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Commercializing technology from university-industry collaborations: A configurational perspective on organizational factors

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ABSTRACT

Organizational factors have always influenced how universities commercialize their technologies. This commercialization process, once viewed as a linear one, is now understood as being the result of more intricate university-industry collaborative activities. In addressing this issue, universities increasingly face new challenges at the organizational level, such as lack of funding and competencies to manage this process. Many have started to adopt instruments that bridge financial and managerial gaps to better interact with industry. In identifying organizational factors that recently have emerged (i.e., gap-bridging instruments), this study investigates how they relate with other organizational factors in facilitating technology commercialization from university-industry interactions. Through a fuzzy-set qualitative comparative analysis of 47 Italian universities, we specifically examine how relationships among organizational factors foster the emergence of licensing contracts from university-industry interactions. This study contributes to the technology transfer literature by unveiling the role of gap-bridging instruments when combined with other organizational factors, as well as how their effectiveness varies based on universities' size and their technology transfer offices' capacity.

1. Introduction

In the technology transfer (TT) literature, organizational factors (i.e., organizational support, formal incentives for researchers, and research quality)[1] constantly influence how universities commercialize their technologies for industrial use (Leischnig et al., 2014; Battaglia et al., 2017). Furthermore, universities consider these factors as they structure themselves and their technology transfer offices (TTOs) to foster TT activities in ways that impact society (Giuri et al., 2019; Grimaldi et al., 2021). The TT literature recognizes that organizational factors play a role in enabling universities to commercialize their technologies (Schoen et al., 2014; Horner et al., 2019; Abramo and D'Angelo, 2022). This TT process often occurs through licensing contracts (Wu et al., 2015; Kim et al., 2019), which universities use to transfer their technologies' intellectual property rights to other players, often companies, in exchange for licensing fees on a percentage of sales of new products or services developed using these technologies (Roessner et al., 2013; Rossi et al., 2017).

However, while TT commercial outcomes, such as licensing contracts, typically have involved a linear process, in which universities (i.e., the licensors) have valorized their portfolios to industry, and companies (i.e., the licensees) have opted for licensing contracts to access breakthrough technologies (Weckowska et al., 2015; Baglieri et al., 2018), the process today increasingly has been becoming nonlinear. Furthermore, university-industry interactions are geared more toward addressing specific companies' problems and needs (Lee et al., 2019). Therefore, licensing contracts between universities and industry seem to be more likely to emerge as the result of collaborative activities, such as collaborative research, contract research, and innovation consulting (Bonaccorsi and Piccaluga, 1994; Lai, 2011; Liefner et al., 2019).

With the emergence of these new interaction modes, universities have started to face two main challenges at the organizational level: a lack of funding and a lack of competencies to manage the technology commercialization process (Munari et al., 2018). These gaps in resources and expertise not only have hindered universities' capacity to commercialize technologies effectively, but also have exposed them to risks from not keeping up with an increasingly competitive market in which substantial funding and cross-cutting skills are becoming more

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[1] In this article, we use the term *organizational factors* to refer to elements within an organization that influence its functioning, performance, and overall effectiveness at the TT level (van Wijk et al., 2008).

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relevant (Battaglia et al., 2021b; Alexandre et al., 2022). Therefore, universities have started to equip themselves with instruments that bridge their financial and managerial gaps with industry, such as proof-of-concept (PoC) programs (Battaglia et al., 2021a) and services that external TT intermediaries provide (Villani et al., 2017). Such instruments have been integrated progressively into universities' organizational structures and implemented as part of the support that universities' TTOs provide to researchers (Passarelli et al., 2020; Seeber et al., 2022).

However, two aspects remain underexamined when we consider organizational factors' role in technology commercialization resulting from university-industry collaborative activities. First, extant literature mostly has investigated instruments that bridge financial and managerial gaps separately (e.g., Wright et al., 2008; Munari and Toschi, 2021; Alexandre et al., 2022). Therefore, we argue that the two need to be investigated together as organizational factors that may facilitate commercialization of technology resulting from university-industry collaborative activities (Weckowska, 2015; Rossi et al., 2017). Second, given these instruments' recent emergence, we argue that extant literature on the organization of TT (van Wijk et al., 2008; Battaglia et al., 2017) has overlooked the configuration of different organizational factors to understand how to foster technology commercialization resulting from university-industry collaborative activities (Zhao et al., 2020). Thus, previous literature has analyzed how each of these organizational factors (i.e., *organizational support*, *presence of incentives*, and *university quality*) relates to each other in technology commercialization in this specific context; however, how they interact to foster commercial outcomes remains underexamined.

Therefore, our study aims to investigate the following research questions:

(i) Is there a relationship between the activation of instruments that bridge financial and managerial gaps and the emergence of commercial outcomes resulting from university-industry collaborative activities?

(ii) How do different organizational factors relate to each other in fostering technology commercialization resulting from university-industry collaborative activities?

To answer these questions, drawing on Ragin (2009), we conducted a fuzzy-set qualitative comparative analysis (fsQCA) on a dataset that included the cases of 47 Italian universities, encompassing almost 80 % of total faculty members. We collected data within the framework of an annual survey conducted by Netval, the Italian association of TTOs of universities and public research organizations. These data are used widely in the TT literature (Muscio and Ramaciotti, 2019; Micozzi et al., 2021). Given their strategic relevance to research and practice (Roessner et al., 2013; Wu et al., 2015; Kim et al., 2019), we investigated the licensing contracts resulting from university-industry collaborative activities as the main commercial outcome of this study. With respect to quantitative methods that have been designed to investigate the effects of certain causes, fsQCA represents a methodology designed to understand the causes of some effects (Vis, 2012). Treating different cases as configurations, fsQCA is suitable for answering our research questions by identifying whether these configurations are associated with an outcome of interest (Schneider and Wagemann, 2010).

More specifically, our study examines the relationship between activation of instruments that bridge financial and managerial gaps and the emergence of commercial outcomes resulting from university-industry collaborative activities, as well as how different configurations of organizational factors affect technology commercialization resulting from these activities.

Therefore, our study contributes to the TT literature in three ways. First, while extant literature has overlooked instruments' role in bridging financial and managerial gaps, we view them as organizational factors and examine how they relate to each other in technology commercialization in the specific context of university-industry collaborations, thereby expanding Perkmann et al.'s (2021) framework. Second, while prior research mostly has investigated these instruments separately (e.g., Wright et al., 2008; Munari and Toschi, 2021; Alexandre et al., 2022), we unveil the emerging role of the combination of both in facilitating commercialization of technology resulting from university-industry collaborative activities. Third, we identify a set of theoretical configurations that reveal which combinations of organizational factors are more likely to foster commercialization of technology resulting from university-industry collaborative activities. Furthermore, our research also provides practical implications for TT managers and university administrators with regard to adapting organizational factors to their specific contexts. Our findings suggest that large universities with large TTOs may leverage diverse gap-bridging instruments, while smaller ones may benefit from focusing on implementation of instruments that bridge the managerial gap to foster commercial outcomes resulting from university-industry collaborative activities.

The study is organized as follows: In Section 2, we provide the theoretical framework, then in Section 3, we describe data collection and methods. We then present the findings in Section 4 and discuss them in Section 5, including implications for theory and practice. Finally, Section 6 concludes the paper.

2. Theoretical framework

2.1. Organizational factors in university-industry collaborations

TT always has represented a core element in many countries' economic and technological growth (Bozeman, 2000), leading to more and more organizations approaching its inherent challenges and strengthening its effectiveness (D'Este and Perkmann, 2011). While a systemic perspective on TT investigates a vast series of components that assume relevance in this process (e.g., individual, institutional, and cultural) (López-Martínez et al., 1994; D'Este and Patel, 2007; Perkmann et al., 2013), organizational factors have gained growing importance over time. Furthermore, the TT literature specifically has recognized that organizational factors affect TT activities' functioning, performance, and overall effectiveness within universities (van Wijk et al., 2008; Perkmann et al., 2013; Pohle et al., 2022). Such factors consistently shape how universities are structured (Battaglia et al., 2017) and commercialize internally developed technologies outside their boundaries (Leischnig et al., 2014) to impact society (Giuri et al., 2019; Grimaldi et al., 2021).

However, while commercialization of universities' technology traditionally has been presented as a rather linear process (Weckowska et al., 2015; Baglieri et al., 2018), this no longer seems to be the case today. Furthermore, even though more long-established TT activities, such as licensing contracts, remain the key commercialization paths for assets developed inside universities' laboratories and departments (Wu et al., 2015; Kim et al., 2019), coproduction of new knowledge within the scheme of collaborative activities with industry also has gained relevance (Jonsson et al., 2015; Rossi et al., 2017). Among the possible set of such TT activities, we can cite collaborative research, contract research, and innovation consulting (D'Este and Patel, 2007; Lai, 2011; Liefner et al., 2019), which universities practice widely (Perkmann and Walsh, 2008; Ankrah et al., 2013) and which have become relevant sources of innovation for society (Broström et al., 2009; Audretsch, 2014). Therefore, technology commercialization outcomes, such as licensing contracts, tend to emerge from collaborative activities between university and industry, rather than via more long-established approaches (Battaglia et al., 2021a; Perkmann et al., 2021). This entails a series of challenges at the organizational levels that affect how universities interact with industry and commercialize their technologies.

Perkmann et al. (2021) recognized a set of organizational factors that underpin technology commercialization resulting from university-industry collaborative activities. The first factor is *organizational support*. The organization of universities is recognized to account for the effectiveness of the TT process (Heisey and Adelman, 2011; Horner et al., 2019). Furthermore, the presence of organizational structures

specifically designed to support TT – such as TTOs (Muscio, 2010; Battaglia et al., 2017), cooperative research centers (Dolan et al., 2019), and incubators or science parks (Huyghe et al., 2014) – leads to the emergence of university-industry collaborative activities by reducing the gap between academic research and industry . In particular, these organizations' *size* positively influences generation of university-industry collaborative activities, such as number of research contracts (Caldera and Debande, 2010; Van Looy et al., 2011), and directly reflects their experience in years (Cesaroni and Piccaluga, 2016), as well as the commercial potential of the local context in which they operate (Berbegal-Mirabent et al., 2015; Baglieri et al., 2018).

Another organizational factor is the *presence of incentives*, which has been examined extensively in the literature in terms of TT organizational design (Horner et al., 2019). Siegel et al. (2003) viewed faculty reward systems for TT activities as being among the most critical organizational factors in universities' external engagement. University-industry collaborative activities, particularly consulting, seem to be preferred to more traditional approaches to commercialization of academic research because of the higher royalties generated from licensing contracts (Halilem et al., 2017). This partially explains why the incentive structure to commercialize technology from university-industry collaborative activities differs from other more linear technology commercialization routes (Abreu and Grinevich, 2013). Thus, the percentage of *income from licensing contracts* to inventors has been recognized widely as being among the most common incentives in TT (Conti and Gaule, 2011; Moog et al., 2015). Universities that award a higher percentage of licensing income to inventors tend to engage more often with industrial partners through collaborative activities and, therefore, commercialize more technology (Caldera and Debande, 2010; Wu, 2010). Regarding the US context, Roessner et al. (2013) found that higher amounts of royalty income generate follow-on investments in collaborative research, as well as indirect income at the local level.

The last organizational factor that emerges from the TT literature is *university quality*. This factor makes a positive impact on TT and research commercialization (Di Gregorio and Shane, 2003; O'Shea et al., 2005), but when we consider university-industry collaborative activities, empirical evidence leads to different conclusions based on the measures used. Ponomariov (2008) found that an academic institution's prestige is associated positively with likelihood of commercialization of technologies with industry at an institutional level, but that it affects individual scientists' interactions with industry negatively. More recent studies have identified different patterns across scientific disciplines. For example, a negative link was found between university quality and these interactions with industry among researchers in basic sciences, while a positive relationship was found for those in the applied sciences (Perkmann et al., 2011; Scandura and Iammarino, 2022).

Even though the TT literature has acknowledged these factors' presence and relevance, no firmly established extant research results exist yet on how different organizational factors interact among them, nor on this interaction's role in shaping scientists' collaborative activities (Zhao et al., 2020). In particular, these various organizational factors always have been considered separately and not within an integrated framework of analysis (Perkmann et al., 2021).

2.2. Bridging financial and managerial gaps

When it comes to considering organizational factors and their influence on technology commercialization, in regard to university-industry collaborative activities, a challenging issue emerges in research and practice. TT effectiveness now is understood as being strongly inhibited by a lack of funding and competencies to finance and manage the technology commercialization process (Munari et al., 2018). This path has become increasingly costly in terms of both technology development and valorization (Battaglia et al., 2021b), but it also has required an increasingly wider range of skills – from product-service development to marketing (Villani et al., 2017; Alexandre et al., 2022). Therefore, implementing instruments that bridge financial and managerial gaps has become a top priority for universities willing to engage with industry (Bradley et al., 2013; Villani et al., 2017). Among the various solutions introduced (Rasmussen and Sorheim, 2012; Kochenkova et al., 2016), universities progressively have integrated these instruments inside their TTOs' organizational settings to better support scientists facing challenges related to interactions with industry. Thus, these instruments have become part of organizational support that researchers have received to commercialize their technologies (Passarelli et al., 2020; Seeber et al., 2022).

Specifically, when we consider instruments that bridge the financial gap, TT research and practice have paid growing attention to so-called *Proof-of-Concept (PoC) programs* (e.g., Munari et al., 2016), which are pre-seed TT instruments that aim to decrease the technological uncertainty of research-based inventions by increasing their technology readiness level (TRL) and strengthening their attractiveness to external actors who potentially are interested in engaging with universities (Gulbranson and Audretsch, 2008; Bradley et al., 2013). By advancing ideas into prototypes (Munari et al., 2017; Croce et al., 2014), they enhance researchers' interactions with industry by providing a combination of supporting elements related not only to the financial side, but also to networking and external relationships-building (Munari et al., 2016; Tolin and Piccaluga, 2024). These instruments as such build on the concept of "academic capitalism" (Slaughter and Leslie, 2001), which considers, of utmost importance for technology transfer effectiveness, the presence of solutions that can foster market orientation of academic departments, better attract funding, and support the commercialization process, relying not only on technology development, but also on marketing activities (Ylijoki, 2003). Munari and Toschi (2021) emphasized that these instruments function as a catalyst to accelerate the transition of scientific breakthroughs toward practical applications in terms of university-industry collaborations (i.e., R&D contracts or innovation consulting activities) and, therefore, technology commercialization. Furthermore, Battaglia et al. (2021b) asserted that PoC instruments function as "relational enablers," thereby facilitating researchers' approach to industrial stakeholders through several mechanisms oriented toward enhancing commercial opportunities beyond academia's boundaries.

When we consider instruments that bridge the managerial gap, TT research and practice have been paying growing attention to *external TT intermediaries* (e.g., Bessant and Rush, 1995), a term that researchers use to refer to external organizations set up to support activities conducted by TTOs or internal university offices dealing with knowledge valorization (Muscio, 2010; Battaglia et al., 2017). Even though in most cases, internal offices (i.e., TTOs) remain the main providers of support for TT researchers (Weckowska, 2015; Lafuente and Berbegal-Mirabent, 2019), universities in some cases decentralize activities to these intermediaries so that these various organizations can coexist and collaborate (Brescia et al., 2016). Organizational structures of this sort may function as university incubators (McAdam et al., 2006), scientific and technological parks (Giaretta, 2014), TT companies (Meseri and Maital, 2001), university foundations (Pohle et al., 2022), or licensing intermediaries (Kim et al., 2019). When we consider mid-range universities, these organizations play a fundamental role in bridging the gap between different actors in university-industry collaborative activities such as contract research or consulting (Wright et al., 2008; Alexandre et al., 2022). Villani et al. (2017) claimed that external TT intermediaries attempt to reduce not only geographical distance, but also social distance, by engaging researchers and industrial actors in collaborations oriented toward developing mutual trust and strengthening ties.

While considering these two different instruments that bridge the gap between universities and industry, two concerns need to be addressed. First, these instruments' role has been addressed mostly separately (e.g., Wright et al., 2008; Munari and Toschi, 2021; Alexandre et al., 2022); therefore, we argue that these two instruments need to be investigated together to bridge financial and managerial gaps,

functioning as organizational factors that can facilitate commercialization of technology resulting from university-industry collaborative activities (Weckowska, 2015; Rossi et al., 2017). To facilitate comprehension of these various organizational factors, we schematized them in Table 1.

Second, given the recent emergence of instruments of this sort in how universities organize their TT activities (Munari et al., 2018; Battaglia et al., 2021a), we argue that further investigation is required from a configurational perspective to examine how instruments used to bridge managerial and financial gaps interact with other organizational factors recognized in the literature (i.e., *organizational support*, *presence of incentives*, and *university quality*) to foster commercialization of technology resulting from university-industry collaborative activities. When it comes to considering the wider set of organizational factors that underpin university-industry collaborations and the commercial outputs that follow them, extant literature so far has led to "ambiguous" or "conflicting" results (Perkmann et al., 2021). Therefore, as discussed in the previous subchapter, there is room to develop a unified framework to reveal which combinations of organizational factors are more likely to foster commercialization of technologies resulting from university-industry collaborations.

Table 1
Organizational factors.

Organizational factors	Description	Theoretical and empirical referents
Organizational support	This factor refers to the presence of organizational structures and offices specifically designed to facilitate university-industry interactions that enhance technology commercialization in university-industry interactions.	Muscio (2010); Battaglia et al. (2017); Baglieri et al. (2018); Horner et al. (2019).
Presence of incentives	This factor refers to the presence of incentive systems within universities that motivate faculty to engage in university-industry interactions and commercialize technologies.	Siegel et al. (2003); Abreu and Grinevich (2013); Moog et al. (2015); Halilem et al. (2017); Horner et al. (2019).
University quality	This factor refers to an academic institution's reputation and prestige, which influence research commercialization outcomes in university-industry interactions.	Di Gregorio and Shane (2003); O'Shea et al. (2005); Ponomariov (2008); Perkmann et al. (2011); Scandura and Iammarino (2022).
Gap-bridging instruments: *Financial gap*	This factor refers to the activation of programs to provide financial support to reduce technological uncertainty and increase the Technology Readiness Level within collaborative schemes between universities and industry.	Gulbranson and Audretsch (2008); Bradley et al. (2013); Munari et al. (2016); Battaglia et al. (2021b).
Gap-bridging instruments: *Managerial gap*	This factor refers to external organizations that support universities in technology transfer activities, complementing internal TTOs by fostering university-industry collaborations and reducing social and geographical barriers in knowledge valorization processes.	Wright et al. (2008); Weckowska (2015); Villani et al. (2017); Alexandre et al. (2022).

3. Data and methods

This paper addressed two research questions: *(i) Is there a relationship between the activation of instruments that bridge financial and managerial gaps and the emergence of commercial outcomes resulting from university-industry collaborative activities? (ii) How do different organizational factors relate to each other in fostering technology commercialization resulting from university-industry collaborative activities?* To better define our study's scope, we provide a visualization of the theoretical framework in Fig. 1.

Research of this sort might have been based on a quantitative econometric analysis to assess the impact of a set of independent variables on the outcome. However, the limited availability of data, combined with the need for a configurational perspective on this phenomenon, encouraged us to consider a configurational comparative method, namely fsQCA. In this regard, fsQCA is suitable to integrate quantitative and qualitative approaches to identify causal relationships among configurations and combinations of conditions leading to the same outcome (Ragin, 2009). This approach assumes relevance in studies that deal with small samples (Schneider and Wagemann, 2010). In our study, we adopted a fsQCA on the university-industry collaborative activities of 47 Italian universities, encompassing almost 80 % of the total national faculty.

3.1. Research setting and case selection

University-industry collaborative activities are viewed as a key channel through which to transfer technologies developed inside universities' laboratories, and they have experienced significant growth recently within the European context (Cambell et al., 2022). Among the set of possible national contexts appropriate for this analysis, we chose the Italian one for two reasons. First, Italian universities always have been recognized as latecomers in the TT scenario (Micozzi et al., 2021), even though the Italian academic system is well-known for its high-quality research and productivity (Grimaldi et al., 2021). Most Italian universities established their TTOs in the early 2000 s (Muscio, 2010). This represents a peculiarity with respect to universities in other European countries and the US, which have longer TT traditions. Second, even though Italian universities remain in a catching-up phase, they have experienced fast growth, developing TT models that can engage constantly with external actors (Cesaroni and Piccaluga 2016), thereby demonstrating a case of complementarity between collaboration and commercial activities (Marullo et al., 2022). Furthermore, university-industry collaborative activities always have been part of Italian TTOs' practices, dealing with a peculiar local context characterized by SMEs that often are linked to low-tech industries (Grimaldi et al., 2021).

Even though these activities vary from country to country based on their specific characteristics, the rationale that underpins these schemes is similar in all national contexts in which they are applied (Kochenkova et al., 2016). For this reason, even though our study mostly lies within the Italian context, it also can provide valuable applications in all the contexts in which universities deal with these interactions. In particular, the specific case of Italy assumes strategic relevance for universities whose TT organizational infrastructures remain in the early stages of development.

We collected data in 2020 and 2021, during which time, the authors

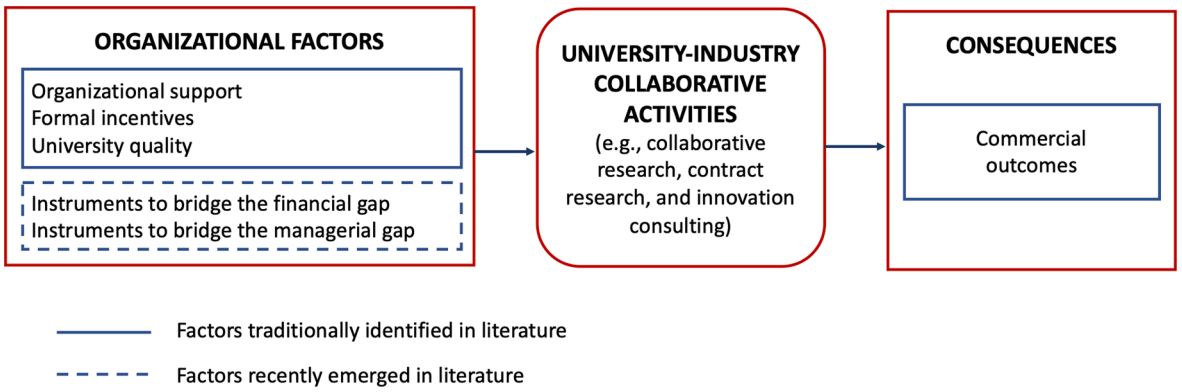

Fig. 1. Theoretical framework.

supported Netval[2] in the process of monitoring TT activities in Italy through a national survey of universities and public research organizations. The survey also aimed to understand more about licensing activities in Italy. Being connected closely to Netval allowed the authors to access information and data that we employed in our study (please see the data source column in Table 3). To address our research question, we considered data related to licensing contracts, TTO size, and the percentage of licensing income given to inventors, as well as the presence of internally developed PoC programs and intermediaries for technologies' valorization.

The key survey items that we considered in our research are presented in Appendix A. We integrated survey-based data with additional inputs collected from external sources available online. We used the Italian Center for Social Investment Studies (Censis) and the Times Higher Education (THE) databases to gather data on universities' sizes and their performance in terms of quality among education, research, and third mission activities.

Among the population of 71 universities, in compliance with Marullo et al. (2022), we only considered 47 cases for the sake of our analysis, selected based on two inclusion criteria. First, each TTO must have been active for at least 10 years. By examining the foundation distribution of Italian TTOs (Cesaroni and Piccaluga, 2016) and the growth of TT in Italy in the past 20 years (Netval, 2021), this is a reasonable time frame for comparing TTOs in terms of organizational structures and TT transfer volumes. Second, the TTOs are active in patenting activity. In line with our study's purpose and the outcome of interest identified, we only included universities with a patent portfolio higher than zero, and with at least one licensing contract with industry in 2019.

Even though considering a single year of analysis may be criticized for being a static approach (Schneider and Wagemann, 2010), the cross-sectional data that we analyzed in this study reflected simplified configurations of a process that takes time to settle and results after years of collaborative activities through interactions with industry (Abreu and Grinevich, 2013; Fini et al., 2018).

According to the Censis ranking and its four different classes, our sample contained 13 mega, 11 big, 17 medium, and six small universities. Among the 13 mega-universities, we decided to include two outlier universities, belonging respectively to the small and medium classes mainly because of their outperformance in terms of TT activities.

[2] Netval is an Italian association of research centers and universities that represents a forum for cooperation and exchange of information on the valorization of research results. Netval participates in ASTP, a network that brings together European individuals and national networks active in TT (Netval, 2021). Since the early 2000s, this association has conducted a survey to monitor TT patterns in Italy, collecting data from universities' TTO managers on TT organizational characteristics, inputs, and outputs. Prominent studies have used this data (Muscio and Ramaciotti, 2019; Micozzi et al., 2021).

By examining the descriptive statistics presented in Table 2, we measured the average patent portfolio, average licensing contracts resulting from commercial activities, and average amount of licensing contracts in the whole patent portfolio, with a specific emphasis on the geographic area in which these universities operate. We made three insightful observations, the first being how mega-universities tend to pursue disproportionate activities with respect to other cases in the sample. This is a key aspect that we are going to consider during the calibration process to compare our outcome variable within the same university size class. Second, the universities that we investigated are distributed equally across the nation. Third, university size does not necessarily reflect the average size of the patent portfolio and, therefore, the average number of patents valorized through licensing contracts. For example, small universities tend to license out a higher percentage of their patent portfolios.

3.2. Methodology

In this study, we conducted a fsQCA to examine how organizational factors relate to each other to foster commercial outcomes of university-industry collaborative activities, particularly regarding licensing contracts directly resulting from these kinds of activities. QCA has been applied successfully in innovation (Del Sarto et al., 2021; Kraus et al., 2018) and technology management studies (Battaglia et al., 2021a; Subramanian et al., 2022). Through a configurational comparative method able to integrate qualitative and quantitative approaches, these studies employed QCA to gather evidence on causal relationships among configurations (Pappas and Woodside, 2021), particularly when it comes to considering different systems oriented toward reaching the same final output by starting amid different conditions and pursuing different paths (Schneider and Wagemann, 2010).

Table 2
Descriptive statistics on the sample.

University Size	No. of Cases	Average Patents' Portfolio	Average Licensing Contracts	Average Licensing Contracts/ Patents Portfolio	Geographic Area
Mega	13	279.1	100.8	30.8 %	*North (7); Center (5); South (1).*
Big	11	64.4	4.6	8.7 %	*North (7); Center (2); South (2).*
Medium	17	50.8	10.5	24.8 %	*North (6); Center(5); South (6).*
Small	6	19	4.1	38 %	*North (1); Center (2); South (3).*

Table 3
Calibration of conditions and outcomes.

Conditions/ Outcomes	Variable name	Description	Calibration	Data source	Organizational factors /Consequences	Previous literature
Conditions:					*Organizational factors*	
TTO size	*Size*	Categorical variable indicating the number of employees working in the universities' TTOs	More than 10 → 1 Between 5 and 10 → 0.67 Between 3 and 5 → 0.33 Fewer than 3 → 0	Netval	Organizational support	Baglieri et al. (2018)
Licensing income to inventors	*Income*	Categorical value indicating the percentage of licensing income to inventors	Higher than 60 % →1 Between 60 and 40 % →0.67 Between 40 and 20 % →0.33 Lower than 20 % →0	Netval	Formal incentives	Caldera and Debande (2010)
University quality	*Quality*	Categorical variable indicating the university's position in the Italian ranking	Presence in the first quartile → 1 Presence in the second quartile → 0.67 Presence in the third quartile → 0.33 Presence in the fourth quartile → 0	THE	University quality	Munari et al. (2018)
Presence of PoC programs	*PoC*	Dichotomous variable indicating the presence or absence of proof-of-concept programs	Presence → 1 Absence → 0	Netval	Gap-bridging instruments – *Financial gap*	Battaglia et al. (2021a)
Presence of external intermediaries	*Inter*	Dichotomous variable that specifies whether or not external TT intermediaries are present	Presence → 1 Absence → 0	Netval	Gap-bridging instruments – *Managerial gap*	Kim et al. (2019); Subramanian et al. (2022)
Outcome					*Consequence:*	
Licensing contracts from collaborations	*Lic_Col*	Dichotomous variable that indicates whether the number of licensing contracts resulting from university-industry collaborative activities (i.e., collaborative research, contract research, and innovation consulting) is below or above the average of other universities of the same size.	Higher than the average by university size → 1 Lower than the average by university size → 0	Netval, Censis	Commercial outcomes	Kim et al. (2019); Marullo et al. (2022)

This methodology aims to answer questions related to understanding what configurations of conditions are associated with an outcome of interest. The focus is not related inferentially to the demonstration of a causal relationship between variables, but on revealing patterns that underlie these relations (Greckhamer et al., 2018). QCA assumes causal complexity and, therefore, asymmetric relationships that underpin configurations and that allow for reaching specific outcomes of interest (Ragin, 2009). Furthermore, configurations result in a combination of two possible kinds of conditions: necessary conditions, which are minimally necessary, i.e., those whose presence is mandatory for achieving certain outcomes, and sufficient conditions, i.e., those whose presence as standalone factors lead to specific outcomes (Fiss, 2007).

Our model includes several theoretical conditions, namely *TTO size*, *licensing income to inventors*, *university quality*, *presence of PoC programs*, *presence of external intermediaries*, and an outcome of interest termed - *licensing contracts from collaborations*. To understand how such a set of different factors fosters this commercial outcome of university-industry collaborative activities, our study aimed to employ innovative analytical methods. For example, if we consider PoC programs' presence, these gap-bridging instruments can be ineffective if not properly supported by a certain number of TT professionals, the right incentive system for researchers, and/or a high level of research quality (Munari et al., 2018). For this reason, we propose that this emerging complexity requires a configurational approach designed to understand how different factors jointly foster the emergence of a certain outcome of interest.

Furthermore, our study's scope did not encompass understanding whether these different organizational factors impact commercial outcomes resulting from university-industry collaborative activities, which already has been assessed in extant literature that considered these factors together or separately (e.g., Schoen et al., 2014; Horner et al., 2019; Scandura and Iammarino, 2022). Instead, our scope aimed to understand how this process takes place, examining how relations among different organizational factors (i.e., their presence or absence within a configuration that reflects real cases) foster an outcome of interest.

To address these issues, we considered a specific QCA technique, namely the fuzzy-set qualitative comparative analysis (fsQCA). Assuming causal complexity (Woodside, 2013), fsQCA aims to establish logical connections between combinations of causal conditions that result in rules that outline sufficiency between subsets of all possible combinations based on their causal conditions and outcomes. However, unlike the crispy set, the membership to a condition also is related to a gradual scale, rather than just a binary variable. In particular, Kraus et al. (2018) recommended using fsQCA to obtain higher granularity when interpreting results, particularly when the object of the study is multiple and connective, as it is in our case. When it comes to considering TT commercial outcomes, this model has been applied successfully, such as in the analysis of PoC programs managed at an Italian university (Battaglia et al., 2021a) and in Spanish universities' licensing activities (Escobar et al., 2020).

Ragin (2009) identified several steps in fsQCA, the first related to building a so-called truth table, a 2^k rows matrix in which *k* stands for the number of causal conditions used in the analysis. Each row in the table represents a combination of attributes toward a certain outcome, and each column represents a condition. The table lists all possible combinations (Fiss, 2007). We present the truth table from our study in

Appendix B. The second step leads to a reduction of the rows displayed in the truth table based on two conditions: coverage, or how closely a perfect relation is approximated between a configuration and outcome (i.e., the proportion of cases indicating the configuration that exhibits the outcome), and consistency, or gauging a configuration's empirical relevance (i.e., the proportion of cases indicating outcome capture by a specific configuration) (Greckhamer et al., 2018). Aligning with Ragin (2009), we applied a frequency cut-off of 1 and a consistency cut-off of 0.75.

In the third step, we simplified the truth table through the Quine-McCluskey algorithm by reducing the obtained solutions' complexity. The algorithm is based on Boolean algebra and leads to a counterfactual analysis of causal conditions. Furthermore, this approach leads to three different solutions: (i) the *parsimonious solution*, which considers all simplified assumptions regardless of inclusion of easy or difficult counterfactuals; (ii) the *intermediate solution*, which considers simplified assumptions by including easy counterfactuals; and (iii) the *complex solution*, which considers neither easy nor difficult counterfactuals.

3.3. Calibration and measures

With a fsQCA, calibration of the theoretical conditions that underlie a specific outcome is required before constructing the truth table. In the calibration process, data are converted into a scale from 0 to 1 within predetermined sets based on previous studies and contextual knowledge (Greckhamer et al., 2018). In this study, calibration of collected data is summarized in Table 3. Using Battaglia et al.'s (2021a) approach, we built fuzzy sets using a four-value scale (i.e., 0, 0.33, 0.67, or 1). Establishing the 0.5 level as the crossover point, we set 1 as the full-membership value and 0 as the full-nonmembership value. The conditions 0.33 and 0.67 represented out and in measures, respectively, but more moderately with respect to the other "full" conditions. Thus, we represented other conditions through crispy variables (i.e., 0 or 1), indicating whether they were "fully out" or "fully in." Consistent with the approach used in Subramanian et al. (2022), for all the categorical variables, we decided threshold values for calibration based on the distribution of values, while for dichotomous variables, we considered the presence or absence of a specific condition.

Our outcome measure (i.e., *licensing contracts from collaborations*) is a dichotomous variable determined by an empirical condition related to commercial outcomes resulting from university-industry collaboration: whether the number of licensing contracts resulting from these activities is below or above the average of other universities of the same size (Kim et al., 2019; Marullo et al., 2022). To measure the variable and answer our research questions properly, we started with three building blocks.

First, to distinguish clearly between *traditional* licensing contracts resulting linearly from TT and those resulting from collaborations, we viewed only those directly emerging from activities that comply with Perkmann et al.'s (2021) definition of licensing contracts. Therefore, we viewed only collaborative research, contract research, and innovation consulting as university-industry collaborative activities. Given the novelty and consequent low diffusion of this specific typology of licensing contract, we decided not to apply the analysis differentiating the outcome measures based on the various typologies of activities. Starting from this definition, we manually screened all the Italian licensing contracts signed by external actors collected from the Netval database to distinguish whether they resulted from a linear TT process or from university-industry collaborative activities. Second, we accounted for the number of licensing contracts resulting from collaborations activated in 2019. As previously noted, we considered only one specific year because contracts of this sort take time to emerge, indirectly capturing a long time frame in a 0/1 outcome measure. Furthermore, university-industry collaborative activities tend to precede commercialization in time, functioning as an input factor for outcomes of this sort (Perkmann et al., 2013). In the context that we examined, before commercializing technologies through licensing contracts, researchers spend months, often years, collaborating and co-generating knowledge through collaborative activities with external actors that will access this knowledge through licenses after the end of these interactions with universities (Muscio et al., 2017; Rossi et al., 2017). Third, we constructed the outcome measures depending on the different universities' sizes previously described (i.e., mega, big, medium, and small) to compare the results among similar organizations. Thus, we avoided the risk of comparing a group of top licensors with the remaining universities. The variable received a value of 1 if the number was higher than the average number of other universities of the same size, and 0 otherwise.

We then considered five different theoretical conditions related to the four organizational factors described in our theoretical framework. Three have been identified traditionally in the literature (Perkmann et al., 2021), and one has been integrated into this study based on the emerging literature on gap-bridging instruments (Munari et al., 2018). TTO size is a categorical variable related to organizational support. We also did not account for TTOs' experience because, as previously noted, TTOs' size tends to reflect their age in the Italian context (Cesaroni and Piccaluga, 2016) and is a fuzzy-set condition depending on the dimension of people employed within the universities' TTOs and on the years of activities within these offices. The role that these organizational factors have played in TT activities has been recognized and discussed widely in the literature (Berbegal-Mirabent et al., 2015; Baglieri et al., 2018). Licensing income to investors is a categorical value that indicates the percentage of income licenses to inventors. Drawing on Caldera and Debande (2010), we set this theoretical condition to measure organizational factors in terms of formal incentives. When considering the - university quality condition, we included a categorical variable consistent with the distribution of values that emerged from the THE ranking – previously employed in similar studies (Munari et al., 2018) – which measures research-based universities based on five performance indicators: teaching, research, citations, international outlook, and income generated from TT.

Furthermore, drawing on Battaglia et al. (2021a) and Subramanian et al. (2022), we integrated the framework by considering two dichotomous variables related to the so-called *gap-bridging instruments* as a theoretical measure: the *presence of PoC programs* internally organized by universities and the *presence of external intermediaries* for the valorization of research, particularly via licensing contracts.

Finally, one can raise the issue of using some contextual variables to control this analysis. While it is true that the local context influences the emergence of collaborative activities between university and industry (Azagra-Caro et al., 2006; Zhao et al., 2020), our study was related to organizational factors identified in the literature and discussed previously. Even though some attempts have been made (Del Sarto et al., 2020), it is not easy to integrate control variables into a configurational study (Greckhamer et al., 2018). However, drawing on Pappas and Woodside's (2021) methodological insights, the variable *TTO size* notably depended on the context in which the university operates (Caldera and Debande, 2010; Van Looy et al., 2011). Therefore, we argue that TTO size indirectly also captures universities' local or regional indicators in terms of technological, human, and financial capital variety (Berbegal-Mirabent et al., 2015; Baglieri et al., 2018).

4. Findings

4.1. Descriptive statistics

In Table 4, we reported the descriptive statistics related to the theoretical conditions and outcome of our sample. The data revealed that the TTOs' average size (i.e., number of employees) was 5.52. In some cases, some outliers may have been present among the TTOs in terms of size, given that the maximum was 18 employees, and the standard deviation was 3.72. The average percentage of licensing income received by inventors was 54.9 %. While the descriptive statistics

Table 4
Descriptive statistics of the theoretical conditions and outcome.

Theoretical conditions/Outcome	Mean/ count	Standard deviation	Min	Max	% of the sample
TTO size	5.52	3.72	1	18	
Licensing income to inventors	54.9 %	19.5 %	0 %	70 %	
University quality	2.21	1.14	4	1	
Presence of PoC programs (count)	13				27 %
Presence of external intermediaries (count)	12				25.5 %
High licensing propensity (count)	15				32 %
Low licensing propensity (count)	32				68 %

revealed that this percentage was zero at some universities, they represented the minority in the sample, given that the standard deviation was 19.5 %. In terms of the universities' position in the Italian ranking, in a range from one to four (i.e., a value assigned for each quartile of the ranking), the average was 2.21. We observed an equal distribution of the universities across the ranking if we considered that the maximum was 2 and the minimum was 4. Regarding the presence of PoC programs and external intermediaries, more than one university out of four presented at least one of the two theoretical conditions.

Finally, regarding outcomes, in 32 % of the cases, the number of licensing contracts resulting from university-industry collaborative activities was above the average of other universities of the same size (i.e., high licensing propensity). However, 68 % of the cases presented a number below the average, i.e., some universities stood out for these contracts, but did not represent most of the cases.

4.2. Analysis of necessary conditions

We conducted an analysis of necessary conditions to determine whether any causal conditions needed to be present for the outcome to occur, which in our case were licensing contracts resulting from university-industry collaborative activities. Schneider and Wagemann (2010) observed that a consistency threshold of 0.9 was required for a condition to be necessary. In Table 5, we present the results from the analysis, which considered the conditions' presence.

The consistency value for each condition was below 0.9; therefore, we argue that none of the five conditions alone was necessary for the outcome of interest that we identified, i.e., no single condition by itself led to the final output on its own.

4.3. Analysis of sufficient conditions

We conducted an analysis of sufficient conditions to identify all the organizational factors that are sufficient for an outcome of interest to occur. In this case, as previously discussed, we applied a frequency threshold of 1 and a consistency threshold of 0.75, in compliance with extant fsQCA literature (Ragin, 2009), as well as in innovation (Kraus et al., 2018; Del Sarto et al., 2021) and technology management (Battaglia et al., 2021a; Subramanian et al., 2022) studies. Using the notation for the solution introduced in Fiss (2011), the findings from the analysis of sufficient conditions are presented in Table 6.

Table 5
Analysis of necessary conditions.

Outcome: Licensing contracts from collaborations	Consistency	Coverage
TTO Size	0.59	0.49
Licensing income to inventors	0.52	0.50
University quality	0.42	0.61
Presence of PoC programs	0.47	0.75
Presence of external intermediaries	0.52	0.36

For this analysis of sufficient conditions, we used the intermediate solution for three main reasons. First, this solution has been recognized as the most suitable for theoretical interpretation (Ragin, 2009). Second, it has been used in similar studies (e.g., Kaya et al., 2020; Battaglia et al., 2021a). Third, it is characterized by an overall solution coverage greater than 0.25 and by an overall solution consistency greater than 0.75; therefore, it can be viewed as informative (Fiss, 2011; Woodside, 2013). Moreover, the intermediate solution accounted for only the logical remainders that are consistent with theoretical and substantive knowledge. In this way, this solution represented a more conservative scenario, addressing only those cases that represent the most plausible simplified assumptions (Ragin, 2009). We observed three configurations with a consistency higher than 0.75, i.e., they represented sufficient conditions for the occurrence of our outcome of interest. We reported complex and parsimonious solutions in Appendix C.

Configuration (1) may be described as follows:

Size*Income*Inter*Quality.

This configuration indicated that a sufficient condition for *licensing contracts from collaborations* to occur was related to a combination of several conditions – such as TTO size, high level of licensing income to inventors, and university quality – together with the presence of one specific kind of gap-bridging instrument, i.e., external intermediaries.

Configuration (2) is as follows:

Size*PoC*Inter*Quality.

This indicates that a sufficient configuration for the emergence of licensing contracts directly related to university-industry collaborative activities comprised a combination of a set of conditions related to organizational factors, such as TTO size, as well as the combined presence of instruments that bridge financial and managerial gaps (i.e., the presence of PoC programs and external intermediaries). In this configuration, university quality also was a sufficient condition.

Finally, we specified Configuration (3) as follows:

Size*~Income*~PoC*Inter*~Quality.

The final configuration indicates that a sufficient condition for our outcome of interest was the combination of TTO size and the presence of intermediaries, combined with the absence of specific conditions, such as TTO size, licensing incentives, PoC programs, and university quality. However, following the approach described in Ragin (2009), we were able to consider only Configurations (1) and (2). Furthermore, configurations with the greatest raw coverage (i.e., higher than 0.10) were those viewed as empirically relevant.

5. Discussion

5.1. General discussion

The analysis of necessity conditions revealed that no condition alone directly affects the emergence of commercial outcomes resulting from

Table 6
Analysis of sufficient conditions.

Theoretical condition/ Configuration	1	2	3
TTO Size	●	●	●
Licensing income to inventors	●		⊗
University Quality	●	●	⊗
Presence of PoC programs		●	⊗
Presence of external intermediaries	●	●	●
Consistency	0.90	1	0.80
Raw coverage	0.17	0.17	0.07
Unique coverage	0.05	0.05	0.07
Overall solution consistency	0.94		
Overall solution coverage	0.30		

Note: A full dot indicates the presence of the condition, while a crossed dot illustrates its absence; the absence of a dot of any kind represents the condition's irrelevance for the outcome of interest.

university-industry collaborative activities. For this reason, our first research question, concerning instruments that bridge financial and managerial gaps (i.e., PoC programs or external intermediaries), represents one of the possible conditions that may lead to the outcome of interest occurring, but only when combined with other factors within a configurational perspective. While prior studies have addressed these organizational factors separately (e.g., Wright et al., 2008; Munari and Toschi, 2021; Alexandre et al., 2022), other authors have arrived at similar conclusions. For example, Battaglia et al. (2021b) asserted that PoC programs can foster research commercialization when implemented in an integrated way with other factors that facilitate researchers' interaction with industry. Brescia et al. (2016) recognized external TT intermediaries as one of the possible organizational factors that can foster emergence of universities' commercial outcomes. However, none of them considered these instruments together as organizational factors crucial to bridging both financial and managerial gaps – and, therefore, to fostering research commercialization.

The presence of at least one gap-bridging instrument always was found in all three conditions resulting from our intermediate solution. Thus, these conditions assume relevance for our outcome to occur. Furthermore, the presence of intermediaries emerged in all the configurations as a sufficient condition for the occurrence of the commercial outcomes that we considered in our analysis. While this positive relationship between the presence of external intermediaries and commercial outcomes has been discussed previously in the literature (Villani et al., 2017; Alexandre et al., 2022), Configuration (2) revealed that specific cases exist, which we will examine below, in which the commercial outcome can be reached only when the two gap-bridging instruments are activated.

In answering our second research question, we observed three different paths among the three configurations that underpin our outcome of interest resulting from the fsQCA. When we consider Configuration (2), the integration among four different conditions appears to be related positively to the emergence of licensing contracts resulting from university-industry collaborative activities. The configuration reveals a combination of all the theoretical conditions except formal incentives. When we searched for the most representative cases related to this configuration in our database, we found that they all are mega-universities characterized by large departments with sizable and experienced TTOs, as well as by intense TT activity. One explanation for this is that a wide integration of these conditions mostly can work within universities with an infrastructure large enough to manage the complex interactions between all these organizational factors (Munari et al., 2018; Baglieri et al., 2018). Furthermore, this is the only configuration that considers the simultaneous presence of both gap-bridging instruments that we included in our analysis. Furthermore, these representative cases are related to specific Italian geographical contexts characterized by high industrial intensity, in which universities are key players in specific local innovating ecosystems.

A very similar case emerged from Configuration (1), in which the presence of large TTOs and external TT intermediaries was related positively to our outcome of interest when combined in configurations characterized by high university quality and a high percentage of licensing income for inventors. Even though the number of employees working in the universities' TTOs was high, when we searched for these cases in our database, they all were associated with smaller universities. By considering gap-bridging instruments and how they interact with other organizational factors, these configurations reflected that for smaller universities, the combination of multiple gap instruments does not facilitate the emergence of licensing contracts resulting from university-industry collaborative activities. Furthermore, focusing only on one of them (i.e., external intermediaries) seems to represent the best fit for commercial outcomes of this sort (Wright et al., 2008; Alexandre et al., 2022). The final configuration indicated that a sufficient condition for our outcome of interest was the combination of TTO size and the presence of intermediaries, combined with the absence of specific conditions, such as TTO size, licensing incentives, PoC programs, and university quality. However, following the approach described in Ragin (2009), we were able to consider only Configurations (1) and (2). Furthermore, only configurations with the greatest raw coverage (i.e., higher than 0.10) were viewed as empirically relevant.

5.2. Implications for theory and practice

Our study contributes to the TT literature in three ways. First, while extant literature identified a set of organizational factors that underpinned the emergence of technology commercialization resulting from university-industry collaborations, it did not account for instruments that bridge financial and managerial gaps (Perkmann et al., 2021). In this study, work, we provide a framework that includes not only the traditionally recognized organizational factors but also the emerging role of gap bridging instruments, exploring how they relate to each other in this TT setting. Deepening into the organizational factors associated with 47 Italian universities, we show how different combinations lead to the emergence of commercial outcomes. In this field, the idea that organizational-level conditions affect university-industry collaborative activities has gained increasing prominence in the literature (Zhao et al., 2020), and we provide a further understanding of how this process takes place.

Second, as introduced in the theoretical framework, extant studies have considered instruments that bridge financial and managerial gaps separately (e.g., Wright et al., 2008; Munari and Toschi, 2021; Alexandre et al., 2022). On the contrary, our work accounts for those gap bridging instruments within the scope of the same research, unveiling the emerging role of their combination in fostering the commercialisation of technology resulting from university-industry collaborative activities. Furthermore, from the perspective of instruments to bridge the financial gap (Munari et al., 2016), we shed light on how the idea of PoC as an "integrated tool," rather than a standalone instrument, may be implemented in practice, favoring the transition from research-based inventions to commercial outcomes that foster involvement by multiple partners, consistent with previous research on these programs (Battaglia et al., 2021b). Instead, from the perspective of instruments that bridge the managerial gap (Bessant and Rush, 1995), we contribute empirical evidence to this literature stream that views external TT intermediaries as enablers for the emergence of commercial outcomes resulting from university-industry collaborative activities, particularly when dealing with licensing contracts (Wright et al., 2008; Alexandre et al., 2022), by indicating in which configurations they can be integrated effectively toward this outcome of interest.

Third, in providing a configurational explanation of how organizational factors relate to each other, we identify two theoretical configurations that reveal the factors' combinations that are more likely to foster commercialization of technology resulting from university-industry collaborative activities. In particular, we proposed two Configurations (1 and 2) suitable for theoretical interpretation (Ragin, 2009) that can further support extant organizational-level studies on university-industry interactions that have called for more attention on the topic (D'Este and Perkmann, 2011; Huyghe and Knockaert, 2015; Battaglia et al., 2017).

Furthermore, our research poses implications for practitioners – such as TTOs' managers or, more generally, university managers and professors responsible for development of universities' strategies for engaging with industry – as well as for policymakers. For university TT managers, whether they work in a TTO or not, the need emerges to configure available organizational factors based on the presence or absence of specific conditions. In particular, when it comes to considering gap-bridging instruments, large universities, with large TTOs, can combine different kinds of tools of this sort. Nevertheless, in the case of smaller universities (particularly small- or medium-sized), our findings suggest that it is preferable to focus on one specific bridging instrument, particularly by activating the presence of external TT intermediaries.

Finally, this study also poses implications for policymakers. Italian universities always have been viewed as TT latecomers (Micozzi et al., 2021), even though they have experienced relevant growth processes in the past decade (Cesaroni and Piccaluga, 2016). Our study may help provide configurations of organizational factors to implement in other less-mature TT contexts to foster the emergence of commercial outcomes resulting from university-industry interactions. Policymakers could implement specific policy instruments through co-financing schemes between policy authorities and universities to facilitate development of PoC programs or to make it easier to access external TT intermediaries. Based on the findings we discussed, we assert that measures of this sort may assume relevance for smaller universities with small TTOs that are more likely to face challenges at the organizational level related to lack of funding and competencies to manage the technology commercialization process (Munari et al., 2018). As discussed in Kochenkova et al. (2016) and Brescia et al. (2016), the regulatory framework can affect development of TT activities significantly, with a specific emphasis on university-industry collaborative activities and their commercial outcomes.

6. Conclusion

In this study, we adopted a fsQCA to examine (i) whether a relationship exists between activation of instruments that bridge financial and managerial gaps, and the emergence of commercial outcomes resulting from university-industry collaborative activities, and (ii) how different organizational factors relate to each other in fostering technology commercialization resulting from university-industry collaborative activities.

To address our research questions, we started by drawing on the TT literature, with a particular emphasis on organizational factors that underpin university-industry collaborative activities (Perkmann et al., 2013; Perkmann et al., 2021) regarding instruments that bridge financial and managerial gaps (Munari et al., 2018). This led us to identify five different theoretical conditions, namely *TTO size*, *licensing income to inventors*, *university quality*, *presence of PoC programs*, *presence of external intermediaries*, and one outcome variable, i.e., *licensing contracts from collaborations*. Subsequently, we conducted a fsQCA to analyze relationships between gap-bridging instruments (i.e., PoC programs and external intermediaries) and the outcome of interest, as well as interactions between these instruments and other organizational factors that we identified.

The findings related to our fsQCA led us to three main conclusions. First, the sole presence of gap-bridging instruments on their own (neither PoC programs nor external intermediaries) does not represent a necessary condition for the outcome of interest that we considered. However, they assume relevance within this scheme when we view them as part of a configuration with other organizational factors that underpin university-industry collaborative activities. Second, the co-presence of gap-bridging instruments can function mostly with mega-universities with large TTOs. Furthermore, these organizations can rely on large infrastructures that can manage complex interactions between organizational factors. However, when considering small universities, even those with large TTOs, the combination of multiple gap-bridging instruments does not facilitate the emergence of licensing contracts resulting from university-industry collaborative activities. Thus, it is better to focus only on one gap-bridging instrument (i.e., external intermediaries). Three, regardless of university size, the presence of formal incentives (i.e., licensing income to inventors) and activation of gap-bridging instruments, such as PoC programs, are quasi-substitutes, i.e., universities with a higher volume of licensing resulting from university-industry collaborative activities may have either of these puzzle pieces in place, but not necessarily both.

Indeed, our study contains limitations that can provide avenues for future research on TT from the perspective of university-industry collaborative activities, as well as on organizational factors that underpin commercial outcomes. First, due to our study's exploratory aims and the characteristics of the context we considered, we narrowed our study to a specific commercial outcome resulting from university-industry interactions. Further research may investigate the configurations that led to the emergence of other outcomes that can surface in more mature TT contexts with the aim of better understanding different interaction paths and how they foster commercial consequences. Second, we only focused on the Italian context. Even though the rationale behind these activities is similar across the national contexts in which they are applied (Kochenkova et al., 2016), as previously discussed, our findings' generalizability must be considered carefully. Extending our analysis to other European or international contexts may elicit results with implications for the various regions addressed, as Munari et al. (2016) found. This may pave the way for a better understanding of the systemic view on TT that always has been recognized to foster TT impact and effectiveness (Bozeman, 2000). For example, the study could be replicated in other countries with more advanced or experienced organizational support. Furthermore, these contexts may provide different configurations of organizational factors that may be useful for larger universities with more-established TTOs. Based on our findings, we can argue that in these universities, instruments that bridge the financial gap may assume more relevance than those that bridge the managerial gap. Furthermore, we expect that more-mature TTOs may be better structured in terms of personnel to engage with the industry. Third, future qualitative studies may investigate the single cases further. As Subramanian et al. (2022) suggested, future research could conduct supplementary analysis to gain additional insights from configurational studies of this sort. Given the extensive literature that analyzes this phenomenon through quantitative methods, a qualitative approach may represent a suitable way to better examine the cases and the solutions that emerged in our study, relying on interviews and focus groups to investigate the configurations that emerged in this study further.

CRediT authorship contribution statement

Giovanni Tolin: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Andrea Piccaluga:** Writing – review & editing, Superivison, Conceptualization.

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Appendix A:. Netval survey items

Does your university/institution have a TTO (or more generally, an office that deals with technology transfer)? Please, indicate the year of establishment of this office.

Please, indicate the number of FTE (Full Time Equivalent) employees on the staff of the TTO (including collaborators) and – whether this information is available – break them down into structured and unstructured staff.

Please, state the total number of patents granted in the year and the number of active patents held in your portfolio.

Please, indicate the total number of active patents under license/option and break them down according to the year in which the licensing contracts were signed.

Break the total number of active licensing contracts depending on whether they emerge from collaborative research, contract research, and innovation consulting, none of the previous.

Indicate how many patents in the year were entrusted to intermediaries for licensing activities.

Could you indicate the criteria for the distribution of licensing revenues adopted at your university among the following categories of subjects: University, TTOs, Inventors, and Inventors Departments.

This year, has your university/body been engaged in Proof of Concept (PoC) initiatives internally developed (other than those related to national PoC calls for proposals)?

Appendix B:. Truth table

Conditions						Outcome	raw	PRI	SYM
TTO size	Licensing income to inventors	Presence of PoC programs	Presence of external intermediaries	University quality	number	Licensing contracts from collaborations	consist.	consist.	consist.
1	0	1	1	1	2	1	1	1	1
1	1	1	1	1	2	1	1	1	1
1	0	0	1	0	2	1	0.80	0.80	0.80
1	1	0	1	1	1	1	0.75	0.75	0.75
1	1	1	0	1	1	0	0.62	0.62	0.62
0	1	0	1	1	1	0	0.60	0.60	0.60
0	1	0	1	0	1	0	0.60	0.60	0.60
1	0	1	0	1	2	0	0.55	0.55	0.55
0	0	1	0	1	4	0	0.54	0.54	0.54
0	0	1	0	0	1	0	0.50	0.50	0.50
1	1	0	0	0	2	0	0.41	0.41	0.41
0	0	0	1	0	1	0	0.40	0.40	0.40
0	0	0	0	0	6	0	0.31	0.31	0.31
0	1	0	0	0	2	0	0.27	0.27	0.27
1	0	0	0	0	3	0	0.26	0.26	0.26
0	0	0	1	1	1	0	0.25	0.25	0.25
1	0	0	0	1	7	0	0.14	0.14	0.14
1	1	0	0	1	1	0	0.12	0.12	0.12
0	0	0	0	1	6	0	0.10	0.10	0.10
0	0	1	1	1	1	0	0	0	0

Note: Rows are labelled as follows: 1 membership in the set, 0 non-membership in the set. The truth table does not display 12 rows since they do not contain empirical evidence.

Appendix C:. Analysis of sufficient conditions – Complex and parsimonious solutions

Theoretical condition/ Configuration	**Complex solution**			**Parsimonious solution**
	1	**2**	**3**	**1**
TTO size	●	●	●	●
Licensing income to inventors	●		⊗	
University quality	●	●	⊗	
Presence of PoC programs			⊗	
Presence of external intermediaries	●	●	●	●
Consistency	0.90	1	0.80	0.95
Raw coverage	0.17	0. 17	0.07	0.33
Unique coverage	0.05	0.05	0.07	0. 33
Overall solution consistency	0.94			0.95
Overall solution coverage	0.30			0.33

Data availability

Data will be made available on request.

References

Abramo, G., & D'Angelo, C. A. (2022). Drivers of academic engagement in public–private research collaboration: An empirical study. *The Journal of Technology Transfer, 47*(6), 1861–1884. https://doi.org/10.1007/s10961-021-09884-z

Abreu, M., & Grinevich, V. (2013). The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. *Research Policy, 42*(2), 408–422. https://doi.org/10.1016/j.respol.2012.10.005

Alexandre, F., Costa, H., Faria, A. P., & Portela, M. (2022). Enhancing University–Industry collaboration: The role of intermediary organizations. *The Journal of Technology Transfer, 47*(5), 1584–1611. https://doi.org/10.1007/s10961-021-09889-8

Ankrah, S. N., Burgess, T. F., Grimshaw, P., & Shaw, N. E. (2013). Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit. *Technovation, 33*(2–3), 50–65. https://doi.org/10.1016/j.technovation.2012.11.001

Audretsch, D. B. (2014). From the entrepreneurial university to the university for the entrepreneurial society. *The Journal of Technology Transfer, 39*(3), 313–321. https://doi.org/10.1007/s10961-012-9288-1

Azagra-Caro, J. M., Archontakis, F., Gutiérrez-Gracia, A., & Fernández-de-Lucio, I. (2006). Faculty support for the objectives of university–industry relations versus degree of R&D cooperation: The importance of regional absorptive capacity. *Research Policy, 35*(1), 37–55. https://doi.org/10.1016/j.respol.2005.08.007

Baglieri, D., Baldi, F., & Tucci, C. L. (2018). University technology transfer office business models: One size does not fit all. *Technovation, 76*, 51–63. https://doi.org/10.1016/j.technovation.2018.05.003

Battaglia, D., Landoni, P., & Rizzitelli, F. (2017). Organizational structures for external growth of University Technology Transfer Offices: An explorative analysis. *Technological Forecasting and Social Change, 123*, 45–56. https://doi.org/10.1016/j.techfore.2017.06.017

Battaglia, D., Paolucci, E., & Ughetto, E. (2021a). Opening the black box of university Proof-of-Concept programs: Project and team-based determinants of research commercialization outcomes. *Technovation, 108*, Article 102334. https://doi.org/10.1016/j.technovation.2021.102334

Battaglia, D., Paolucci, E., & Ughetto, E. (2021b). The role of Proof-of-Concept programs in facilitating the commercialization of research-based inventions. *Research Policy, 50*(6), Article 104268. https://doi.org/10.1016/j.respol.2021.104268

Berbegal-Mirabent, J., García, J. L. S., & Ribeiro-Soriano, D. E. (2015). University–industry partnerships for the provision of R&D services. *Journal of Business Research, 68*(7), 1407–1413. https://doi.org/10.1016/j.jbusres.2015.01.023

Bessant, J., & Rush, H. (1995). Building bridges for innovation: The role of consultants in technology transfer. *Research policy, 24*(1), 97–114. https://doi.org/10.1016/0048-7333(93)00751-E

Bonaccorsi, A., & Piccaluga, A. (1994). A theoretical framework for the evaluation of university-industry relationships. *R&D Management, 24*(3), 229–247. https://doi.org/10.1111/j.1467-9310.1994.tb00876.x

Bozeman, B. (2000). Technology transfer and public policy: A review of research and theory. *Research policy, 29*(4–5), 627–655. https://doi.org/10.1016/S0048-7333(99)00093-1

Bradley, S. R., Hayter, C. S., & Link, A. N. (2013). Proof of concept centers in the United States: An exploratory look. *The Journal of Technology Transfer, 38*(4), 349–381. https://doi.org/10.1007/s10961-013-9309-8

Brescia, F., Colombo, G., & Landoni, P. (2016). Organizational structures of Knowledge Transfer Offices: An analysis of the world's top-ranked universities. *The Journal of Technology Transfer, 41*(1), 132–151. https://doi.org/10.1007/s10961-014-9384-5

Broström, A., McKelvey, M., & Sandström, C. (2009). Investing in localized relationships with universities: What are the benefits for R&D subsidiaries of multinational enterprises? *Industry and Innovation, 16*(1), 59–78. https://doi.org/10.1080/13662710902728076

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

Cesaroni, F., & Piccaluga, A. (2016). The activities of university knowledge transfer offices: Towards the third mission in Italy. *The Journal of Technology Transfer, 41*(4), 753–777. https://doi.org/10.1007/s10961-015-9401-3

Conti, A., & Gaule, P. (2011). Is the US outperforming Europe in university technology licensing? A new perspective on the European Paradox. *Research Policy, 40*(1), 123–135. https://doi.org/10.1016/j.respol.2010.10.007

Croce, A., Grilli, L., & Murtinu, S. (2014). Venture capital enters academia: An analysis of university-managed funds. *The Journal of Technology Transfer, 39*(5), 688–715. https://doi.org/10.1007/s10961-013-9317-8

D'Este, P., & Patel, P. (2007). University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research policy, 36*(9), 1295–1313. https://doi.org/10.1016/j.respol.2007.05.002

D'Este, P., & Perkmann, M. (2011). Why do academics engage with industry? The entrepreneurial university and individual motivations. *The journal of technology transfer, 36*(3), 316–339. https://doi.org/10.1007/s10961-010-9153-z

Del Sarto, N., Di Minin, A., Ferrigno, G., & Piccaluga, A. (2021). Born global and well educated: Start-up survival through fuzzy set analysis. *Small Business Economics, 56*(4), 1405–1423. https://doi.org/10.1007/s11187-019-00238-6

Del Sarto, N., Isabelle, D. A., & Di Minin, A. (2020). The role of accelerators in firm survival: An fsQCA analysis of Italian startups. *Technovation, 90*, Article 102102. https://doi.org/10.1016/j.technovation.2019.102102

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research policy, 32*(2), 209–227. https://doi.org/10.1016/S0048-7333(02)00097-5

Dolan, B., Cunningham, J. A., Menter, M., & McGregor, C. (2019). The role and function of cooperative research centers in entrepreneurial universities: A micro level perspective. *Management Decision*. https://doi.org/10.1108/MD-10-2018-1172

Escobar, E. S. O., Valle, M. B. A., & Akhmedova, A. (2020). What influences the dynamics of technology licensing in academia? The case of Spanish universities. *International Journal of Intellectual Property Management, 10*(3), 233–251. https://doi.org/10.1504/IJIPM.2020.111372

Fini, R., Rasmussen, E., Siegel, D., & Wiklund, J. (2018). Rethinking the commercialization of public science: From entrepreneurial outcomes to societal impacts. *Academy of Management Perspectives, 32*(1), 4–20. https://doi.org/10.5465/amp.2017.0206

Fiss, P. C. (2007). A set-theoretic approach to organizational configurations. *Academy of management review, 32*(4), 1180–1198. https://doi.org/10.5465/amr.2007.26586092

Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in organization research. *Academy of management journal, 54*(2), 393–420. https://doi.org/10.5465/amj.2011.60263120

Giaretta, E. (2014). The trust "builders" in the technology transfer relationships: An Italian science park experience. *The Journal of Technology Transfer, 39*(5), 675–687. https://doi.org/10.1007/s10961-013-9313-z

Giuri, P., Munari, F., Scandura, A., & Toschi, L. (2019). The strategic orientation of universities in knowledge transfer activities. *Technological Forecasting and Social Change, 138*, 261–278. https://doi.org/10.1016/j.techfore.2018.09.030

Greckhamer, T., Furnari, S., Fiss, P. C., & Aguilera, R. V. (2018). Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research. *Strategic Organization, 16*(4), 482–495. https://doi.org/10.1177/1476127018786487

Grimaldi, R., Kenney, M., & Piccaluga, A. (2021). University technology transfer, regional specialization and local dynamics: Lessons from Italy. *The Journal of Technology Transfer, 46*(4), 855–865. https://doi.org/10.1007/s10961-020-09804-7

Gulbranson, C. A., & Audretsch, D. B. (2008). Proof of concept centers: Accelerating the commercialization of university innovation. *The Journal of technology transfer, 33*(3), 249–258. https://doi.org/10.1007/s10961-008-9086-y

Halilem, N., Amara, N., Olmos-Peñuela, J., & Mohiuddin, M. (2017). "To Own, or not to Own?" A multilevel analysis of intellectual property right policies' on academic entrepreneurship. *Research Policy, 46*(8), 1479–1489. https://doi.org/10.1016/j.respol.2017.07.002

Heisey, P. W., & Adelman, S. W. (2011). Research expenditures, technology transfer activity, and university licensing revenue. *The Journal of Technology Transfer, 36*(1), 38–60. https://doi.org/10.1007/s10961-009-9129-z

Horner, S., Jayawarna, D., Giordano, B., & Jones, O. (2019). Strategic choice in universities: Managerial agency and effective technology transfer. *Research Policy, 48*(5), 1297–1309. https://doi.org/10.1016/j.respol.2019.01.015

Huyghe, A., & Knockaert, M. (2015). The influence of organizational culture and climate on entrepreneurial intentions among research scientists. *The Journal of Technology Transfer, 40*(1), 138–160. https://doi.org/10.1007/s10961-014-9333-3

Huyghe, A., Knockaert, M., Wright, M., & Piva, E. (2014). Technology transfer offices as boundary spanners in the pre-spin-off process: The case of a hybrid model. *Small Business Economics, 43*(2), 289–307. https://doi.org/10.1007/s11187-013-9537-1

Lai, W. H. (2011). Willingness-to-engage in technology transfer in industry–university collaborations. *Journal of Business Research, 64*(11), 1218–1223. https://doi.org/10.1016/j.jbusres.2011.06.026

López-Martínez, R. E., Medellín, E., Scanlon, A. P., & Solleiro, J. L. (1994). Motivations and obstacles to university industry cooperation (UIC): A Mexican case. *R&D Management, 24*(1), 017–030. https://doi.org/10.1111/j.1467-9310.1994.tb00844.x

Jonsson, L., Baraldi, E., & Larsson, L. E. (2015). A broadened innovation support for mutual benefits: Academic engagement by universities as part of technology transfer. *International Journal of Technology Management & Sustainable Development, 14*(2), 71–91. https://doi.org/10.1386/tmsd.14.2.71_1

Kaya, B., Abubakar, A. M., Behravesh, E., Yildiz, H., & Mert, I. S. (2020). Antecedents of innovative performance: Findings from PLS-SEM and fuzzy sets (fsQCA). *Journal of Business Research, 114*, 278–289. https://doi.org/10.1016/j.jbusres.2020.04.016

Kim, Y. C., Rhee, M., & Kotha, R. (2019). Many hands: The effect of the prior inventor-intermediaries relationship on academic licensing. *Research Policy, 48*(3), 813–829. https://doi.org/10.1016/j.respol.2018.11.007

Kochenkova, A., Grimaldi, R., & Munari, F. (2016). Public policy measures in support of knowledge transfer activities: A review of academic literature. *The Journal of Technology Transfer, 41*(3), 407–429. https://doi.org/10.1007/s10961-015-9416-9

Kraus, S., Ribeiro-Soriano, D., & Schüssler, M. (2018). Fuzzy-set qualitative comparative analysis (fsQCA) in entrepreneurship and innovation research–the rise of a method. *International Entrepreneurship and Management Journal, 14*(1), 15–33. https://doi.org/10.1007/s11365-017-0461-8

Lafuente, E., & Berbegal-Mirabent, J. (2019). Assessing the productivity of technology transfer offices: An analysis of the relevance of aspiration performance and portfolio complexity. *The Journal of Technology Transfer, 44*(3), 778–801. https://doi.org/10.1007/s10961-017-9604-x

Leischnig, A., Geigenmueller, A., & Lohmann, S. (2014). On the role of alliance management capability, organizational compatibility, and interaction quality in interorganizational technology transfer. *Journal of Business Research, 67*(6), 1049–1057. https://doi.org/10.1016/j.jbusres.2013.06.007

Lee, Y., Fong, E., Barney, J. B., & Hawk, A. (2019). Why do experts solve complex problems using open innovation? Evidence from the US pharmaceutical industry. *California Management Review, 62*(1), 144–166. https://doi.org/10.1177/0008125619883617

Liefner, I., Si, Y. F., & Schäfer, K. (2019). A latecomer firm's R&D collaboration with advanced country universities and research institutes: The case of Huawei in Germany. *Technovation, 86*, 3–14. https://doi.org/10.1016/j.technovation.2019.03.002

Marullo, C., Piccaluga, A., & Cesaroni, F. (2022). From knowledge to impact. An investigation of the commercial outcomes of academic engagement with industry. *Technology Analysis & Strategic Management, 34*(9), 1065–1080. https://doi.org/10.1080/09537325.2021.1947488

McAdam, M., Galbraith, B., McAdam, R., & Humphreys, P. (2006). Business processes and networks in university incubators: A review and research agendas. *Technology analysis & strategic management, 18*(5), 451–472. https://doi.org/10.1080/09537320601019578

Meseri, O., & Maital, S. (2001). A survey analysis of university-technology transfer in Israel: Evaluation of projects and determinants of success. *The Journal of Technology Transfer, 26*(1), 115–125. https://doi.org/10.1023/A:1007844530539

Micozzi, A., Iacobucci, D., Martelli, I., & Piccaluga, A. (2021). Engines need transmission belts: The importance of people in technology transfer offices. *The Journal of Technology Transfer, 46*(5), 1551–1583. https://doi.org/10.1007/s10961-021-09844-7

Moog, P., Werner, A., Houweling, S., & Backes-Gellner, U. (2015). The impact of skills, working time allocation and peer effects on the entrepreneurial intentions of scientists. *The Journal of technology transfer, 40*(3), 493–511. https://doi.org/10.1007/s10961-014-9347-x

Munari, F., & Toschi, L. (2021). The impact of public funding on science valorisation: An analysis of the ERC Proof-of-Concept Programme. *Research policy, 50*(6), Article 104211. https://doi.org/10.1016/j.respol.2021.104211

Munari, F., Rasmussen, E., Toschi, L., & Villani, E. (2016). Determinants of the university technology transfer policy-mix: A cross-national analysis of gap-funding instruments. *The Journal of Technology Transfer, 41*(6), 1377–1405. https://doi.org/10.1007/s10961-015-9448-1

Munari, F., Sobrero, M., & Toschi, L. (2017). Financing technology transfer: Assessment of university-oriented proof-of-concept programmes. *Technology Analysis & Strategic Management, 29*(2), 233–246. https://doi.org/10.1080/09537325.2016.1241874

Munari, F., Sobrero, M., & Toschi, L. (2018). The university as a venture capitalist? lieing instruments for technology transfer. *Technological Forecasting and Social Change, 127*, 70–84. https://doi.org/10.1016/j.techfore.2017.07.024

Muscio, A. (2010). What drives the university use of technology transfer offices? Evidence from Italy. *The Journal of Technology Transfer, 35*(2), 181–202. https://doi.org/10.1007/s10961-009-9121-7

Muscio, A., & Ramaciotti, L. (2019). How does academia influence Ph. D. entrepreneurship? New insights on the entrepreneurial university. *Technovation, 82*, 16–24. https://doi.org/10.1016/j.technovation.2019.02.003

Muscio, A., Ramaciotti, L., & Rizzo, U. (2017). The complex relationship between academic engagement and research output: Evidence from Italy. *Science and Public Policy, 44*(2), 235–245. https://doi.org/10.1093/scipol/scw057

O'Shea, R. P., Allen, T. J., Chevalier, A., & Roche, F. (2005). Entrepreneurial orientation, technology transfer and spinoff performance of US universities. *Research policy, 34*(7), 994–1009. https://doi.org/10.1016/j.respol.2005.05.011

Pappas, I. O., & Woodside, A. G. (2021). Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing. *International Journal of Information Management, 58*, Article 102310. https://doi.org/10.1016/j.ijinfomgt.2021.102310

Passarelli, M., Landi, G. C., Cariola, A., & Sciarelli, M. (2020). Open innovation in the new context of proof of concepts: Evidence from Italy. *European Journal of Innovation Management*. https://doi.org/10.1108/EJIM-02-2020-0052

Perkmann, M., & Walsh, K. (2008). Engaging the scholar: Three types of academic consulting and their impact on universities and industry. *Research policy, 37*(10), 1884–1891. https://doi.org/10.1016/j.respol.2008.07.009

Perkmann, M., King, Z., & Pavelin, S. (2011). Engaging excellence? Effects of faculty quality on university engagement with industry. *Research Policy, 40*(4), 539–552. https://doi.org/10.1016/j.respol.2011.01.007

Perkmann, M., Salandra, R., Tartari, V., McKelvey, M., & Hughes, A. (2021). Academic engagement: A review of the literature 2011-2019. *Research Policy, 50*(1), Article 104114. https://doi.org/10.1016/j.respol.2020.104114

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'este, P., & Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research policy, 42*(2), 423–442. https://doi.org/10.1016/j.respol.2012.09.007

Pohle, A., Villani, E., & Grimaldi, R. (2022). Personnel motivation in knowledge transfer offices: The role of university-level and organizational-level antecedents. *Technological Forecasting and Social Change, 181*, Article 121765. https://doi.org/10.1016/j.techfore.2022.121765

Ponomariov, B. L. (2008). Effects of university characteristics on scientists' interactions with the private sector: An exploratory assessment. *The Journal of Technology Transfer, 33*(5), 485–503. https://doi.org/10.1007/s10961-007-9047-x

Ragin, C. C. (2009). *Redesigning social inquiry: Fuzzy sets and beyond*. University of Chicago Press.

Rasmussen, E., & Sørheim, R. (2012). How governments seek to bridge the financing gap for university spin-offs: Proof-of-concept, pre-seed, and seed funding. *Technology Analysis & Strategic Management, 24*(7), 663–678. https://doi.org/10.1080/09537325.2012.705119

Roessner, D., Bond, J., Okubo, S., & Planting, M. (2013). The economic impact of licensed commercialized inventions originating in university research. *Research Policy, 42*(1), 23–34. https://doi.org/10.1016/j.respol.2012.04.015

Rossi, F., Rosli, A., & Yip, N. (2017). Academic engagement as knowledge co-production and implications for impact: Evidence from Knowledge Transfer Partnerships. *Journal of Business Research, 80*, 1–9. https://doi.org/10.1016/j.jbusres.2017.06.019

Scandura, A., & Iammarino, S. (2022). Academic engagement with industry: The role of research quality and experience. *The Journal of Technology Transfer, 47*(4), 1000–1036. https://doi.org/10.1007/s10961-021-09867-0

Schneider, C. Q., & Wagemann, C. (2010). Standards of good practice in qualitative comparative analysis (QCA) and fuzzy-sets. *Comparative sociology, 9*(3), 397–418. https://doi.org/10.1163/156913210X12493538729793

Schoen, A., & van Pottelsberghe de la Potterie, B., & Henkel, J.. (2014). Governance typology of universities' technology transfer processes. *The Journal of Technology Transfer, 39*(3), 435–453. https://doi.org/10.1007/s10961-012-9289-0

Seeber, M., Alon, I., Pina, D. G., Piro, F. N., & Seeber, M. (2022). Predictors of applying for and winning an ERC Proof-of-Concept grant: An automated machine learning model. *Technological Forecasting and Social Change, 184*, Article 122009. https://doi.org/10.1016/j.techfore.2022.122009

Siegel, D. S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Research policy, 32*(1), 27–48. https://doi.org/10.1016/S0048-7333(01)00196-2

Slaughter, S., & Leslie, L. L. (2001). Expanding and elaborating the concept of academic capitalism. *Organization, 8*(2), 154–161.

Subramanian, A. M., Nishant, R., Van De Vrande, V., & Hang, C. C. (2022). Technology transfer from public research institutes to SMEs: A configurational approach to studying reverse knowledge flow benefits. *Research Policy, 51*(10), Article 104602. https://doi.org/10.1016/j.respol.2022.104602

Tolin, G., & Piccaluga, A. (2024). Managing proof-of-concept (PoC) programs in public research organizations: A dynamic capabilities perspective. *European Journal of Innovation Management, 27*(9), 516–541. https://doi.org/10.1108/EJIM-09-2023-0751

Van Looy, B., Landoni, P., Callaert, J., Van Pottelsberghe, B., Sapsalis, E., & Debackere, K. (2011). Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. *Research policy, 40*(4), 553–564. https://doi.org/10.1016/j.respol.2011.02.001

Van Wijk, R., Jansen, J. J., & Lyles, M. A. (2008). Inter-and intra-organizational knowledge transfer: A meta-analytic review and assessment of its antecedents and consequences. *Journal of management studies, 45*(4), 830–853. https://doi.org/10.1111/j.1467-6486.2008.00771.x

Villani, E., Rasmussen, E., & Grimaldi, R. (2017). How intermediary organizations facilitate university–industry technology transfer: A proximity approach. *Technological forecasting and social change, 114*, 86–102. https://doi.org/10.1016/j.techfore.2016.06.004

Vis, B. (2012). The comparative advantages of fsQCA and regression analysis for moderately large-N analyses. *Sociological Methods & Research, 41*(1), 168–198. https://doi.org/10.1177/0049124112442142

Weckowska, D. M. (2015). Learning in university technology transfer offices: Transactions-focused and relations-focused approaches to commercialization of academic research. *Technovation, 41*, 62–74. https://doi.org/10.1016/j.technovation.2014.11.003

Woodside, A. G. (2013). Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research, 66*(4), 463–472. https://doi.org/10.1016/j.jbusres.2012.12.021

Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. *Research policy, 37*(8), 1205–1223. https://doi.org/10.1016/j.respol.2008.04.021

Wu, W. (2010). Managing and incentivizing research commercialization in Chinese Universities. *The journal of technology transfer, 35*(2), 203–224. https://doi.org/10.1007/s10961-009-9116-4

Wu, Y., Welch, E. W., & Huang, W. L. (2015). Commercialization of university inventions: Individual and institutional factors affecting licensing of university patents. *Technovation, 36*, 12–25. https://doi.org/10.1016/j.technovation.2014.09.004

Ylijoki, O. H. (2003). Entangled in academic capitalism? A case-study on changing ideals and practices of university research. *Higher education, 45*, 307–335.

Zhao, Z., Broström, A., & Cai, J. (2020). Promoting academic engagement: University context and individual characteristics. *The Journal of Technology Transfer, 45*(1), 304–337. https://doi.org/10.1007/s10961-018-9680-6

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