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## Editorial

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## 1 Background

In the last few decades, the yearly number of new technological inventions that have emerged from the labs of companies and research institutions has drastically grown (Lissoni et al., 2008; OECD, 2014). However, new technology development by itself does not contribute to societal growth, unless technologies are then commercialised. Indeed, technologies that do not enter the market limit the opportunities to generate new value, gain returns from R&D efforts, and foster economic and social wealth creation (Ardito et al., 2015; Carayannis and Rakhmatullin, 2014; Schuh and Drescher, 2014). Technology commercialisation is, therefore, pivotal in today's global economy.

In particular, the commercialisation of university technological inventions has become of foremost importance in the last few years (Grimpe and Hussinger, 2013; Shane, 2002). Notably, the results of university research are more and more deemed to create relevant market opportunities and play a key role within national and regional innovation ecosystems. In this context, the commercialisation of university technological

inventions has been identified as a major mechanism by which academic institutions can sustain market formation and improve global innovative performance, hence shifting their traditional primary role from education providers and scientific knowledge creators towards a more complex ‘entrepreneurial’ organisation (Del Giudice et al., 2013; Etzkowitz et al., 2000; Philpott et al., 2011). Accordingly, nowadays, universities tend to actively secure rents arising from their proprietary inventions and add to firms’ innovative activities by defining ad-hoc strategies to manage the deployment and commercialisation of their technical discoveries in the society (Messeni Petruzzelli, 2011; Thursby et al., 2001).

So far, a first stream of the literature has delved into the dynamics underlying the processes through which universities license or sell their inventions (i.e., the external technology commercialisation approach) (Grimpe and Hussinger, 2013; Shane, 2002). This line of inquiry discusses this strategy in order to understand how to reduce search and transaction costs by favouring the commercialisation of universities’ inventions, protect their intellectual property, implement the functions of technology commercialisation into universities’ strategies and routines, and unveil the contingencies of this specific strategy. Yet, more effort is needed to further comprehend how to overcome the impediments towards the adoption of an effective licensing/selling strategy for universities, such as misalignment of incentives, inappropriate staffing, researchers aversions to selling their inventions, and the differences characterising the environments, norms, and values of academic institutions and companies (Franco and Haase, 2015; Messeni Petruzzelli and Rotolo, 2015; Perkmann et al., 2013).

Furthermore, a second research stream has attempted to analyse the formation of university spin-offs and new ventures. Indeed, universities may commercialise their technological inventions through the formation of companies managed by researchers (Rasmussen et al., 2014; Swamidass, 2012). Nevertheless, a number of universities face relevant difficulties in creating successful spin-offs and gaining advantage from this technology commercialisation approach. Thereby, examining how the transition from the research university to the entrepreneurial one occurs is relevant to understand how academic research enters the market and allows achieving returns from related inventive efforts (Carayannis et al., 2015; Van Burg et al., 2008). This corresponds to a more thorough comprehension of the interplay between the university, department, and inventor-level responsibilities in new ventures creation, the role of the technology transfer offices (TTOs), the potential benefits of university science parks, the policy systems sustaining university spin-offs, and the factors required to sustain the growth of these new ventures (Philpott et al., 2011; Rasmussen et al., 2014).

Eventually, despite a better comprehension of the commercialisation mechanisms and dynamics of university technological inventions is deemed to be relevant and some studies have provided some relevant insights, important gaps still exist. Based on its contributions and related findings, this special issue has aimed to contribute to the extant literature on the commercialisation of university technological inventions by shedding more light into this phenomenon from both a research, practical, and policy perspective. This special issue editorial proceeds with an overview of the contributions featured in this issue and concludes with future research directions.

## 2 Contributions to this special issue

All in all, the special issue is composed of seven articles. These have approached the topic of university technology commercialisation from different perspectives and levels of analysis. The paper by Ardito focuses on technology-level variables in the context of university technology selling. Dezi et al., Ahmad et al. and Iqbal et al. are more interested in organisational level factors, as they add to the debates on financing, university characteristics, and the role of TTOs for technology licensing and/or spin-off creation. Instead, Dezi et al. (in a second contribution), Colomo-Palacios et al. and Lopes et al. dig into the collaboration mechanisms fostering university technology commercialisation. The only study directly examining policy issues, at a more macro level, is the paper by Meissner.

More in detail, Ardito reveals that the probability that a patented university technology is sold to a company depends on the knowledge characteristics of the created solution. He proves that a firm is more willing to buy a technology if it is not excessively based on multiple knowledge domains. In other words, the level of knowledge breadth increases the probability that the university technology is sold, but only up to a certain extent, after which such probability decreases. Instead, the higher the knowledge maturity of a technology, the lower the likelihood to be purchased by a firm. Finally, the moderating effect of the scientific nature of the university solution is taken into account. It positively moderates the influence of knowledge breadth when it is at a low/moderate level, while it exerts a negative moderating effect when knowledge breadth is at a high level. While the effect of knowledge maturity is less negative if a technology embodies scientific knowledge.

The paper by Dezi et al. tackles the issue of the so-named funding gap, which constitutes a key barrier to the effective commercialisation of university technological inventions. Specifically, it aims to understand what increases equity crowdfunding performance since equity crowdfunding is gaining momentum and is considered as a more valuable mean to attain funds than more traditional ones, such as bank loans, venture capital, and public programs. To do so, the impact of external knowledge management on equity crowdfunding performance has been examined. Findings reveal that absorptive capacity has a significant positive effect on equity crowdfunding performance. Moreover, it has been proved that this relationship is mediated by equity acquisition and connective capacity. The mediating effect of ICT capabilities, instead, has found to be not significant.

Ahmad et al. distinguish hard and soft elements characterising entrepreneurial universities, with the attempt to identify differences in the initiatives made in action by such academic institutions (i.e., research mobilisation, unconventionality, industry collaboration, university policy, entrepreneurial university mission, environmental formal factor, environmental informal factor). Hard elements signify more orientation towards patenting, incubation, and spin-off creation, whereas soft elements indicate greater inclination towards the development of strategic visions, entrepreneurship courses, and networking. A discriminant analysis shows that while, in terms of academics' involvement, there is no significant distinction between the two groups, universities that possess the hard-core elements of entrepreneurial university, differ in many dimensions respect to those focusing on soft elements. For instance, a noteworthy variance has been revealed in the context of research mobilisation. Moreover, universities characterised by hard-core elements especially inspire their graduates to become entrepreneurs. Likewise,

such type of universities is more engaged in collaborations with the private sector and actively supports technology transfer as an environmental formal factor.

Iqbal et al. has delved into the role of TTOs in facilitating technology commercialisation and the creation of new ventures in the United Arab Emirates (UAE). Indeed, interviews at the Khalifa University and Masdar Institute have revealed that, in the UAE, technology commercialisation mechanisms are still in their infancy. Therefore, it is essential to underline the critical success factors TTOs should take into account. Overall, TTOs are mainly asked to support university researchers by:

- a evaluating whether and to what extent the technological knowledge of an invention can be disclosed
- b identifying the most effective intellectual property protection mechanisms
- c making decisions between internal and external technology commercialisation strategies
- d managing legal agreements and contracts.

However, it is worth mentioning that two obstacles need to be addressed in order to make TTOs able to pursue those activities. The first is the availability of financial resources, while the second is the small number of technology transfer personnel employed in TTOs.

A second contribution by Dezi et al. has sought to contribute to the debate of university-industry linkages. Broadly speaking, they suggest that firms' innovativeness benefit from research partnerships with universities. The adoption of two main types of tie explains this finding, namely URP and URS. The former reflects formal partnerships aimed at conducting R&D activities (e.g., R&D projects, collaborative research activities, also known as sponsored research, and development of firm-university research centres). The latter refers to the possibility of universities to deliver research services, according to the needs of industrial clients. Additionally, the authors have revealed that the URP-innovativeness and URS-innovativeness relationships are positively moderated by the firms' level of absorptive capacity and the breadth of external knowledge sourcing, hence highlighting that internal R&D capabilities and the willingness to source external knowledge make firms in a better position to turn the technological knowledge provided by universities into innovations.

Lopes et al.'s paper is closely related to the previous one. Although it is not focused on university-industry linkages directly, through three case studies, the paper attempts to unveil the mechanisms fostering the commercialisation of university technological inventions within the context of their respectively prevailing regional innovation systems and with a specific focus on the relationships with incubators. The authors highlight that technology commercialisation is not only the mere processes of signing an agreement to license patents or create spin-offs. Rather, it requires extensive academic commitment. This includes the establishment of cooperation networks with incubators; they are relevant to bond researchers, companies, and, sometimes, the government, as well as they may identify influential people for the sectors targeted. Moreover, they should facilitate the access to new sources of financing, e.g., by maintaining connections with business angel networks, especially in the regional context.

So far, most of the attention has been devoted to university-industry relationships. Instead, the paper by Colomo-Palacios et al. redirects the attention to

university-government relationships. In detail, it examines, over time, the construction of a research collaboration between a department of a public university and a municipality in Norway. Findings of the analysis depict a framework discussing different levels of maturity of the collaboration. There is an initiation stage where the local authority asks services to the university, which is however not completely involved in the research project due to a lack of trust and the inability to apply the academic technological knowledge. Afterward, as common trust and understanding grow, more complex problems were addressed jointly. The third step reflects the establishment of repeated collaborations between the university and the municipality, with a stronger cross fertilisation between academic and governmental competencies. Finally, only in a mature collaboration, the government and the university were able to propose a joint project and actually develop a new technological product.

Meissner has gone beyond organisational-level factors. Indeed, on the basis of the triple helix (government-industry-university) and knowledge triangle (research-teaching-innovation) models, he has scrutinised the potentials and limitations of some governmental policies that may enhance university-industry linkages for technology commercialisation. The case examined finds confirmation for the key role played by universities in regional innovation ecosystems. Therefore, in responding to question of how the role of universities in regional context is changing, the author contends that they are central actors for diffusion of education, research, and innovation activities at the local and regional level. However, not all universities may excel in all these tasks and trade-offs must be managed in designing funding schemes. Furthermore, to improve the effectiveness of technology commercialisation, some actions should be made, as decentralisation of governance and greater autonomy of institutions, increasing international connectivity, allowing the exchange and mutual learning in research activities and education practices, and expanding the scope of third mission activities. Overall, it has been highlighted that policymakers still require comprehending the nature of university activities to capture the potential of policy interventions stimulating the commercialisation of technological inventions.

### **3 Concluding remarks**

In attempting to summarise the focal areas and findings of the papers featured in this issue, it becomes evident that the topic of university technology commercialisation is extremely complex and can be analysed through different lenses and perspectives. Respect to the proposed topics, this special issue has moved one step forward the discussion on university-industry relationships, with also a focus on incubators. Moreover, it has highlighted the relevance of university-government relationships. The role of TTOs, university-specific actions, and policymaking has also been touched, thus suggesting that these issues have still open questions. Finally, another less developed line of inquiry has been underlined, as represented by the technology-level factors fostering the commercialisation of university technologies.

Despite the relevance of these contributions, it is worth mentioning that some important topics have been left out. For instance, no research has been conducted on the legal aspects and (combination of) intellectual property mechanisms for university technology commercialisation. Likewise, the micro foundations of technology commercialisation has not been addressed, e.g., the characteristics of academic

entrepreneurs. Also, if and how universities manage internal and external technology commercialisation strategies simultaneously have not received attention.

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