM university departments and entrepreneurial orientation (Tijessen, 2006; Riviezzo *et al.*, 2019). The second source of diversity is gender diversity, as literature provides evidence that female directors make the difference when a firm's strategy is focused on innovation (Dezso and Gaddis Ross, 2012) and also because there is a literature gap in the research on women directors' IC and innovation (Le Loarne-Lemaire *et al.*, 2021). The third source of diversity is managerial experience of the external board members, supposed to have a positive impact on the USOs' creation (Meoli *et al.*, 2019).

Figure 1 illustrates how we declined the UET framework within the university context and which observable variables decided to measure as proxies of cognitive base values of board members, related to the strategic choices (in our model the strategic decisions related to innovation) and ultimately with the knowledge performance outcomes (measured with the establishment of USOs).

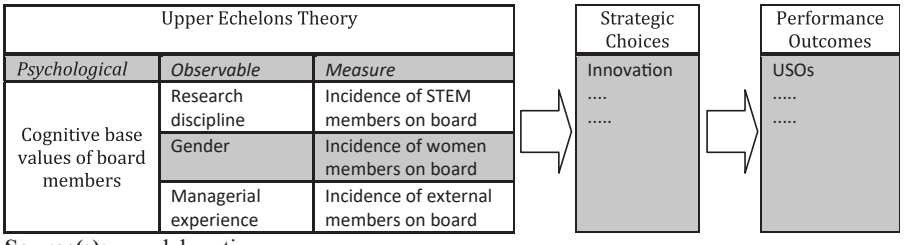
Next section briefly examines the theoretical and empirical literature focused on the association between these three source of diversity within boards (research discipline, gender and managerial experience) and innovation outcome, measured with KT performance.

2.2 The association between the three source of diversity within board and KT performance

The first feature supposed to be related to the knowledge strategic decision of the USOs' development is the belonging of internal board members to STEM research areas, the acronym for "Science, Technology, Engineering and Mathematics".

Entrepreneurship, of which spin-offs development are one of the key performance indicators, has become of primary importance in the current economic context, as a means to foster economic and social progress (Arenal *et al.*, 2017; Armuña *et al.*, 2020), so contributing to the wealth of nations and their economic dynamism (Decker *et al.*, 2014). Many of the innovative entrepreneurs and their businesses relate to the STEM fields (O'Shea, 2007) and, over the years, the interest in STEM disciplines has been increasing worldwide (OECD/European Union, 2019; Poggesi *et al.*, 2020).

STEM fields are surely relevant for innovation and technological development for nations and regions (Kuschel *et al.*, 2020), but these disciplines are also acknowledged by the literature as the sources of knowledge for spin-off activity in the university realm, given the innovation and science-based nature of USOs (Meoli *et al.*, 2019; Meoli and Vismara, 2016). Previous studies



Source(s): our elaboration

Figure 1.
The UET framework employed in the research

in fact provided evidence that scientists from biomedical and STEM have a higher spin-off creation (Zucker *et al.*, 2002; Gittelman and Kogut, 2003; O'Shea *et al.*, 2005; Abreu *et al.*, 2016).

The entrepreneurial literature underlined a higher entrepreneurial commitment of scientists from the medical and technology field with respect to the commitment of the scientists from the economic and social sciences, therefore providing evidence that the scholars' research disciplines affect their entrepreneurial intentions (Perkmann *et al.*, 2011; Huyghe and Knockaert, 2015; Walter *et al.*, 2013; Abreu and Grinevich, 2013; Fini and Toschi, 2016; Moog *et al.*, 2015; Prodan and Drnovsek, 2010).

A recent systematic literature review on the drivers, barriers and success factors of academic spin-offs (Hossinger *et al.*, 2020), provided evidence that individual factors have significantly higher explanatory power in relation to the entrepreneurial behavior of academics, reviewing studies showing that entrepreneurship-specific human capital variables have higher explanatory power regarding entrepreneurial opportunity exploration and exploitation (Ucbasaran *et al.*, 2008; Guerrero *et al.*, 2008; Liñán, 2008; Raposo *et al.*, 2008; Krabel and Mueller, 2009; Prodan and Drnovsek, 2010; Clarysse *et al.*, 2011; Rasmussen, 2011; D'Este *et al.*, 2012; Goethner *et al.*, 2012; Grimm and Jaenicke, 2012; Marion *et al.*, 2012; Abreu and Grinevich, 2013; Goel and Göktepe-Hultén, 2013; Moog *et al.*, 2015; Scholten *et al.*, 2015; Zapkau *et al.*, 2015; Fini and Toschi, 2016; Huyghe *et al.*, 2016; Miranda *et al.*, 2017).

In the literature, empirical researches focused on entrepreneurial universities are mainly carried out on STEM departments (Fini *et al.*, 2011) and STEM researchers (Hossinger *et al.*, 2021). Several studies focused on the university sector provided evidence of an association between STEM research fields and entrepreneurial orientation, measured in terms of academic entrepreneurship (spin-offs). Among these studies we can quote those of Tijessen (2006) and Riviezzo *et al.* (2019). The study of Tijessen (2006) underlines that university departments including STEM fields are those engaged in industrially relevant research and thus more likely to exhibit an entrepreneurial orientation; the study of Riviezzo *et al.* (2019) provide evidence of a positive association between the entrepreneurial orientation of university departments and their entrepreneurial performance.

Given the empirical evidence and the theory examined above, we propose our first research hypothesis as follows:

H1a. The presence on university's board of STEM internal directors is positively associated with the university KT performance.

The second individual members' board feature supposed to be related with the strategic decision to establish new USOs is the gender of the directors, which is the main demographic characteristic used as proxy for the cognitive attributes of managers/directors (Ge *et al.*, 2011). The theme of the association between women as board components and the organizational performance has raised great interest in researchers in the last few years, also due to the enactment of national laws addressed to strengthen the presence of women on boards for public companies; it has also been the object of several empirical papers that provided mixed results, finding positive, negative or no relationship between women directors and organizational performance (i.e. Bøhren and Strøm, 2010; Rubino *et al.*, 2017; Scafarto *et al.*, 2021; Veltri *et al.*, 2021). As regards the association between the presence of women on the board of directors and innovative strategic decisions/outcomes, literature, in the literature women's cognitive frames are supposed to impact firm innovative decision processes: women directors are more likely to attend meetings (Adams and Ferreira, 2009) and to be more open to risk-taking in comparison to their male counterparts (Adams and Funk, 2012). Recent studies have underlined that a board with higher female director representation is likely to promote greater information sharing as well as closer cooperation among directors (Post and Byron, 2015; Chen *et al.*, 2021) decreasing internal conflicts and that female directors can help male executives supplement their knowledge and information

outside the bounds of their experience, ultimately resulting in better innovation decisions made together (Simao and Franco, 2018; Fu *et al.*, 2021). Furthermore, women's cognitive schema and values are supposed to limit narrow-mindedness, stimulate debate and foster the board's problem-solving attitude (Huse and Solberg, 2006). These circumstances increase the range and quality of solutions, leading to more creative decision outcomes (Dìaz-Garcìa *et al.*, 2013). They also encourage the identification of innovative opportunities and improve both product and service innovation (Chen *et al.*, 2005; Miller and del Carmen Triana, 2009), leading to increased investments in Research & Development (Midavaine *et al.*, 2016).

There are still few empirical studies on the association between women directors and innovation (Foss *et al.*, 2021; Best *et al.*, 2016). Miller and del Carmen Triana (2009), for a sample of Fortune 500 firms, find a positive relationship between board gender diversity and innovation. Chen *et al.* (2018), for a sample of innovation-intensive companies, provide evidence that firms with female directors tend to invest more in innovation. Saggese *et al.* (2021), drawing on a sample of Italian high-tech listed companies, found that having women on the board positively affects R&D intensity (the ratio between R&D spending and total sales), but only when they reach a critical mass. Javaid *et al.* (2021) found that, among Chinese listed firms, female CEOs play an important role in producing higher level of innovation output (patents) by improving the governance structure. Also, Ain *et al.* (2022), found, for a sample of Chinese listed firms, that gender diversity on the board has a positive effect on corporate innovation. Chen *et al.* (2021), for a sample of US firms, provide evidence that female directors positively affect R&D performance, measured as one-year lagged R&D expenditures. No study investigated this association for universities' women directors. For the university realm, we can quote the studies of La Rocca *et al.* (2017) and Sciarelli *et al.* (2021), providing contrasting results. The study of La Rocca *et al.* (2017), on the female representation in management team on research spin-offs (RSOs) and their performance in terms of financial and innovation performance instead provide evidence of this association. The study of Sciarelli *et al.* (2021), on the association between female representation on the boards of USOs and three different measures of performance (market-based, accounting-based and organization-based) find evidence of a negative and not significant association between women directors and organizational performance.

Given this mixed evidence, we propose our second hypothesis in the null form:

H1b. The presence of women directors on the university's board is associated with the university KT performance.

The third individual members' board feature supposed to be related with the strategic decision to establish new USOs is the presence of directors not employed by the university itself (external, outside or lay directors). In our research framework, external directors are expected to bring an entrepreneurial attitude to the university where they are appointed, so favoring the establishment of USOs (Meoli *et al.*, 2019), and this was arguably the basis of regulatory changes introduced by the 240/2010 Law (i.e. the obligation to include a certain number of external members within the board of directors). Lay members should be selected according to their individual skills, either "managerial experience" or "cultural-scientific competencies", with the role to represent the stances and increase the engagement of the external community (Donina *et al.*, 2015). According to the organizational literature, the managerial experience brought in by lay members is likely to enhance positively the consolidation of an institutional culture where each member of the academic staff is encouraged to promote change, knowledge transfers, and, ultimately, firm creations (Kezar and Eckel, 2002), thus in the literature a positive effect on the rate of establishment of USOs is expected when the incidence of external members on universities' board increases. Nevertheless, the consideration developed about women's presence on the board and board diversity are also valid for external members. The only empirical study focused on this issue (Meoli *et al.*, 2019) does not find evidence of the positive

association between the regulatory changes introduced by the 240/2010 law and the rate of establishment of USOs, and finds only a weak association between the increase of external members in the universities' board of directors and the creation of USOs. Furthermore, also the study of Prencipe (2016) on the incidence of outside members on the USOs' boards provide evidence of a positive but not significant association between the incidence of outside directors on USOs' boards and the innovation performance of USOs. Given this mixed evidence, we propose our third hypothesis in the null form:

H1c. The presence of external directors in the university's board is associated with the university KT performance.

3. Research methodology

The section illustrates the methodology followed in the paper, comprehensive of the regulatory context, the data source and sample selection, the variables measurement and the empirical model.

3.1 Regulatory context

The research has been carried out on southern Italian public universities. In Italy, as in most countries, State universities are autonomous organizations (Meoli *et al.*, 2019). The governance of universities in Italy, as in all of continental Europe, is portrayed as a bureaucratic–oligarchic model, where collegial decision-making bodies, composed mainly of professors, dominate internal university governance (Braun and Merrien, 1999). Nevertheless, since the mid-1970s, new public management (NPM) and managerialism call for new ways of viewing the universities, as organizations rather than institutions. It is in this context of change that universities have been subjected to external pressures to create a new institutional and organizational environment aimed at substituting the collegial model with a managerial one (Diogo *et al.*, 2021). Also in Italy, from the mid-1990s, several laws have been issued with the aim to favor the shift from a bureaucratic model, in which the state played a key role in deciding how many resources each university might receive and how these resources had to be spent, to a managerial model, that entails a high degree of freedom in the use of public funds and in the governance of Italian state universities (Aversano *et al.*, 2018). The most important laws were the 168/1989 law, which endorsed the self-regulation principle, increasing university administrative autonomy in managing the transferred resources and contemporaneously introducing the evaluation of universities' results; the 537/1993 Law, that further elaborated on this new institutional framework, by introducing greater freedom for universities in the use of funds coming from the Ministry, and the possibility of attracting external funding and the 240/2010 Law, that radically reorganized the university system, linking resources granted to universities to their own performance indicators (Aversano *et al.*, 2018; Fini *et al.*, 2011) and imposing on state universities a minimum number of lay members on their board of directors, at least two if the board has up to ten posts, three otherwise (Meoli *et al.*, 2019).

The most important legislative change related to USOs was the 297/1999 Law, which introduced the possibility of public researchers being formally involved in the creation of a spin-off or in other technology-transfer projects between a university and a firm while keeping their university position and salary. The constitutional reform of 1999 which, for the first time, assigned legislative power in several domains (among which the one related to innovation policies) previously reserved for the national government to regional governments and the increasing quota, starting from 2004, of public funds based on performance, including technology transfer, were also important (Meoli *et al.*, 2018) [1]. All these changes have boosted the number of USOs established since 2004, and the phenomenon of USOs is attracting increasing academic attention (Parmentola and Ferretti, 2018).

As regards the features of the southern regions of Italy, previous literature highlights a territorial distribution of academic spin-offs mainly concentrated within northern regions of Italy, in favor of northern regions (Algieri *et al.*, 2013). Furthermore, southern regions of Italy face internal and external barriers that are less present for northern Italian regions (Parmentola and Ferretti, 2018; Sciarelli *et al.*, 2021). Finally, the Italian southern regions' USOs have been analyzed in only two other studies (Parmentola and Ferretti, 2018; Sciarelli *et al.*, 2021), but both of them investigated a research question different from ours.

3.2 Sample selection and data source

Our sample is represented by the southern Italian state universities. We choose this sample for several reasons that make this a homogeneous sample to investigate our Research Question (RQ). Firstly, because the distribution and surviving probability of USOs is different in the center and the north of Italy with respect to the south, since the largest cities in central and northern Italy are characterized by a high number of spin-offs, as a result of the presence of large universities (Iacobucci and Micozzi, 2015). Secondly, southern Italy is considered a context where the emergence of new companies is extremely difficult and even more so for the high-tech sector (Parmentola and Ferretti, 2018). Third, because the rate of creation of academic spin-offs increased in regions with higher skilled unemployment and in universities with fewer academic career opportunities, rather than in more research-oriented or more prestigious universities (Meoli *et al.*, 2018). The choice to focus on southern Italian state universities allowed us to examine common effects, and to focus on a context that has been analyzed in few other studies (Sciarelli *et al.*, 2021). We carried out our model for 2019. Consistently with Trequattrini *et al.* (2018), we used only one year as our study is a pilot study. As we are not interested in a temporal variation of the association between two variables, but in portraying a situation at a defined point of time, we look at only at 2019. Our model is not a longitudinal one, as we investigate whether the spin-offs activated up to a certain date have a relationship with certain characteristics of the University. For this reason, we have not taken into account variables that vary over time. In fact, the characteristics of the university like the number of students are not variables that change from year to year as they depend on the university policies that do not change from one year to another; also the corporate governance items, like the composition of the board, remain unchanged for long periods of time. In the literature, this property is known as "stickiness" (Brown *et al.*, 2010). Our model is not a retrospective one, as we are not interested to portray the situation to date, in terms of spin-off number and evaluate how the situation was several years before. This is the reason why we do not use a lag dependent variable.

Table 1 presents the 23 public universities located in the eight regions of southern Italy.

As regards the data source, the data have been hand collected by consulting the website of the sampled universities from April 2021 to July 2021. When we encountered missing data we recovered the information by mailing/calling the offices appointed to collect this kind of data. Furthermore, the data was separately collected, coded and compared by the authors, in order to achieve an investigator triangulation. In order to ensure the data reliability, the authors held several meetings to define which explicative variables have to be considered as observable variables (see Figure 1) and how to measure these, and which control (university and regional) variables to include in the model and how to measure them.

3.3 Variables measurement

3.3.1 The university knowledge transfer performance. The term KT is used to identify the set of activities and processes through which universities accomplish their third mission objectives (Meoli *et al.*, 2019). A particularly comprehensive definition has been agreed by the Research Councils and the Department for Innovation, Universities and Skills (DIUS) of the United Kingdom (UK), according to which KT "encompasses the systems and processes by which

Regions	State universities	Name
Basilicata	1	University of Basilicata
Abruzzo	3	University of Teramo
		University of L'Aquila
		University of Chieti and Pescara–Gabriele D'Annunzio
Calabria	3	University of Reggio Calabria–Mediterranea
		University of Catanzaro–Magna Grecia
		University of Calabria
Campania	6	University of Sannio
		University of Napoli (Naples) "Orientale"
		University of Napoli (Naples)–Parthenope
		Second University of Napoli (Naples)
		University of Salerno
		University of Napoli (Naples) Federico II
Molise	1	University of Molise
Apulia (Puglia)	4	University of Foggia
		Polytechnic (Politecnico) of Bari
		University of Salento
		University of Bari
Sardegna (Sardinia)	2	University of Sassari
		University of Cagliari
Sicilia (Sicily)	3	University of Messina
		University of Palermo
		University of Catania

Table 1.
Sampled universities

knowledge, expertise, and skilled people transfer between the research environment (universities, centers and institutes) and its user communities in industry, commerce, public and service sectors" (RCUK, 2007, p. 5). Although there are several indicators that could be used to measure the performance of universities in knowledge transfer activities (Rossi and Rosli, 2015; Campbell *et al.*, 2020), in the paper we focus on the most used measure of KT, that is the number of spin-offs (Agasisti *et al.*, 2019), that is, the new ventures commercializing results and scientific knowledge from universities (Mathisen and Rasmussen, 2019; Hossinger *et al.*, 2020). In the literature, some studies measure the performance of KT activities focusing on the income generated by KT commercialization, revenues obtained from patents, R&D collaborations (Siegel *et al.*, 2003), spillover effects (Audretsch and Lehmann, 2005), or total university earnings (Goldstein, 1990). Other studies, instead, believe that KT performance should focus on knowledge outcome indicators such as number of patents, spin-offs and license agreements (Vinig and Lips, 2015). We share this approach and we decided to measure our dependent variable as a count of the number of university spin-offs as this is the KT outcome measure more used in this literature stream (Puntillo *et al.*, 2022; Meoli *et al.*, 2019). USOs are one of the possible measures of university's KT strategy, but it is the one that received the greatest attention from researchers and policymakers because of their potential ability to advance scientific knowledge, as well as to contribute to regional economic growth (Colombo and Piva, 2012; Colombo *et al.*, 2010a, b). Furthermore, the creation of USOs is increasingly being used as a performance indicator to evaluate public investments in universities and public research organizations (Meoli *et al.*, 2019; Meoli and Vismara, 2016). For these reasons, we decided to select the USOs as a measure of the university KT strategy.

In detail, we measure the number of USOs from each given university belonging to our sample (southern universities) for 2019. We focused on 2019 as our study is a pilot study, consistently with Trequattrini *et al.* (2018).

3.3.2 The university board of directors' composition. The three profiles under which universities' boards were investigated (the scientific background of the internal board

members, the presence of women, the presence of external members) have been measured in terms of percentage incidence on the total number of board members. The three profiles examined were considered as alternative ones, so the internal university board members were divided into members belonging to STEM areas and members not belonging to STEM areas, referring to their belonging to the scientific disciplinary sector (SSD), without taking into consideration their gender, the external members were not divided according to their scientific knowledge or their gender and women were not divided according to their scientific areas or if they were employed or not by the university itself. The data were hand collected by consulting the website of the sampled universities and referring to other sites when the university does not provide the searched information.

3.3.3 The control variables. In accordance with recent literature on the determinants of academic spin-off creation and with a specific reference to the Italian context, consistently with Meoli *et al.* (2019), we identified two sets of control variables as predictors of spin-off activity which account for the specificities of the academic and the local context.

The first category is composed of university-level control variables. University size (number of students) is included as a general proxy of the organizational assets available, while university age (number of years since foundation) controls for the differences in the organization, resources, and culture of older and newer institutions. The faculty/students ratio (ratio between the number of academic staff and the total number of students) measures the endowment of academic staff with respect to institutional size, and it was chosen, consistently with Meoli *et al.* (2018, 2019), as the indicator to control for the university first mission (teaching) whilst the indicator chosen to control for the university second mission (research) is not the publications per faculty (number of publications divided by the number of professors), instead, consistently with Tijssen (2006) we measure research productivity considering public-private co-authored publications, as our dependent variable, the USOs, are technology ventures that involve stakeholders and resources of both a public and private nature. The number of students and the university age have been collected from the universities' website, the faculty/student's ratio from the website USTAT MIUR, whilst the public-private co-authored publications per million populations was taken from the Regional Innovation Scoreboard (RIS). As regards the expected signs, the sign of university age is controversial, since older, prestigious universities could positively affect USOs (Fini *et al.*, 2017), but also newer universities could be more risk-taking so more prone to invest in innovative activities (Meoli *et al.*, 2019). Instead, we expect a positive sign for university size and teaching, as the higher the number of faculty members and support staff, the higher the likelihood that some research can be effectively transferred to the market (Fini *et al.*, 2017). We also expect a positive sign for research, as the knowledge exploited by USOs is generated by university research, even more by industrially important research, given the specific type of USO venture, involving public and private resources and stakeholders (Fini *et al.*, 2017; Tijssen, 2006).

Some regional-level factors may also impact on spin-off foundation and growth. To account for this, consistently with Guerrero *et al.* (2015) and Zhang *et al.* (2016), we decided to include a score to measure the regional competitiveness in terms of innovation [2]. We prefer to refer to an innovation score instead of a pure economic measure, as our dependent variable is the number of USOs, a specific venture embedded with innovation. In our model, we measured the regional innovativeness making reference to the RIS, which ranks 220 regions of the EU according to their innovation levels into four categories: leaders, strong innovators, moderate innovators and modest innovators. We should underline that the RIS score is a composite index, given by a combination of different indicators, included in different categories, which control for different regional conditions (Regional Innovation Scoreboard, 2019). RIS innovation score is a regional extension of the European Innovation Score (EIS, 2019). RIS score summarizes the regional innovative performance based on 17 indicators

grouped into four main types *framework conditions*, *investments, innovation activities* and *impacts,* divided into 10 innovative dimensions.

Framework conditions include indicators related to the cultural background of the human resources (such as the population with tertiary education and lifelong learning) and to the attractiveness of the research system (measured with scientific co-publications and most cited publications).

Investments include indicators that control for finance and support to the innovation activity (measured by the regional R&D public expenditures as percentage of GDP, the regional R&D public expenditures as percentage of GDP and a measure of public support for the innovation activity, regional R&D business expenditures which controls for the amount of R&D business expenditure as a measure of propensity to innovate in the region in which the university is located, and regional non R&D innovation expenditures of SMEs as percentage of total turnover).

Innovation activities, include indicators which control for innovative SMEs (measured with the percentage of innovator SMEs with reference to product or process innovations, to marketing or organizational innovations, to in-house innovation), the number of linkages (measured with innovative SMEs collaborating with others; public-private collaborations) and regional intellectual assets (measured with PCT patent applications, trademark applications and design applications).

Impacts control for the employment *impacts* (measured with employment manufacturing and knowledge) and sales *impacts* (measured with sales of new-to-market and new-to-firm innovations). It should also be underlined that the eight regions including the sampled universities show a similar level (moderate) of regional innovativeness. The impact of regional context on the number of USOs is controversial, as empirical studies recorded both a positive (Muscio *et al.*, 2016), then a negative (Riviezzo *et al.*, 2019; Meoli *et al.*, 2019) and a not significant influence (Iacobucci *et al.*, 2021). Details on the variable definitions and their sources are reported in Table 2.

3.4 The empirical model

We analyzed our dataset with a cross-sectional approach using an ordinary least squares analysis, consistently with Sciarelli *et al.* (2021), through the SAS software package.

The functional form of the model is as follows:

$$USOs_i = \beta_0 + \beta_1 STEM_i + \beta_2 Women_i + \beta_3 External_i + \beta_4 University\ \ age_i + \beta_5 University\ \ size_i + \beta_6 Didactics_i + \beta_7 IRR_i + \beta_8 RIS\ \ 2019_i + \varepsilon_i$$

where the subscript i denotes the university, and ε_i is the error term.

4. Main findings

4.1 Descriptive statistics

Table 3 presents the descriptive statistics.

The average number of USOs is 13, but there is a great variance among universities, as testified by the value of the standard deviation. Women weight on the total number of directors for 29.3%, external members for 21.5%, whilst the internal members belonging to the STEM areas for 46.8% (and the internal members for 78.5%), underlining that the governance model in southern Italian universities is still a traditional model, where collegial decision-making bodies, composed mainly of professors, dominate internal university governance (Meoli *et al.*, 2019). The average Italian southern state university enrolls approximately 21,000 students, with a faculty per student ratio of 3.3%. Each faculty publishes, over the sampling period, less than one (<0.2) public-private

Category	Variable name	Variable description	Calculation	Source
University KT performance	USOs	Number of University Spin-offs	Total number of USOs active in university *i* in the year *t*	Universities' websites
University board of directors' composition	STEM	The incidence of STEM internal members on directors	The ratio of total number of STEM internal directors on total number of university's board directors	Universities' websites
	Women	The incidence of women on directors	The ratio of total number of women directors on total number of university's board directors	Universities' websites
	External	The incidence of external members on directors	The ratio of total number of external directors on total number of university's board directors	Universities' websites
University-level variables	University Age	University Age	Number of years from foundation	Universities' websites
	University size	Number of Students	The total number of university students, including master, PHD and specialization courses	Universities' websites
	Didactics	Teachers/students	Ratio between the number of academics and the number of students	USTAT MIUR
	IRR	Industrially relevant research	The ratio of the number of public-private co-authored academic publications per total regional population	Regional Innovation Score
Regional-level variables	RIS	Regional Innovation score	RIS is an innovation score of the region surrounding universities, obtained combining several indicators of the regional context supposed to affect regional innovation	Regional Innovation Score

Table 2.
Variables used in the empirical analysis

co-authored publication. Given the presence of historic universities among southern Italian state universities, the average age of an Italian university in 2019 is as high as 186 years. As regards the RIS score, the average value of 59.9 underlines that the 23 southern Italian state universities operate in eight regions all belonging to the category of moderate innovators (whose regional innovation performance is between 50 and 90% of the EU average).

Table 4 presents the correlation matrix, that evidences the absence of multicollinearity problems, as well the VIF numbers (the highest VIF number is 2.66, well below the value of 5, which denotes potentially severe correlation between a given predictor variable and other predictor variables in the model).

4.2 Main results

An ordinary least squares (OLS) regression analysis was employed to address our H1, that is the board of directors' individual members' features are positively related to the establishment of USOs, detailed into three different research hypotheses, namely whether the STEM internal directors (H1a), women directors (H1b) and external directors (H1c) are

Table 3.
Descriptive statistics

Variables	Minimum	Lower quartile	Median	Upper quartile	Maximum	Mean	Std dev	Pr > |t|
USOs	0.00	4.00	11.00	19.00	33.00	12.91	8.93	<0.0001
STEM members	0.00	0.25	0.50	0.60	1.00	0.47	0.25	<0.0001
Women directors	0.00	0.20	0.300	0.42	0.58	0.29	0.14	<0.0001
External members	0.17	0.20	0.20	0.22	0.30	0.22	0.03	<0.0001
University Age	22.0	31.00	56.00	401.00	797.00	186.96	221.17	0.0005
University size	4795.00	10075.00	16.229.00	25.965.00	76.282.00	21.299.57	16.969.49	<0.0001
Didactics	0.02	0.03	0.03	0.04	0.05	0.03	0.01	<0.0001
IRR	0.08	0.15	0.16	0.19	0.27	0.17	0.06	<0.0001
RIS	51.10	56.50	61.20	63.30	69.80	59.96	6.05	<0.0001

Variables	USOs	Women	External	STEM	University size	University age	Didactics	IRR	RIS 2019	VIF
USOs	1	−0.097	0.098	0.523**	0.554***	0.140	−0.297	0.128	−0.217	–
Women	−0.097	1	−0.179	−0.276	0.008	0.055	−0.078	0.144	−0.154	1.196
External	0.098	−0.179	1	−0.055	0.488**	0.376*	−0.216	0.154	0.122	1.496
STEM	0.523**	−0.276	−0.055	1	0.136	0.065	0.098	−0.152	0.046	1.259
University size	0.554***	0.008	0.488**	0.136***	1	0.628***	−0.492**	0.291	0.011	2.669
University age	0.140	0.055	0.376*	0.065	0.628***	1	−0.155	0.579***	−0.103	2.570
Didactics	−0.297	−0.078	−0.216	0.098	−0.492**	−0.155	1	−0.038	0.035	1.467
IRR	0.128	0.144	0.154	−0.152	0.291	0.579***	−0.038	1	0.035	1.671
RIS	−0.217	−0.154	0.122	0.046	0.011	−0.103	0.035	0.035	1	1.094

Note(s): *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 4.
Correlation matrix

related to the university KT performance, proxied by the number of USOs. The model included, beyond these explicative variables, the university-level and regional-level control variables supposed to be related to the number of USOs. Table 5 presents the results of the regression investigating the association between the board of directors' universities main features (STEM directors, women directors, external directors) supposed to affect universities' KT performance outcomes (USOs) according to our research framework.

The model has a good explicative power, as attested by the values of R-squared and adjusted R-squared and the *F*-test indicates that the independent variables jointly considered improve the fit to the data.

Among the control variables, with reference to the university-level control variables, we find that larger and newer universities establish more USOs, as in Meoli *et al.* (2019). As regards the two main missions of universities, namely didactics and research, we find that institutions with greater productivity in terms of industrially relevant research establish more USOs, whilst the faculty per student ratio has a positive (as expected) yet not significant association with the USOs establishment. As regards the regional-level control variables, our study, coherently with Meoli *et al.* (2019) and Riviezzo *et al.* (2019), who measured the regional innovativeness with the R&D regional expenditures, provide evidence of a negative significant association between the RIS score and the establishment of USOs.

As regards the explicative variables, the findings of our regression model provide evidence that the board of directors' composition is positively related to the creation of USOs limited to the background of the internal board members belonging to the STEM areas. Instead, our findings provide evidence of a negative and not significant association between respectively the women directors and the external directors and the establishment of USOs. The next section discusses the main findings of the regression.

5. Discussions

As regards the positive association of STEM internal directors and the establishment of USOs, our findings provide evidence that STEM knowledge is not only associated with a country's level of innovation and competitiveness and social and economic growth (OECD/European Union, 2019), but that the scientific knowledge of members of universities' board of directors is positively associated with the KT university performance, in detail with the establishment of USOs, coherently with the literature investigated in the previous literature review section. This expected result is still relevant, as no study, to the best of our knowledge, focused on the individual board directors' profile, searching for an association with the KT universities' performance.

Table 5.
OLS Regression results

DV: USOs	*B (SE)*
Intercept	25.21 *(16.64)*
STEM	18.66*** (*5.52*)
Women	−2.62 *(9.29)*
External	−14.00 *(43.91)*
University Age	−0.02** (*0.008*)
University size	0.0004*** *(0.0001)*
Didactics	−57.56 (*158.66*)
IRR	53.40* (*26.78*)
RIS	−0.47** (*0.211*)
R-square	0.73
Adjusted *R*-square	0.58
F statistic	4.91**

Note(s): *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

This result is in line with the result of Riviezzo *et al.* (2019), that provides evidence of a positive association between the entrepreneurial orientation of university scientific departments and the academic entrepreneurship performance outcomes (i.e. the number of USOs generated from research). The result also underlines that, for USOs creation, the scientific knowledge in research fields of acknowledged industrial importance and the correlated entrepreneurial orientation of the researchers in these fields assumes a particular prominence, owing to the substantially knowledge and technology-driven nature of USOs.

As regards the association between respectively women directors/external directors and the creation of USOs, our findings provide evidence of a negative and not significant association, giving credit to the theoretical claim according to which heterogeneous boards are less effective in making strategic decisions and that both women and external directors do not reach the critical mass requested to have an effect on universities' board strategic decisions (Diogo *et al.*, 2021).

Table 6 highlights the universities' board of directors' composition:

In detail, as regards the association between women directors and innovative strategic decisions, our results are in line with Saggese *et al.* (2021), that provide evidence that women affect innovative strategic decisions only then they reach a critical mass (more than 3); in our sample the mean value of women is 3, with a great variance (from 0 to 7 women on board). Our results are also consistent with the study of Sciarelli *et al.* (2021), on the USOs' board of directors, which provides evidence of a negative and not significant association between women on the board and organizational performance. A possible explanation of the not significant effect could be related to the glass cliff theory, which posits that often women are not appointed to strategic positions, even when they were able to break the glass ceiling barrier and reach top management positions (Ryan and Haslam, 2007; Diogo *et al.*, 2021). In our study, given the low number of women observed, we do not analyze women's managerial tasks in corporate decision-making, that is, their capability to affect strategic KT decisions, whether they are active in STEM or non-STEM areas and if they are employed by the university itself or not.

The number of external members on board, 2, is even lower than the number of women. This means that universities, in respecting the 240/2010 Law to appoint external members, do not go beyond the legal minimum (at least two lay members are required if the board has up to ten posts, three otherwise). Our results are in line with Meoli *et al.* (2019), providing evidence that the regulatory changes requiring State universities to appoint lay members to their board of directors did not increase the rate of establishment of USOs, and of Prencipe (2016), focused on the USOs' boards of directors. A possible explanation of our result could be related to the circumstance that usually outside directors lack key academic knowledge compared to those inside, also, they are unfamiliar with the university activity and resources, including innovative ones. This lack of knowledge of outsiders seems to be potentially more evident in the USOs. Furthermore, generally lay members are supposed to bring to universities' board their managerial competencies and experience, in other words their entrepreneurial orientation (EO), however some of the lay members are entrepreneurs and manager of private firms, while others are retired professors or local stakeholders, not possessing any entrepreneurial or managerial experience; within less industrialized contexts, such as the Southern regions of Italy, the probability is real that the lay members without managerial experience are the majority of lay members. If we divide the external board members of our sample into members with EO (entrepreneurs and managers) and members without EO (local stakeholders and retired professors), we can see that the latter account for 69% of total external members.

As for the association between the USOs and the regional innovation score (RIS), our findings provide evidence of a negative and not significant association RIS and USOs, in line with the result of Meoli *et al.* (2019) and Riviezzo *et al.* (2019). A possible explanation of this

Table 6.
Universities' board of directors' composition

Universities	Total board members	Internal	Internal (%)	Women	Women (%)	External	External (%)	External with EO	External without EO	External with EO/external	External without EO/ external
University 1	10	8	80%	1	10%	2	20%	0	2	0%	4%
University 2	12	10	83%	5	50%	2	20%	0	2	0%	4%
University 3	10	8	80%	2	20%	2	20%	1	1	2%	2%
University 4	12	9	75%	4	40%	3	30%	0	3	0%	6%
University 5	12	10	83%	5	50%	2	20%	1	1	2%	2%
University 6	9	7	78%	3	30%	2	20%	1	1	2%	2%
University 7	10	8	80%	2	20%	2	20%	1	1	2%	2%
University 8	10	7	70%	3	30%	3	30%	0	3	0%	6%
University 9	11	8	73%	2	20%	3	30%	1	2	2%	4%
University 10	9	7	78%	2	20%	2	20%	3	0	6%	0%
University 11	8	6	75%	5	50%	2	20%	0	2	0%	4%
University 12	10	8	80%	3	30%	2	20%	0	2	0%	4%
University 13	9	7	78%	4	40%	2	20%	0	2	0%	4%
University 14	11	9	82%	3	30%	2	20%	0	2	0%	4%
University 15	9	7	78%	1	10%	2	20%	0	2	0%	4%
University 16	9	7	78%	1	10%	2	20%	2	0	4%	0%
University 17	10	8	80%	4	40%	2	20%	1	1	2%	2%
University 18	10	8	80%	2	20%	2	20%	0	2	0%	4%
University 19	12	10	83%	7	70%	2	20%	2	0	4%	0%
University 20	11	8	73%	4	40%	3	30%	1	1	2%	2%
University 21	13	10	77%	4	40%	3	30%	2	1	4%	2%
University 22	10	8	80%	0	0%	2	20%	0	2	0%	4%
University 23	9	7	78%	4	40%	2	20%	0	2	0%	4%
Total	236	185	78%	71	30%	51	22%	16	35	31%	69%
Mean	10.26	8.04		3.09		2.22		0.70	1.52		
Std dev	1.29	1.15		1.65		0.42		0.9	0.8		

Note(s): Legenda EO = Entrepreneurial orientation

counterintuitive result could be relative to a possible substitute effect between the university-level supporting mechanisms and regional level supporting mechanisms, that is, the RIS decreases in a context where the university-level supporting mechanisms are positively related to the USOs number (Fini *et al.*, 2011).

6. Considering conclusions

Transferring productive knowledge to the economy has become a "third mission" for universities, complementing the traditional research and teaching missions: universities are no longer ivory towers, producing knowledge in isolation, but they are expected to engage with a multiplicity of stakeholders in order to deliver economic benefits (Etzkowitz *et al.*, 2000). The majority of universities in the Western world have incorporated technology transfer in the university objectives besides the traditional goals of education and research (Rasmussen, 2008) and governments increasingly provide incentives to ensure an effective KT from universities to the local contexts.

Our paper aims to study the relationship between the governance structure of universities, proxied with the board of directors as key actor of the university governance and knowledge transfer activity of universities, measured with the establishment of academic spin-offs, a key measure of university's third mission performance outcomes.

This study of the relationship between the governance of universities and the establishment of academic spin-offs is of current interest, especially at a European level. Performance-based research funding systems in the European Union (EU) include a number of established spin-offs among the measures of universities' third mission, performed by universities in relation to external environments and most countries have recently redesigned the governance structures within universities. In the reconfigured university governance, boards of directors are expected to be key decision-makers on central university-level, and this happens in Italy, where the board of directors needs to formally approve the USOs establishments. The growth of USOs in a country with low R&D investments but at the same time high performance of its researchers makes Italy an interesting case, since its evolution can be paradigmatic for other countries involved in catching-up processes in the field of innovation and knowledge-based entrepreneurship (Cesaroni and Piccaluga, 2016; OECD/European Union, 2019). This is even truer for the southern Italian context, characterized by lower R&D investments with respect to the Italian northern regions. These are the main reasons why we test the association for southern Italian state universities, analyzed in few other studies (Parmentola and Ferretti, 2018; Sciarelli *et al.*, 2021).

Based on the UET, we focus on the features of individual board members supposed to affect the USOs establishment, namely the research disciplines of academics, measured with the incidence of internal STEM directors, the gender, measured by incidence of women directors and the managerial experience, measured by the incidence of external directors.

Our study provides some of the first evidence that the board of directors, the highest echelon of the university's strategic decision-making body, is related to the USOs creation, limited to the industrial scientific relevant knowledge of the board internal directors. The other two individual board members' features (i.e. gender and the internal/external links with the university itself) seem not to be related to USOs, but we think they deserve a further analysis, when the number of women and external members will reach a critical mass.

The study is not without limitation, as we proxy universities' governance structure with the board of directors and the KT performance outcome with the USOs establishment. Future research may broaden the spectrum of analysis to embrace other structures or measures of governance, or different aspects of technology transfer (such as patents and licenses) and of regional context, may analyze with a more fine-grained USOs, distinguishing between technological and service ones (Meoli *et al.*, 2019), may focus on the USOs' growth and

development (Iazzolino *et al.*, 2019; Fini *et al.*, 2017), may analyze the impact of USOs on regional development (Agasisti *et al.*, 2019), may focus on the university-level and regional level supporting systems effective for the USOs creation (Fini *et al.*, 2011), may focus on the process and practices of strategizing in the board (Watson and Ireland, 2021), may focus on a lower university-level of analysis, that is, the university department or even the research group (Riviezzo *et al.*, 2019), may focus on a second level of analysis, i.e. at USO level, to analyze whether the board composition of USOs affect their knowledge performance. Finally, future research may broaden the time span and the countries investigated. Our study is focused on a single country, Italy, in detail the south of Italy, and this could constrain the generalizability of our results, as theories and practices developed in a single institutional setting do not necessarily hold across countries, thus future research could perform a comparative analysis among other European countries. Future research would also benefit from longitudinal data, analyzing how the process unfolds over time, and thus adding more value to the proposed framework.

We hope that the above-mentioned points can be interesting directions for future avenues of research to expand the present study. However, even considering its limitations and recalling its exploratory nature, we believe that it makes an original contribution to the literature in examining in depth the university board's structure and inferring variables that can provide significant insights into the links between the features of board members and the USOs establishment. Furthermore, it sheds more light on the context of southern Italy, which has been investigated in only a limited number of previous studies, and provides a series of findings that can be successively tested in other studies and that constitute the basis for giving suggestions to policy makers to the possible policies to support the spin-off creation.

Our findings have several policy and practical implications. For example, to favor the spin-off initiatives, the policy makers could implement policies that encourage scientific excellence. Furthermore, to guarantee that the spin-off idea will be effectively converted in a company, policy makers must implement policies that can encourage the university to provide supporting infrastructures for the spin companies or to create relationship between academics and external environment. Finally, in contexts like those analyzed in the sample, characterized by a substation effect between university level and regional level supporting mechanisms, universities should pursue incremental investments in university-level and regional-level supporting mechanisms.

Notes

1. In the first five-year (2004–2010) of the research quality evaluation exercise (Valutazione della qualità della ricerca – VQR), participating institutions were evaluated only for the research quality. In the second five-year (2011–2014) research evaluation exercise, the third mission profile of universities is explicitly accounted for research funds attribution and number of spin-offs created during the past ten years is one performance indicator considered (Meoli *et al.*, 2018). In the third five-year (2015–2019) research evaluation exercise, participating institutions will be also evaluated on third mission case studies.
2. Other studies focused on the gross value added per capita (Agasisti *et al.*, 2019; Trequattrini *et al.*, 2018), whilst the study of Corsi (2018) developed an ad hoc innovation score (as the combination of high-tech human capital, high-tech patents, R&D investments, R&D human capital).

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