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DOCTORAL STUDENTS IN THE ENTREPRENEURIAL UNIVERSITY: AN UNTAPPED POTENTIAL?

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Ph.D. Student: ***Matteo Opizzi***

Supervisor ***Prof. Michela Loi***

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CONTENT

CHAPTER 1

INTRODUCTION

The present thesis is entirely devoted to shedding light on how doctoral students' entrepreneurial initiatives emerge. In so doing, it addresses the need to study doctoral students as a group of high-educated professionals who have great entrepreneurial potential, which can be triggered by the universities in which they work, thus contributing to social and economic growth. The dissertation is grafted within the conceptual framework of the entrepreneurial university, which is a higher education institution that puts a significant effort into creating the conditions for all academic actors to transfer knowledge and technologies produced through research to the outside world with the use of entrepreneurial tools (Guerrero & Urbano, 2012). Understanding the evolution of this kind of institution and the priorities addressed through its policies and actions is vital for contextualizing the present work, and it is the reason why the frame of reference opens by providing the readers with a detailed section to describe the concept and its history. In turn, to understand fully which activities are pursued by the entrepreneurial universities, the concept of third mission has to be introduced and detailed, that consists in generating a social and economic impact on the local communities and implies higher education institutions to be conducive to the instances from the external stakeholders (Compagnucci & Spigarelli, 2020). However, a relevant effort is required at the individual level from all academic actors to actually realize the third mission, albeit with their different characteristics (Bercovitz & Feldman, 2008). In studying how academics decide to become entrepreneurs, this work focuses purely on doctoral students because of their being a particularly promising entrepreneurial potential resulting from a shift in the consideration of what doctoral degree is (Mars & Moravec, 2022; Muscio & Ramaciotti, 2019).

1. RESEARCH OBJECTIVES

An ancient Hindu metaphor tells that when six blind men were asked to describe an elephant after touching it, they provided very different descriptions after focusing on one very specific part of the animal and neglecting the others (Quigley, 1974). The present thesis assumes that the same fate would attend research on entrepreneurial initiatives within the university if the multiplicity of factors involved at various levels were not included in the explanation (Fini, Rasmussen, Wiklund & Wright, 2020; Rasmussen, 2011). Especially within the framework of the entrepreneurial university, neither institutional support nor micro-level factors influencing perceptions cannot be excluded to reach a comprehensive understanding of the phenomenon, because of its multilevel nature (Balven, Fenters, Siegel & Waldman, 2018). Interestingly, some recent empirical works have attempted to highlight the complexity of entrepreneurial initiatives enacted by academic actors (Galati, Bigliardi & Passaro, 2020; Hayter, Fischer & Rasmussen, 2021), with a multiplicity of factors considered to explain the emergence of entrepreneurship at the individual, university, and institutional levels (Neves & Brito, 2020). Huyghe, Knockaert, & Obschonka (2016) represent a significant example of a micro-level perspective to address pre-foundational dynamics within academia: they considered scientists' passion and identity to explain the formation of their entrepreneurial intentions. On the other hand, university-level perspectives have addressed both the social context surrounding scientists (Goethner, Obschonka, Silbereisen & Cantner, 2012; Klingbeil, Semrau, Ebers & Wilhelm, 2019) and the institutional support provided by the university (Bolzani, Munari, Rasmussen & Toschi, 2020; Nicolaou & Souitaris, 2016). Interestingly, typical structures of the entrepreneurial university, such as the technology transfer offices, incubators, and entrepreneurship training courses, have been widely studied as enablers of entrepreneurship among tenured professors (Rothaermel & Thursby, 2005; York & Ahn, 2012). However, the vast majority of published works

assumes that these forms of support have actually a role in nurturing entrepreneurship among university players, although some dissenting voices have questioned their effectiveness (e.g., Huyghe, Knockaert, Piva, & Wright, 2016). On the other side, it appeared somewhat surprising to discover that the need to generate social impact with research has not been studied so far to explain academics' entrepreneurial decision. There are only two exceptions to this general lack. On one hand, Ramos-Vielba, Sánchez-Barrioluengo, & Woolley, (2016) identified scientists' desire to generate social impact as a determinant of collaboration with external partners. On the other, Iorio, Labory, & Rentocchini (2017) found a relationship between scholars' motivations and diversity and the frequency of their knowledge transfer activities. The common element between these two works lies in the assumption that scientists can be motivated by the desire to use their research to improve the world in which they live. This is consistent with Mertonian principles that guide scientific research (Merton, 1973), as well as with published works that seek to understand what motivates scholars to do research (Jindal-Snape & Snape, 2006; Ryan, 2014). In light of this, it is wondered why this intrinsic drive should not also be an inner push for scientists in knowledge transfer activities, in a perspective of alignment between institutional third mission and individual priorities related to generating a social impact with research (Bercovitz & Feldman, 2008). The idea of a university that is responsive to instances coming from the external environment is well established from a theoretical and empirical point of view (Breznitz & Feldman, 2012; Lahikainen & Kolhinen, 2019), but it is still unclear whether and to what extent researchers at the individual level feel the essence of the third mission as an individual priority. The present thesis assumes that shedding light on this aspect would be insightful from both theoretical and empirical points of view, especially with regard to doctoral students, who walk the line between the "ivory tower" and the outside world.

This work addresses recent claims for a multilevel and holistic approach, which takes into consideration the multiplicity of factors and micro and macro level which affect the phenomenon, to the study of entrepreneurial dynamics in academia (Rasmussen, 2011; Wood, 2011). In so doing, the thesis explores the third mission at both the institutional and individual levels. Understanding the dynamics behind the arising of doctoral students' entrepreneurial initiatives is extremely relevant to understand how this target might contribute with its potential to the pursuit of entrepreneurial universities' third mission by acting as a connection between the ''ivory tower'' and the external environment. Thus, it remains unclear whether, to what extent, and how entrepreneurial university structures actually support the process of doctoral students' entrepreneurial decision (Bienkowska, Klofsten & Rasmussen, 2016). The mechanisms linking institutional support to the decision to become entrepreneurs deserve attention for two main reasons. (i) This group might be less likely to be reached by the policies and facilities enacted by universities to promote entrepreneurship (Bienkowska et al., 2016). Indeed, these forms of support have been originally designed for tenured scholars and hardly ever consider the different nuances of expectations, motivations, and identity issues that differentiate academic actors (Hmieleski & Powell, 2018; Muscio & Ramaciotti, 2019). (ii) Doctoral students have greater entrepreneurial potential than tenured faculty, being less influenced by social dynamics that act as inhibitors for entrepreneurial initiatives due to a less defined professional and social identity (Colombo & Piva, 2012; Philpott, Dooley, Oreilly & Lupton, 2011). As a result, their transition from young members of academia to entrepreneurs is still a black box (Muscio & Ramaciotti, 2019). In particular, there is a lack of in-depth understanding of the mechanisms linking multiple individual factors and those related to the academic and extra-academic environment. More specifically, drawing from previous studies, this thesis aims to address (i) the multilevel nature of entrepreneurship among academic players, which involves micro and macro factors (Fini, Rasmussen, Wiklund & Wright, 2019, 2020;

Rasmussen, 2011); (ii) the precise role of institutional support provided by entrepreneurial universities in nurturing entrepreneurship among doctoral students (Bergmann, Hundt & Sternberg, 2016; Bienkowska et al., 2016); (iii) whether, to what extent and how individual motivations come to play in the aforementioned decision-making process (Balven et al., 2018; Lam, 2011), and how they are related to other individual and institutional factors.

In light of this, the overall purpose of this thesis is to shed light on the mechanisms that underly and link the multiplicity of factors involved in doctoral students' decision to become entrepreneurs. Multiple burning questions emerged by looking at the current body of knowledge, which describe the complexity behind the emergence of Ph.D. entrepreneurship. For this reason, a broad research question might be indicative to summarize the whole research in the present dissertation, that is: How do doctoral students decide to become entrepreneurs? In addressing this broad research question, the present thesis is articulated around the three specific research objectives described below.

(i) To develop a research agenda for future research on academic entrepreneurship, whose knowledge is fragmented, and current inquiry lacks a holistic understanding of the phenomenon, which is necessary for reaching a sound theoretical explanation (Shepherd & Suddaby, 2017; Wood, 2011).

(ii) To understand whether and to what extent the university support system and the individual human capital and motivations influence the arising of Ph.D. entrepreneurship. In so doing, the thesis aims to shed light on whether and how individual dimension and entrepreneurial support provided by universities nurture the arising of Ph.D. entrepreneurship.

(iii) To dig deeper into the multiplicity of factors involved in the early stage of Ph.D. entrepreneurship, by understanding how doctoral students' entrepreneurial initiatives emerged. In this vein, the dissertation aims to decode not only the ingredients but also the recipe that lead to their entrepreneurial decision.

2. FRAME OF REFERENCE

This paragraph provides the theoretical framework of the thesis, assuming the necessity to clarify how the contribution is positioned in the scholarly conversation (Shepherd & Suddaby, 2017). First, the emergence and evolution of the entrepreneurial university concept are recounted, up to the most recent contributions. Next, the ongoing debate on the university's third mission is outlined, and the new role of universities as engines of social and economic growth is presented. In light of this, it is provided a conceptual and empirical baseline on the potential of entrepreneurship among academic actors as a tool to generate social and economic growth by leveraging research results and specific competencies. The following section describes how the role of doctorate holders is changed in recent times, as a consequence of the arising of the knowledge society and the new role of universities within local communities. The final section exposes doctoral students' great entrepreneurial potential which makes them an ideal bridge between the "ivory tower" and the real world. It is done by presenting the specific characteristics that differentiate them from other targets.

2.1 The entrepreneurial university – a historical and conceptual overview

In the context of the knowledge society, intangible assets such as specific skills and know-how are more important than tangible means of production (Audretsch, 2009; Drucker, 1993). With these premises, knowledge acquires vital importance for long-term economic growth (Romer, 1986), and this has made universities increasingly relevant as producers of new research (Ghio, Guerini,

Lehmann & Rossi-Lamastra, 2015; Madruga, 2008). Thus, modern universities have responded to the push from external stakeholders by engaging in an organizational transformation that embraces an entrepreneurial path (Breznitz & Feldman, 2012; Etzkowitz, 2003; Guerrero & Urbano, 2012).

While two hundred years ago Cardinal John Newman defined the ideal university as one devoted to seeking knowledge as an end in itself (Klofsten & Jones-Evans, 2000), the situation has drastically changed in the recent year, leading to the normalization of the interactions between the "ivory tower" and the external stakeholders. The first steps toward the entrepreneurial university were taken after World War II, as a response to a time-tested wartime collaboration between universities and private industry for military development (Etzkowitz, Webster, Gebhardt & Cantisano-Terra, 2000). Bush's (1945) statement is one of the first documents that emphasizes the vital role of science in making the world a better place, ushering in a line of thinking that would spread to more and more scholars. A few years later, the first embryonic conceptualization of the entrepreneurial university paradigm emerged concretely when, in 1963, Chancellor Clark Kerr of the University of California coined the term "multiversity". By this term, he meant a university that is heavily involved in the economy and culture of society (Breznitz & Feldman, 2012). However, it is only recently, around the turn of the century, that the idea of universities as active players in local development has taken shape (Goddard & Chatterton, 1999). As a result, on one side the number of university students drastically increased worldwide, gradually impacting the innovation system in which they operate (Urbano & Guerrero, 2013): it rose from 50 million in 1990 to 100 million in 2000, until approximately 210 million in 2015 (Strassel, 2018). On the other, universities have started to provide a number of facilities to facilitate knowledge transfer through academic actors' entrepreneurial initiatives (Guerrero & Urbano, 2012).

Given the differences between one organization and another, as well as the distinctive contexts in which they are embedded, it is not an easy task to unambiguously identify which precise characteristics an entrepreneurial university is supposed to have in order to be defined as such (Cerver-Romero, Ferreira & Fernandez, 2021). However, in the present thesis, it is embraced the definition provided by Guerrero, Urbano, Cunningham, & Organ (2014, p. 415) as "a natural incubator that tries to provide a supportive environment in which the university community can explore, evaluate and exploit ideas that could be transformed into social and economic entrepreneurial initiatives". Thus, in order to be entrepreneurial, universities need to be responsive to external stakeholders' issues and needs, whether private businesses, non-profit organizations or public bodies (Breznitz & Feldman, 2012). In meeting the challenge of becoming more responsive to social issues, promoting public welfare and social equality (Subotzky, 1999), institutional boundaries have become more permeable to the external stakeholders' needs (Etzkowitz, 2013; Zhao, Broström & Cai, 2020), being anchored to local dimension as extremely relevant players for development (Deem, 2001). In conclusion, the modern conceptualization of the entrepreneurial university sees entrepreneurship as a tool to facilitate the dissemination of knowledge in the surrounding environment (Fini, Rasmussen, Siegel & Wiklund, 2018).

2.2 University's third mission: an emerging and evolving priority

Universities have gone through two "academic revolutions" during the long evolution throughout their history that led them to become the universities as they are today (Etzkowitz, 2003). The first occurred in the 19th century and saw the introduction of research, in adjunct to teaching, as one of the main activities of universities (Jencks & Riesman, 1967). At the end of the same century, two worlds apparently distant as academia and private industry began to converge, and the second academic revolution occurred. It transformed universities into institutions simultaneously pursuing

education, research, and local growth (Loi & Di Guardo, 2015). Recognizing their role as active players in the surrounding communities, they incorporated "economic development […] as an academic function along with teaching and research" (Etzkowitz, 1998, p. 833). In doing so, they have begun to organize and participate in collaborative initiatives with neighboring stakeholders to translate the knowledge produced into social and economic impact (Agasisti, Barra & Zotti, 2019; Breznitz & Feldman, 2012).

Traditionally, the most effective way to facilitate knowledge and technology transfer has been identified with the creation of academic spin-offs, new companies created to commercialize research results, or specific expertise developed within academia (Shane, 2004). Recently, new perspectives of inquiry have emerged that challenge the definition of "entrepreneurship" in academia, ultimately conceived as any initiative that facilitates the beneficial spillover of knowledge from the university to external stakeholders (Johannisson, 2022; Mars & Rios-Aguilar, 2010). In this sense, it encompasses a broader range of university-led projects that foster social and economic development (Compagnucci & Spigarelli, 2020; Sam & Van-Der-Sijde, 2014). Recently, the focus has been switched more to social impact-oriented initiatives than on entrepreneurial activities per sè (Fini et al., 2018; Subotzky, 1999). An insightful example is represented by Dodd, Graves & Hentzen, (2022), that highlighted the need for these institutions to foster social inclusion in their local communities, emphasizing the social role they play. Ultimately, academic actors - tenured professors, graduate and undergraduate students, and technical staff - are encouraged to act entrepreneurially to contribute to the pursuit of the university's third mission (Bercovitz & Feldman, 2008; Etzkowitz & Zhou, 2008). While being aware of the relevance of the external environment in fostering academics' entrepreneurial initiatives (Goethner et al., 2012), the present thesis mostly focuses on the interplay between the individual and university dimension to shed light on how the

entrepreneurial university comes into play in the arising of entrepreneurial phenomena among its members.

2.3 Doctoral education: classic and ascending perspectives

The doctorate is the most advanced degree obtainable in tertiary education worldwide (Unesco, 2012). The number of people who choose a doctoral program is rather small: 650.800 people were enrolled in a doctoral program in Europe at the end of 2020 [1], representing about .14 percent of the population (source: Eurostat online database).

The classical view of the scientist locked in laboratories and isolated from the needs of the outside world is now outdated (Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011), and this transition has inevitably challenged the role of doctoral education. In fact, it is no longer solely viewed as the route to an academic career, but rather as the highest qualification that creates highly specialized profiles that can contribute extensively to the advancement of society in many ways (Auriol, 2010; Shin, Kehm, & Jones, 2018). As a result, the role of doctoral students and graduates in society has changed dramatically (Bienkowska et al., 2016). In response to this paradigm shift, universities endeavor to shape doctoral graduates who are not only future scholars, but also players in social and economic change (Klofsten, Jones-Evans & Pereira, 2021; Rippa, Landi, Cosimato & Turriziani, 2022), assuming that they have the potential to transform knowledge produced within the ivory tower into social and economic impact through entrepreneurship (Fini et al., 2018; Lean, 2012). This target possesses specific characteristics that make them high-potential entrepreneurs, becoming the ideal bridge between the university and the outside world (Muscio, Shibayama & Ramaciotti, 2021). First, doctoral students no longer receive an exclusively scientific education, but

[1]Retrieved on 05.11.2022 from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Number_of_tertiary_education_students_by_sex_and_level_of_education,_2020_(1_000)_ET2022.png

their training increasingly has practical characteristics that help them navigate even in contexts outside academia (Klofsten et al., 2021; Rippa et al., 2022). In addition, their young average age and willingness to take more risks than tenured academics makes them more likely to launch new initiatives (Boh, De-Haan & Strom, 2016; Hakala, 2009; Lean, 2012). Finally, because there are no defined career paths, this target audience is apt to develop a professional identity that can have entrepreneurial characteristics (Pretorius & Macaulay, 2021; Sweitzer, 2009). For all these reasons, it is argued that this group of academic actors deserves to be explored separately from university faculty and students. Currently, it is estimated that about half of doctoral students will be employed in professions outside academia (Sauermann & Roach, 2012), implying that not all doctorate holders can, and will, aspire to become scholars (Gould, 2015). It is a fact that doctoral students and Ph.D. graduates have great potential to create innovations, given their vast scientific knowledge and research experience (De-Haan, Shwartz & Gómez, 2019; Pretorius & Macaulay, 2021). However, scholarly attention to the entrepreneurial initiatives put in place by this target has so far been rather low (Dooley & Kenny, 2015; Muscio et al., 2021).

2.4 Doctoral students as high-potential entrepreneurs

Doctoral students are a target with great entrepreneurial potential, due to a number of reasons (Klofsten et al., 2021). The first is that doctoral students receive a practical as well as academic education, producing professionals who may be very helpful in a number of circumstances outside academia (Klofsten et al., 2021; Rippa et al., 2022). This target is also suitable to create a professional identity that may include entrepreneurial traits because there is not a well-defined career path (Pretorius & Macaulay, 2021; Sweitzer, 2009). Last but not least, this group is particularly sensitive to the instances of external actors, and thus has great potential in directing research projects toward social needs that need to be solved (Mars & Moravec, 2022).

3. THEORETICAL IMPLICATIONS

In addressing the aforementioned research objectives, the present dissertation contributes to theory building mainly in two ways. First, it contributes to the scientific debate around institutional support for doctoral students' entrepreneurial initiatives (Bienkowska, Klofsten & Rasmussen, 2016; Hayter, Lubynsky, & Maroulis, 2017; Muscio et al., 2021) by improving the understanding of whether and how - and in some sense questioning - the effectiveness of the stand-alone institutional support in fostering the arising of Ph.D. entrepreneurship (e.g., Guerrero, Urbano, & Gajón, 2020). In this way, this thesis provides an in-depth analysis of when and in which way the university support system facilitates doctoral students in concretizing their decision to become entrepreneurs by creating new organizations to leverage their research or specific competencies matured within academia, which is the stepping stone to founding a new business (Thompson, 2009). Second, this thesis contributes to the understanding of the dynamics underlying the target's entrepreneurial decision to use their research and competencies to address societal issues through entrepreneurship (Mars & Moravec, 2022; Rizzo, 2015). In doing so, the role of pro-social motivation, human capital, and the university support system is proposed and tested as enablers of their decision, and then an in-depth picture of the factors involved at different levels – individual and contextual level -and the dynamics that underlying them is provided.

4. RESEARCH APPROACH: AN OVERVIEW

4.1 The Italian setting

The present dissertation entirely draws on data collected in Italy. As demonstrated by the large body of research in academic entrepreneurship based on similar data (Meoli, Fini, Sobrero & Wiklund, 2020; Muscio et al., 2021; Rizzo, 2015), this context is useful for drawing conclusions that can be applied to other similar nations (Meoli et al., 2020). Italian universities have been actively involved in knowledge and technology transfer activities toward external partners since the early 1990s (Iacobucci, Micozzi & Micucci, 2013). Today, most Italian universities have a technology transfer office and an increasing number of them dispose of an incubator (Balderi, Butelli, Conti, Di Minin & Piccaluga, 2007; Netval, 2021). In general, it can be said that these universities, like all European universities, provide tenured staff, undergraduates, and doctoral students with various forms of support for entrepreneurship (Cesaroni & Piccaluga, 2016; Loi & Di Guardo, 2022). In addition, like other European nations, Italian regulation recognizes the doctorate as the higher level of education, with the minimum duration of the doctoral program regulated by law at three years (DM 45/2013). The number of doctoral students enrolled in Italian universities (N = 31.533 in 2020, source: Eurostat online database) is below the European trends and corresponds to about .06 percent of the country's population. However, the new role of doctoral graduates within and outside academia have been recognized by Italian government, in recent years public authorities have begun to act for valorizing the doctorate in a perspective of generating economic and social growth (Brait, De-Vitiis, Petrillo, Russo, Strozza & Ungaro, 2009). For example, with Decree Law 179/2012, a specific requirement was introduced for innovative start-ups: at least one-third of the shareholders must have a Ph.D. (Manzo & Pais, 2017). Nowadays, only 40.9 percent of PhDs hold a position in academia, such as a postdoc or assistant professor (ISTAT, 2018). The report on the employment

status of doctoral holders provided by Almalaurea (2022, b) is illuminating to understand the working conditions of this target. By looking at these date, it can be argued that holding a Ph.D. also offers prospects outside academia, as 93.8 percent of graduates have a job one year after the degree. More specifically, 65.8 percent of PhDs have a job in the public sector, 31.6 work for a private company, and the remaining 2.4 percent are employed in the non-profit sector. Furthermore, one year after earning a doctorate, 82.8 percent of those employed are in an intellectual occupation, scientific and highly specialized profession: specifically, 43.8 percent are researchers or graduate technicians in the university while the remaining 39.0 percent are in another intellectual, scientific and highly specialized profession (Almalaurea, 2022b). One year after earning a doctorate, 82.8 % of those employed are in an intellectual occupation, scientific and highly specialized profession: specifically, 43.8 percent are researchers or graduate technicians in the university while the remaining 39.0 percent are in another intellectual, scientific and highly specialized profession. These patterns show that doctoral students in Italy, like their colleagues worldwide, do not take academic careers for granted. Compared to Ph.D. graduates, the limited number of tenure-track positions represents an external push for PhDs to look outside academia. In a recent survey provided by Almalaurea (2022a), it was found that only one in three Ph.D. students in Italy intends to pursue an academic career, and the possibility of embracing an academic career does not appear entirely ruled out. Moreover, Italy has a structural limitation in terms of employability of R&D personnel in private companies, given the overall low private investment in basic and applied research: Italian private R&D spending is among the lowest in Europe: 0.93 percent of gross domestic product, compared to a European average of 1.52 percent [2]. Inevitably, this limit makes it challenging for researchers to be absorbed into the job market outside academia.

[2]Retrieved on 05.11.200 from:
https://ec.europa.eu/eurostat/databrowser/view/RD_E_BERDINDR2__custom_3700137/default/table?lang=en

Surprisingly, Rizzo's (2015) findings from a sample of spin-off founders in a specific Italian region like Emilia Romagna highlight this structural limitation as the main individual motivation for PhDs to create a spin-off for bringing their scientific expertise to the market.

4.2 Research design

In the present thesis, both deductive and inductive reasoning is used to approach the phenomenon of Ph.D. entrepreneurship (Okasha, 2002). Coherently with seminal literature debating different epistemological paradigms in social science (Deshpande, 1983; Patton & Patton, 1980; Rist, 1977), it assumes that there is not an absolute opposition and mutual exclusion between inductive and deductive reasoning, but these two epistemological perspectives are complementary. The empirical foundations of research in entrepreneurship are based on deductive approaches whose goal was to test theoretical models borrowed from other disciplines (Grant & Perren, 2002). However, recently there have been several claims for more extensive use of inductive perspectives for theory-building in entrepreneurship as an autonomous field of study (Hlady-Rispal, Fayolle & Gartner, 2021; Javadian, Dobratz, Gupta, Gupta & Martin, 2020; Van-Burg, Cornelissen, Stam & Jack, 2020). In addressing these claims, the empirical research in this thesis begins with a logical-positivist approach aiming at verifying a conceptual model drawn from existing theory, although derived from different knowledge fields such as organizational behavior, social entrepreneurship, and academic entrepreneurship. Consequently, the need to observe and explore the phenomenon with no restrictions has been recognized as a necessary step toward theory-building about the phenomenon. This is why empirical inquiry in this thesis continues with a phenomenological approach to studying the emergence of Ph.D. entrepreneurship. More precisely, the first effort has been put into bringing order to the existing body of knowledge and highlighting knowledge gaps that need to be addressed in future research. Consequently, the empirical investigation begins with

a quantitative approach, in which a conceptual model is proposed, based on the existing literature. It has been tested on a sample of 261 doctoral students enrolled in Italian universities through Partial Least Square - Structural Equation Modeling (PLS-SEM) using SmartPls4® software (Hair, Hult, Ringle & Sarstedt, 2017). Then, data collected through interviews with a sample of 28 Ph.D. founders have been qualitatively analyzed following Gioia, Corley, & Hamilton's (2013) methodological suggestions with the use of NVivo® 13 software.

5. THE DISSERTATION: A GENERAL OUTLINE

The present thesis is the main result of the author's learning process along his doctoral journey. As it is structured on one conceptual and two empirical papers, hopefully, the reader will be able to reconstruct the author's personal growth as a young researcher and grasp an increasing awareness of the topic. This whole thesis is the main result of the candidate's learning process throughout the doctoral journey, which lead him to start the inquiry to unpack academic entrepreneurship in general, discovering along research that the specific target of doctoral students deserved to be studied, because of their potential for universities' third mission. In line of this, the SLR began with a broad research purpose – to unpack academic entrepreneurship as the process of creating academic spin-offs. Later on, the need to understand the multiple shades of entrepreneurial initiatives put in action by doctoral students lead to go beyond the mere spin-off creation to embrace a broader lens of analysis in order to capture doctoral students' entrepreneurial dynamics in their entirety.

Overall, the thesis is structured into five chapters. It opens with the present general introduction on the topic and a general layout of the subsequent sections. In the second chapter, a

solid conceptual foundation for the entire work is provided by means of a systematic literature review (SLR) to address the process of academic entrepreneurship which considered both the role of individual factors and the surrounding social and organizational context along the process unfolding. By analyzing data through thematic analysis and narrative synthesis, a comprehensive understanding of the state of art of the entrepreneurial process in academia is achieved. The process has been articulated into three entrepreneurial outcomes - opportunity identification, entrepreneurial intentions, and spin-off creation - and the findings shed light on what is known so far about the role of individual and socio-organizational variables along the entrepreneurial process. Finally, a research agenda is developed around three questions, which pave the way for the following empirical work.

The third chapter aims to shed light on the origin of Ph.D. entrepreneurship, conceived as doctoral students' decision to become entrepreneurs. To achieve this, a conceptual model is proposed and empirically tested, that integrates the individual dimension with the university support system. Human capital is proposed as an antecedent of doctoral students' entrepreneurial alertness, and the university support system is hypothesized to reinforce the cognitive transition from entrepreneurial alertness and doctoral students' decision to become entrepreneurs, and its role is questioned in favor of their pro-social motivation. What emerged from the empirical analysis is that the decision of Ph.D. students to become entrepreneurs is a multifaceted phenomenon in which different factors at diverse levels come into play. It made necessary a deeper investigation for identifying the many factors involved and the complex dynamics behind this decision. Addressing this issue is the purpose of the following empirical work, which constitutes the fourth chapter of the present thesis. An inductive approach is adopted to analyze the complexity of Ph.D. entrepreneurship (Shepherd & Suddaby, 2017), and what emerged is a prominent role of the

individual dimension and social context, represented by the other individuals who socially interact with Ph.D. founders at different levels, such as friends, colleagues, and supervisors. Overall, these findings highlighted a marginal role of the university support system.

The thesis concludes with a general discussion of the results obtained in the three works. The final chapter discusses an integrative overview of the results and theoretical implications overall that emerged from the thesis. In doing so, it is described how the thesis contributes to the scholarly debate around entrepreneurial university and Ph.D. entrepreneurship. Finally, the findings' practical implications are discussed.

CHAPTER 2

REFRAMING SPIN-OFF CREATION AS AN UNIVERSITY-EMBEDDED PROCESS: A SYSTEMATIC LITERATURE REVIEW

ABSTRACT

As the social information processing perspective asserts that individual behavior results from a combined effect of socio-organizational context and individual-level factors, the present chapter aims to shed light on how individual dimension and university-level context influence the spin-off creation process.

Through a systematic review of the literature based on the PRISMA protocol and methodological reflection developed in management research, organizational context and individual factors emerge as critical factors that have been mainly studied as separate issues.

A static view of academic spin-off creation emerges, with a clear imbalance in emphasis on entrepreneurial intentions versus opportunity identification. A clear understanding of the mechanisms linking the various entrepreneurial outcomes still needs to be improved in the academic context.

A research agenda is then proposed highlighting the need to understand the origin of the entrepreneurial path, the role of entrepreneurial opportunity in relation with entrepreneurial intentions and spin-off creation, and the mechanisms connecting organizational and individual dimensions throughout the spin-off creation process to contribute to recomposing the puzzle of this research stream.

Keywords: Academic Entrepreneurship, Opportunity Identification, Entrepreneurial Intentions, Spin-off creation, Social Information Processing, Entrepreneurial university; Systematic literature review; SLR

1. INTRODUCTION

Academic entrepreneurship is defined as founding academic spin-offs, firms created to commercialize patented inventions or non-patented expertise (Shane, 2004). This kind of venture enhances the impact of university intellectual capital on the external environment (Audretsch, 2014; Bolzani, Munari, Rasmussen, & Toschi, 2020; Etzkowitz, 2014; Mariani, Carlesi, & Scarfò, 2017). For this reason, they are widely accepted as an entrepreneurial university's tool to promote knowledge diffusion and technology transfer (Guerrero & Urbano, 2012; Klofsten, Fayolle, Guerrero, Mian, Urbano & Wright, 2019; Visintin & Pittino, 2014). Furthermore, these ventures are also important because they positively affect the research performance of universities. Indeed, prior empirical research confirmed that being entrepreneurial improves scientists' productivity in terms of the amount and quality of scientific publications (Abramo, D'Angelo, Ferretti, & Parmentola, 2012; Van-Looy, Ranga, Callaert, Debackere, & Zimmermann, 2004). As a result, universities have prioritized exploiting their knowledge to be more effective in developing their territories (Battaglia, Paolucci, & Ughetto, 2021). Thus, the best way to support universities in this endeavour is up for debate and research.

Unfortunately, the exact mechanisms by which academic entrepreneurship arises by the creation of academic spin-offs are still unknown, most likely because studies are not well theoretically grounded (Nicolaou & Birley, 2003; Rasmussen, Mosey, & Wright, 2011). Although a number of models have been proposed to explain the multi-level nature of entrepreneurship (Davidsson & Gruenhagen, 2021; Davidsson & Klofsten, 2003), these findings cannot be extended to academic entrepreneurship, due to its specificities mostly related to the uniqueness of university setting and academic actors' entrepreneurial identity (Fini et al., 2019; Hayter, Fischer, & Rasmussen, 2021). Thus, essential questions have yet to be addressed from a theoretical

perspective (Amit, Glosten, & Muller, 1993), and empirical studies are still fragmented, with the findings only marginally addressing the complexity of underlying academic entrepreneurship. Therefore, overcoming this fragmentation is critical for the field to enhance the understanding of the mechanisms surrounding the spin-off creation process (Galati, Bigliardi, & Passaro, 2020; Wood, 2011), and it makes complicated explaining the phenomenon.

The present work argues that further effort is needed at this time to recompose the topic's fragmentation and to address future research toward a theory-driven explanation of the phenomenon. To address this issue, a systematic literature review (SLR) is conducted, based on the PRISMA protocol (Moher, Shamsee, Clarke, Ghersi, Liberati, Petticrew, Shekelle & Stewart, 2015; Tranfield, Denyer, & Smart, 2003). This contribution is not the first published literature review on academic entrepreneurship, although it retains some elements of originality that differentiate it from others. Miranda, Chamorro & Rubio (2018) is a relevant example of SLR on this topic. The authors reflected on the pre-existing body of knowledge on academic spin-offs, trying to understand how they have been studied so far and thus to target future research. In doing so, the entire body of research was examined without adopting a precise theoretical lens. In this sense, the present work differs from this article, and in some sense complements it, because it adopts a precise theoretical lens to investigate the process of spin-off creation as a clearly specified phenomenon. Skute (2019) conducted a bibliometric analysis of academic entrepreneurship in general to disentangle the multiple streams of research that have characterized the investigation of the topic and thus map the current body of knowledge. His work, although extremely useful in bringing order to a broad and mostly messy topic like academic entrepreneurship, lacks a precise focus on academic entrepreneurship as a process toward the creation of academic spin-offs. In this sense, the present review differs from the one cited above and extends it by further ordering one of the

strands of research that emerged from Skute's bibliometric analysis, which specifically concerns spin-offs. Finally, the literature review by Perkmann, Salandra, Tartari, McKelvey & Hughes (2021) represents a significant attempt to bring order to the literature on academic entrepreneurship. Conceiving academic entrepreneurship as a broad phenomenon composed of a multiplicity of activities in addition to spin-off creation, they focused on the antecedents of entrepreneurial behavior in academia. This chapter extends Perkmann's important contribution by shedding light on academic entrepreneurship as a process rather than as a single action occurring from one day to the next, thus articulating it around three outcomes, and analyzing the variables at different levels that have been studied in relation to each of these outcomes.

The academic entrepreneurship process is approached using the postulates of the social information processing theory (Salancik & Pfeffer, 1978). In asserting that all organizational behaviors result from an interplay between individual and organizational dimensions, this theoretical lens illuminated the streamlining of the existing literature, ultimately defining three relevant objectives that this study aims to achieve. (i) The body of knowledge on critical individual factors and organizational context elements in academic entrepreneurship is scanned. (ii) The state of on the process of academic entrepreneurship is investigated. Focusing on opportunity identification, entrepreneurial intentions, and spin-off creation as indexes of entrepreneurial outcomes, it is spotlighted whether and to what extent the entrepreneurial outcomes and the connections between them have been studied. (iii) Drawing on what is known to assess what should be studied further, relevant research questions are identified that future studies should address to help closing existing theoretical gaps and gain a more comprehensive understanding of the academic entrepreneurship process.

Overall, the present findings bring two important contributions. (i) Relying on past research to theoretically and empirically reflect on the process behind academic entrepreneurship (Rasmussen, 2011; Wood, 2011), the entire process is conceptualized, from opportunity identification to entrepreneurial intentions and spin-off creation. In so doing, a solid theory-driven is achieved, providing the baseline for future empirical inquiry and overcoming the static view of previous investigations (Neves & Brito, 2020). (ii) In extending the contribution of Miranda et al. (2018), this work helps the scholar community to recompose the field's fragmentation of the myriad of individual and organizational variables that have been investigated in the last 30 years of research (Perkmann, Salandra, Tartari, & Mckelvey, 2019). Thus, a multi-level conceptualization of academic entrepreneurship is reached (Bozeman, Fay & Slade, 2013).

The following is how the chapter is structured. First, the concepts representing the contribution's theoretical pillars are defined. Second, an accurate research methodology description is produced. Third, the findings are presented beginning with a descriptive analysis of the main characteristics of the reviewed papers and progressing through narrative synthesis and thematic analysis. Finally, an agenda for future research is presented.

2. THEORETICAL BACKGROUND

Guided by seminal literature on entrepreneurship and organizational behavior (Mcmullen & Dimov, 2013; Salancik & Pfeffer, 1978), the present chapter approaches academic entrepreneurship as an organizational behavior resulting from a process that implies the interaction between individual factors and social-organizational context (Rasmussen, 2011; Rasmussen & Wright, 2015). The following two paragraphs illustrate the assumptions drawn from organizational studies and entrepreneurship that guided the SLR.

2.1 A social information processing perspective

Assuming that entrepreneurship cannot be studied as an event occurring in a vacuum, it is contended that the social information processing perspective is an insightful theoretical lens for studying entrepreneurial behavior in universities. This lens conceives organizational behaviors resulting from a combined effect of individual-level factors and university-level context. While the formers are conceptualized as the set of personal and psychological characteristics that identify the single researcher or student, the latters are defined as the set of organizational culture, knowledge and tangible structures influencing an individual attitude or behavior within an established organization like universities (Lu, Leung, & Koch, 2006). The adoption of this lens has been insightful in explaining organizational behaviors, as demonstrated by Gundlach, Douglas & Martinko (2003), which used the theoretical perspective of social information processing to explain the whistle-blowers' decision-making process, demonstrating that this behavior is socially affected. Furthermore, Kessler, Lucianetti, Pindek & Spector (2020) empirically tested a model in which subordinates' compliance is affected by the safety climate at the organizational level and frontline supervisors' conduct, demonstrating that this phenomenon is socially influenced. These studies confirm that individual characteristics or organizational context alone are insufficient to explain

organizational behavior when considered separately (Chatman, 1989; Staw & Ross, 1985). For this reason, and in line with existing research in academic entrepreneurship, which conceptualized the phenomenon as a complex process involving many micro and macro factors (Hayter et al., 2021; Miranda et al., 2018; Rasmussen, 2011), it is argued that the phenomenon's investigation should be approached from the perspective of social information processing. Indeed, it is a theory that considers the different dimensions - and their interplay - involved in academic entrepreneurship process. This lens allows for reframing the study of academic entrepreneurship by suggesting three foci of analysis: (i) individual factors, (ii) organizational context, and (iii) the interactions between individual factors and organizational context.

The present SLR, articulated along the aforementioned three foci, rationalizes the empirical evidence on academic entrepreneurship. In so doing, it provides a more comprehensive and holistic view of how entrepreneurship functions in academic settings.

2.2 Research-based Spin-off creation and the entrepreneurial process

Seminal literature suggests that academic entrepreneurship should be studied as a complex and iterative process leading to the formation of a new organization rather than a specific action occurring at a certain point in time (e.g., Bhave, 1994; Mcmullen & Dimov, 2013; Ndonzuau, Pirnay, & Surlemont, 2002; Wood, 2011). In extending this view, recent qualitative and conceptual studies have identified and theorized several different entrepreneurial processes leading to the foundation of an academic spin-off. Hannibal, Evers, & Servais (2016) highlighted the role of opportunity identification and intentionality as the main phases of the academic entrepreneurship process. Their findings confirmed that identifying the entrepreneurial opportunity represents the first step in academic entrepreneurship. Being a *'conditio sine qua non'* entrepreneurial process cannot unfold, they also highlighted the vital role of entrepreneurial intentions as drivers of entrepreneurial

behavior, as proposed in several seminal works in entrepreneurship (Ajzen, 1991; Krueger, Reilly, & Carsrud, 1993). Moreover, Parmentola & Ferretti (2018) have proposed a five-stage process formed of research, pre-incubation, incubation, start-up, and growth. They emphasized that scientists start to recognize the commercial potential of their results in the research phase. This condition presents an overlap with the identification of an entrepreneurial opportunity. The next step proposed in their model is the pre-incubation, in which scientists decide to become entrepreneurs, which means they are intentioned to act entrepreneurially (Thompson, 2009). The last meaningful example is Müller-Wieland, Muschner, & Schraudner (2019), which proposed a four-phase process: research, orientation, pre-founding, and establishment. They show that the phase in which researchers have already decided to be entrepreneurs can be assimilated into forming entrepreneurial intentions.

Learning from the studies described above, three major entrepreneurial outcomes are highlighted in academic entrepreneurship process: the identification of an entrepreneurial opportunity (Ardichvili, Cardozo, & Ray, 2003; Shane & Venkataraman, 2000), the formation of entrepreneurial intentions (Bird, 1988; Thompson, 2009), and the creation of a spin-off. Opportunity identification is the cognitive process through which an individual realizes to have identified an opportunity (Ardichvili et al., 2003). It is widely accepted in entrepreneurship as the first stage toward creating a new venture (Baron & Ensley, 2006; Gaglio & Katz, 2001; Shane & Venkataraman, 2000). After identifying the entrepreneurial opportunity, entrepreneurs should decide to develop and exploit it (Ardichvili et al., 2003; Kuckertz, Kollmann, Krell, & Stöckmann, 2017), meaning that they need to be intentioned to act entrepreneurially (Thompson, 2009). Finally, since literature conceives entrepreneurship as the process leading to the foundation of a new venture (Gartner, 1988; McMullen & Shepherd, 2006), creating an academic spin-off should be considered the outcome of the academic entrepreneurship process.

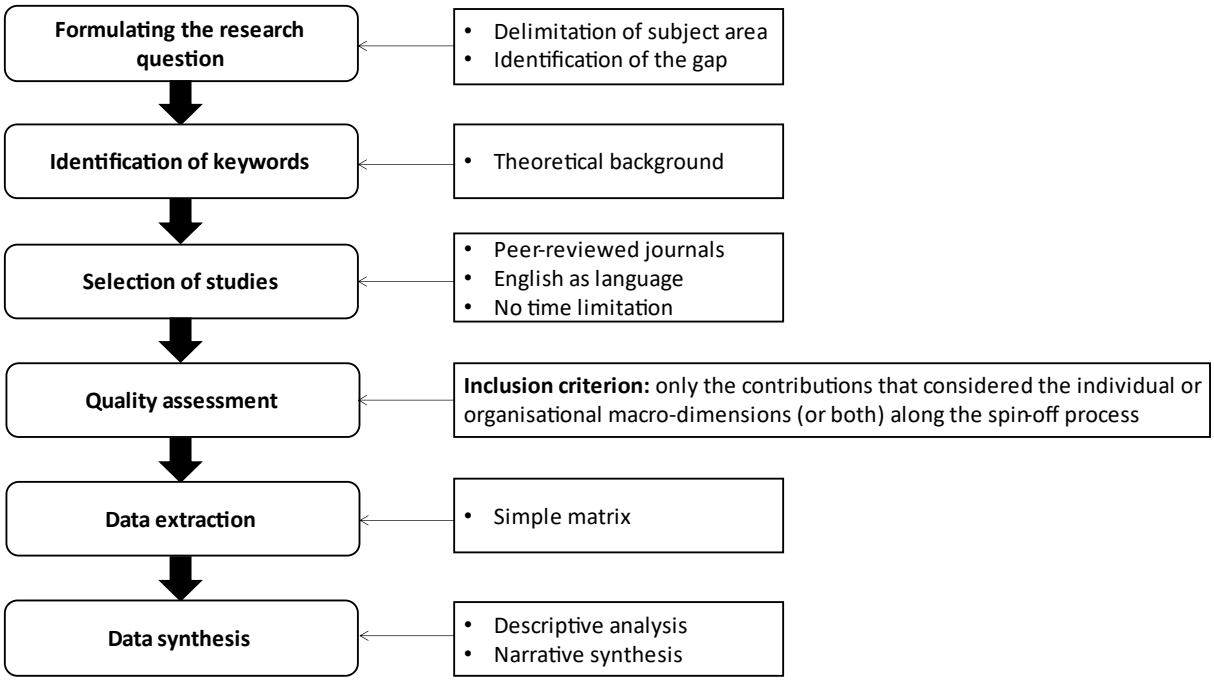
Many voices have taken part in the scientific debate about how academic spin-offs are created – that is the essence of the academic entrepreneurship process. However, how scholarly investigation has approached the phenomenon of academic entrepreneurship seems familiar with the metaphor of the blind man and the elephant, which tells of six blind men who touch various parts of an elephant and provide wildly diverse accounts of its features (Quigley, 1974). As this story tells, scholars have deeply studied just some shades of the phenomenon, but a holistic and process-based explanation of how it develops is still missing (Miranda, Chamorro, & Rubio, 2018; Rasmussen, 2011; Wood, 2011). This work claims the necessity to look back to existing research. It is needed to clearly understand what has been done until now and what should be done in the future. However, it should be done with a precise theoretical lens that guides the research community toward a comprehensive understanding of the phenomenon, taking stock of what is known to understand what is needed to be known (Paul & Criado, 2020). In addressing this gap, the SLR aims to make order in the scatter plot of existing research and reframe the future body of knowledge by combining the processual perspective of entrepreneurship with the social information processing perspective. In so doing, three important objectives are achieved. (i) Decisive individual factors and elements of the organizational context for the process development are highlighted. (ii) The state of scientific inquiry about the academic entrepreneurship process is pointed out, articulated around three entrepreneurial outcomes – opportunity identification, entrepreneurial intentions, and spin-off creation. (iii) The critical unanswered questions are highlighted in light of the research findings, providing a research agenda for future investigations on academic entrepreneurship.

3. METHODOLOGY

An SLR is conducted to streamline the existing knowledge around specific research purposes (Hiebl, 2021; Snyder, 2019; Tranfield, Denyer, & Smart, 2003). This method is widely used in management studies (e.g., Crossan & Apaydin, 2010; Hanelt, Bohnsack, Marz, & Marante, 2020). However, it is still sparingly adopted in entrepreneurship (Champenois, Lefebvre, & Ronteau, 2020). It appears surprising, given its usefulness in studies where a precise selection of contributions is required to address fragmentation and reframe a specific but multifaceted phenomenon using a specific perspective (Briner & Walshe, 2014; Nightingale, 2009).

PRISMA protocol (Moher, Shamseer, Clarke, Ghersi, Liberati, Petticrew, Shekelle, Stewart, PRISMA-P Group, 2015), combined with the methodological reflections developed by Tranfield et al. (2003), is used as a guiding tool for implementing the SLR. The work is organized along the following stages: (i) identification of keywords, (ii) selection of studies and quality assessment, (iii) data extraction and data synthesis. Each step is described in the next paragraphs, while Figure 1 synthesizes the whole process.

Figure 1. Flowchart of the procedure adopted in the review.



3.1 Identification of keywords

Table 1 reports the keywords identified to retrieve studies, in line with the SLR's aim. An analysis of the literature has guided the selection of the keywords for opportunity identification (Alvarez & Barney, 2007; Mickiewicz & Kaasa, 2020). A similar procedure is followed for entrepreneurial intentions, being widely accepted as a construct in entrepreneurship (Liñán & Fayolle, 2015). The strings developed for opportunity identification and entrepreneurial intentions have been combined with another one that encompasses the academic setting, drawn from previously published reviews in academic entrepreneurship (Skute, 2019). Finally, new keywords have been developed *ex novo* for spin-off creation. This choice is supported by the need to stay within the SLR's scope of investigating the spin-off creation process.

Table 1. WoS Database Search Query.

Entrepreneurial Outcome	String	N
Opportunity Identification	*('opportunity recognition'* OR *'opportunity identification')* AND *('academic entrepreneurship' OR 'academi* spin*'* OR *'academi* commercialization'* OR *'universit* commercialization')*	164
Entrepreneurial Intentions	*(entrepreneurial intent*)* AND *('academic entrepreneurship' OR 'academi* spin*'* OR *'academi* commercialization'* OR *'universit* commercialization')*	769
Spin-off Creation	*(academic entrepreneurship* OR *entrepren* academi*)* AND *(entrepreneurial behavior* OR *entrepreneurial action* OR *spin* creation* OR *spin* foundation*)	304
Database	Isi – Wos (Web of Science)	
Language	English	
Publication types	Journal articles	
Publication date	Before december 2020	

3.2 Selection of studies

An extensive search for journal articles has been performed for 1990-2020 using Wos Database, which is extensively adopted for literature reviews in entrepreneurship (Crisan, Salanta, Beleiu, Bordean, & Bunduchi, 2019; Eveleens, Van-Rijnsoever, & Niesten, 2017; Mian, Lamine, & Fayolle, 2016). The articles included are written in English and published in peer-reviewed journals. This criterion is instrumental in accurately depicting the past and current scientific conversation (Hiebl, 2021).

The first search returned 1237 journal articles divided as follows: 164 articles for opportunity identification, 769 articles for entrepreneurial intentions, and 304 for spin-off creation.

3.2.1 Quality assessment. As second step, the articles returned from the first search have been qualitatively assessed. The following inclusion criteria guided the selection (Hiebl, 2021):

(i) only empirical contributions – not conceptual papers nor literature reviews. It is because the research purpose was to shed light on how academic entrepreurship has been empirically addressed so far;

(ii) research focused on at least one of the entrepreneurial process outcomes, that are opportunity identification, entrepreneurial intentions, and spin-off creation;

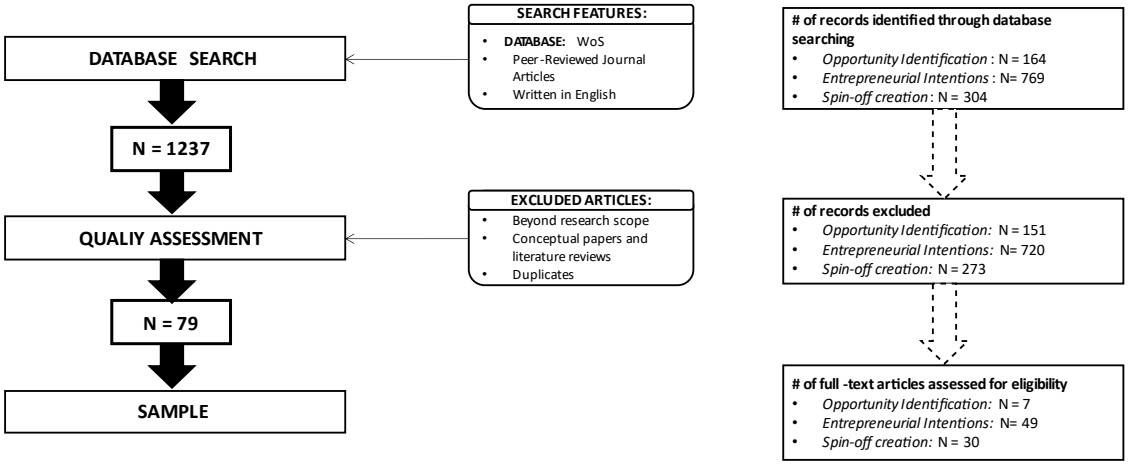
(iii) papers whose research questions or hypotheses were within the scope of the review – that is, studying the impact of the individual factors and/or organizational context on the entrepreneurial process outcomes in the academic setting;

(iv) studies that used samples of scientists, graduate students, or undergraduate students. More specifically, only the contributions that framed students as actors of science commercialization and knowledge transfer have been considered for what concerns students. It means that the papers that used students as a convenience sample to draw findings have been excluded as being beyond the scope of the research. With this choice, the present work aimed at addressing recent research which regards students as extremely relevant actors in the entrepreneurial university (Bienkowska, Klofsten, & Rasmussen, 2016; Bolzani, Munari, Rasmussen, & Toschi, 2020; Mars, 2009).

This paragraph presents some illustrative examples of excluded papers. (i) Dolhey (2019) is a literature review on entrepreneurial intentions. (ii) Tseng, Huang, & Chen (2020) focuses on the factors affecting the university performance in terms of technology transfer, with no mention of opportunity identification, entrepreneurial intentions, or spin-off creation as a behavior. (iii) Gilsing, Burg & Romme (2010) studied only the policy actions to foster high-tech entrepreneurship without considering individual factors or the organizational context. (iv) Marvel (2013) drew on a sample of founders, from inside and outside academia, in a university incubator: it was excluded for being out of the scope of academic entrepreneurship. Figure 2 shows the detailed procedure followed for selecting studies and quality assessment. It leads us to a final sample of 7 articles for opportunity

identification, 49 for entrepreneurial intentions, and 30 for spin-off creation. A comprehensive overview of the selected articles is provided in the Appendix A.

Figure 2 – Detailed Description of Selection of Studies and Qualitative Assessment.



3.2.2 Data extraction. Torraco's (2016) suggestions are used to extract data from the papers. Specifically, a simple matrix has been manually created to categorize studies based on the entrepreneurial process's three outcomes and cross-reference them with information about individual factors and organizational context.

3.3.3 Data synthesis and interpretation. The selected papers have been analyzed in three stages of analysis. (i) A descriptive report shows the general characteristics of the papers composing the unit of analysis with a specific focus on research design, temporal perspective, type of samples, outlets, and publication trends. (ii) A theoretical thematic analysis - a technique for detecting, analyzing, and reporting specific theoretical themes inside data (Braun & Clarke, 2006) - recomposes the disorder characterizing the existing body of knowledge. This scrutiny is instrumental in highlighting the different research directions that characterized the scientific inquiry in academic entrepreneurship, which was conducive to reaching the first research objective. (iii) A narrative synthesis maps the state of art on academic entrepreneurship, focusing on three entrepreneurial outcomes - opportunity identification, entrepreneurial intentions, and spin-off creation. In the end, drawing on

the review's findings, a research agenda is developed that addresses future research on the unspotted gaps that should be investigated to enhance the understanding of academic entrepreneurship as a process (Hedström & Wennberg, 2017; Post, Sarala, Gatrell, & Prescott, 2020).

4. REVIEW OF THE LITERATURE

This section discusses the findings of the SLR, which have been obtained through manually-performed content analysis (Neergaard & Ulhøi, 2007). The paragraph opens with a descriptive report on academic entrepreneurship studies. This initial description is followed by an integrative review based on a thematic analysis of the literature (Torraco, 2016), completed by the narrative synthesis. Then, the generative part of the review is represented by a research agenda for future inquiry. The thematic analysis was critical in achieving the first research objective of reorganizing the tangled body of knowledge on individual and organizational dimensions in the academic entrepreneurship process. Instead, the narrative synthesis was instrumental in deeply investigating how the mechanisms linking opportunity identification, entrepreneurial intentions, and spin-off creation were studied, leading to the achievement of the second research objective. Finally, the research agenda, which highlights questions for future research, was used to achieve the third objective while also highlighting important gaps that will need to be filled in the future.

4.1 Descriptive report

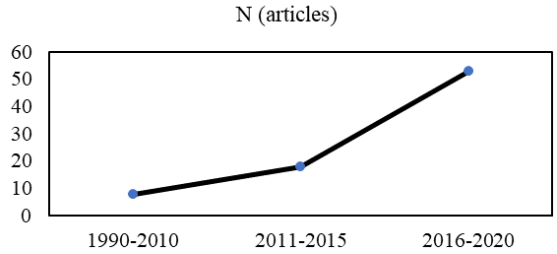
The most widely used research approach is quantitative – 84% of the reviewed papers used a quantitative approach versus the remaining 16% of qualitative papers. 82 % of studies adopted a cross-sectional design, while the other 18% opted for a longitudinal approach. For example,

Parmentola & Ferretti (2018) used a qualitative and longitudinal design, while Feola, Vesci, Botti, & Parente (2019) opted for a quantitative and cross-sectional approach. These trends highlight that current research is drastically imbalanced toward confirming extisting models rather than on theory-building through qualitative inquiry.

Most of the reviewed studies drew on a sample of scientists (60%). However, an increasing proportion of them (34%) investigated samples of students as potential entrepreneurs, demonstrating the growing interest in this target as fundamental players in universities' knowledge and technology transfer activities (Marzocchi, Kitagawa, & Sánchez-Barrioluengo, 2019).

Figure 3 demonstrates the growing research interest in academic entrepreneurship, as highlighted in recent bibliometric analyses (Secundo, Rippa, & Cerchione, 2020; Skute, 2019).

Figure 3 – Time trends in publications on academic entrepreneurship.



Finally, as shown in Table 2, two international journals gather around 21% of all the contributions, namely The *Journal of Technology Transfer* (13%) and *Research Policy* (8,5%). Other relevant outlets for the topic are *Technovation* (3,5%) and *The International Journal of Entrepreneurial Behavior & Research* (3,5%). Interestingly, an epistemological diversity is found between the journals. Although the majority of reviewed articles have been published in outlets specialized in business and management (N = 67, 85% of the reviewed articles), journals from other disciplines have given space to the scientific debate on academic entrepreneurship, such as

education (N = 6, 7% of reviewed articles), psychology (N = 3, 4% of the reviewed papers), but also computer science and engineering, although marginally.

Table 2 – Publication trends in terms of outlets.

Journals	N	% of the Total
The Journal of Technology Transfer	10	12.65
Research Policy	7	8.86
Small Business Economics	4	5.06
Technovation	3	3.79
International Journal of Entrepreneurial Behavior and Research	3	3.79
Studies in Higher Education	3	3.79
Journal of Small Business Management	3	3.79
International Entrepreneurship and Management Journal	3	3.79

4.2 Thematic Analysis

The reviewed articles showed a long and heterogeneous list of individual factors and elements of the social-organizational context which have been used to explain the development process of academic entrepreneurship. It is not surprising, being a symptom of the huge fragmentation that characterized empirical inquiry about this phenomenon. By a superficial analysis, this could seem like a chorus of scattered voices. However, a deeper glance inside the conceptual foundations of the reviewed articles revealed four recurring conceptual themes around which research on the topic was developed: entrepreneurial university, institutional factors, human capital, and psychological factors. Two are associated with the organizational dimension, while the others describe the surrounding university context. The following sections describe each of the conceptual themes. After conceptualizing each theoretical cluster, the most and the least studied variables are highlighted, and it is described how they have been studied. A synthesis of the conceptual themes that emerged from this analysis is provided in Table 3.

Table 3 – Conceptual Themes.

THEME	DEFINITION	MOST USED VARIABLES
Entrepreneurial University	The new model of higher education institution aiming to foster entrepreneurship as tool to pursue the third mission and that provides facilities and support to foster entrepreneurship	• Entrepreneurship Education (N=25) •Technology Transfer Office (N=20) • Concept Development Support (N=5) • Business Development Support (N=5)
Institutional factors	The factors identifying an institution, which is a stable social structure that encompasses tangible characteristics, social interactions, and intangibles determinants	•University Policy (N=4) •Organizational Culture (N=2)
Human capital	A set of skills and knowledge, acquired from individuals' specific characteristics and past experience, that can be useful for a given task (Becker, 1962; Dimov, 2017)	• Gender (N=6) •Work Experience (N=2)
Psychological factors	An umbrella concept which encompasses the personality dimensions and motivations	• Entrepreneurial Attitude (N=18) • Perceived Behavioral Control (N=13) • Subjective Norms (N=13) • Entrepreneurial Self-Efficacy (N=12)

4.2.1 Entrepreneurial university. The entrepreneurial university aims to generate social and economic growth in the external environment with its research, pursuing the so-called third mission (Bolzani, Munari, Rasmussen, & Toschi, 2020). Being entrepreneurship a tool for knowledge and technology transfer (Fini & Wiklund, 2018), this university model develops a wide support system to foster entrepreneurial attitudes and actions among tenured scholars, doctoral and undergraduate students (Fayolle & Redford, 2014).

In line with this theoretical framing, the variables in this cluster mostly concern the many shades of support universities provide. The most studied manifestations of it have been entrepreneurship education (N=25, 32% of the reviewed articles) and the technology transfer office (N=20, 25% of the reviewed studies; i.e., Feola, Vesci, Botti, & Parente, 2019; Nosella & Grimaldi, 2009; Sansone, Battaglia, Landoni, & Paolucci, 2019). Surprisingly, the less studied variables have been start-up competitions (N=1, e.g., Nosella & Grimaldi, 2009) and financial support provided by the universities (N=1, Li & Zhang, 2020). This first theme has driven a large amount of current research (N = 38, 48% of the reviewed articles).

Interestingly, recent empirical research has focused on entrepreneurship education and technology transfer office. The former has been mostly studied as a predictor of scientists' entrepreneurial intentions. For example, Urban & Chantson (2019) framed the provision of entrepreneurship education as a form of university support. In so doing, they empirically tested its causal effect on scientists' entrepreneurial intentions with the mediation of perceived entrepreneurial support. In contrast, technology transfer offices have generally been conceptualized as having a role in academic entrepreneurship process. A meaningful example is Fini, Grimaldi, Santoni, and Sobrero (2011). In their contribution, they recognized and empirically confirmed technology transfer offices' role in academic entrepreneurship, not only considering its presence but also a number of characteristics, such as being affiliated with a technology transfer consortium and the office's human capital endowment. Noteworthy, other forms of tangible support, such as academic incubators and business plan competitions, have been poorly studied. Nosella & Grimaldi (2009) is one of the few exceptions that jointly included university-based incubators and business plan competitions as forms of entrepreneurial support provided by the universities whose presence affects the unfolding of academic entrepreneurship process.

4.2.2 Institutional factors. An institution is defined as a stable social organization in which three primary components can be identified: tangible traits, social interactions, and intangible causes (Zucker, 1987; Scott, 2013). Because of its characteristics, academia should be studied as an institution (Scott, 2011). Thus, as an institution, it might affect its actors' entrepreneurial attitudes and behaviors (Fini, Grimaldi, & Meoli, 2020).

Despite the evident fragmentation in this cluster, two variables can be identified as the most studied: university policy (N=4, 5% of the reviewed articles; i.e., Rasmussen & Wright, 2015) and organizational culture (N=2, 2% of the reviewed articles; i.e., Urban & Chantson, 2019). Other

variables have been sparingly studied, such as university governance (N=1; e.g., Muscio & Ramaciotti, 2019). Overall, 24 reviewed articles (30 % of the sample) have studied institutional variables, which include tangible characteristics (N=14, 18% of the sample), social interactions (N=15, 19 % of the reviewed articles), and intangible causes (N=10, 13% of the sample). The vast majority of them explore spin-off creation.

University's size, regulation, and governance are meaningful examples of tangible characteristics. Fini, Grimaldi, Santoni, & Sobrero (2011) explored the causal effect of university size and regulation on academic entrepreneurship, while Meoli, Paleari, & Vismara (2019) did the same with university governance. Complementarily, Huyghe & Knockaert (2015) empirically tested the university reward system as a predictor of scientists' entrepreneurial intentions. On the other side, many variables represent social interactions in academic institutions. A meaningful illustration is represented by Prodan & Drnovsek (2010), which combined personal networks and university role models, as expressions of social interactions, with other individual characteristics to develop a model which explains the formation of scientists' entrepreneurial intentions. Moreover, an insightful merge between social interactions and intangible causes for explaining academics' entrepreneurial intentions is Klingbeil, Semrau, Ebers, Ebers, & Wilhelm (2019), which jointly studied university-level commercialization logic and research group's leader influence. Finally, organizational culture (Urban & Chantson, 2019) can be considered a meaningful example of an intangible determinant.

4.2.3 Human capital. Human capital refers to individuals' specific characteristics and prior experiences that generated skills, abilities, and knowledge, affecting their capacity to perform a task (Dimov, 2017; Marvel, Davis, & Sproul, 2016). Becker's (1962) seminal work distinguished two forms of human capital. While general human capital implies a set of skills that can be useful for a wide set of activities, specific human capital is connected to a narrow list of tasks. This concept has

already been used in entrepreneurship, especially to explain entrepreneurs' ability to recognize opportunities (Ucbasaran, Westhead, & Wright, 2008; Ucbasaran, Westhead, Wright, & Binks, 2003).

The most studied variables embedded in this theme are gender (N = 6; i.e., Roy & Das, 2020) and prior work experience (N=2; i.e., Erikson, Knockaert, & Foo, 2015). Interestingly, a wide set of variables describing specific human capital have been poorly studied, such as experience outside the university (N=1; e.g., Dottore & Kassicieh, 2017) and length of service (N=1; e.g., Miranda, Chamorro-Mera, Rubio, & Pérez-Mayo, 2017).

The variables that describe some forms of human capital have been used mostly to explain the formation of entrepreneurial intentions and behavior, often combined with institutional variables. In their conceptual model, Clarysse, Tartari, & Salter (2011) combined a form of specific human capital – entrepreneurial experience – with the presence of a technology transfer office and scientists' social environment to explain academic entrepreneurship. In a different vein, Erikson, Knockaert, & Foo (2015) focused their inquiry on how human capital affects doctoral students' entrepreneurial intention. In so doing, a combination of variables has been studied, such as patent experience, start-up experience and professional experience, and no contextual factor has been considered.

4.2.4 Psychological factors. Psychological factors represent the set of variables which describe any form of psychological traits or cognitive components (Gorgievski & Stephan, 2016). The ratio behind using these variables in entrepreneurship is grounded in the intentional nature of entrepreneurial behavior, as it is widely accepted in the conceptual and empirical literature (Bird, 1988; Krueger, 2017). The focus on the cognitive side of academic entrepreneurship has characterized the debate

since the publication of seminal works twenty years ago (e.g., Ndonzuau, Pirnay, & Surlemont, 2002; Stuart & Ding, 2006).

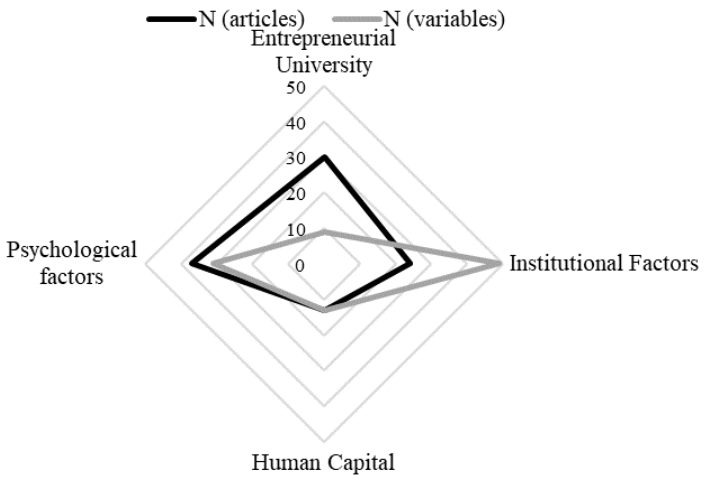
The predictors of the theory of planned behavior (Ajzen, 1991) stand out among the most studied psychological factors. Entrepreneurial attitudes (N=18, 21 % of the reviewed articles, i.e., Laudano, Zollo, Ciappei, & Zampi, 2019), which are individuals' evaluations of the feasibility of starting a new business, take the stage as the most used variable. Second place goes to perceived behavioral control (N=13, 15% of the total; i.e., Trivedi, 2016) and subjective norms (N=13, 15 % of the total; i.e., Goethner, Obschonka, Silbereisen, & Cantner, 2012). In addition, entrepreneurial self-efficacy, which refers to a person's confidence in their own capacity to complete entrepreneurial tasks (McGee, Mueller, & Sequeira, 2009), received wide attention (N=12, 14% of the reviewed articles). Surprisingly, individual motivations have been scarcely studied (N=3; e.g., Galati, Bigliardi, & Passaro, 2020), and they have been used mostly to explain spin-off creation. Overall, these variables characterized the widest portion of empirical debate about the academic entrepreneurship process (N = 37, 47% of the reviewed articles).

A wide plethora of empirical contributions combined the theory of planned behavior with other cognitive and contextual variables to explain the formation of entrepreneurial intentions. In this vein, the contribution by Feola, Vesci, Botti, & Parente (2019) is indicative since it combined the theory of planned behavior with the triple helix model (Etzkowitz, Ranga, Benner, Guaranys, Maculan, & Kneller, 2008). They combined social norms, perceived behavioral control, and entrepreneurial attitudes with some expressions of researchers' surrounding context, namely university government, and financial support. Similarly, entrepreneurial self-efficacy has been studied in combination with contextual variables to explain the arising of academic entrepreneurial intentions. Huyghe & Knockaert (2015) are emblematic in this sense: they assume that a high level

of entrepreneurial self-efficacy strengthens the causal relationship between university role models, which are part of the social context, and scientists' entrepreneurial intentions.

4.2.5 Overall considerations on thematic analysis. Thematic analysis shows that four conceptual themes have driven empirical research on academic entrepreneurship. However, the body of knowledge appears scattered and fragmented, although some insightful trends emerge. As Figure 3 displays, psychological factors have been the most studied in terms of the number of articles (N =37), followed by the entrepreneurial university (N=30). Reversely, the high number of variables used to describe institutional factors (N=49), compared with the relatively small number of articles in this conceptual cluster, highlights a fragmentation in the use of institutional theory to explain the academic entrepreneurship process. Figure 4 provides a visual synthesis of the main findings in the thematic analysis. In Appendix B, a comprehensive overview of the variables used by each reviewed article is provided.

Figure 4 – Articles VS Variables for each conceptual theme.



4.3 Narrative synthesis

This section provides a narrative synthesis of the state of art in academic entrepreneurship (Torraco, 2016). The present analysis provides insights into how the entire entrepreneurial path, from opportunity identification to entrepreneurial intentions and spin-off creation, has been studied so far. As a result, the synthesis contributes to the second research goal by providing an appropriate answer to the question: what is known about the academic entrepreneurship process? The paragraph is organized around three entrepreneurial outcomes: identification of opportunities, entrepreneurial intentions, and spin-off creation. For each of them, it is described how deeply they have been researched and how the connections between them have been investigated.

4.3.1 Opportunity identification. Since Shane and Venkataraman's (2000) seminal work on entrepreneurship, opportunity identification is commonly recognized as the starting point of the entrepreneurial process. In light of this, the present entrepreneurial outcome should be investigated in depth to capture its complexity (Davidsson, 2015).

Notwithstanding, the review highlighted scant scholarly attention for clarifying the role of the opportunity in the academic setting and how it is recognized (N=8, 9.5 % of the reviewed

articles). Moreover, what comes before or after the opportunity identification along the academic entrepreneurship process is unclear, therefore understanding its role in academic entrepreneurship appears still far off.

A large part of the contributions in the sample - 5 out of the 8 reviewed articles - attempted to combine opportunity identification with the onset of entrepreneurial intentions into a single model, being mostly limited by the heterogeneous conceptualization of what opportunity identification is. Indeed, Hassan, Saleem, Anwar, and Hussain (2020) found that opportunity identification, conceptualized as an individual skill, positively affects undergraduates' entrepreneurial intentions. In a different vein, Puni, Anlesinya, Dzigbordi, & Korsorku (2018) operationalized opportunity identification as a dimension of entrepreneurship education and highlighted its positive impact on students' entrepreneurial intentions. On the other side, Karimi, Biemans, Lans, Chizari, & Mulder (2016) defined opportunity identification as the subjective perception of having identified an opportunity, demonstrating its positive impact on students' entrepreneurial intentions. Finally, Oftedal, Iakovleva, & Foss (2017) conceptualized the construct as alertness toward entrepreneurial opportunity, highlighting that the university environment positively affects students' opportunity identification and entrepreneurial intentions.

Overall, two main elements emerge from the analysis of the first entrepreneurial outcome. First, how entrepreneurial opportunity is identified in the academic setting has been poorly studied, and a relevant gap persists. Second, an extremely heterogeneous conceptualization of what opportunity identification emerges.

4.3.2 Entrepreneurial Intentions. The formation of entrepreneurial intentions is acknowledged as a useful predictor for entrepreneurial behavior, given its intentional nature (Bird, 1988; Krueger,

2017). It emerged to be at the heart of academic entrepreneurship research (N=49; e.g., Feola et al., 2019; Prodan & Drnovsek, 2010), with plenty of quantitative contributions aiming to confirm existing models to explain how intentions arise in academic contexts. The proposed and tested models strive to interpret how scientists, Ph.D., and undergraduate students form their entrepreneurial intentions, often combining different sets of individual factors and context-related elements. Klingbeil, Semrau, Ebers, & Wilhelm (2019) studied academics' entrepreneurial intentions by combining the theory of planned behavior's predictors with the university support system and institutional factors. On the other side, Wegner, Thomas, & Teixeira (2019) combined individual motivation, perceived support from the university and entrepreneurial self-efficacy to explain undergraduates' entrepreneurial intentions. Interestingly, Muscio & Ramaciotti (2019) are one of the few empirical contributions focalized on doctoral students' entrepreneurial intentions. They proposed a set of human capital items and institutional factors as predictors. These contributions emphasize the intensity of scientific inquiry for understanding how entrepreneurial intentions are formed in the academic context.

Similarly, to what extent entrepreneurial intentions are embedded in the academic entrepreneurship process is anything but clear. A meaningful exception is represented by Gieure, Benavides-Espinosa, & Roig-Dobón (2020), which tried to overcome the intention-action gap (Van-Gelderen, Kautonen, & Fink, 2015) by testing entrepreneurial intentions' causal effect on entrepreneurial action.

Concluding, two pieces of evidence emerge from the narrative synthesis on entrepreneurial intentions in academia. First, conceptual models striving to explain scientists' and students' entrepreneurial intentions are center-staged in the scientific conversation on academic entrepreneurship. Second, the current inquiry has scantly tried to build a bridge between

entrepreneurial intentions and other entrepreneurial outcomes, making a holistic understanding hard to achieve.

4.3.2 Spin-off creation. In line with Gartner's (1988) seminal contribution, which conceptualizes entrepreneurship as the process of new venture emergence, creating an academic spin-off represents the final outcome of the academic entrepreneurship process (Shane, 2004). Thus, founding a new venture to spread research outside academia represents the terminus of the long and iterative process leading academics to become entrepreneurs (Hayter, Fischer, & Rasmussen, 2021).

All contributions aiming to explore how academic spin-offs are created (N = 29) adopt a qualitative approach, meaning that the investigation of this entrepreneurial outcome still needs refined theory to be developed.

In general terms, it is still known very little about the process of recognizing entrepreneurial opportunities in academia. Moreover, a grey area of knowledge exists in comprehending how highly intentioned academic actors finally create an academic spin-off. In a similar vein, besides the contribution of Gieure, Benavides-Espinosa, & Roig-Dobón (2020) described above, few others works strive to shed light on the relationship between opportunity identification – although heterogeneously conceptualized – and spin-off creation.

5. DISCUSSION

The present chapter blends the social information processing approach (Salancik & Pfeffer, 1978) with the processual paradigm of entrepreneurship (Gartner, 1988) to recompose the fragmentation which characterized the scientific investigation of the academic entrepreneurship process. The findings highlighted a strong focus on shaping entrepreneurial intentions at the expense of opportunity identification, which has been heterogeneously conceptualized, and spin-off creation, and a poor understanding of the relationships occurring between the entrepreneurial process outcomes. Finally, the organizational context is prominently studied to explain the creation of the spin-off, while the individual variables are mostly considered predictors of entrepreneurial intentions and, albeit to a smaller extent, opportunity identification. Overall, current research on academic entrepreneurship process appears to be stuck on a static and confirmatory approach. A very low interest emerged in exploring the processual side of academic entrepreneurship and discovering the countless variables that influence the development of the phenomenon (Mars & Rios-Aguilar, 2010; Rasmussen, 2011), and how the process arises is still anything but clear. Indeed, a gap emerges concerning the origins of academic entrepreneurship. The lack of attention to understanding how entrepreneurial opportunities are recognized in the academic setting, and a huge body of knowledge on the formation of entrepreneurial intentions, make it hard to determine how academic actors mature the decision to valorize research through spin-offs. Indeed, what leads research results to become entrepreneurial opportunities is still a black box. Furthermore, the current body of knowledge determines a general lack of clarity about the mechanisms guiding the process unfolding. Since the three entrepreneurial outcomes have been studied separately, their relationships are still mostly underexplored. It implies that it is still unknown how academic actors mature their decision to become entrepreneurs. Finally, the use of individual and organizational

dimensions to explain the process' outcomes appear unbalanced. While the empirical models addressing the formation of entrepreneurial intentions paid more attention to individual factors, the research aiming to understand what leads to creating an academic spin-off has given more attention to the organizational context. It makes it overall difficult to understand whether in which measure and how the individual and contextual factors affect the academic entrepreneurship process.

In this vein, three open questions emerged. (i) The dynamics involved in the arising of academic entrepreneurship are still unknown, (ii) as well as the mechanisms that link the three entrepreneurial outcomes, and (iii) the combination of the individual and contextual factors needed for the process to unfold. Indeed, addressing these open questions would enhance scientific understanding of the complex and multi-level dynamics underlying the process of academic entrepreneurship.

6. RESEARCH AGENDA

In addressing the third research purpose, a research agenda is developed to address future inquiry on academic entrepreneurship, and the three open questions are discussed below.

The first research question concerns the mechanisms which explain how individual and organizational dimensions affect the decision to found a spin-off: despite the efforts to understand how academic spin-offs are created (e.g., Rasmussen, 2011; Urban & Chantson, 2019), a significant lack of attention is discovered in providing a theoretical explanation for how the spin-off process emerges in the academic context (Choi & Shepherd, 2004; Nair, Gaim & Dimov, 2020). Some published contributions speculate on potentially marketable research results as the trigger factors

for the academic entrepreneurship process to arise (Galati et al., 2020). In so doing, it is assumed that research-based spin-offs are created deliberately to commercialize research (Chiesa & Piccaluga, 2000; Clarysse, Wright, Lockett, Van-De-Velde, & Vohora, 2005; Mustar, 1997). However, it is a fact that not all research outcomes are transformed into an academic spin-off, even when their potential as entrepreneurial opportunities is evident (Ndonzuau, Pirnay & Surlemont, 2002). It implies that the existence of potentially marketable research is a necessary but not sufficient condition for academic entrepreneurship to emerge. Understanding which factors are involved in the arising of academic entrepreneurship and which dynamics connect them would be critical in developing a solid theory-driven foundation to explain the phenomenon.

Entrepreneurial processes are extensively recognized as context-embedded since potential entrepreneurs are strongly connected with their local environment (Anderson & Jack, 2002). Arguing that it is true also when entrepreneurship occurs in the academic setting, the present work challenges the assumption that research outcomes are the sole factors that trigger the academic entrepreneurship process. Thus, it is needed to grasp the trigger factors of academic entrepreneurship process and to understand which combinations of them push the decision to commercialize research. It would provide a theoretical explanation of the phenomenon's origins to clarify why just a portion of the potentially marketable research results flows in an academic spin-off, in this way improving the comprehension of the complex dynamics surrounding knowledge transfer activities.

The second research question concerns the mechanisms linking opportunity identification, entrepreneurial intentions, and spin-off creation, which explain how individual factors and organizational context affect the aforementioned entrepreneurial process outcomes. Most of the reviewed contributions analyzed data cross-sectionally. It means that, with very few exceptions

(e.g., Angel-Ferrero & Bessière, 2016; Hassan et al., 2020), empirical research has focused, until now, on one entrepreneurial outcome separately from the others. Furthermore, a large portion of longitudinal studies investigated the phenomenon from an atheoretical standpoint to reconstruct the path toward creating the new venture – i.e., the academic spin-off - and highlight the individually perceived enablers and constraints along the way. As a result, despite their importance in entrepreneurship, the relevance of opportunity identification and entrepreneurial intentions as the starting point of the academic entrepreneurship process remains undefined. Shedding light on the mechanisms linking opportunity identification and entrepreneurial intentions to spin-off creation would improve the theoretical understanding of the cradle of entrepreneurship inside universities, which is extremely relevant in comprehending how the university support system might be improved. In light of the social information processing theory, it is argued that there is promise in investigating how the socio-organizational dimension influences the identification of entrepreneurial opportunities and the formation of entrepreneurial intentions. This approach may have important policy implications. Indeed, a better understanding of the relationship between entrepreneurial outcomes would give higher education institutions and research organizations more precise knowledge about what variables and mechanisms influence the individual decision-making process toward creating an academic spin-off.

The third research question addresses the need to clarify how and to what extent the individual and contextual factors combine and how their relevance changes along the academic entrepreneurship process. The present review found varying attention for individual factors and organizational context depending on the entrepreneurial outcome, revealing a general lack of a comprehensive analysis of the entire process. In this sense, a better understanding of the relative role of individual and contextual dimensions is promising to explain the development of the

academic entrepreneurship process theoretically within entrepreneurial universities. Indeed, in pointing the light to the phenomenon, it is necessary to consider how the various forms of support are perceived within their organizational setting, exploring their effect jointly with individual dimensions.

The chapter is not without limitations. At first, academic entrepreneurship is conceived as creating research-based spin-offs, following the conceptualization proposed by Shane (2004). Future research might extend the investigation to all the activities which characterize academic engagement (Perkmann, Salandra, Tartari, McKelvey, Hughes, 2021) to broaden the comprehension of the current body of knowledge. Moreover, the present review has not considered whether the relationships between variables and outcomes theorized in the reviewed articles have been empirically confirmed or not, being out of the scope of analysis. In this sense, a meta-review of the reviewed quantitative studies could extend these findings by providing a clear picture of how the individual factors and organizational context affect opportunity identification, entrepreneurial intentions, and spin-off creation.

7. IMPLICATIONS FOR THEORY AND PRACTICE

The present chapter holds sound implications for theory and practice, that are presented in the current section.

7.1 Theoretical implications

This contribution aims to overstep the limits of research on academic entrepreneurship, which is poorly grounded in theory and mainly based on a descriptive approach (Nicolaou & Birley, 2003). Indeed, current research rarely considers the processual and multi-level nature of the phenomenon (Miranda et al., 2018; Rasmussen, 2011; Wood, 2011). In this sense, the current body of knowledge has two main gaps. On one side, it is mainly static, inasmuch as it neglects the need to capture the evolution of the process over time, and it tends to consider the factors that can explain the phenomenon separately – overlooking the phenomenon's complexity. By proposing a theory-driven model which considers individual and organizational dimensions - as well as their interplay - to explain the process which leads to the creation of academic spin-offs, the present chapter extends theory in two main ways. First, it addresses the lack of a processual understanding of academic entrepreneurship by proposing a dynamic perspective articulated around three entrepreneurial outcomes – opportunity identification, entrepreneurial intentions, and spin-off creation. In this way, the focus is put back on the process by introducing three pillars that should guide scholars toward recognizing the centrality of the process in future empirical research. Thus, it cannot be reduced to the action of creating a new venture to commercialize research but rather as a not-necessarily-linear process leading to spin-off as the final outcome (Davidsson & Gruenhagen, 2021; Galati, Bigliardi, & Passaro, 2020; Gartner, 1988; Hayter et al., 2021). Second, a theory-driven approach is proposed to study the phenomenon. Through the lens of the social information processing perspective, academic entrepreneurship is regarded as a phenomenon resulting from the interplay between the

individual and the surrounding university context. In so doing, a multi-level model is proposed to address future research toward the holistic view required to adequately comprehend the phenomenon. Indeed, a broad understanding of the factors at different levels involved in the process is relevant to capture the complexity of academic entrepreneurship.

7.2 Practical implications

On the managerial side, this work facilitates universities in implementing value-driven policies to foster entrepreneurial behavior among their members, giving a better understanding of how the phenomenon occurs. Indeed, this review is critical to assess existing empirical evidence about the impact of the individual and organizational variables on the process, suggesting which elements should be part of a university policy to foster entrepreneurship. In this sense, the present work provides the management of universities and higher education institutions with relevant material to refine and improve their policies to foster entrepreneurship, relying on a clear framework of the current empirical research on the entrepreneurial process in academia.

APPENDIX A.

To access Appendix A, which contains the list of the reviewed papers, please click the link below:

Appendix A

APPENDIX B.

To access Appendix B, which contains the results of the thematic analysis, please click the link below:

Appendix B

CHAPTER 3

INSTITUTIONAL SUPPORT VS PRO-SOCIAL MOTIVATION: A PH.D. PERSPECTIVE IN THE ENTREPRENEURIAL UNIVERSITY

ABSTRACT

Illuminated by the social information processing perspective, which theorizes that organizational behavior results from the interplay between the individual and the surrounding context, this chapter aims to shed light on how doctoral students decide to become entrepreneurs. A conceptual model integrating doctoral students' specific human capital, their pro-social motivation, and the university support system is proposed to explain their cognitive transition from entrepreneurial alertness to intentions, and empirically tested.

A structured questionnaire is administered to 261 doctoral students enrolled in 19 Italian universities. Partial Least Square Structural Equation Modeling (PLS-SEM) tests for causal relationships among latent variables. Necessary Condition Analysis (NCA) is adopted to clarify whether the relevance of the university support system changes with different levels of doctoral students' pro-social motivation.

While demonstrating a causal relationship between doctoral students' specific human capital and their entrepreneurial alertness, the results do not confirm the role of the university support system in reinforcing the cognitive transition from entrepreneurial alertness to intentions. A post-hoc necessary condition analysis shows that university support is a 'condicio sine qua non' for doctoral students' entrepreneurial decision when their pro-social motivation is weak. Conversely, it is not a necessary condition when they are driven by a weak pro-social motivation.

There are three theoretical implications for this work. (i) By contributing to the literature on the entrepreneurial university, the role of the university support system in the early stage of Ph.D. entrepreneurship is questioned. (ii) By joining the debate on academic entrepreneurship, the understanding of the multi-level dynamics underpinning doctoral students' decision to become entrepreneurs within the academic setting is enhanced. Finally, (iii) the overall comprehension of individual motivations underlying academic entrepreneurship is extended by proposing pro-social motivation as a driving factor in doctoral students' decision to become entrepreneurs.

Keywords: Entrepreneurial University, Ph.D. Entrepreneurship, Social Information Processing, University Support

1. INTRODUCTION

As a consequence of the arising of the knowledge society, a new world emerged where competencies, know-how, and specific skills are vital to foster innovation (Lucas, 1988; Romer, 1986). In this setting, universities have become increasingly important for economic, social, and cultural growth, being knowledge producers (Audretsch, 2014; Breznitz & Feldman, 2012). However, research produced within academia needs to be transferred outward to help generate social and economic innovation (Etzkowitz, 2014; Wright & Phan, 2018). Therefore, higher education institutions have implemented several structures to support the knowledge and technology transfer toward external stakeholders, such as technology transfer offices, incubators, accelerators, and science parks (Etzkowitz, 2013; Fayolle & Redford, 2014; Guerrero & Urbano, 2012; Albahari, Pérez-Canto, Barge-Gil & Modrego, 2017). As a result, the recent body of knowledge has been focused on understanding whether and how these structures positively influence the entrepreneurial initiatives of academic actors (e.g., Chirgui, Lamine, & Mian, 2016; Fitzgerald & Cunningham, 2016).

In this new framework, entrepreneurship is a vehicle for academic actors to translate knowledge produced within the "ivory tower" into social and economic impact (Caiazza, Belitski & Audretsch, 2020; Fini, Rasmussen, Siegel & Wiklund, 2018). Because of this, universities are increasingly involved in promoting entrepreneurship among tenured professors, and doctoral and undergraduate students (Audretsch & Belitski, 2021). Out of all of them, doctoral students are worth studying as potential academic entrepreneurs because of their great entrepreneurial potential, due to a number of specific characteristics that distinguish them from the other groups (Muscio & Ramaciotti, 2019). These attributes include their deep scientific experience and specific skills, which make them potential innovators (Pretorius & Macaulay, 2021), and their not-yet-established professional identity, which makes entrepreneurship a viable option for their future careers (Link,

2021; Muscio et al., 2021). In addition, doctoral students are particularly sensitive to instances from the external environment, which they tend to absorb into their research projects (Mars & Moravec, 2022). For these reasons, it is argued that doctoral students' entrepreneurial initiatives deserve to be studied because of their potential in transforming knowledge into social and economic impact (Bienkowska, Klofsten, & Rasmussen, 2016; Mars & Moravec, 2022).

However, doctoral students are still overall understudied (Muscio et al., 2021; Muscio & Ramaciotti, 2019). Current research has mostly addressed Ph.D. entrepreneurship focusing on specific entrepreneurial outcomes, such as entrepreneurial intentions (e.g., Bienkowska, Klofsten, & Rasmussen, 2016; Feola et al., 2019) or venture creation (Muscio & Ramaciotti, 2019), but still lacks a multi-level understanding of doctoral students' entrepreneurial decision, which takes into consideration both individual dimensions and institutional support.

In addressing this issue, the chapter draws on a social information processing perspective, according to which an individual decision in an established organization results from the interplay between micro and macro dimensions (Salancik & Pfeffer, 1978). A conceptual model is proposed and empirically tested to explain how they become entrepreneurially alert and then decide to become entrepreneurs- that is becoming intentioned to act entrepreneurially (Balven, Fenters, Siegel & Waldman, 2018; Gielnik, Zacker & Wang, 2018; Thompson, 2009). The framework integrates their specific human capital, which is a set of specific skills which make them suitable for performing entrepreneurship (Becker, 1962; Marvel, Davis & Sproul, 2016), and the university support system, articulated into entrepreneurship education, concept and business development support (Kraaijenbrink, Bos & Groen, 2010). Finally, pro-social motivation, conceived as the need to generate a social impact with their research (Bartha, Gubik & Bereczk, 2019; Yitshaki & Kropp, 2016; Yu, Ye & Ma, 2020) is proposed as an inner urge which might drive doctoral students' purposeful

action to create a new venture (Bandura, 2018), marginalizing the role of the institutional support in this decision.

The hypotheses resulting from the conceptual model have been tested through PLS-SEM and NCA (Dul, 2016; Hair, Hult, Ringle & Sarstedt, 2017). The results have shown that the more doctoral students are endowed in terms of human capital, the more likely they are to be alert to entrepreneurial opportunities. Moreover, the analysis has not confirmed the role of the university support system in favoring doctoral students' transition from being entrepreneurially alert toward becoming intentioned to be entrepreneurs - the moderating effect of the three dimensions of university support was found to not be statistically significant. On the contrary, this chapter's findings demonstrated that pro-social motivation is an inner drive for their entrepreneurial decision. Indeed, the university support system has not been found to be a necessary condition for doctoral students' entrepreneurial decisions when a strong pro-social motivation drives their actions.

The present chapter provides a threefold theoretical contribution. First, a piece of knowledge is provided to the scientific debate on entrepreneurial universities, by debunking the widely held assumption that institutional support is required for the emergence of Ph.D. entrepreneurship (Cunningham, Lehmann & Menter, 2022; Etzkowitz & Zhou, 2008). Second, the chapter contributes to the understanding of the multilevel dynamics underlying doctoral entrepreneurship as an organizational behavior by presenting and empirically testing a conceptual model that integrates human capital, pro-social motivation, and university support system (Bienkowska et al., 2016; Mars & Moravec, 2022). Third, the comprehension of the individual motivations that drive doctoral students to pursue entrepreneurship is improved (Balven et al., 2018; Iorio, Labory & Rentocchini, 2017). The crucial role of pro-social motivation is demonstrated in stimulating the entrepreneurial decision of doctoral students. In so doing, the present findings

have shown that the university support system becomes scarcely relevant in the early stage of Ph.D. entrepreneurship when doctoral students are pushed by a strong pro-social motivation.

The chapter is structured as follows. (i) Theoretical foundations are discussed, and the model's hypotheses are presented. (ii) The methodology adopted in this research is exposed: sample, procedure, measures, and data analysis. (iii) The results of PLS-SEM and NCA analyses are shown. (iv) Theoretical and practical implications are discussed.

2. THEORETICAL BACKGROUND

2.1 Doctoral students as high-potential entrepreneurs

The knowledge society is characterized by the prominent role of intangible assets such as specific skills, abilities, and networks, which become far more relevant than physical means of production (Drucker, 1993; Powell & Snellman, 2004). In this new social and economic model, universities, as knowledge producers (Sam & Van-Der-Sijde, 2014), are extremely relevant players in regional ecosystems for generating social and economic development (Audretsch, 2014; Carayannis, Grigoroudis, Campbell, Meissner & Stamati, 2017).

The institutional switch toward the entrepreneurial university implied a transition at the individual level: the classic vision of the scientist locked in laboratories and isolated from the needs of the outside world is out of date (Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011). This transition inevitably called into question the role of doctoral education. Indeed, it is no longer seen exclusively as the pathway toward an academic career, but rather as the highest qualification that creates highly specialized profiles who can widely contribute to the advancement of society in many ways (Auriol, 2010; Shin et al., 2018). As a result, the role of Ph.D. graduates and doctoral students

in society drastically changed (Bienkowska et al., 2016). In response to this paradigm shift, universities are striving to train doctoral students who are not only future scholars but also actors of social and economic change (Klofsten et al., 2021; Rippa et al., 2022), assuming that they have the potential to transform the knowledge produced inside the ivory tower into social and economic impact by means of entrepreneurship (Fini et al., 2018; Lean, 2012). This target holds specific characteristics which make them high-potential entrepreneurs, becoming the ideal bridge between the university and the external world (Muscio et al., 2021). First, doctoral students no longer receive an exclusively scientific education, but their training increasingly has practical features that help them navigate their way also in contexts outside academia (Klofsten et al., 2021; Rippa et al., 2022). Furthermore, their average young age and willingness to take more risks than tenured academics make them keener to launch new ventures (Boh et al., 2016; Hakala, 2009; Lean, 2012). Finally, because there are no defined career paths, this target is suitable to develop a professional identity that may have entrepreneurial characteristics (Pretorius & Macaulay, 2021; Sweitzer, 2009). For all these reasons, it is argued that this group of academic actors deserves to be studied further separately from faculty and undergraduate students.

2.2 Ph.D. entrepreneurship as an organizational behavior: individual vs university

According to social information processing theory, an interplay between the individuals and the surrounding organizational context affects attitudes and decisions, which in turn are the premises for a specific organizational behavior (Salancik & Pfeffer, 1978). Dropped into the university context, it would mean that the decision to enact a specific organizational behavior, such as academic entrepreneurship, should be studied without excluding from the perspective of analysis neither the individual dimension nor the context. On one side, this assumption is theoretically supported by a large body of research highlighting the multi-level nature of academic entrepreneurship (Fini et al.,

2019; Fini, Rasmussen, Wiklund & Wright, 2020; Wood, 2011). On the other, plenty of contributions have empirically demonstrated that the academic entrepreneurship process is jointly affected by micro and macro factors, although these elements have been studied mostly separately. Ndonzuau, Pirnay, & Surlemont's (2002) seminal work is a meaningful example. They pointed out the first stage of academic entrepreneurship, conceived as the generation of business ideas, proposing that it is influenced both by exquisitely individual identity factors and by elements related to the organizational context, such as the academic culture. Several empirical contributions have been published afterward, considering different individual rather than organizational variables (e.g., Goethner, Obschonka, Silbereisen, & Cantner, 2012; Urban & Chantson, 2019).

However, published contributions on Ph.D. entrepreneurship seem to underestimate the complexity of the phenomenon (Muñoz et al., 2020), although notable exceptions exist. Bienkowska et al. (2016) investigated how doctoral students perceive different levels of university settings to be entrepreneurially supportive, looking at some specific individual characteristics such as age, faculty affiliation, and participation in collaborative research as these aspects imply a different perception of entrepreneurial support by doctoral students. Feola et al. (2019) proposed and empirically tested a model which uses the theory of planned behavior's (Ajzen, 1991) predictors and the framework of the triple helix (Etzkowitz et al., 2000) in an interesting attempt to integrate the individual dimension with the surrounding context to explain the formation of doctoral students' entrepreneurial intentions. Although these examples show that scholarly attention to the pre-founding stages of Ph.D. entrepreneurship is increasing, they also highlight that the understanding of the phenomenon is still nuanced. In particular, the theoretical lens adopted in this chapter leads to question whether there are individual factors that foster the emergence of the process and how they interplay with institutional support. More specifically, it is wondered whether doctoral students' prior experience

and individual motivation may play a stand-alone triggering effect on doctoral students' entrepreneurial decision, which may be fostered by an organizational context perceived as conducive to entrepreneurship.

2.3 Human capital and entrepreneurial alertness

Social information processing theory emphasizes the binding role of prior experience, particularly relevant to individuals in accruing specific attitudes, decisions, and behaviors within an organizational setting (Salancik & Pfeffer, 1978). The individuals' stock of experiences and background is extremely relevant if the focus is on entrepreneurial activities (Marvel et al., 2016), considering that a constant process of individual learning at the base of entrepreneurship underlies the entrepreneurial path, through which, with greater or lesser success, prior experience is transformed into meaningful knowledge for entrepreneurial action (Lindh & Thorgren, 2016; Matsuo, 2019).

Entrepreneurship scholars have extensively used the notion of human capital to explain pre-foundational dynamics, such as the individuals' capability to identify an entrepreneurial opportunity or the formation of entrepreneurial intentions (Marvel et al., 2016). This concept is conceived as the set of soft and hard skills useful for performing broad or specific tasks gained by an individual through experience (Becker, 1962; Ucbasaran et al., 2003). Notably, Corbett (2007) was a pioneer in emphasizing that prior knowledge is necessary for nascent entrepreneurs to identify entrepreneurial opportunities. In subsequent years, other empirical contributions have shown that the greater the nascent entrepreneurs' stock of experience, the more likely they are to identify entrepreneurial opportunities (i.e., Ucbasaran, Westhead, & Wright, 2008, 2009). More recently, Mueller & Shepherd (2016) broadened the inquiry perspective by pointing out that it is difficult for nascent entrepreneurs to take advantage of opportunities without a solid understanding of how

products do not meet current consumer needs. More generally, it can be argued that the more entrepreneurial experience individuals have, the more they tend to be entrepreneurially alert.

Some empirical works have succeeded in using the human capital perspective to explain the entrepreneurial performance of scientists. For example, Toole & Czarnitzki (2009) studied the relationship between human capital related to research and to entrepreneurship and the researchers' entrepreneurial performance. In contrast, Goethner et al. (2012) integrated human capital with other cognitive predictors to explain scholars' entrepreneurial intentions. Interestingly, Erikson, Knockaert, & Foo (2015) combined the human capital perspective with institutional and self-efficacy theories in an interesting attempt to propose a model to explain doctoral students' entrepreneurial aspirations. In doing so, previous entrepreneurial, industrial, and patent experiences were accounted for.

However, to the best of the author's knowledge, no study has focused on the relationship between scientists' human capital and their alertness to entrepreneurial opportunities, least of all with regard to doctoral students. This chapter argues that, to explain how doctoral students become entrepreneurially alert, it is needed to consider both entrepreneurship-oriented human capital and academic engagement-oriented human capital. The former is represented by prior experiences that might be useful in performing entrepreneurial tasks, such as previous start-up or work experience (Neves & Brito, 2020; Ucbasaran et al., 2003, 2008). The latter is conceived as the set of experiences related to academic engagement, such as patenting, licensing, and contract research, that could facilitate young scholars toward their entrepreneurial decision (Erikson et al., 2015; Perkmann et al., 2021). Based on these considerations, the present work aims to shed light on the causal relationship between these two forms of doctoral students' human capital and their focus on entrepreneurial opportunities, as illustrated in the following hypotheses:

H1: *Entrepreneurship-oriented human capital positively affects doctoral students' entrepreneurial alertness*

H2: *Academic engagement-oriented human capital positively affects doctoral students' entrepreneurial alertness*

2.4 The origin of Ph.D. entrepreneurship

Despite the vigorous scholarly debate around the concept of entrepreneurial opportunity (Wood & McKinley, 2020), it is a fact that the field of entrepreneurship has pivoted around identifying and exploiting opportunity since the publication of Shane & Venkataraman's (2000) seminal work. Based on the assumption that no entrepreneurship is without opportunity (Davidsson, 2015), a juxtaposition between opportunity recognized and created still exists. It means that it is yet to be disputed whether the opportunity exists independently of the entrepreneurs or if it must be created by the entrepreneurs themself (Alvarez & Barney, 2007; Ramoglou & Tsang, 2018). However, whether discovered or created, it is a fact that entrepreneurial opportunities can only be identified under certain conditions (Dimov, 2007). Given this, standing in line with the Austrian school (Kirzner, 1973), it is argued that doctoral students need to be alert to identify an entrepreneurial opportunity (Kirzner, 2009; Martin & Wilson, 2015; Shane, 2000). Drawing on this premise, it is posited that entrepreneurial alertness is a precondition for the emergence of Ph.D. entrepreneurship.

However, entrepreneurial alertness is not in itself enough to trigger the entrepreneurial process (Baron & Ensley, 2006; Mckelvie et al., 2020). Indeed, the entrepreneur needs to decide to act to leverage a potential opportunity (Ardichvili et al., 2003; Shepherd et al., 2015). Thus, the decision to become an entrepreneur involves a cognitive transition from systematically looking for entrepreneurial opportunities - i.e., being entrepreneurially alert - to planning to take action to create a business at some point in the future, which means becoming intentioned to do so (Patel &

Fiet, 2009; Thompson, 2009). In this sense, an individual-level cognitive effort is required to take the first step toward an entrepreneurial journey (Balven et al., 2018; Shook et al., 2003). Therefore, the origin of the entrepreneurial process is conceived to be the cognitive transition of doctoral students from being entrepreneurially alert toward making an entrepreneurial decision, as outlined in the third hypothesis:

H3*: Doctoral students' entrepreneurial alertness positively affects their entrepreneurial intentions*

2.5 The role of university support system

Providing tangible and intangible facilities to foster entrepreneurship among tenured staff, undergraduate and doctoral students is part of the essence of entrepreneurial universities (Guerrero & Urbano, 2012; Lazzeroni & Piccaluga, 2003). The effectiveness of university facilities for scientists' entrepreneurial ventures has been extensively studied (Sandström et al., 2018), but doctoral students as a target have been overall understudied (Bienkowska et al., 2016).

Existing empirical research on the relationship between the university support system and the pre-foundational stage of academic entrepreneurship is largely focused on entrepreneurial intentions (Neves & Brito, 2020), and the narrow state of the art on doctoral students does not differ in this sense. Published works mainly focus on the specific structures provided by the entrepreneurial university as predictors of entrepreneurial intentions, with some meaningful exceptions (e.g., Loi & Di Guardo, 2020). On the one hand, Feola et al. (2019) is an explanatory example that confirms this trend, as this model conceives the presence of technology transfer, patent office, and academic incubators as antecedents of doctoral students' entrepreneurial intentions. On the other hand, Bienkowska et al. (2016) is an enlightening exception, as they conceptualize entrepreneurial support from universities at a perception level.

In line with Bienkowska et al.'s (2016) assumptions, it is argued that focusing on the perception of support is promising to understand the relationship between single individuals and the university context (Nicolaou & Souitaris, 2016). Existing studies based on the perception of support have justified the choice of considering perceived multidimensional support with the need to capture the multiple ways in which a university can provide entrepreneurial support and understand how it is received at the individual level (Saeed, Yousafzai, Yani-De-Soriano, & Muffatto, 2015; Trivedi, 2016). Assuming the presence of the facilities described above in the vast majority of universities (Brescia et al., 2016), it is argued that this approach provides richer insights into the mechanisms surrounding entrepreneurial initiatives in academia (Klingbeil et al., 2019). Indeed, the mere presence of specific structures may poorly capture the complex process of attributing meaning to the surrounding context that leads a doctoral student to act entrepreneurially and implies awareness of the presence of the aforementioned structures (Huyghe et al., 2016; Johannisson, 2022). Therefore, the following hypotheses are proposed:

H4: *Entrepreneurship education provided by the university strengthens doctoral students' transition from entrepreneurial alertness to intentions*

H5: *Concept development support provided by the university strengthens doctoral students' transition from entrepreneurial alertness to intentions*

H6: *Business development support provided by the university strengthens doctoral students' transition from entrepreneurial alertness to intentions*

2.6 An inner urge: pro-social motivation

Bush's (1945) declaration emphasizes the potential of research to make the world a better place, recognizing scientists as having a leading role and no less a great responsibility. Through the exploitation of the universities' third mission, research results can potentially address social or

economic issues being transferred outside academia through entrepreneurship (Clauss et al., 2018). However, academic actors are supposed to be motivated in order to take action for transferring knowledge through entrepreneurship (Lam, 2011). In acknowledging this assumption, several studies have strived to shed light on scientists' individual motivations, whether intrinsic or extrinsic, to transfer knowledge through entrepreneurship (Balven et al., 2018; Miller, McAdam, & McAdam, 2018). Interestingly, the relevance of financial gain for academic entrepreneurs has been widely questioned, in favor of other motivations, such as the need to support research activities (Bozeman et al., 2013), the possibility of increasing scientific reputation (Perkmann et al., 2013), and that of disseminating new technologies developed within laboratories (Hayter, 2011). On the other hand, Rizzo (2015) is an insightful exception concerning Ph.D. entrepreneurship, showing that this target is predominantly motivated by the need to create an alternative career to academia or R&D in the private sector.

It is widely accepted that scientists are intrinsically motivated to do research by their desire to make the world a better place (Jindal-Snape & Snape, 2006; Ryan, 2014). Extending this assumption to entrepreneurial action as well, Iorio et al. (2017) brought to the fore the desire for social change as a vital driver for scientists' entrepreneurial decision, suggesting that this factor should be explored further. Since doctoral students have a strong propensity to view their research as a response to social issues (Mars & Moravec, 2022), it is argued that is still necessary to explore their pro-social motivation as a trigger factor toward their decision to pursue entrepreneurship. To fill this gap, it is suggested that when a strong pro-social motivation drives their action, doctoral students' entrepreneurial initiative might be a purposeful action, pursued at the individual level regardless of the influence of the institutional context (Bandura, 2018). It would make the university support system weakly relevant for their entrepreneurial decision.

While some published contributions have questioned the efficacy of university structures for entrepreneurship (Huyghe et al., 2016), a holistic understanding of the complementary or substitutive role of institutional support versus individual motivation is still lacking. Specifically, it is still unknown whether and to what extent the university support system is relevant when doctoral students have a strong rather than weak pro-social motivation. Therefore, in order to answer the burning question of whether the university support system is a game license for doctoral students' entrepreneurial decision (Linder, Moulick & Lechner, 2022), the last hypothesis is formulated:

H7: *University support system is critical for doctoral students' entrepreneurial intentions when their pro-social motivation is weak*

3. RESEARCH METHOD

3.1 Sample

In addressing recent methodological and empirical research claiming a comprehensive representation of national contexts (Acs & Audretsch, 2010; Feola et al., 2019), a sample of doctoral students enrolled in Italian universities is used. It is argued that the Italian institutional structure is comparable to that of other European countries (Fini, Grimaldi & Meoli, 2020), given that most Italian universities have an in-house technology transfer office, and an increasing proportion of them also have an incubator (Balderi et al., 2007; Netval, 2021). In general, it can be said that these universities offer tenured faculty, undergraduate and doctoral students different types of support for entrepreneurship, in line with the other universities in the European context (Cesaroni & Piccaluga, 2016).

A semi-structured questionnaire has been administered to 261 doctoral students from universities in different geographical areas of the country. The sample size needed to test the model was assessed using a priori power analysis (Faul et al., 2009) in G*Power software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). In line with Cohen's (1988) methodological suggestions, it is assumed a minimum R^2 of .10, a statistical power of 80%, and 13 predictors (i.e., the university support system had the most predictors). A priori calculation of G* power suggested that a sample size of 131 is required, implying that the sample size in this research exceeds the minimum numerosity required to test this model. An overview of the sample's demographic characteristics is provided in Table 1.

Table 1 – Demographic overview of the sample.

Characteristics		N	%
GENDER	Female	128	49
	Male	123	47
	Non-binary	1	.4
	I prefer not to say	9	3,4
AGE	< 30	208	79.7
	31 - 40	44	17.0
	41-50	9	3.5
GEOGRAPHICAL AREA	North-west Italy	88	33.7
	North-East Italy	103	39.5
	Center Italy	16	6.1
	South Italy	54	20.7
RESEARCH FIELD	Agriculture & Farming	6	2.3
	Biotech	13	5.0
	Engineering & ICT	101	38.7
	Hard sciences	40	15.4
	Humanities	33	12.6
	Medical sciences	10	3.8
	Social science	58	22.2

3.2 Research procedure

Data were gathered using an online survey based on Microsoft Forms and administered in English. As Forza (2002) suggested, 19 doctoral students at the University of Cagliari (Italy) were asked to

complete the questionnaire and provide feedback concerning comprehensibility and logical structure.

3.3 Measures

The existing literature served as the basis for defining metrics for each variable. Entrepreneurial alertness, entrepreneurial intentions, and university support system were considered reflective, as done in previous empirical work (e.g., Feola et al., 2019; Obschonka, Goethner, Silbereisen, & Cantner, 2012; Othman, Othman, & Juhdi, 2020). On the other hand, human capital has been conceptualized as a formative construct, as suggested by Dimov (2017). The following section provides a detailed description of how each measure was operationalized.

3.3.1 Human capital. Prior start-up and work experience, as well as having at least one entrepreneurial parent, have been used as indicators for entrepreneurship-oriented human capital, in line with prior empirical studies (Ucbasaran et al., 2008). On the other side, indicators for academic engagement-oriented human capital were derived from the practices regarded as academic engagement: consulting, contract research, patenting, and training experience (Perkmann et al., 2021).

3.3.2 Entrepreneurial alertness. Entrepreneurial alertness was operationalized using the scale created by Kuckertz, Kollmann, Krell, & Stöckmann (2017) to measure opportunity identification, previously adopted in empirical research (Maran, Bachmann, Mohr, Ravet-Brown, Vogelauer, & Furtner, 2021; Rahman, Khan, Al-Abri, & Taghizadeh, 2021). Following the original format, all six scale items were included in the questionnaire and scored on a 7-point Likert scale, with 1 (complete disagreement) as the minimum and 7 as the maximum score (total agreement). For example, item 1 was "I am always alert to business opportunities," while item 4 was "I seek information about new ideas or products or services."

3.3.3 Entrepreneurial intentions. The entrepreneurial intentions were measured using the six-item Entrepreneurial Intentions Questionnaire proposed by Liñán & Chen (2009), assuming the formation of entrepreneurial intentions as a good proxy for the decision to become an entrepreneur (Thompson, 2009). Conspicuous research into entrepreneurship has already used the questionnaire (e.g., Feola et al., 2019; Gieure, Benavides-Espinosa, & Roig-Dobón, 2019). As with the focus on entrepreneurship, a 7-point Likert scale was adopted, ranging from a value of 1 (complete disagreement) to 7 (complete agreement). Significant examples of items are "I have thought very seriously about starting a business" (item 2) and "I am determined to start a business in the future" (item 4).

3.3.4 University Support System. For measuring the university support system, the scale IN three dimensions developed by Kraaijenbrink et al. (2010) is used, as done in previous empirical contributions (e.g., Trivedi, 2016; Wegner et al., 2019). The metric consists of 14 questions, of which 6 are about entrepreneurship education, 4 explore perceived concept development, and 4 perceived business development. As in the original version, a 7-point Likert scale is adopted, where 1 meant total disagreement and 7 meant total agreement. Some significant examples are here provided for each dimension. "My university organizes conferences/workshops on entrepreneurship" (Item 5 - entrepreneurship education), "My university creates awareness of entrepreneurship as a possible career choice" (Item 3 - concept development support), and "My university uses its reputation to support students starting a new business" (Item 1 - business development support).

3.3.5 Pro-social motivation. Pro-social motivation is derived from the social entrepreneurship literature, drawing on the scale developed by Satar & Natasha (2019) to measure social entrepreneurship orientation. Although this scale has already been used in social entrepreneurship

(e.g., Naveed, Zia, Younis, & Shah, 2021), it has never been adopted to study entrepreneurship in academia. The 3 items describing the specific dimension of social passion have been used to measure pro-social motivation. A 7-item Likert scale was adopted, where the minimum value was 1 (total disagreement) and the maximum was 7 (total agreement). An example of an item on this scale is "I explicitly focus on creating social value" (item 1).

3.4 Data analysis

Using the statistical software SmartPls4® (SmartPLS GmbH, Bönningstedt, Germany), data were analyzed using Partial Least Square Structural Equation Modeling (PLS-SEM) and Necessary Condition Analysis (NCA). In so doing, methodological suggestions provided by Hair, Hult, Ringle and Sarstedt (2017) and Hair, Sarstedt, Ringle and Gudergan (2017) are followed. On the one hand, PLS-SEM is strongly recommended when research is based on a complex model such as the one in this chapter (Hair, Ringle, & Sarstedt, 2011). On the other, NCA is extremely useful for assessing whether a certain condition is necessary for something to occur (Dul, 2016; Dul, Van-Der-Laan, & Kuik, 2020).

4. RESULTS

This section opens with an overview of the correlations among the latent variables. Next, the results of PLS-SEM and NCA are presented.

4.1 Correlations

Table 2 summarizes Pearson bivariate correlations among the latent variables.

Table 2 – Correlations matrix.

		1	2	3	4	5	6	7
1.Entrepreneurship Human Capital	Pearson correlation	1						
	Sign. (two tales)							
2. Engagement Human Capital	Pearson correlation	.306**	1					
	Sign. (two tales)	.000						
3. Entrepreneurial Alertness	Pearson correlation	.373**	.368**	1				
	Sign. (two tales)	.000	.000					
4. Entrepreneurship Education	Pearson correlation	.096	.146*	.126*	1			
	Sign. (two tales)	.130	.021	.047				
5. Concept Development Support	Pearson correlation	.141*	.153*	.191**	.855**	1		
	Sign. (two tales)	.025	.015	.002	.000			
6. Business Development Support	Pearson correlation	.139*	.130*	.133*	.774**	.859**	1	
	Sign. (two tales)	.028	.040	.036	.000	.000		
7. Pro-Social Motivation	Pearson correlation	.297**	.249**	.312**	.168**	.132*	.161*	1
	Sign. (two tales)	.000	.000	.000	.008	.037	.011	
8. Entrepreneurial Intentions	Pearson correlation	.341**	.336**	.836**	.106	.154*	.098	.276*
	Sign. (two tales)	.000	.000	.000	.094	.014	.122	.000

**. Correlation is statistically significant at .01 (two tails) *. Correlation is statistically significant at .05 (two tails)

In support of the relationships proposed in this model, a statistically significant correlation was found between entrepreneurship-oriented human capital and entrepreneurial alertness (r = .373**) as well as between academic-oriented human capital and entrepreneurial alertness (r = .368**). Similarly, a high correlation emerged between entrepreneurial alertness and entrepreneurial intentions (r = .836**). Finally, the three dimensions of the university support system appeared to be correlated with entrepreneurial alertness (r = .126* for entrepreneurship education; r = .191** for concept development support; r = .133* for business development

support). The university support system and entrepreneurial intentions deserve slightly different consideration. While the correlation of entrepreneurship education and business development support with entrepreneurial intentions is not statistically significant (r = .106 for entrepreneurship education and r = .098 for business development support), concept development support appears to be correlated with the same variable (r = .154*).

4.2 Structural Equation Modelling

This section shows the assessment of the measurement and structural models of PLS-SEM, as suggested by recent methodological reflections (Benitez, Henseler, Castillo & Schuberth, 2020).

4.2.1 Measurement model. Composite reliability (CR) expresses the true variance ratio to the model's observed variance (Brunner & Süß, 2005). The average variance extracted (AVE) defines a measure of the amount of variance captured by a construct versus the amount of variance due to measurement error. Cronbach alpha assesses the degree of interrelationship between a group of items (Cronbach, 1951). All of these indicators have been used to assess reflective constructs.

In contrast, convergent validity and reliability measures could not be applied to formative variables because the formative indicators are co-causes of the latent variables and are not necessarily correlated (Hair, Sarstedt, Pieper & Ringle, 2012). Therefore, the variance inflation factor (VIF) and external weights are used to evaluate the formative variables. The former is the ratio of the variance estimated for some indicators in a model that considers many indicators to the variance of a model generated using only one term. It is useful for assessing collinearity (Diamantopoulos & Winklhofer, 2001; Hu & Bentler, 1998). The latter is the coefficient that links each indicator with the next variable (Anderson, 1987).

Table 3 – Assessment of reflective variables.

Variable	Item	Outer Loadings	AVE	CR	Cronbach α
Entrepreneurial Alertness	EA_1	.870**	.737	.916	.910
	EA_2	.903**			
	EA_3	.895**			
	EA_4	.743**			
	EA_5	.872**			
Entrepreneurial Intentions	EI_1	.923**	.860	.967	.967
	EI_2	.900**			
	EI_3	.936**			
	EI_4	.958**			
	EI_5	.896**			
	EI_6	.948**			
Entrepreneurship Education	EE_1	.788**	.674	.957	.907
	EE_2	.800**			
	EE_3	.774**			
	EE_4	.778**			
	EE_5	.889**			
	EE_6	.887**			
Concept Development Support	CDS_1	.798**	.744	.896	.885
	CDS_2	.899**			
	CDS_3	.862**			
	CDS_4	.887**			
Business Development Support	BDS_1	.838**	.766	.865	.847
	BDS_2	.922**			
	BDS_3	.864**			

**. Correlation is statistically significant at .01 (two tails) *. Correlation is statistically significant at .05 (two tails)

The values of Cronbach alpha (>.70), CR (>.70) and AVE (>.50), as shown in Table 3, are all higher than those recommended by Hair et al. (2017), which means that all reflective measures showed adequate internal consistency, further confirmed by the statistical significance of all indicators. In addition, it is recognized that the high correlation between alertness and intentions may represent a problem for the model's reliability. Therefore, the discriminant validity of the constructs has been assessed through the heterotrait-monotrait relationship, whose value (HTMT = .892) is below the threshold of .90 proposed in methodological literature (Henseler, Ringle & Sarstedt, 2015).

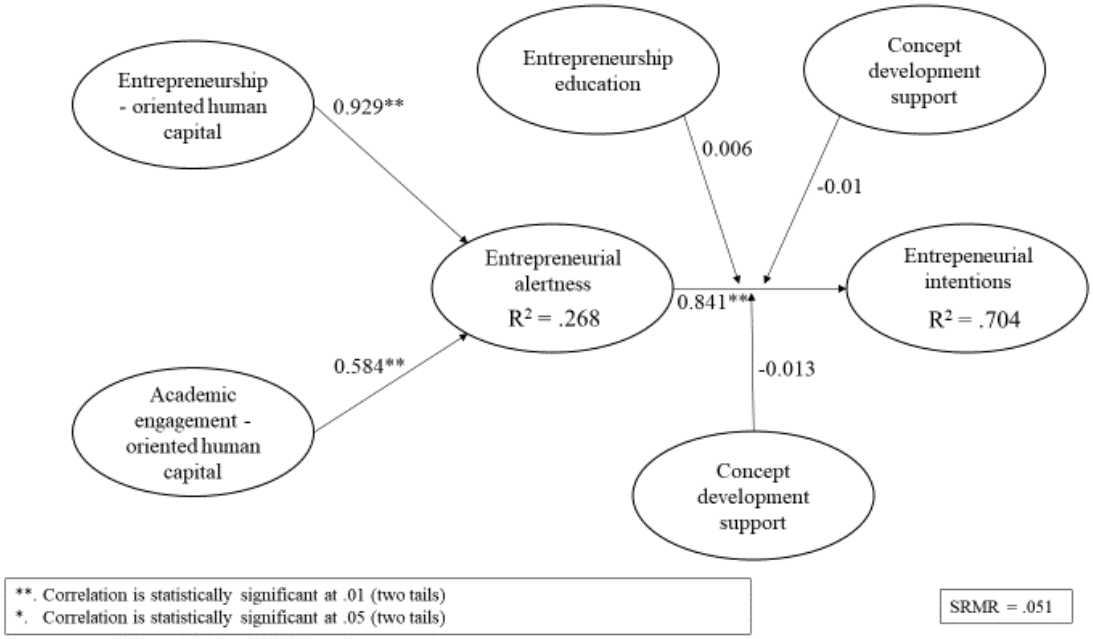
Table 4 – Assessment of formative constructs.

Variable	Item	Outer Weight	VIF
Entrepreneurship-human capital	HC_FAM	.123	1.039
	HC_EXP	.218	1.087
	HC_EEXP	.888	1.101
Academic engagement - human capital	HC_CON	.583	1.128
	HC_CONTRES	.036	1.235
	HC_JOINT	.284	1.147
	HC_PAT	.338	1.060
	HC_TRAIN	.401	1.071

The results of the evaluation of the formative constructs are shown in Table 4. Except for two indicators of human capital related to entrepreneurship (family business and work experience) and two indicators of human capital related to academic engagement (contract research and joint research), all external weights were found to be statistically significant. However, the indicators were left in the model because, as suggested in the methodological literature (Cenfetelli & Bassellier, 2009; Hair, Hult, Ringle, & Sarstedt, 2017), their correlations with the constructs to which they belong were statistically significant. They counted respectively, $r = .666$, $p < .01$ for family business, $r = .718$, $p < .01$ for work experience, $r = .666$, $p < .01$, $= .629$, $p < .01$ for contract research, and $r = .594$, $p < .01$ for joint research.

4.2.2 Structural Model. As suggested by Hair et al. (2017), a bootstrapping with 3.000 resamples is conducted to estimate path coefficients between latent variables and assess the statistical significance of the relationships. The resulting framework is shown in Figure 1.

Figure 1 – Results of the structural model.



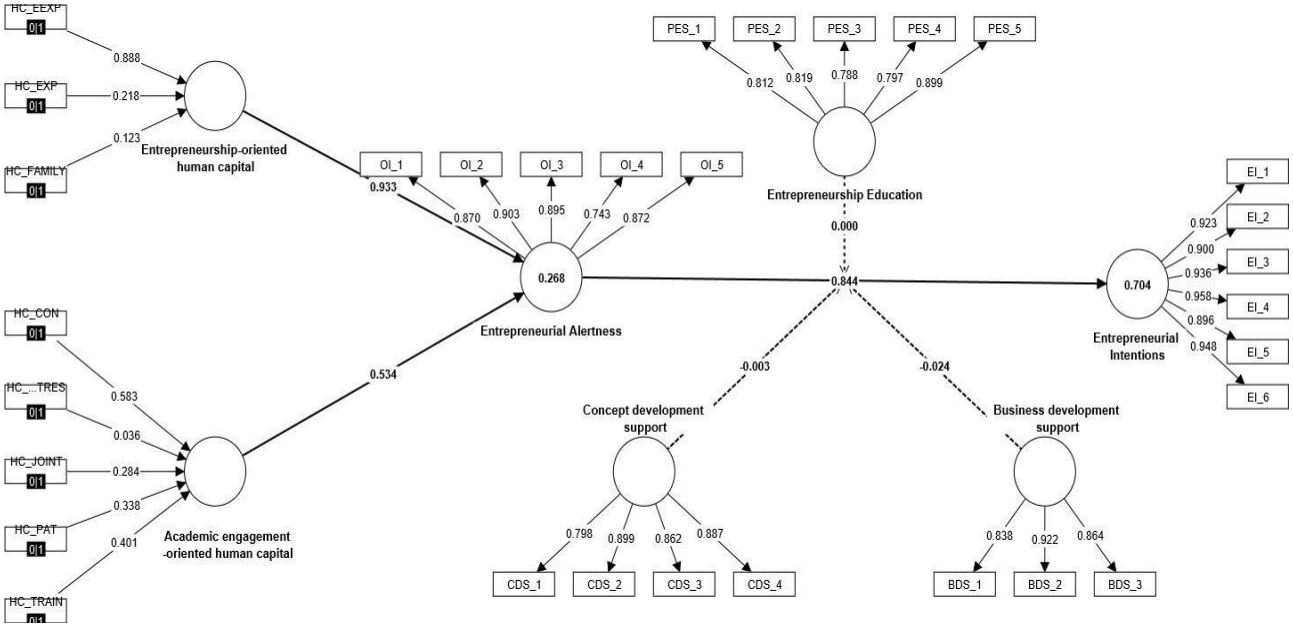
The root mean square residual (SRMR), defined as the difference between the measured correlation and the model's implied correlation matrix, has a value above the threshold of .08 suggested in methodological literature (Hair et al., 2017). The coefficient of determination (R^2) indicates that the model explains 26.8 % of the variance in entrepreneurial alertness (R^2 =.268) and 70.4 % of the variance in entrepreneurial intentions (R^2 =.704). Both forms of human capital showed a statistically significant effect on entrepreneurial alertness. As exposed in Table 5, the results demonstrate that the largest effect on entrepreneurial alertness is exerted by human capital related to entrepreneurship (β = .929), followed by human capital related to academic engagement (β = .584). In addition, their coefficient highlights the causal relationship between entrepreneurial alertness and entrepreneurial intentions (β = .841).

Table 5 – Assessment of structural model.

Hypothesis	Relationship	β	95 % CI	Std error	t	p	f^2
H1	Entrepreneurship-oriented human capital → Entrepreneurial alertness	.929	.597	.166	5.622.000	.000	.157
H2	Academic engagement – oriented human capital → Entrepreneurial alertness	.584	.351	.119	4.478.000	.000	.070
H3	Entrepreneurial Alertness → Entrepreneurial Intentions	.841	.773	.030	27.885.000	.000	2.125.000
H4	Entrepreneurship Education x Entrepreneurial Alertness → Entrepreneurial Intentions	.006	-.126	.066	.0210	.983	.000
H5	Concept development support x Entrepreneurial Alertness → Entrepreneurial Intentions	-.010	-.253	.113	.035	.972	.000
H6	Business development support x Entrepreneurial Alertness → Entrepreneurial Intentions	-.013	-.161	.085	.275	.783	.000

Surprisingly, not all external loadings are statistically significant: the moderating effect of the three forms of university support does not significantly affect the transition from entrepreneurial alertness to entrepreneurial intentions. The path coefficients are all close to zero (β = .006 for entrepreneurship education, β = -.010 for concept development support, β = -.013), and in any case, all three are statistically non-significant. Their p-values confirm it: t= .983 for entrepreneurship education, t= .972 for concept development support, and t= .783 for business development support. In light of these values, H4 and H5 are not supported by the analysis. A general graphic synthesis of results - that combine the outer weights and outer loading of the indicators and the path coefficients - is provided in Figure 2.

Figure 2 - graphic synthesis of PLS-SEM results.



4.3 Necessary Condition Analysis

NCA was conducted to assess whether the university support system is needed. It is tested with the whole sample and in two sub-samples: doctoral students with strong and weak pro-social motivation. This methodology, which is relatively new (Braumoeller & Goertz, 2000), is suggested to empirically test "necessary but not sufficient" conditions, i.e., cases in which the existence of a specific variable or construct is essential for the occurrence of an entrepreneurial outcome (Dul, 2016; Linder et al., 2022). It has been widely used in management (Dul et al., 2010), being suggested in addition to more traditional methods such as PLS-SEM, to emphasize further the concept of causality within the necessary-but-not-sufficient paradigm (Dul, 2016; Dul et al., 2010). The analysis was conducted using SmartPLS 4® (SmartPLS GmbH, Bönningstedt, Germany). A ceiling enveloping with free disposition hull (CE-FDH) was used, being proposed as a default method to assess the ceiling area, i.e., the empty area above the ceiling line (Dul, 2016).

To clarify the role of pro-social motivation in Ph.D. students' entrepreneurial decision, the sample has been divided into two groups according to the median of this variable (i.e., low vs high). Then, significant differences have been tested in the median of pro-social motivation for the two groups using the SPSS® t-test (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0). As shown in Table 6, the 134 respondents with strong pro-social motivation showed greater entrepreneurial alertness (M = 3.032, SD = 1.747) and seemed to be more determined to become entrepreneurs (M = 2.817, SD = 1.934) than the 124 respondents with weak pro-social motivation. They were less entrepreneurially alert (M = 2.325, SD = 1.213) and less determined to become entrepreneurs (M = 2.122, SD = 1.371). The difference between the means is confirmed by the results of the t-test: between-group differences in alertness, t (185) = -2.065, p = .04, and entrepreneurial intentions, t (182) = -2.121, p = .035.

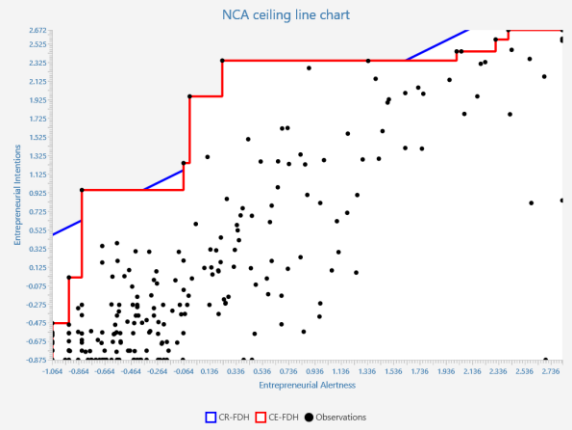
Table 6 – Differences between Ph.D. students with strong and weak pro-social motivation.

Pro-social motivation		N	Mean	Standard Deviation
Entrepreneurial intentions	weak pro-social motivation	124	2.122	1.371
	strong pro-social motivation	134	2.817	1.934
Entrepreneurial Alertness	weak pro-social motivation	124	2.325	1.213
	strong pro-social motivation	134	3.032	1.747

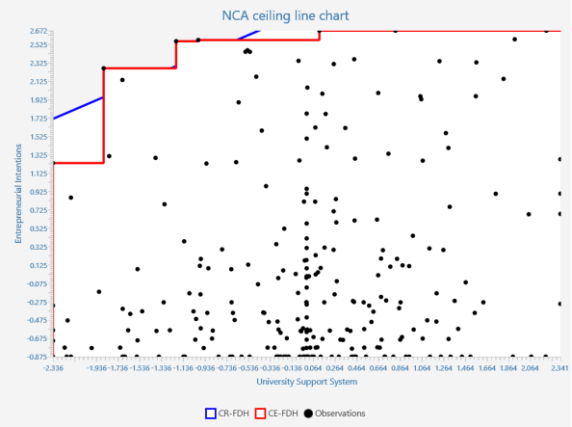
The boundary condition for necessity (Ceiling Envelopment - FDH) and the regression line (Ceiling Regression - FDH line) based on the full sample are plotted in Figure 3 respectively for entrepreneurship alertness, university support system and the moderating factor for these two variables.

Figure 3 – NCA plot for the full sample.

—---------- A —----------



—---------- B —----------



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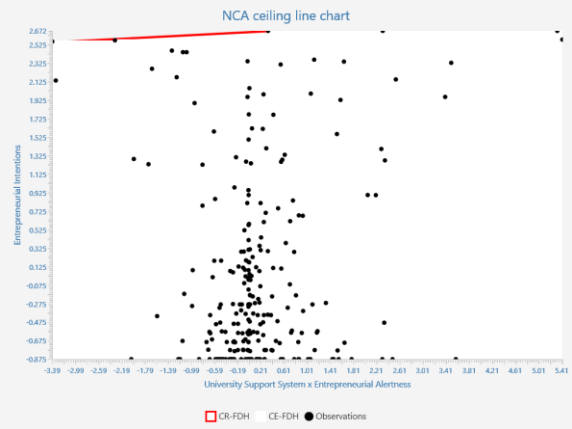


At a glance, the ceiling zone of diagram A (entrepreneurial alertness and intentions) is much larger than the ceiling zones of the other diagrams - diagram B and diagram C. It might suggest that entrepreneurial alertness is necessary for doctoral students to decide to become entrepreneurs,

while the same is not true for the university's support system. Table 7 numerically supports this first impression by providing the results of the NCA permutation to assess the effect size of the necessary condition.

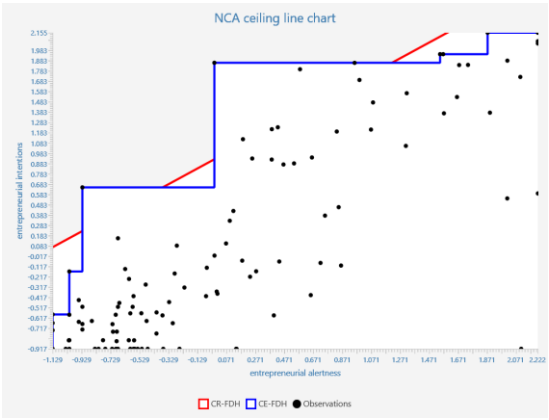
Table 7 – NCA permutation for the full sample.

	Original effect size	CI 95 %	Permutation p-value
Entrepreneurial Alertness	.211	.016	.000
University Support System	.065	.109	.248
University Support System x Entrepreneurial Alertness	.013	.222	.965

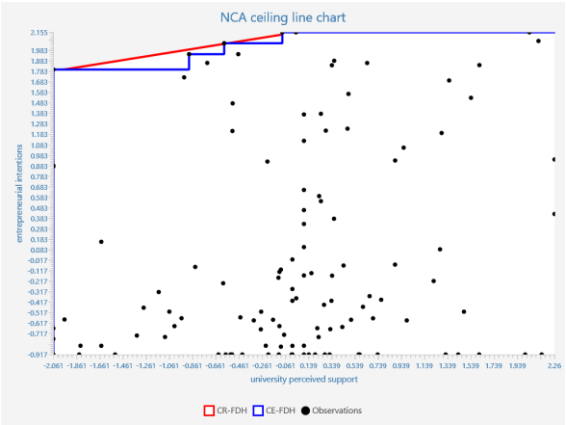
NCA permutation has been conducted to assess the effect size- i.e., the ratio of ceiling area to scope - and its statistical significance (Dul et al., 2020). The analysis showed a statistically significant effect size only for entrepreneurial alertness (d = .211, p = .000) and not for university support (d = .065, p = .248) and moderating effect (d = .013, p = .965). It implies that university support is not necessary for doctoral students to decide to become entrepreneurs when the sample is studied in its entirety. Subsequently, an NCA analysis was conducted with the two subsamples- high vs low - pro-social motivation - to assess whether the university support system is necessary when pro-social motivation is strong rather than weak. Figure 4 graphically shows the ceiling lines for respectively entrepreneurial alertness, university support system, and moderation effect with the sub-sample characterized by a strong pro-social motivation.

Figure 4 – NCA plot for strong pro-social motivation.

—---------- A —----------



—---------- B —----------



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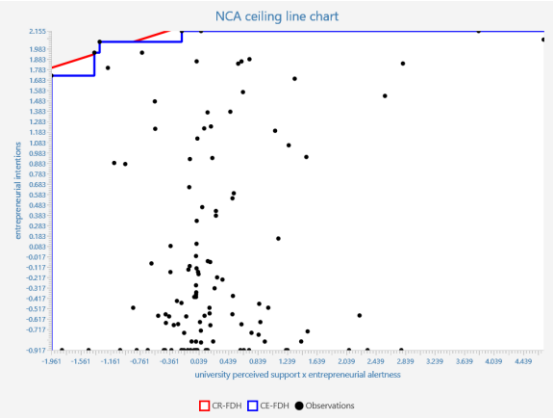


The ceiling area for university support - diagram A - and the moderation factor - diagram B - seems to shrink compared to the first scenario with the whole sample. At the same time, it appears large enough to conceive entrepreneurial alertness as a necessary condition for doctoral students'

entrepreneurial intentions, even when they have a strong pro-social motivation. Table 8 supports this consideration, showing a very similar effect size for entrepreneurial alertness (d = .235, p = .000), as well as a weaker and statistically insignificant effect size compared to the whole sample for the university support system (d = .040, p = .341) and the moderation factor (d = .019, p = .912).

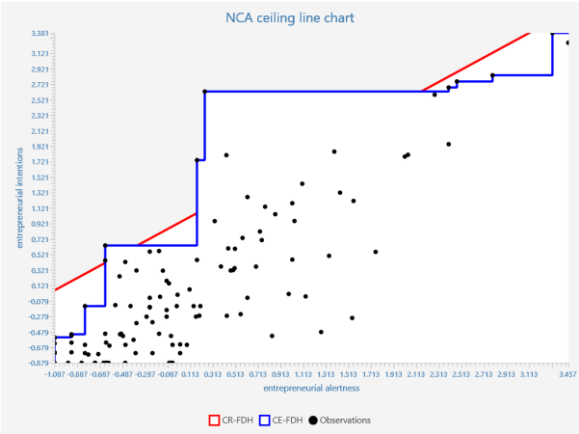
Table 8 - NCA permutation for doctoral students endowed with strong social motivation.

	Original effect size	CI 95 %	Permutation p-value
Entrepreneurial alertness	.235	.026	.000
University perceived support	.040	.099	.341
University perceived support x entrepreneurial alertness	.019	.143	.912

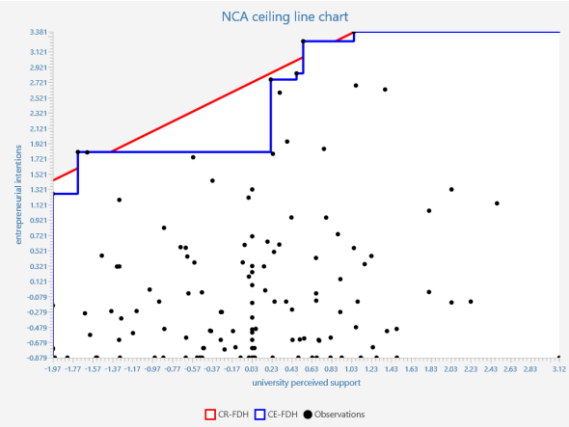
Finally, Figure 4 plots the results of CE-FDH and CR-FDH for what concerns the sub-sample characterized by a weak pro-social motivation, respectively for entrepreneurial alertness, university support system, and the moderation effect. In the latter scenario, a larger ceiling area can be observed for entrepreneurial alertness, university support system and moderation variable.

Figure 4 – NCA plot for sub-sample with weak pro-social motivation

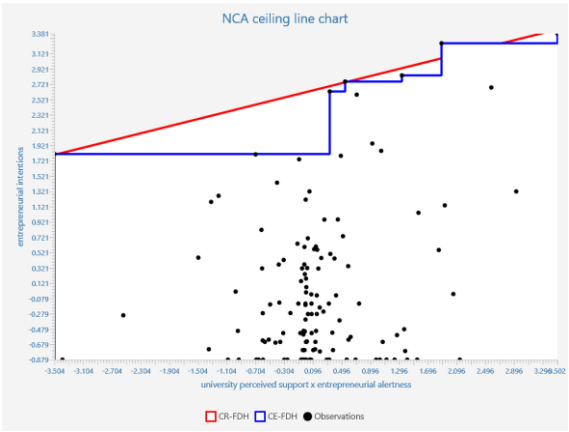
—---------- A —----------



—---------- B —----------



—---------- C —----------



This visual representation suggests that the three variables might all be necessary conditions for doctoral students' entrepreneurial decision when their pro-social motivation is weak. Indeed, while the ceiling areas in diagrams A and C appear to be similar than in previous cases, the one in diagram B - university support system - appears wider than the ones in prior cases. It opens up speculations about entrepreneurial support as a necessary condition in students with weak pro-social motivation.

Table 9 - NCA permutation for doctoral students endowed with weak social motivation.

	Original effect size	95,00 %	Permutation p-value
Entrepreneurial alertness	.320	.072	.000
University perceived support	.177	.168	.035
University perceived support x entrepreneurial alertness	.241	.368	.609

In confirmation of this, Table 9 shows that entrepreneurial alertness is necessary (d = .320, p = .000), as is the university support system (d = .177, p = .035) for doctoral students' decision to become entrepreneurs. In contrast, the moderation effect shows a stronger effect size than in previous scenarios. However, it is not statistically significant (d = .241, p = .609).

5. DISCUSSION

Guided by a social information processing lens, this paper sheds light on doctoral students' decision to become entrepreneurs. To achieve this, a theoretical model has been proposed and tested, integrating the individual dimension with the university support system. Specifically, two different forms of specific human capital are considered, entrepreneurship-oriented and academic engagement-oriented, as predictors of doctoral students' entrepreneurial alertness. Then, the role of the university support system is tested, conceived as entrepreneurship education, support for business conception and development, strengthens their cognitive transition leading to their entrepreneurial decision. Finally, it is hypothesized that the level of doctoral students' pro-social motivation might make the university support system more or less essential to their decision to become entrepreneurs.

On the one hand, the results demonstrated the vital role of human capital for doctoral students to become alert to entrepreneurial opportunities. On the other hand, the model refines the understanding on the effectiveness of university support system as enabler in their decision to become entrepreneurs and brought out the driving role of social motivation. Indeed, the analysis showed that when doctoral students have a strong pro-social motivation, having a supportive university is not vital for their decision to become entrepreneurs. Oppositely, the university support system is essential when their pro-social motivation is weak.

6. IMPLICATIONS AND FUTURE RESEARCH

6.1 Theoretical contribution

The chapter's theoretical implications are threefold. First, it contributes to the literature on the entrepreneurial university (Compagnucci & Spigarelli, 2020; Etzkowitz et al., 2008) by refining the empirical understanding of the perceived university support system in nurturing entrepreneurship among doctoral students (Bienkowska et al., 2016; Muscio et al., 2021). The present work proposes a complex model that seeks to explain how institutional support can influence the decision-making process underlying doctoral students' entrepreneurial journey. In so doing, it goes beyond the presence of specific structures that should facilitate the process, such as the technology transfer office or academic incubator, which have already been extensively studied (Bengtsson, 2017; Lamine, Mian, Fayolle, Wright, Klofsten & Etzkowitz, 2018). In this way, a conceptual framework is provided, that clearly explains whether, how, and at what stage of the entrepreneurial decision the institutional support matters. Second, the understanding of the multi-level dynamics underlying the arising of academic entrepreneurship is improved (Johannisson, 2022; Miranda, Chamorro & Rubio, 2018). It is done by conceiving Ph.D. entrepreneurship as an organizational behavior, proposing and empirically testing a conceptual model that integrates the individual dimension and the university support system into a single framework. Third, this chapter digs deeper into the individual motivations that drive Ph.D. students' entrepreneurial behavior (Lam, 2011; Rizzo, 2015), introducing pro-social motivation as an internal driver of their entrepreneurial decision, which might make institutional support marginal. In this way, the work revealed that young researchers, even if not destined for an academic career, are driven by the inner impulse to make the world a better place through their research, implicitly aligning with the third mission pursued by their universities (Fini et al., 2018).

6.2 Policy implications

Last but not least, this chapter has crucial policy implications, because of its focus on the university support system. In questioning the effectiveness of the university support system in fostering the arising of Ph.D. entrepreneurship and precisely defining when it is needed, and when it is not, these results provide universities with insights that might be useful in designing and developing policies for entrepreneurship. First, these findings emphasize that universities should be aware that any form of support cannot be effective if it does not consider the individuals they are designed for. Support policies should be customized on the base of the specific features of the targets, overcoming the one-size-fits-all assumption. Second, universities should design support tools to foster entrepreneurship among Ph.D. students taking into consideration the crucial role of their motivations, not the least of which is pro-social motivation. Finally, suppose the aim is to foster the arising of entrepreneurial initiatives. In that case, doctoral students should feel supported at the institutional level in their goal to generate a social impact with research. In this sense, university policies should go beyond the idea that Ph.D. entrepreneurship is a mere tool for technology transfer, but it is something more.

6.3 Limitation and future research

This chapter is not without limitations. Since the model has been tested in a relatively narrow setting, future research is suggested to stress it by testing with data collected in cross-national samples to not ignore the influence of cultural, economic, and institutional differences that make each university unique. On the other hand, it is recognized that doctoral students have been defined as a specific target based on the extensive literature that has highlighted how they differ from tenured professors and undergraduate students. However, future research should test the same model with a sample consisting of the three targets in order to empirically investigate the

differences between them. Moreover, further inquiry is needed to dig deeper into the role of pro-social motivation in doctoral students' decision to become entrepreneurs, to reach a wider and clearer understanding of how individual motivations combine with contextual factors toward doctoral students' entrepreneurial decision.

CHAPTER 4

TEARING THE VEIL OF MAYA: HOW DO DOCTORAL STUDENTS DECIDE TO BECOME ENTREPRENEURS?

ABSTRACT

Doctoral students deserve to be studied as actors of social and economic change, endowed with extensive entrepreneurial potential because of their specific characteristics which make them the ideal bridge between the ''ivory tower'' and the external environment. However, existing empirical research has mainly studied doctoral students' role in creating research-based spin-offs, retaining a myopic perspective in the analysis of their entrepreneurial initiatives. It made it hard to grasp the many nuances of doctoral students' entrepreneurship and to understand how the phenomenon arises. In addressing this gap, the present work sheds light on doctoral students' decision to become entrepreneurs, by (i) highlighting the different factors which affect their decision to become entrepreneurs; (ii) identifying the combinations of factors that lead to Ph.D. entrepreneurship; (iii) discovering the dynamics at the base of doctoral students' decision to become entrepreneurs.

Overall, 28 semi-structured online interviews were conducted with Ph.D. founders, defined as those who decided to start a new organization while enrolled in a doctoral program, until theoretical saturation was reached. An inductive approach is used to analyze data in order to highlight key factors and dynamics surrounding doctoral students' decision to become entrepreneurs.

Three aggregate factor dimensions emerged from the coding structure: Individual, context, and individual-idea nexus. As a result, two different mechanisms of Ph.D. entrepreneurship emerged. The first mechanism, titled Inner push, is dominated by the individual dimension, especially related to the need to generate social impact through entrepreneurship with one's research ideas and results. The second mechanism, titled Social pull, is pushed by the social dimension, as doctoral students are pulled into the entrepreneurial process by the context, with the influence of the supervisor as the most relevant factor. Finally, the individual-idea nexus, that is the fit between the individuals and the entrepreneurial idea at the base of their entrepreneurial action, determines which of the two identified mechanisms triggers doctoral students' entrepreneurial decision.

The present work captures Ph.D. entrepreneurship in its different nuances, by shedding light on the complex dynamics connecting the factors involved in the emergence of doctoral students' entrepreneurial process.

Keywords: Ph.D. entrepreneurship; knowledge transfer; entrepreneurial university; third mission; individual-idea nexus

1. INTRODUCTION

The knowledge society recognizes a greater value in intangible assets like specific competencies and know-how than in physical means of production (Lucas, 1988; Powell & Snellman, 2004). Consequently, knowledge producers such as universities assume a leading role in promoting local and national development (Audretsch, 2009; Zaharia & Gibert, 2005), becoming actors of social and economic change (Klofsten et al., 2019). In this framework, academic entrepreneurship is an individually-enacted tool to convert research results and specific competencies into social and economic growth for local communities (Fini et al., 2018; Roncancio-Marin, Dentchev, Guerrero & Diaz-Gonzalez, 2022). Thus, it sounds quite simplistic to assume that the phenomenon coincides only with the creation of academic spin-offs (Siegel & Wright, 2015), since academic entrepreneurs are not necessarily driven by financial motivations in acting as a bridge between the ''ivory tower'' and the external environment, given that it might be done in several ways, such as creating no-profit organizations (Mars & Rios-Aguilar, 2010). Among all academic actors, doctoral students are those with higher entrepreneurial potential, given the specific characteristics and attitudes which characterize the target. On one side, individuals in this target do not have a defined career path, thus entrepreneurship might be pursued as a career after Ph.D. graduation (Pretorius & Macaulay, 2021). On the other side, they have a deep scientific knowledge of the research topic they work on, and they have matured specific competencies during their path (Hakala, 2009; Lean, 2012), which makes them potential innovators. Last but not least, the new generations of doctoral students are increasingly responsive to social issues, and they feel it is a priority to make a social and economic contribution through their research (Mars & Moravec, 2022).

Despite the characteristics which make them high-potential entrepreneurs, doctoral students' entrepreneurial initiatives are overall understudied (Klofsten et al., 2021). Although some

insightful contributions have tried to clarify specific aspects of this target's relevance for academic entrepreneurship (Bienkowska et al., 2016; Boh et al., 2016; Hayter et al., 2017), two main gaps emerge. The current inquiry has mainly studied doctoral students' role in creating research-based spin-offs and provided scant attention to understanding how they decide to act entrepreneurially. In fulfilling this gap, this work assumes that academic entrepreneurship is the creation of any form of new organization from academic actors, aiming to unpack the arising of Ph.D. entrepreneurship by exploring which factors come to play in doctoral students' decision to become entrepreneurs, how they combine toward the entrepreneurial decision, and which are the dynamics underlying this combination. An inductive approach guided the inquiry (Okasha, 2002), with 28 semi-structured interviews that have been conducted with Ph.D. founders to reconstruct their process toward the entrepreneurial decision, and qualitatively analyzed following the methodological suggestions for qualitative data (Gioia, Corley & Hamilton, 2013).

The present chapter provides a twofold theoretical contribution. (i) In picking up recent claims for a more complete understanding of academic entrepreneurship (Mars & Rios-Aguilar, 2010; Siegel & Wright, 2015), it extends the conceptualization of academic entrepreneurship beyond the mere creation of academic spin-offs, by defining the phenomenon as the creation of a new organization, whether for-profit or no-profit. As a result, a broad account emerged of doctoral students' decision to create a profit or no-profit venture to valorize their research and specific competencies. (ii) By digging deeper into the multiplicity of factors involved in doctoral students' decision to become entrepreneurs and the dynamics surrounding their combinations, the work contributes to comprehending the complex and multilevel dynamics underlying the arising of academic entrepreneurship (Rasmussen, 2011).

The chapter is structured as follows. First, the theoretical background of the work is shown and the knowledge gap is defined. Second, the methodology adopted is described, in terms of the research setting, data collection, and data analysis. Finally, the findings and the research implications are presented and discussed.

2. THEORETICAL BACKGROUND

2.1 Doctoral students as knowledge-transfer brokers

Although universities and research institutions are historically connected with external stakeholders (Etzkowitz et al., 2000), it is with the advent of the knowledge society that the relevance of universities as active players in local communities started to increase significantly (Unger, Marsan, Meissner, Polt, & Cervantes, 2020; Zaharia & Gibert, 2005). Under the framework of the knowledge society, in which knowledge is considered an asset (Audretsch, 2009; Lucas, 1988), universities are valued for their role as knowledge producers (Audretsch, 2009; Zaharia & Gibert, 2005). Consequently, higher education and research institutions have started to pursue another mission besides teaching and research: being actively involved in knowledge valorization activities to generate social and economic impact for local communities (Audretsch, 2014; Loi & Di Guardo, 2015). In so doing, universities became actors in economic development and social change (Klofsten et al., 2019), investing a significant effort for being able to translate the knowledge produced into social and economic impact for local communities. Academic entrepreneurship is an effective tool to pursue this objective (Hayter et al., 2021). However, it needs to be enacted at the individual level for transforming research results and specific competencies into social and economic impact (Fini et al., 2018). Consequently, an academic entrepreneur is any academic actor who identifies and

exploits an entrepreneurial opportunity by leveraging research results or specific competencies to generate economic, social, and political change (Mars & Rios-Aguilar, 2010).

2.2 A multifaceted perspective on academic entrepreneurship

Traditionally, academic entrepreneurship has been identified with the creation of academic spin-offs, which are new for-profit ventures founded to commercialize research results or specific competencies gained inside academia (Rasmussen, 2011; Shane, 2004). In this traditional framework, academic entrepreneurship coincides with research commercialization, and academic actors are supposed to have relationships only with industrial partners with the only goal of achieving financial gain, whether for themselves, the university, or both (Markman, Siegel, & Wright, 2008; Wright & Phan, 2018). Arguing that this conceptualization of academic entrepreneurship needs to be widened, several scholars proposed to reopen the debate to overcome the reduction of academic entrepreneurship into research commercialization (Jessop, 2017; Mars & Rios-Aguilar, 2010; Subotzky, 1999).

Both scientists, undergraduates, and doctoral students are potential academic entrepreneurs (Siegel & Wright, 2015; Skute, 2019). Among all, doctoral students deserve to be studied because of their great entrepreneurial potential in a society that recognizes knowledge as an asset (Kehm, 2007; Lean, 2012), and that no longer views this target only as future academics (Cyranoski, Gilbert, Ledford, Nayar, & Yahia, 2011; Enders, 2002; Fogelberg & Lundqvist, 2013). Thus, doctoral students possess three relevant characteristics that determine their entrepreneurial potential and make them a target worth studying. First, they possess a deep knowledge of the research topics they work on and have gained profound specific competencies during their doctoral studies (Pretorius & Macaulay, 2021). This endowment in terms of human capital makes them potential innovators and actors of change (Bienkowska et al., 2016; Thune, 2009). Second, the lack

of established career trajectories makes this target suitable for building a professional identity that may include entrepreneurial characteristics (Baker & Lattuca, 2010; Sweitzer, 2009). Last but not least, universities are recognizing the new role of doctoral education and thus beginning to provide this target with not only theoretical but also practical training (Rippa et al., 2022). This allows doctoral students to orient themselves outside academia, even in an entrepreneurial sense (Klofsten et al., 2021). In light of this, it is clear that doctoral students walk the line between academia and the external environment and can act as knowledge brokers in the constant process of translating research and specific skills into social and economic impact for local communities (Mars & Moravec, 2022; Muscio & Ramaciotti, 2019).

Current research has made considerable efforts in a particular way to study the entrepreneurial manifestations of tenured academics (e.g., Hayter et al., 2021) and undergraduate students (e.g., Wegner et al., 2019). However, scholarly attention on doctoral students have been scarce so far (Muscio & Ramaciotti, 2019). Some few contributions have attempted to open the black box of doctoral students' entrepreneurship, striving to shed light on specific aspects of this complex and broad phenomenon. Notable examples are Bienkowska et al., (2016) and Klofsten et al. (2021), who analyzed the different nuances of support provided by universities to foster Ph.D. entrepreneurship. The former focused on the impact of university support on doctoral students' entrepreneurial intentions, while the latter aimed to investigate a specific form of an entrepreneurship education program designed for this target. In a different vein, Boh et al. (2016) and Hayter et al. (2017) highlighted the key role of doctoral students in the creation of academic spin-offs, albeit always together with other academic actors. Two main gaps emerge from this overview. (i) Current inquiry has mainly studied doctoral students as actors who may be involved in the creation of research-based spin-offs, following a narrow conceptualization of the phenomenon.

(ii) The existing body of knowledge has focused on specific factors, such as their entrepreneurial attitude (e.g., Feola et al., 2019) that may influence the arising of entrepreneurship among doctoral students, with the lack of a holistic understanding of the process that leads doctoral students to decide to become entrepreneurs. As a result, still little is known about which factors and which combinations of them influence the emergence of doctoral students' entrepreneurship, as well as the dynamics behind their transition to entrepreneurship.

3. METHODOLOGY

The following paragraph describes in detail how the research has been conducted. First, the research setting and the sample for the qualitative analysis are illustrated. After that, the procedure followed for collecting and analyzing data is exposed.

3.1 The Italian setting

The present work aims to unpack Ph.D. entrepreneurship, using the findings drawn from the Italian context for theory-building on the phenomenon. As demonstrated by the multiplicity of published research in academic entrepreneurship based on Italian data (e.g., Fini, Grimaldi, & Meoli, 2020; Muscio & Ramaciotti, 2019; Rizzo, 2015), this setting is functional to draw findings that are generalizable to other similar countries. However, in line with the methodological suggestions for qualitative research in entrepreneurship (Neergaard & Ulhøi, 2007), this section provides a detailed description of the context from which the data have been collected.

In Italy, the doctoral degree is considered the highest level of education, and the minimum duration of the Ph.D. program is set by law at 3 years (DM 45/2013). Although 93.8% of Ph.D. graduates have a job one year after having completed their Ph.D. (ISTAT, 2018), only 40.9% of them

hold some kind of position within academia, whether it is a post-doc or assistant professorship (Almalaurea, 2022). This trend proves that Italian Ph.D. graduates, like their counterparts worldwide, are not taking an academic career for granted. Overall, the number of doctoral students in the whole country, considering both private and public universities, was 31.533 in 2020 (source: Eurostat online database). Muscio & Ramaciotti's (2018) survey is illuminating to frame Ph.D. entrepreneurship in Italy. Their findings pointed out that 6% of their respondents had already created a new venture, while 5 % of them were actively working to settle down a new organization.

In terms of institutional setting, Italy is in line with the European countries (Fini et al., 2020). The vast majority of Italian universities have a technology transfer office and provide other forms of entrepreneurial support to tenured staff and students (Cesaroni & Piccaluga, 2016), and universities are overall quite active in supporting entrepreneurial initiatives (Loi & Di Guardo, 2022). Moreover, Law 240/2010 introduced the third mission among the universities' priorities, allowing professors and researchers to create academic spin-offs to commercialize research results or specific expertise (Conti, Granieri & Piccaluga, 2012; Fini et al., 2020).

3.2 Sample

Recognizing the need to put clear boundaries on the concept of academic entrepreneurship (Castillo Holley & Watson, 2017), the definition of entrepreneurial behavior embraced in this work derives from Gartner's (1988) seminal definition of the phenomenon as the creation of a new organization. Consequently, Ph.D. entrepreneurs are here intended as those who decided to create a new organization during their doctoral program, whether it is an academic spin-off or not, for-profit or not-for-profit organization.

The sample is formed of 28 Italian Ph.D. founders, representative of the entire country. At the time of data collection, 15 were still enrolled in a Ph.D. course, while the others had already

completed the program. Over the total, 16 respondents identified themselves as males, while the other 12 as females. Following the geographical segmentation provided by the Italian Ministry of Education, it has been noticed that almost half of the interviewed Ph.D. entrepreneurs (N=13) were or still are enrolled in a university in central Italy. In contrast, the others come from universities in northern (N=7), southern and insular (N=8) Italy. All the interviewed Ph.D. entrepreneurs were enrolled in a 3 years-lasting doctoral program. Table 1 shows a synthesis of the meaningful characteristics of the sample.

Table 1-Overview of the sample.

RESPONDENT	UNIVERSITY	RESEARCH AREA	AREA (MIUR)
Riccardo	Università degli Studi di Roma 'La Sapienza'	Media and Communication	Center
Luca	Politecnico di Torino	Communication Engineering	North-West
Sergio	Università degli Studi di Bologna	Software Engineering	North-East
Michele	Università degli Studi di Brescia	Information Engineering	North-West
Andrea	Università degli Studi di Cagliari	Environmental Biotechnology	Islands
Eraldo	Scuola Normale Superiore di Pisa	Medical Engineering	Center
Irene	Università degli Studi di Cagliari	Biological Science	Islands
Giulia	Università degli Studi di Roma 'La Sapienza'	History and Archeology	Center
Danila	Università degli Studi di Salerno	Medical Biotechnology	South
Marco	Università degli Studi di Bologna	Industrial Engineering	North-East
Antonio	Università Politecnica delle Marche	Biological Science	Center
Marta	Università degli Studi di Genova	History and Archeology	North-West
Luigi	Scuola Superiore Sant'Anna	Medical Engineering	Center
Mario	Università Politecnica delle Marche	Electronic Engineering	Center
Silvio	Università degli Studi di Cagliari	Telecommunication Engineering	Islands
Maurizio	Università degli Studi di Roma 'La Sapienza'	Energy Engineering	Center
Giada	Università degli Studi di Milano	Veterinary Science	North-West
Amelia	Università di Roma 'Tor Vergata'	History and Archeology	Center
Giovanni	Scuola Superiore Sant'Anna	Software Engineering	Center
Lavinia	Università degli Studi 'Roma 3'	Political Science	Center
Tommaso	Università degli Studi del Sannio - Benevento	Law	South
Francesca	Università degli Studi di Sassari	Biological Science	Islands
Ludovica	Università degli Studi di Firenze	History and Archeology	Center
Chiara	Università degli Studi di Roma 'La Sapienza'	Health Science	Center
Emanuele	Università Politecnica delle Marche	Mechanical Engineering	Center
Giorgia	Università di Venezia 'Ca' Foscari'	Law	North-East
Serena	Università degli Studi di Cagliari	Computer Science	Islands
Mattia	Università degli Studi di Napoli 'Federico II'	Industrial Engineering	South

All the interviewees have been found through LinkedIn, through a combined search using the keywords *'Ph.D.'* and *'founder'*, or *'dottorando'* (Italian for Ph.D. student) and *'founder'*. Data collection continued until theoretical saturation was reached, as suggested in methodological contributions for qualitative research (Tracy, 2020).

3.3 Data Collection

Overall, 28 semi-structured interviews have been conducted. This method is suitable for reconstructing how the entrepreneurial process arose since participants are invited to think about their experiences and express themselves with freedom (Barribal & While 1994; Dulini & Patriotta, 2020). In this sense, interviews are appropriate to dig deeper into how the respondents lived the specific experience of deciding to become an entrepreneur (Neergaard & Ulhøi, 2007; Tracy, 2020). However, the main pain point of this methodology is the issue of time (Miller, Cardigan, & Glick, 1997). In addressing it, the interview protocol has been designed to be focused on the precise event in order to improve the validity of the reconstruction (Glick, Huber, Miller, Doty & Sutcliffe, 1990; Kriz & Welsh, 2018).

All interviews have been conducted online, using the video-call platform Zoom (Zoom Video Communications Inc., 2016). Methodologic literature on qualitative research recognizes this software as a valid and efficient alternative to face-to-face interviews (Archibald, Ambagtsheer, Casey & Lawless, 2019). The interviews lasted from 25 to 55 minutes, all digitally recorded after requesting the respondents' consent. Before contacting the sample, an interview protocol has been developed to ensure that the questions and the interview's general structure can fully address the research question (Castillo-Montoya, 2016). The interviews began by asking Ph.D. entrepreneurs to describe their entrepreneurial projects and expose how they developed the decision to begin their entrepreneurial journey. Starting with such a question rooted in the need to break the ice with a familiar and enthralling topic for the respondents. Thereafter, the interviewer made sure to deepen the relevant themes and deal with all the topics established in the interview protocol to explore the complex dynamics behind this decision.

3.4. Data Analysis

Data have been coded using NVivo® 11 software. This tool is widely accepted as a valid support to enhance rigor and transparency in qualitative research (Brandão, 2015; Kikooma, 2010; Siccama & Penna, 2008). The analysis protocol followed the procedure proposed by Gioia et al. (2013). It began with open coding: data obtained with the interviews have been labeled with codes. After that, twenty-two first-order concepts have been recognized, which were coherent with the informants' shared accounts. They were named with phrasal descriptors close to the words used in the interviews. The concepts were then examined to identify specific patterns, and the number of first-order concepts was decreased to a manageable threshold on the basis of recurring phrasal descriptions. The concepts were then utilized as inputs to obtain a set of seven research-centric second-order themes focused on theoretical pillars. During this procedure, it has been investigated how second-order themes may be arranged in accordance with existing theory in terms of aggregated dimensions. Thus, three theoretical aggregate dimensions have been obtained: 'individual', 'context', and 'individual-idea nexus'.

The research's trustworthiness refers to how data have been gathered and findings have been drawn. Since the replicability issue does not fit with the inductive epistemological approach (Pratt et al., 2020), the research's trustworthiness is supported by authenticity. It is argued that the Ph.D. entrepreneurs' stories should be trusted based on the relationship created with the interviewers. Moreover, their founding experience during their Ph.D. The interviewer and the interviewees were both academics, therefore, the researcher was regarded as a peer, who demonstrated a genuine desire to comprehend the respondents' perspectives and experiences. Anonymity has been guaranteed.

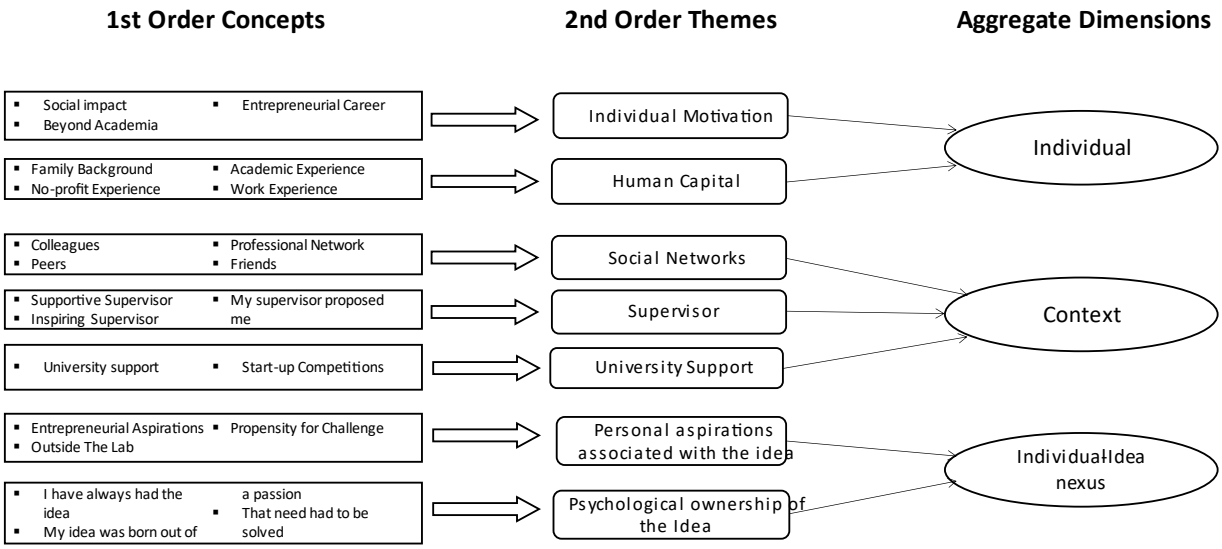
4. FINDINGS

First, the data analysis identified the factors which influence doctoral students' transition toward entrepreneurship. Second, it is sought to account for the differences in the combination of factors influencing doctoral students' decision to become entrepreneurs. In so doing, more than one combination – from now on, mechanism – emerged from the analysis. Finally, data analysis highlighted that these combinations varied on the base of the individual-idea nexus. Although the sample was not composed with the explicit goal of differentiating between different levels of individual-idea nexus, it became evident throughout the analysis that this dimension had a role in determining how the doctoral students' entrepreneurial process emerges. Indeed, it became clear that when there is a strong individual-idea nexus, the process essentially results from an inner push, with personal networks and individual motivations as prominent factors. Oppositely, when there is a weak nexus between the individual and the entrepreneurial idea, the process is driven by a social push, with the social factors – mainly the supervisor and the Ph.D. founders' social network - covering a prominent role.

4.1. Factors triggering Ph.D. Entrepreneurship

As shown in Figure 1, the emerging coding structure highlights a set of factors related to (i) individual, (ii) context, and (iii) individual-idea nexus that correspond to the aggregated dimensions of the inductive model. As appears in Figure 1, each aggregate dimension described below contains second-order themes, for a total of seven.

Figure 1 – Coding structure.



4.1.1 The individual. This aggregate dimension comprises any motivational factor, prior experience, and background element identifying specific Ph.D. entrepreneurs and differentiating them from the others (Guerrero & Urbano, 2014).

The need to generate a social impact with their research and knowledge is a prominent motivation for doctoral students' decision to join entrepreneurship. The desire to *'bring to society a unique contribution'* (Giulia) is emblematic to express how this motivation is vital for doctoral students' decision to become entrepreneurs.

However, the analysis highlights that the perceived necessity to create an alternative to an academic career is a relevant motivational factor, too. It is confirmed by the fact that the respondents do not take academia as a job perspective that can be taken for granted, as Antonio's account demonstrates:

'The first reason was that I wanted to carve out a chance to go beyond academia; after three years of doctoral work, I can say to know that environment, and to be aware of the limitations and difficulties of the academic route' (Antonio).

Moreover, some of the interviewees explicitly declared that they have been pushed to join a Ph.D. by the motivation to become entrepreneurs. It highlights that doctoral experience might be considered a privileged way to develop specific competencies and professional networks, which are determinants for exploiting their entrepreneurial idea. In this sense, the following quote is insightful for explaining the link between joining a Ph.D. and entrepreneurial aspiration:

'For me, Ph.D. is a tool for facilitating the possibility of opening a business' (Riccardo).

Human capital closes up the individual dimension, being formed by family background, work experience, and no-profit experience. This latter element is the most noticeable element of novelty that emerged from the analysis. Sergio took part in an NGO when he was younger. His account highlights a connection between the no-profit experience and the capability to manage a new company later:

'This experience gave me several soft skills which have been useful for me' (Sergio).

4.1.2 Context. In general terms, there is no entrepreneurship without context (Welter, 2011), since the context in which entrepreneurship occurs might be an enabler or an obstacle to its unfolding (Ramoglou, Zyglidopoulos, & Papadopoulou, 2021; Welter & Baker, 2021). The present findings demonstrated this assumption for what concerns doctoral students in the academic setting. Indeed, the context is highly considered in their accounts, although in different shades. Figure 1 illustrates three second-order themes defining the aggregate dimension related to the context: social networks, the supervisor, and university support. While social networks imply a peer-to-peer relationship with other actors inside and outside the university that may inspire Ph.D. entrepreneurs, the supervisors intervene in different ways in doctoral students' entrepreneurial decision, but their relationship with Ph.D. entrepreneurs cannot be considered a peer-to-peer one.

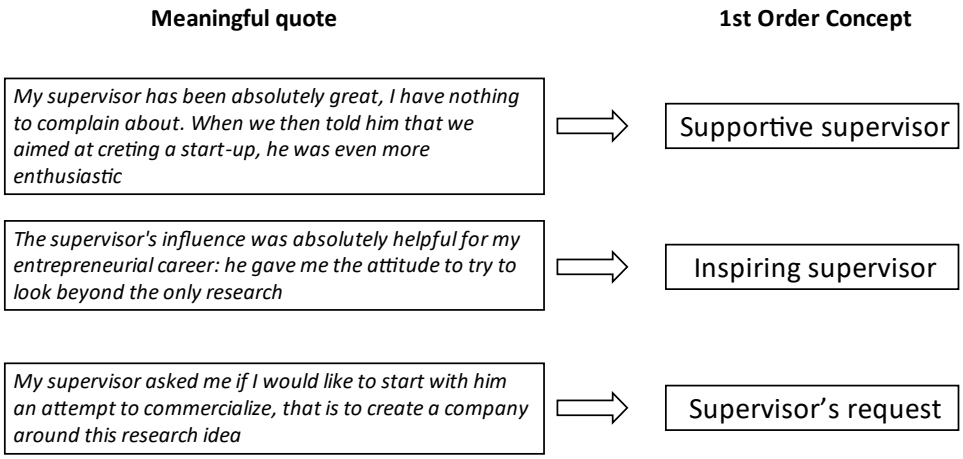
In a different vein, university support comprises the structures and facilities which are supposed to facilitate doctoral students' entrepreneurial path, from the early stage onward.

In terms of social networks, these findings recognize a prominent role for colleagues and friends. In this vein, the importance of both formal and informal relationships is recognized. The quote below perfectly synthesizes how friends might influence doctoral students' decision to become entrepreneurs:

'We were neighbors, and from there a wonderful friendship was born, [..]she had a similar idea' (Amelia).

The influence of the supervisors, although multifaceted, appears to be significant for doctoral students' entrepreneurial decision. Supervisors come into play in three main ways. In the first scenario, they provide tangible or intangible support for an essentially individual-driven decision. Reversely, in the second scenario, the supervisors act as sources of inspiration for doctoral students' decision to be entrepreneurs. Finally, in the third case, the supervisor is the most determinant push factor toward doctoral students' entrepreneurial decision. The multifaceted role of supervisors deserves some more reflection. It is the reason why their different influences are synthesized in Figure 2, which also provides meaningful quotes for each of the scenarios described above.

Figure 2 – Multifaceted role of the supervisor.



The support provided by the university for entrepreneurship, which is widely considered in the literature about the entrepreneurial university (Fayolle & Redford, 2014), has been mentioned in Ph.D. entrepreneurs' accounts regarding their decision, although to a noticeably reduced extent compared to the other contextual factors. Two first-order concepts define the factors which have in some way affected their entrepreneurial decision: entrepreneurial support and start-up competitions.

Surprisingly, the university support system has overall a secondary role in the arising of the entrepreneurial process for doctoral students, and it mostly works as a confirmatory test for an entrepreneurial idea that they already had, as Marco's account clearly emphasizes:

'I participated in a series of start-up competitions to test the response from the public and the market' (Marco).

The informants emphasized that being start-up competitions mostly focused on technological ventures, they tend to leave out potential entrepreneurs lacking a technical background, or those who are driven by social motivations, like Giorgia's reconstruction, which perfectly describes:

'These courses are too focused on science disciplines, and they leave out all those who do not come from that world. That's why I didn't finish that course' (Giorgia).

Moreover, these findings illuminate the dark side of the university support system. As a meaningful example, Mattia highlights how the technology transfer office has not been helpful to his entrepreneurial journey:

'[..], the technology transfer office was just composed of administrative staff. It was completely useless for supporting us' (Respondent 28).

Overall, it can be argued that the university's role in triggering doctoral students' decision to become entrepreneurs is challenged by these findings.

4.1.3 Individual-idea nexus. Interestingly, the analysis highlighted a third aggregate dimension, that describes the nexus between Ph.D. entrepreneurs as individuals and the idea at the base of their entrepreneurial path, as having a vital role in the target's entrepreneurial decision. Two second-order themes emerged: the psychological ownership of the idea and doctoral students' personal aspirations associated with the idea. Psychological ownership is the mental condition in which Ph.D. entrepreneurs believe that their entrepreneurial idea is "theirs" (Pierce, Kostova & Dirks, 2001). It represents a proxy of how much doctoral students feel that they own the entrepreneurial idea at the base of their entrepreneurial decision, and to what extent they feel to fit with the idea. It is formed of three first-order concepts that represent (i) doctoral students' conviction of having had the entrepreneurial idea a long time before the entrepreneurial decision. It is a proxy of how strong their fit with the entrepreneurial idea is. (ii) The link between the entrepreneurial idea and doctoral students' passion for that topic, and (iii) Ph.D. entrepreneurs' awareness that a specific need had to be solved.

Surprisingly, the data demonstrated that there might be different levels of psychological ownership of the idea. Riccardo's account is salient as an example of a respondent endowed with a high level of it, having had the entrepreneurial idea for a long time:

'There has always been the idea of a business start-up in this field' (Riccardo).

Serena's narrative is completely opposed. She has been involved in an entrepreneurial project to exploit a specific research result, which appeared to be promising. However, as she claimed, she would never have had the idea without the supervisor's insistence – *'If he [ed. my supervisor] had not insisted, I would not have done it'*. This account testifies that the idea's psychological ownership was significantly low.

Personal aspirations related to the idea appear to complement the psychological ownership in defining the individual-idea nexus. This second-order concept describes why doctoral students decided to engage in entrepreneurial activity to exploit a specific business idea, that is, the intrinsic reason why they decided to act on one business idea and not another. In this vein, the need that Ph.D. entrepreneurs feel to not stay just within academia is meaningful. It explains, and in some sense connects, two apparently antithetical career paths: joining a Ph.D. and becoming an entrepreneur. In some cases, respondents' narratives highlight that they have always seen entrepreneurship as a tool for impacting the local community. In this respect, Andrea's account is emblematic:

'I've always been interested in being an entrepreneur, and in having an impact on my local area' (Andrea).

The propensity to look outside the lab is another element that moved Ph.D. founders to make an effort to assess whether their research might solve any kind of social or economic issue by

constantly looking outside the laboratory they were working on and being aware of what priorities deserve to be addressed. This aspect is highlighted by Danila's account:

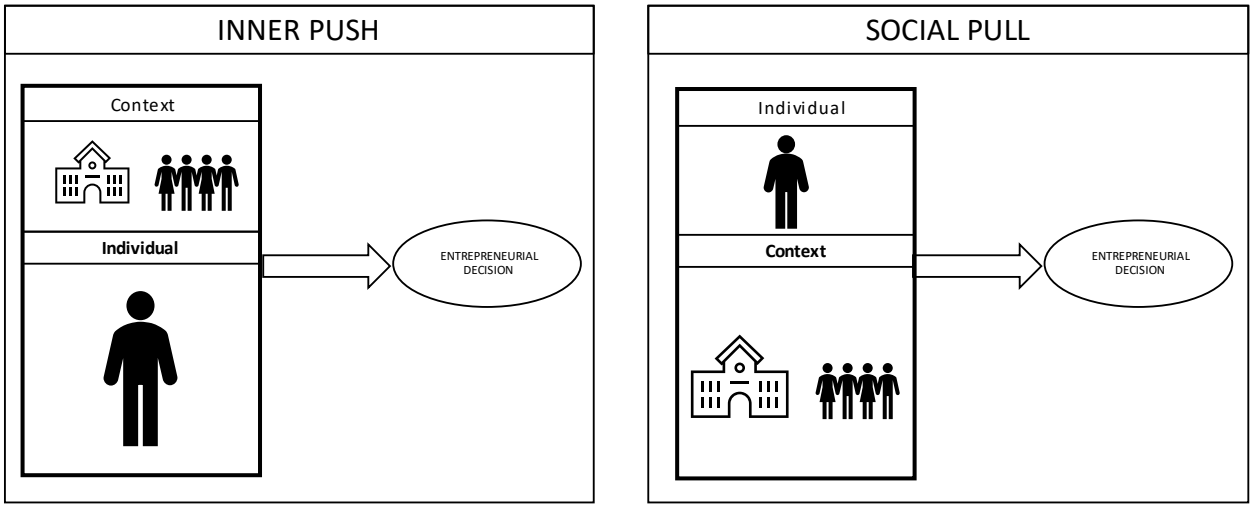
'We had already analyzed the problems, and the issues related to the circular economy were already in our minds, as well as the problem of food waste and food wastage' (Danila).

Overall, doctoral students' decision to become entrepreneurs is essentially driven by a combination of individual and contextual factors, but it also depends on the nexus between the individual and the entrepreneurial idea.

4.2 The combination of factors: more than one "blasting mixture"

After having identified the factors involved in doctoral students' decision to become entrepreneurs, the present study aimed at understanding the "blasting mixture" of Ph.D. entrepreneurship. The first burning question is: what is it? It is the winning combination of factors whose interaction leads to doctoral students' entrepreneurial decision. Assuming that the relevance may not be the same for all factors, the present work aims to explore how the individual, the context, and the individual-idea nexus combine toward the arising of Ph.D. entrepreneurship. Two different "blasting mixtures" emerged from the analysis, as shown in Figure 3.

Figure 3 – Two "blasting mixtures" of doctoral students' entrepreneurial decision.



The inner push mechanism sees a clear prominence of the individual dimension, with a marginal role of the social and institutional context. More specifically, individual motivations take over, with the need to generate a societal impact with their research and to create an alternative career beyond academia as leading players in this decision. Amelia's narrative shows that the individual dimension was prominent in her entrepreneurial decision, with two main factors as constituents: her desire to generate social impact with her research and expertise, and her personal background. The question, *'How can I contribute to social transformation?'* was the basis of her entrepreneurial decision, corroborated by a personal background strongly related to the project she intended to pursue and an inner need to constantly look outside the laboratory for social issues to address, as she put it, *'I feel bad if I have to stay only within academia. Especially since I deal with contemporary issues in my research, I firmly believe that the most sensible thing for me is to put my knowledge to use'*. In contrast, the surrounding context, including the supervisor, was drastically marginal in her decision.

Reversely, in the social pull mechanism, the contextual factors mostly drive doctoral students' decision. with a prominent role of the supervisors.

. In this scenario, the supervisors include Ph.D. students in an entrepreneurial project when it is already ongoing. The findings highlight that in these circumstances, doctoral students' social motivation is usually weaker, and the only individual driver coming into play is the perceived necessity to create an alternative career to academia. Silvio's experience is illuminating in this sense. As clearly stated in his narrative, the entrepreneurial decision had two fundamental ingredients: the supervisor and the external stakeholders. The former has been the *'driving force for everything'*, and the latter exhibited a particular pain point that needed to be addressed. Of course, it does not mean that the individual dimension did not have a role, since '*the idea of bringing together a group of*

people working in a coordinated way to achieve a common goal [..]' is something that has always fascinated him.

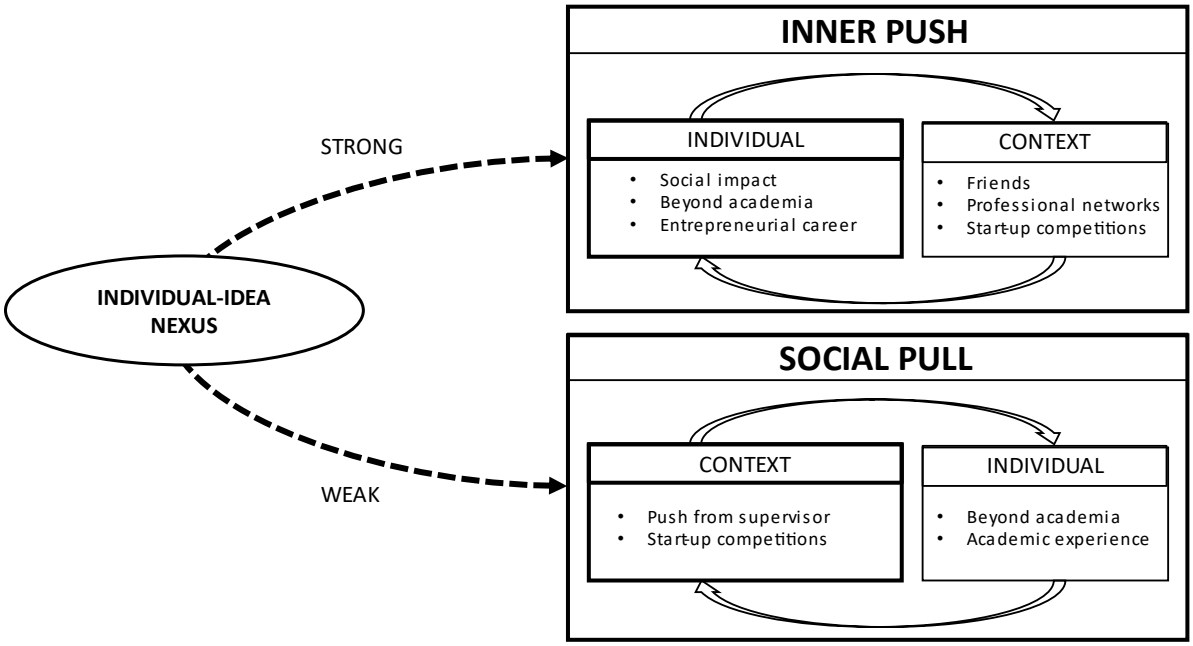
Regarding the entrepreneurial support from the university, findings show that it is somewhat marginal in both mechanisms. Technology transfer offices and university incubators just marginally foster this decision, and a mismatch clearly emerges between Ph.D. entrepreneurs' needs and what is offered by these structures. Instead, start-up competitions begin to have a role in confirming the feasibility of an already identified entrepreneurial opportunity. It can be argued that this form of support comes into play in the last mile of the complex and long process toward the individual decision to become entrepreneurs.

4.3 The dynamics: the role of individual-idea nexus

In the paragraph above, the factors leading to doctoral students' entrepreneurial decision have been elucidated and the mechanisms in play have been identified. However, it is still to be determined whether such a combination is influenced by other circumstances, and how the different individual and contextual factors combine toward doctoral students' entrepreneurial decision.

The entrepreneurial idea lies at the foundation of the entrepreneurial process, both within and outside academia (Hayton & Cholakova, 2012; McMullen & Shepherd, 2006), and all the informants have dwelt a lot on this aspect. However, the nexus between the individual and the entrepreneurial idea has been recognized to have a relevant role in the early stage of the entrepreneurial process (Davidsson, 2015), and its key role in doctoral students' entrepreneurial decision is demonstrated by these findings. The dynamics surrounding the decision to become entrepreneurs differ depending on how Ph.D. entrepreneurs feel to own the idea they aim to exploit by means of entrepreneurial action. Thus, two different pathways toward entrepreneurship can be specified, as depicted in Figure 4.

Figure 4 – Dynamics behind doctoral students' entrepreneurial decision.

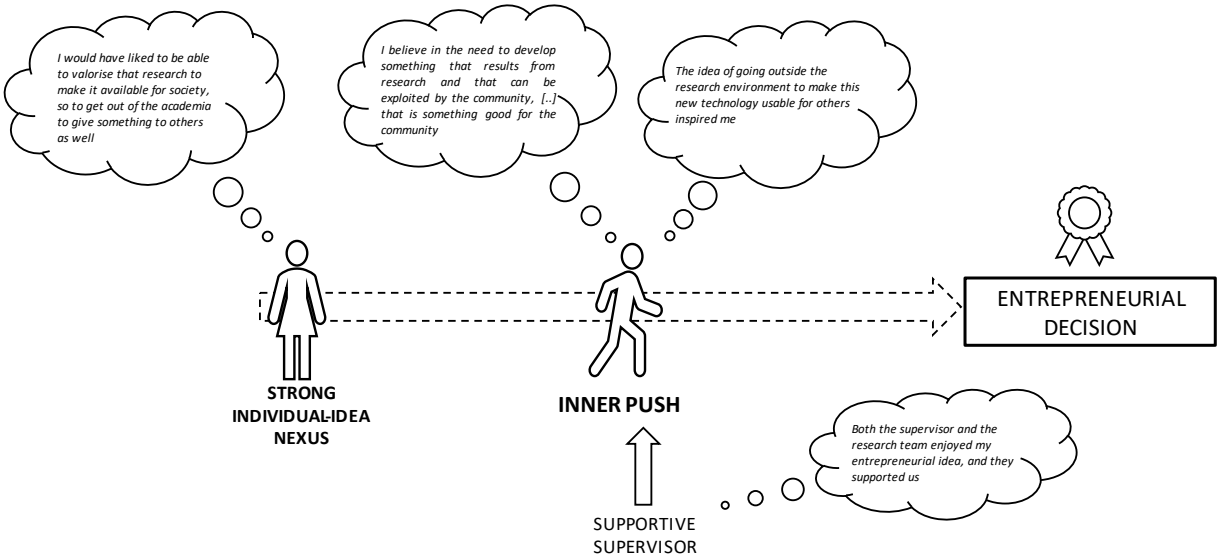


Depending on the nexus which links doctoral students as individuals and the entrepreneurial idea they are pursuing, two different combinations of factors can be identified. When the nexus between the Ph.D. founders and the idea they are pursuing is strong, the inner-push mechanism is triggered: the individual dimension is the prominent factor dragging the decision. Reversely, when the nexus between doctoral students and the idea is weak the social pull mechanism is triggered: the individual motivation appears to be low, and the decision is mostly context-driven, with social context holding the function to push doctoral students toward the decision to become entrepreneurs. Overall, regardless of how strong the nexus is between the individual and the idea, the university support appears marginal: individual dimension and social context - specifically represented by the supervisors - compete to be the driving factors in this decision.

Two accounts are provided as meaningful examples of the two dynamics at the base of doctoral students' entrepreneurial decision: Irene and Marta. As depicted in figure 5, Irene demonstrated to have had a strong aspiration to look outside the lab – *'I would have always liked to be able to valorize that research to make it available for society'*. Thus, she has been pushed

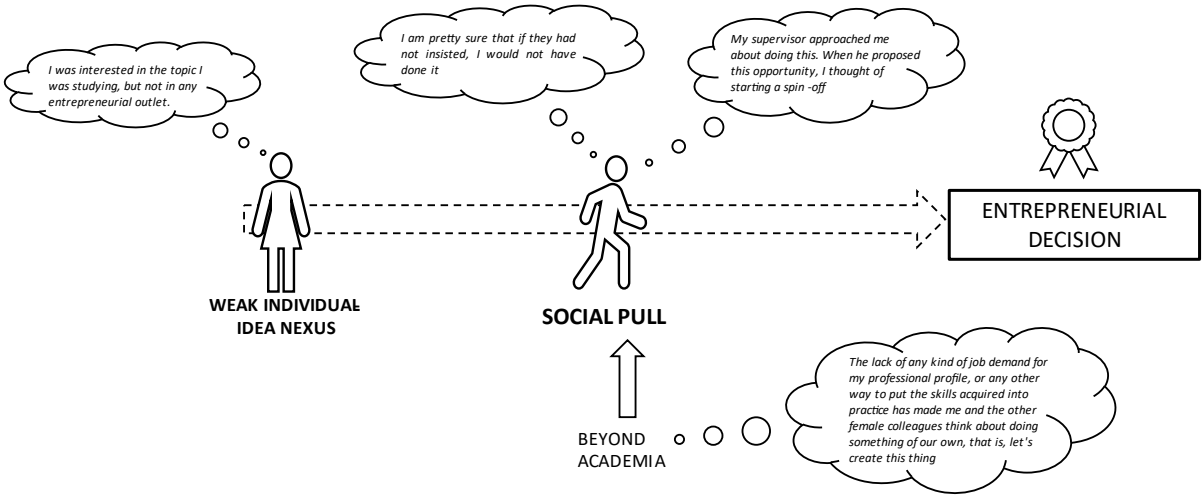
toward entrepreneurship by an inner push to bring research results outside the lab to generate impact for society – e.g., *'The idea of going outside the research environment to make this new technology usable for others inspired me'*. Conversely, the supervisor and the research group have been supportive but they did not have an active role – *'Both the supervisor and the research team enjoyed my entrepreneurial idea, and they supported us'*.

Figure 5 – Irene's narrative.



On the other hand, Figure 6 depicted Marta's path toward the entrepreneurial decision. She showed a weak nexus with the entrepreneurial idea– '*I was interested in the topic I was studying, but not in any entrepreneurial outlet*'. As a result, the suggestion of starting a spin-off originated from the supervisor – '*When he* – i.e., the supervisor - *proposed this opportunity, I thought of starting a spin-off* – and the individual dimension has been overall marginal in her entrepreneurial decision.

Figure 6 – Marta's narrative.



5. DISCUSSION

The present research sheds light on the factors triggering doctoral students' decision to become entrepreneurs, elucidating the dynamics lying behind this decision. The coding structure highlights three aggregate dimensions of factors, namely the individual, the context, and the individual-idea nexus. Furthermore, two mechanisms, named inner-push and social-pull have been identified, with a driving factor that enables them on the base of the strong or the weak nexus between the Ph.D. founder and the entrepreneurial idea.

The present framework highlights a more prominent role for individual motivations and social context rather than entrepreneurial support provided by universities when there is a strong individual-idea nexus. Moreover, the model demonstrates that when there is a weak nexus between the individual and the idea, a push from the social context is needed to trigger Ph.D. students' decision to become entrepreneurs.

5.1 Theoretical implications

The present chapter extends current knowledge on academic entrepreneurship in multiple ways.

First, the work extends the set of individual motivations which trigger the early stage of Ph.D. entrepreneurship. Individual motivations have been already adopted to explain what drives tenured academics (Antonioli, Nicolli, Ramaciotti & Rizzo, 2016; Chell & Allman, 2003) and doctoral students (Rizzo, 2015) toward an entrepreneurial decision. However, this work widens the set of motivations involved in doctoral students' entrepreneurial decision by emphasizing the prominent role of the desire to generate social impact with research as an inner push toward entrepreneurship. In so doing, this finding puts evidence that doctoral students who decided to start a business perceive that addressing societal problems through their research is their priority, and they can use entrepreneurship to pursue this goal (Bianchi & Verganti, 2021; Fini et al., 2018).

What emerged in terms of human capital deserves some reflection, too. While specific human capital oriented to entrepreneurship is not new in academic entrepreneurship (e.g., Scholten, Omta, Kemp, & Elfring, 2015), the findings introduce the relevance of no-profit experience in doctoral students' decision to become entrepreneurs. Although the link between this form of specific human capital and the entrepreneurial decision could seem counterintuitive, the findings in this chapter may open new research paths by creating a conceptual bridge between apparently unconnected topics such as scholars' activism (Autonomous Geographies Collective, 2010) and academic entrepreneurship.

Moreover, the picture that emerged from the analysis of social factors is insightful to framing Ph.D. entrepreneurship within its social-embeddedness nature. While social context has been historically considered in the scientific conversation around the arising of academic entrepreneurship (Casson & Della Giusta, 2007; Mosey & Wright, 2007; Honing & Davidsson, 2003),

this work brings something new to this debate, by highlighting two main social factors in doctoral students' entrepreneurial decision: supervisors and friends. First, a brief discussion about the supervisors' influence on Ph.D. entrepreneurship, given their unquestionable influence as mentors for an academic career and beyond (Vilkinas, 2002). It is known that they can drastically influence doctoral students' performances, their value system, and vocational choices (Ives & Rowley, 2005; Mainhard, Van-Der-Rijst, Van-Tartwijk & Wubbels, 2009), but these findings highlight that supervisors' push can be vital for doctoral students' transition to entrepreneurship, mostly when the psychological ownership of the idea is weak. Second, the data bring to the fore informal social ties like friendship as relevant factors influencing doctoral students' decision to become entrepreneurs. As far as is known, it is something new for current research on Ph.D. entrepreneurship.

This model provides insights into the understanding of the entrepreneurial university's support system, too. Indeed, the present findings question the effective utility of the facilities provided by universities to nurture entrepreneurship in boosting Ph.D. entrepreneurship (e.g., Bienkowska et al., 2016; Feola et al., 2019). Of course, these findings do not automatically imply that university support is ineffective in fostering the emergence of Ph.D. entrepreneurship, but they do highlight the need for universities to reflect on the policies in place to foster academic entrepreneurship.

Overall, this work might be insightful for three main reasons. (i) It highlights how the need to generate a social impact with their research represents an inner urge that leads doctoral students to decide to become entrepreneurs. In this vein, some contact points can be identified between Ph.D. entrepreneurship and social entrepreneurship, whose starting point is the need to address social issues through entrepreneurial action (Corner & Ho, 2010). (ii) On the side of context, this

research recognizes a relevant role for supervisors and friends as social factors that might nurture Ph.D. entrepreneurship. (iii) In challenging the taken-for-granted role of the university support system in the first phases of the entrepreneurial process of doctorial students, these findings highlight that several shades of this support, such as entrepreneurship education, technology transfer office, and university incubators that seem to be perceived as more useful when the decision has been already taken by doctoral students.

From a policy point of view, these findings provide two main insights both for universities and policymakers. First, the university support system's role effectiveness is questioned in boosting Ph.D. entrepreneurship. Being overshadowed by individual and social dimensions, universities and policymakers should improve their support system to leverage motivations and social context to facilitate doctoral students' entrepreneurial decision. Moreover, this work has demonstrated that doctoral students' entrepreneurial journey can arise from a combination of factors weakly related to the university system. This finding should convince higher education institutions to nurture Ph.D. students' passions and soft skills since they could drastically contribute to their contribution to making the world a better place.

5.2 Contribution

The present chapter contributes to the theory advancement in three ways.

First, in taking up recent claims for a broader conceptualization of academic entrepreneurship (Abreu & Grinevich, 2013; Hayter et al., 2020; Mars & Rios-Aguilar, 2010), Ph.D. entrepreneurs are conceived as actors of change who create new organizations to generate a positive effect on the surrounding environment, in line with the University's third mission (Compagnucci & Spigarelli, 2020). A wide depiction of Ph.D. entrepreneurship is provided, by overcoming the taken-for-granted overlap with creating for-profit and research-based spin-offs. In

showing the different forms that can be assumed by the entrepreneurial phenomenon, this work demonstrates that the desire to address social issues matters regardless of whether the founded organization is for-profit or non-profit.

Second, in addressing recent claims to identify the factors involved in the arising of academic entrepreneurship (Rasmussen, 2011), the mechanisms in play in doctoral students' entrepreneurial decision have been identified. The findings highlighted two different combinations of factors that might lead to the arising of Ph.D. entrepreneurship.

Third, the work addresses the claims in existing research to shed light on a complex and multilevel phenomenon such as the origin of Ph.D. students' entrepreneurial process (Hayter et al., 2017). This goal is achieved by identifying the factors that trigger the process and shedding light on the dynamics underlying its emergence. Thus, a driving factor is identified, from which two different entrepreneurial mechanisms originate: the psychological ownership of the entrepreneurial idea determines a different combination of mechanisms at the origin of the Ph.D. entrepreneurship.

5.3 Limitations and future research

The present study is not without limitations. First, even if the Italian universities setting can be representative to study higher education institutions that put great effort to pursue their third mission (Fini et al., 2017, 2020), it is still hard to generalize findings obtained from a narrow geographical context. To overcome this limit, future research is suggested to explore the origins of Ph.D. entrepreneurship by studying wider national or cross-national settings. Second, being the study exploratory in nature, the findings have been drawn on informants' accounts, with no other type of data collected. To fully comprehend the phenomenon, future research might consider the opportunity to complete qualitative data with data from secondary sources.

CHAPTER 5

GENERAL DISCUSSION

The present chapter summarises the overall structure of the thesis elaborating on the main findings' theoretical implications, practical implications, and overall theoretical contribution.

The thesis opened with the introductory chapter (Chapter 1) that provided a theoretical contextualization of the topic under investigation and the knowledge gap that guided the research conducted by involving Ph.D. students. Chapter 2 was a systematic literature review (SLR) that aimed to bring order to the fragmented body of knowledge on the academic entrepreneurship process by focusing on the role of individual and organizational dimensions. It contributes to theory by providing a research agenda articulated around three questions, representing a foundation for the empirical research discussed in subsequent chapters. The third and fourth chapters represented the empirical parts of the thesis and consisted of a quantitative and a qualitative study, respectively. Their purpose was to shed light on the emergence of Ph.D. entrepreneurship by digging deeper into the dynamics that link individual and social key factors toward doctoral students' decision to become entrepreneurs. In conclusion, the theoretical and practical implications of the entire work are discussed in the present chapter.

Overall, the present dissertation represented a sound theoretical contribution to improving the comprehension of whether, how, and to what extent the university support system facilitates the early stage of Ph.D. entrepreneurship. At the same time, it provided solid theoretical insights to understand better the dynamics underlying academic entrepreneurship. Indeed, the findings that emerged from the present dissertation would be new and useful for universities and policymakers, thus constituting a potential theoretical contribution (Corley & Gioia, 2011). On the one hand, the

results are new in the current theoretical and empirical panorama in that they recognized patterns of intervention for entrepreneurial universities to provide entrepreneurial support for doctoral students and highlighted the relationships between the individual and the surrounding context that favor the arising of academic entrepreneurship. In so doing, they are useful both on the conceptual and practical levels. Indeed, the present thesis provided insights to explain how the entrepreneurial process arises and how institutional support has a role in its emergence (Pentland, 1999). In so doing, they become useful for higher education institutions to design and implement policies that can actually facilitate doctoral students in their decision to become entrepreneurs, as is discussed more in detail in the next section.

1. MAIN FINDINGS AND THEORETICAL IMPLICATIONS

A comprehensive overview of the conceptual and empirical results obtained along the author's doctoral journey is instrumental in highlighting how the dissertation fits into, and contributes to, the ongoing scholarly conversation on entrepreneurial university and academic entrepreneurship, by extending the comprehension of how doctoral students decide to become entrepreneurs. Despite receiving little attention from current research, this target has been identified as having a high entrepreneurial potential, making them an ideal bridge between the knowledge produced within the university and instances coming from external stakeholders. Overall, this dissertation provides three main results, which are described in the sections below.

1.1 Shedding light on the complexity behind academic entrepreneurship

The first relevant result emerged from a deep analysis of the body of knowledge in academic entrepreneurship. Indeed, this thesis highlighted that the phenomenon has been studied in a mainly static way, with a lack of a comprehensive understanding of how individual and university

dimensions contribute to its emergence. Most importantly, a general knowledge gap emerged for what concerns the early stage of academic entrepreneurship, as highlighted in the research agenda described in Chapter 2. This agenda, which was supposed to guide future inquiry into the mechanisms that explain the phenomenon as a multi-level process, demonstrated that the arising of academic entrepreneurship is still a black box. It is still unknown how academic actors take the decision to use entrepreneurship to leverage their research results and specific competencies, assuming that academics' entrepreneurial decision results from a constant interplay between the individual dimension and the surrounding context. The inquiry conducted on existing research in Chapter 2 demonstrated the urgent need to unpack the numerous factors involved in their decision to reconstruct a path which may involve also questioning their professional identity.

The complexity behind the arising of entrepreneurship in academia emerged also in the following chapters. In an attempt to shed light on the complexity behind the decision to become academic entrepreneurs, Chapter 3 emphasized that different factors have a role, although in different ways, in doctoral students' decision to become entrepreneurs. It shed light on doctoral students' entrepreneurial decision as a cognitive transition which is not just the formation of entrepreneurial intentions, demonstrating that the university support system poorly affects their decision when they are strongly motivated to generate a social impact with research. A further level of complexity is highlighted by Chapter 4, which took into the stage the nexus between the single individuals and their entrepreneurial idea as a driver of mechanisms behind doctoral students' entrepreneurial decision.

This result has been instrumental for understanding better the multi-level process of academic entrepreneurship, considering that academic actors work in a specific organizational

context such as the university system, which inevitably affects their decisions and behavior, especially in the cases that acting entrepreneurially (Hayter et al., 2021).

1.2 The factors involved in doctoral students' entrepreneurial decision

In shedding light on the early stage of Ph.D. entrepreneurship, the present work empirically proved that several factors are involved in the target's decision to become entrepreneurs. On the one hand, the individual dimension emerged to have a relevant role. Indeed, the results in Chapter 3 demonstrated that the more doctoral students are endowed with human capital, the more likely they are to be alert to entrepreneurial opportunities. Moreover, as highlighted in Chapter 4, the desire to generate social impact with research emerged as one of the most important individual factors, along with other motivations, such as the need to create an alternative career to academia.

On the other hand, the dissertation's results highlighted that the context matters for doctoral students' entrepreneurial decision. More specifically, social actors have been highlighted in Chapter 3, such as friends and, most of all, the supervisors, who have been highlighted as the most relevant social factors, acting as a supportive, inspirational, or driving element. Surprisingly, the institutional support for entrepreneurship was found to be marginal in doctoral students' decision to become entrepreneurs. It emerged as not having a role in reinforcing doctoral students' entrepreneurial decision, although it was found to be a *''condicio sine qua non*'' for their entrepreneurial decision when their pro-social motivation is weak, while it is not necessary when the same motivation is strong.

Another interesting insight on institutional support is that Ph.D. entrepreneurs tend to use specific facilities provided by universities, such as start-up competitions and incubators, when they already have a business idea and want to test it to see if it is worth pursuing the entrepreneurial process.

Overall, the results described above are insightful to understanding how the individual dimension and the context interplay toward doctoral students' entrepreneurial decision, as claimed by recent research (Muscio & Ramaciotti, 2019; Muscio et al., 2021). By demonstrating the role of doctoral students' pro-social motivation as a driver of their decision to become entrepreneurs, the body of knowledge on doctoral students' motivations for entrepreneurship has been extended. Moreover, an alignment between the university's third mission of generating social impact on the surrounding environment and doctoral students' decision to improve society through their research emerged. In general terms, it can be argued that the present chapter might be insightful for conceptualizing the arising of Ph.D. entrepreneurship since it highlighted the relevance of fundamental ingredients such as human capital, pro-social motivation, and the university support system.

1.3 The dynamics behind doctoral students' entrepreneurial decision

The last main result of this thesis demonstrated that doctoral students' entrepreneurial decision stems from an iterative relationship between doctoral students and their surrounding context. On the one hand, Chapter 3 demonstrated that the university support system has not the capability to enhance doctoral students' entrepreneurial decision, but it is necessary when their inner push is weak. Moreover, doctoral students need to be entrepreneurially alert before deciding to become entrepreneurs. On the other hand, Chapter 4 highlighted two different combinations of factors toward their decision to become entrepreneurs. In the first scenario, doctoral students' transition to entrepreneurship results from an inner push, with a clear prevalence of the individual dimension at the expense of the context. In the second scenario, the great importance of the social context emerged, particularly the supervisor, and the individual dimension becomes less relevant. It implied that the factors involved in doctoral students' entrepreneurial decision dynamically combine in

different ways. In clarifying how it happens, the findings in the same chapter showed that the combinations vary on the base of the nexus between the individuals and the entrepreneurial idea they are pursuing.

These findings are insightful to unpack the complexity behind doctoral students' entrepreneurial decision (Hayter et al., 2021; Miranda et al., 2018) since they shed light on how doctoral students as single individuals interact with their surrounding social and institutional contexts, and how the different interaction between the two dimensions determine diverse combinations of factors toward their entrepreneurial decision.

2. LIMITATIONS AND FUTURE RESEARCH

It is acknowledged that the present thesis is not without limitations. It is why the research limitations are presented in this paragraph, providing directions for future research. The limitations are essentially related to the methodology adopted and the sample used to study the phenomenon.

First, the data analysis has been done with a cross-sectional approach. The whole thesis focused on a vertical perspective to delve into the phenomenon. However, this kind of research design might lose the dynamism of the entrepreneurial process. Thus, it might be extended with a horizontal approach that may capture the time element by looking at the phenomenon's evolution. Considering this, a longitudinal investigation would be key to extending current results.

Second, it is a fact that the Italian setting might be considered a narrow context to draw generalizable findings, although it is comparable to other European countries in terms of the institutional and legislative environment and the support provided by universities (Fini et al., 2009; Fini, Grimaldi, et al., 2020). However, the differences due to the institutional and national setting

(Klofsten & Jones-Evans, 2000) may make the findings from the present thesis poorly generalizable to any other setting, although it is remarked its relevance to explore an understudied phenomenon like Ph.D. entrepreneurship. In line with this assumption, it is suggested to extend these studies with samples from other countries, or perhaps with cross-national studies which take in consideration the cultural, legislative, and social differences between different contexts.

As a young researcher, the author has become quite passionate about the topic, which he hopes to explore in the future with the knowledge that has come from having devoted three years of research to it.

3. OVERALL THEORETICAL CONTRIBUTION

Overall, the present thesis has contributed to the scientific conversation by combining and extending two strands of literature. On the one hand, it made a valuable contribution to the comprehension of how the support provided by the entrepreneurial university can facilitate doctoral students' entrepreneurship. In doing so, it responded to recent calls for a deeper understanding of the mechanisms that link micro and macro dimensions and foster this target to become entrepreneurs (Bienkowska et al., 2016; Muscio & Ramaciotti, 2019). On the other, it improved scientific understanding of the complex process underlying the emergence of academic entrepreneurship (Fini et al., 2019; Wood, 2011).

The present thesis addresses recent calls for further investigation into whether and how the university setting may influence doctoral students' entrepreneurial initiatives (Bienkowska et al., 2016; Muscio & Ramaciotti, 2019). On the one hand, it improves the understanding of how university support for entrepreneurship facilitates doctoral students in the early stage of their

entrepreneurial process. First, the literature review revealed a great deal of scholarly attention to the entrepreneurial university's facilities, particularly in studies focused on entrepreneurial intentions and spin-off creation (Dickel, Kiel & Bose, 2019; Fernández-Pérez, Montes-Merino, Rodríguez-Ariza & Alonso-Galicia, 2019). The empirical works then revealed several nuances related to whether and how university support comes into play in the early stages of doctoral students' entrepreneurship. First, it has been shown how the support system generally does not facilitate doctoral students' cognitive transition from entrepreneurial alertness to intentions. More precisely, it has been demonstrated that this type of support is decisive for the aforementioned transition only in the case in which doctoral students' pro-social motivation is weak. In doing so, this thesis has empirically verified that the presence of entrepreneurial support from the university is a necessary condition only in cases where doctoral students are driven by weak pro-social motivation. Still, in any case, it is never a sufficient condition. In fact, it has been shown that doctoral students' entrepreneurial alertness depends essentially on their prior experience. The exploratory analysis then showed how the role of university support in the early stages of doctoral students' entrepreneurship is almost marginal, with one interesting exception. This is the use of the tools of the entrepreneurial university, particularly the business plan competitions, to assess a business idea to figure out whether it is worth pursuing.

Ultimately, the thesis contributed to the literature on the entrepreneurial university by highlighting that institutional support is complementary to the individual dimension in facilitating the arising of Ph.D. entrepreneurship. Thus, the role of university support is questioned and extended simultaneously. On the one hand, the effectiveness of entrepreneurial support is questioned as it comes out significantly downgraded if compared to what has been assumed in past research. On the other hand, the understanding of how support can facilitate entrepreneurship has

been improved by this work, which defined in more detail to what extent and how it comes into play in doctoral students' entrepreneurial decision. Summing up, this thesis' overall results depicted institutional support as oxygen that feeds the flame of entrepreneurship rather than as a spark to ignite the process.

This thesis also contributes to understanding the multi-level dynamics underlying the emergence of academic entrepreneurship (Fini, Rasmussen, et al., 2020; Hayter et al., 2021; Wood, 2011) in two ways. First, in extending current studies conceiving the emergence of Ph.D. entrepreneurship as the sole formation of their entrepreneurial intentions (e.g., Bienkowska et al., 2016; Feola et al., 2019), doctoral students' entrepreneurial decision was envisioned as a complex process involving constant interaction between the individual and the surrounding context. Thus, on the one hand, SLR has been conducted using a precise conceptualization of the academic entrepreneurship process as articulated around three entrepreneurial outcomes: opportunity identification, entrepreneurial intention, and spin-off creation. Subsequently, the thesis empirically helped to define and explain the phenomenon. The early stage of doctoral students' entrepreneurship has been defined as the cognitive transition from entrepreneurial alertness to intentions, defining the latter as a good proxy for the decision to become an entrepreneur (Erikson, Knockaert, & Foo, 2015; Thompson, 2009). Moreover, doctoral students' entrepreneurial decision has been recognized in its complexity by an inductive analysis which shed light on a multiplicity of factors and dynamics which lead them to the decision to become entrepreneurs. Indeed, different combinations of factors have been highlighted to affect a decision that is demonstrated to result from a complex process, and which cannot be reduced to the mere overnight formation of entrepreneurial intention.

4. PRACTICAL IMPLICATIONS

Universities have the capacity to contribute to regional economic and social growth, which is the reason why such institutions are particularly targeted by policymakers (Dinnetz, 2018). Because of this, the present dissertation has relevant practical implications for universities.

Specifically, it provides empirical results that enable them to develop evidence-driven policies to build efficient strategies to foster knowledge and technology transfer through entrepreneurship. In this sense, the results of the current work enable universities to effectively facilitate entrepreneurship among doctoral students by providing them with valuable insights into what forms of support are needed in the different steps of doctoral students' entrepreneurial decision-making. These results highlighted two factors that universities should consider when developing their entrepreneurship policies. First, the motivation of doctoral students - as the inner drive of their entrepreneurial process - should not be ignored, nor should it be underestimated, when support policies are developed. On the one hand, institutional support can indeed compensate for the lack of motivation on the part of doctoral students and thus nurture their decision to become entrepreneurs. On the other hand, the facilities provided by the university for entrepreneurship have a role limited to the verification of the idea. In any case, it must be said that entrepreneurial support comes into play only when doctoral students are already entrepreneurially alert, which depends essentially on their prior experiences.

Essentially, the present thesis suggests that universities should expand forms of entrepreneurial support for doctoral students, focusing on policies that stimulate the inner drive of doctoral students and make them assimilate the priority of the third mission as a shared goal, both by the individual and the institution.

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