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UNIVERSITY ENTREPRENEURSHIP: THE PROCESS OF KNOWLEDGE-BASED VALUE CREATION

by

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"The mediaeval university looked backwards: it professed to be a storehouse of old knowledge... The modern university looks forward: it is a factory of new knowledge"

Thomas Henry Huxley (1825-1895)

Letter to E. Ray Lankester (11 April 1892) Huxley Papers
Imperial College: 30.448

Biographical Note

Sara Neves was born on October 24, 1987.

She concluded her undergraduate studies in Marketing in 2009. During her degree, Sara was abroad for a semester, where she attended The State University of New York and initiated her professional career. For seven months, she worked for The Walt Disney World in the United States of America.

In 2010, she joined the Master in Service Management at the Faculty of Economics of the University of Porto (FEP). Two years later, she completed her degree with the dissertation "The Influence of the Servicescape on Spectators of a Leisure Services", supervised by Professor Teresa Fernandes. In 2015, she enrolled in the school's Doctoral Programme in Business and Management Studies.

In 2016, Sara switched from consulting to the academic world, becoming a researcher in the areas of Innovation, Technology, and Entrepreneurship at the Institute for Systems and Computer Engineering, Technology and Science (INESC TEC).

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Abstract

This thesis is motivated by the recognition that any investment in research may be further valorised through entrepreneurial activities. In this quest for knowledge valorisation, the university holds a crucial mediation role linking academia to the industry and the government and society more broadly. While continuing to enhance teaching and research missions, the university has transformed itself into an entrepreneurial university.

The focus of the research is on the entrepreneurial university, academic entrepreneurship and knowledge valorisation. The main goal of the thesis is to enrich the current understanding of the entrepreneurial university, specifically by answering the following research question: "How does the university enhance the development of knowledge-based value creation?".

The research work was divided into three parts. A systematic literature review was carried out in the first part to have a comprehensive assessment of the current knowledge regarding the variables that encourage the academics to get involved in knowledge valorisation activities. This study provides a factor-listed representation of the individual, organisational, and institutional variables that should be considered in the university's strategies and served as the starting point for the second part of the work.

The second part explored the academics' intentions for six different entrepreneurial activities by considering the universities' characteristics and strategies. The empirical research involved a survey at three Portuguese universities. This study contributes to the literature by identifying the most influential motivations for each activity and demonstrating the differences between the universities.

The research conducted in the third part explored both regional and university variables and their relationship to entrepreneurial activities. The empirical analysis was performed on twelve universities from four European countries: France, Germany, Portugal and the United Kingdom and demonstrated the impacts of the universities' structure and the region's R&D expenditures and GDP per capita on the entrepreneurial university's outputs.

Resumo

Esta tese é inspirada pela constatação de que todo o investimento em investigação pode também ser valorizado através da participação em atividades empreendedoras. Neste esforço para a valorização do conhecimento, a universidade desempenha um papel determinante, articulando a academia com a indústria, o governo e à sociedade em geral. Ao mesmo tempo que promove o ensino e a investigação, a universidade transforma-se numa universidade empreendedora.

O foco da investigação centra-se na universidade empreendedora, no empreendedorismo académico e na valorização do conhecimento. O principal objetivo desta tese é enriquecer o atual conhecimento sobre a universidade empreendedora, mais concretamente responder à seguinte questão de investigação: "Como é que a universidade promove o desenvolvimento da criação de valor baseado no conhecimento?".

A investigação dividiu-se em três partes. Na primeira parte procedeu-se a uma revisão sistemática da literatura para se obter uma extensa compreensão das variáveis que incentivam a participação dos académicos em atividades de valorização do conhecimento. Este estudo apresenta um conjunto de variáveis individuais, organizacionais e institucionais que devem ser consideradas na definição das estratégias da universidade.

A segunda parte investigou a intenção dos académicos para seis diferentes atividades empreendedoras, tomando em consideração as características e estratégias das universidades. A investigação empírica envolveu um inquérito a três universidades portuguesas. Este estudo contribui para a literatura ao identificar as motivações com maior influência relativamente a cada atividade e ao evidenciar também as diferenças entre as universidades.

A investigação conduzida na terceira parte explorou conjuntamente variáveis da região e da universidade na sua relação com as atividades empreendedoras. A análise empírica foi realizada em doze universidades de quatro países europeus: França, Alemanha, Portugal e Reino Unido. O estudo comprou o impacto da estrutura da universidade, do investimento em I&D e do PIB per capita da região nos resultados da universidade empreendedora.

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CHAPTER 1

Introduction

This chapter introduces the focus of the thesis: the entrepreneurial university, academic entrepreneurship, and the value creation from research. It sets the background of the thesis by discussing the relevance and evolution of the entrepreneurial university, academic entrepreneurship and the steps and actors in the process of value creation. The fundamental concepts of the thesis are clarified, giving way to a highlight of the identified research gaps and their related research questions. The outline of the thesis is also detailed, concluding the chapter.

1.1 Motivation and overview

Historically, the university has been criticised for being isolated in its *Ivory Tower*, detached from society and various stakeholders (Haeussler and Colyvas, 2011). Etzkowitz et al. (2019) described this university as a purely academically minded organisation and where practical knowledge is merely created by accident. However, the reality of universities is no longer that, at least since the beginning of the nineteenth century. As a result, the first steps towards knowledge transfer outside the university walls, while very limited, were initiated. At that time, these interactions were a one-way relationship, where knowledge was transferred from the provider (university) to the user (industry, government, and society) (Etzkowitz, 1998; Mitton et al., 2007).

Since then, the university's regional and national systems role has been increasingly more intensive and interactive (Etzkowitz and Klofsten, 2005). Knowledge has matured into a fundamental driver of economic growth (Audretsch, 2014). There has

been an interest to convert university research into products or services (Fontes, 2005), creating a competitive advantage for industries (Rothaermel and Thursby, 2005) and, above all, contributing to economic development (Etzkowitz et al., 2000).

A sequence of interconnected factors has prompted this change in the mission of universities. First, the government budget for research has decreased (Philpott et al., 2011), pushing the universities to find alternative ways to raise capital to fund their research (Ambos et al., 2008). Secondly, universities are expected to deliver research with high value contributing to the socio-economic development of the region (Abreu et al., 2016; Azagra-Caro et al., 2006). Ultimately, policymakers anticipate measurable and direct returns from public research results (OECD, 2013).

Finally, driven by the understanding that university knowledge creation is a crucial source of innovation and competitiveness and, that over time, leads to economic growth (Audretsch, 2014; Maietta, 2015), the topic has gained overwhelming interest from government and policymakers (Audretsch and Belitski, 2021; Compagnucci and Spigarelli, 2020; Miller et al., 2021). In the United States context, the enactment of the Bayh-Dole Act in 1980 was an instrumental legislative reform that led to the substantial rise of university technology transfer (Bradley et al., 2013). As a result of this Act, universities can consider technology transfer a commercial activity (Shane, 2004). Additionally, it allows the university to take ownership of their research breakthroughs, even for research funded by governmental grants (Galán-Muros et al., 2017; Kenney and Patton, 2009). Similarly, substantial European Commission policy's instruments have supported the transformation and modernisation of the European universities. The establishment of the European Framework Programmes in 1984 and the University-Business Forum in 2008 were significant responses from European Commission (EC) to support cooperation between university and industry actors (Davey, 2017; European Commission, 2018). Moreover, the Lisbon Strategy was the EC guiding framework aimed at making the European Union (EU) "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth" (European Parliament, 2000). As part of the Lisbon Strategy, the EU coordinated R&D and innovation (Cunningham and Link, 2015) and encouraged universities to convert scientific research results into new products, services, and jobs (European Commission 2003, 2006).

While retaining their unique teaching and research missions at the core of knowledge creation, universities can anchor competitiveness (European Commission, 2018). The literature has identified several outcomes attributed to successful entrepreneurial university activities, namely, improved students' skills and graduates' employability (Bozeman and Boardman, 2013; De Fuentes and Dutrénit, 2016; Gibb, 2012); the increased impact of academics publications (Perkmann et al., 2015); application of research in real-world practice (Carayannis et al., 2018; Müller and Kaltenbrunner, 2019). Kirchberger and Pohl (2016) further acknowledged creating value via technological advances that outperform existing established products. In addition, the presence of a university in the region tends to foster the creation of innovative start-ups (Baptista et al., 2011) and improve industrial advancement and establishment of knowledge-intensive ventures (Daraio et al., 2011; Giunta et al., 2016). Lastly, universities are valued for their direct outputs, such as patents, licenses, start-up and spin-off ventures, and other technology transfer mechanisms, which are more easily measurable (Tijssen, 2006).

A recent publication from the Organisation for Economic Co-operation and Development (OECD) and based on data from thirty-five OECD countries and China denotes that public research institutions have become more active in patenting, albeit modest compared to the industry's indicators. It highlights that start-ups founded by academics and students account for 15% of all start-ups in science-based disciplines (OECD, 2019).

Bearing these factors into consideration, knowledge valorisation activities has attracted considerable attention from management scholars, especially in entrepreneurship, technology innovation management, and strategic management (Balven et al., 2018).

1.2 Theoretical background

This section provides an introduction to the entrepreneurial university phenomenon. Various definitions of the constructs are explored to develop a thorough comprehension of the entrepreneurial university, academic entrepreneurship, and the process of knowledge-based value creation.

1.2.1 Entrepreneurial university

> *"As knowledge becomes an increasingly important part of innovation, the university as a knowledge-producing and disseminating institution plays a larger role in industrial innovation" (Etzkowitz et al., 2000, p. 314)*

Universities were traditionally large teaching organisations with the principal purpose of passing on knowledge to their students (Etzkowitz, 2003). Afterwards, notably in Europe and the United States, the Industrial Revolution ushered the need to develop specialized competencies and expertise. Despite a desire for independence, there was evidence of cooperation between universities and industry since the late 1800s. In the new model, the Modern University, the universities embrace research as a new mission (Breznitz and Feldman, 2012). The Humboldt model, named after the scientist Wilhelm von Humboldt, is commonly considered the origin of the classic research university (Davey, 2017). Under this model, both faculty and students are supposed to work together to produce new knowledge, centred on the academic freedom of research and teaching (Sam and van der Sijde, 2014).

More recently, the demand for a knowledge-based economy made most universities undergo significant transformations (Blankesteijn et al., 2019). The university evolved with the addition of an entrepreneurial mission. The new redefined mission incorporates the traditional teaching and research activities side-by-side with the so-called Third Mission, which encompasses innovation and entrepreneurship (Etzkowitz, 2016).

Etzkowitz (1983) and Clark (1998) are among the first researchers to address the concept of Entrepreneurial University. For Etzkowitz (1983), the entrepreneurial university embraces activities that can apply research results to the commercial environment. Later, Etzkowitz extended the concept and included "university's financial advantage and that of its faculty" as an internal pressure to become an entrepreneurial institution (Etzkowitz et al., 2000, pp. 833). According to Clark (1998), entrepreneurial universities as those engaged in the inclusion of more valuable knowledge through processes aimed at innovating how they manage their organisations.

The entrepreneurial university can be seen as an intensive knowledge context that creates entrepreneurial opportunities (Guerrero and Urbano, 2014). Its strategy

concentrates on commercialising research results (Urbano and Guerrero, 2013) and fostering a supportive context (Perkmann et al., 2013). Such organisational supports might assume many formats, from entrepreneurship education programmes (Crespo, 2019; do Paço et al., 2015), internal policies to properly exploit the knowledge and technology developed (Baldini et al., 2014; Fini and Toschi, 2016) to the establishment of a technology transfer office (Mascarenhas et al., 2019; Siegel et al., 2007). Additionally, other physical supports can be provided, such as incubators and accelerators (Mian, 1996; Soetanto and Jack, 2016), proof of concept centres (Maia and Claro, 2013) and science and technology parks (Diez-Vial and Montoro-Sanchez, 2017; Hobbs et al., 2017). The support mechanisms are meant to assist the academic community, create an entrepreneurial culture, and bridge the gap between academia and industry, consequently accelerating academic research valorisation (Berbegal-Mirabent et al., 2012). Consistent with this growing support, the literature analysis of Mascarenhas et al. (2017) observed that the universities are increasingly committed to commercialising knowledge.

The university used to produce knowledge. With all these activities under the entrepreneurial university, the process becomes dynamic and runs in two directions. In the new model, the entrepreneurial university finds "problems in industry and society, seeking solutions in academia" and then returns to the classical model, where it produces "serendipitous innovations from the meandering stream of basic research" (Etzkowitz, 2017, p. 122). In sum, the soul of the entrepreneurial university is portrayed clearly in the words of Tijsen (2006) that states: "entrepreneurial research universities are viewed as those that embrace the spirit of enterprise and innovation, promote an entrepreneurial culture, reach across the traditional academic-industry boundaries to form mutually beneficial relationships, and create a variety of functions to accommodate the transfer of knowledge and technologies across these boundaries, while integrating new managerial and market-related practices" (p. 1570).

Although the terms are frequently used interchangeably, the literature on the entrepreneurial university focuses on institutional and national policy issues, whereas academic entrepreneurship emphasises management and entrepreneurship disciplines (Yusof and Jain, 2010).

1.2.2 Academic entrepreneurship

One of the traditional understandings of academic entrepreneurship is considering it as a university that fosters start-up and spin-off creation (O'Shea et al., 2004). This subject has become an exciting research topic. Scholars have looked to academics intentions (Antonioli et al., 2016; Hayter et al., 2017; Markuerkiaga et al., 2016), university factors that boost this activity (Rasmussen et al., 2014; Rasmussen and Wright, 2015; Wright et al., 2012), factors that may lead the spin-offs and start-ups to succeed (Hayter, 2016; Hossinger et al., 2020), and even research to capture their performances (Audretsch et al., 2021; Fini et al., 2017; Mathisen and Rasmussen, 2019). Notwithstanding, a comprehensive conceptualisation of the academic entrepreneurship phenomenon should consider that it is not a single event (Wood, 2011) but rather a multi-stage process (Markuerkiaga et al., 2019) and presupposes a wider variety of commercialisation channels (Amara et al., 2013).

To begin with, following Abreu and Grinevich (2014), we classify academics as those who generate value, from their research, outside academia. In addition, following Holley and Watson (2017), we describe entrepreneurship as the aggregate of activities that the academics might commercialise out of their research. In conclusion, in this thesis, we use the concept of academic entrepreneurship in a broad sense. We assume that academic entrepreneurship encompasses the valorisation of knowledge that academics (students, faculty and researchers) create via patents, licenses, start-ups, spin-offs and industry collaboration (Guerrero and Urbano, 2012, 2014). In other words, we include any activity that occurs beyond the traditional role of teaching and research (Abreu and Grinevich, 2013), which may lead to financial rewards for the academic or the university (Huyghe and Knockaert, 2015) and an increase in the regional and national economic performance (Etzkowitz et al., 2000).

Briefly, an academic spin-off describes a new venture where the commercialisation process is initiated inside the university and is knowledge or technology-based (Rasmussen, 2011; Rippa and Secundo, 2019). In contrast, the start-up represents any company (Huyghe et al., 2016).

Patenting has become a widespread activity (Landry, 2010). Patenting research results provides a temporary monopoly to the commercial exploitation of knowledge

(Bodas Freitas and Nuvolari, 2012). It has been consistently proven to predict a subsequent spin-off foundation (Krabel and Mueller, 2009; Stuart and Ding, 2006).

Lastly, under our definition of university-industry collaboration, we include joint research, research contract, and consulting (Huyghe and Knockaert, 2015; Klofsten and Jones-Evans, 2000). Joint research is the research developed by the university and the industry; in contrast, a research contract is contracted by the industry and conducted solely by the university. These two activities create new knowledge. In turn, consulting is a contract from the industry, usually provided individually by academics (Perkmann and Walsh, 2008), and it does not require the creation of original research (D'Este and Patel, 2007). The knowledge derived from collaborations may expand the scientific knowledge base or focus on economic value production (Bozeman et al., 2013). Alongside these three main activities, other authors also include training company employees, creation of facilities, and meetings and conferences (Huyghe and Knockaert, 2015), student placement (Abreu and Grinevich, 2014; Sjöö and Hellström, 2019), exchange of equipment and purchase of prototypes developed at universities (Lee et al., 2000; Schartinger et al., 2002) within the university-industry collaboration activities (Rasmussen et al., 2006). Collaborations with industry are sometimes referred to as informal activities (Link et al., 2007).

1.2.3 The process of value creation

As discussed, universities are seen as organisations that can create value and subsequently facilitate economic and social wealth. Universities hold a crucial role because they are placed at the intersection between research, innovation and entrepreneurship. Their research creates new knowledge, successively exploits entrepreneurial opportunities, and generates endogenous growth (Acs et al., 2009; Romer, 1990).

The following discussion is based on the analytical model depicted in Figure 1.1. We build our framework model based on Guerrero et al. (2014) and build up with insights from the previous model created within the strategic entrepreneurship literature, particularly the model from Hitt et al. (2011). The model identifies four dimensions: inputs, processes, outputs, and outcomes.

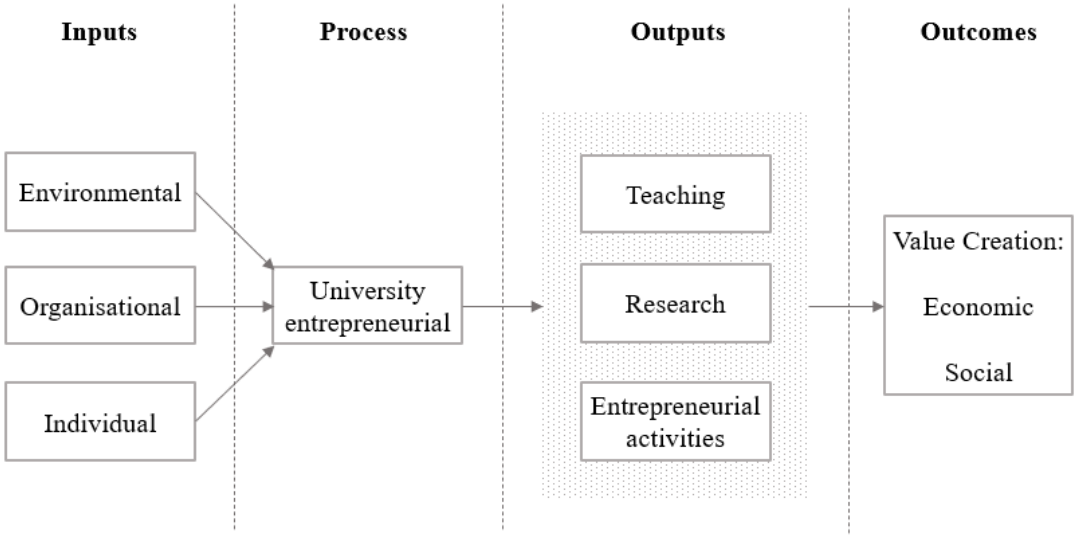

Figure 1.1 Entrepreneurial University Model

The first dimension specifies the inputs. The inputs that are external to the university we classify as environmental. Organisational inputs concern the university, and individual inputs pertain to the academics. From the *institutional economic theory*, the context where the university operates can constrain and facilitate the development of entrepreneurial opportunities (Urbano and Alvarez, 2014). The environmental or institutional factors such as political, economic, social, cultural and infrastructural conditions are determinants of entrepreneurship. According to North (1990), it sets the "rules of the game in a society".

Following Rothaermel et al. (2007) taxonomy of the literature on university entrepreneurship, we identify government policies (Gerbin and Drnovsek, 2016; Kochenkova et al., 2016) and industry context (Davey et al., 2016; Fini et al., 2011) as external variables affecting the university's activity. Government involvement with policies and supporting initiatives is no surprise. Governments of most countries have realised that an entrepreneurial university is an avenue to increase national competitiveness in science and technology (Boardman, 2009). As a result, they have set up incentive policies (Gerbin and Drnovsek, 2016), adapted their legislative context (Mustar and Wright, 2010), changed their intellectual property legislation (Baldini, 2006; Mowery and Sampat, 2004), increased financial support (Link and Scott, 2010, 2013; Rasmussen and Rice, 2012), and fostered a favourable environment for entrepreneurship (Teixeira et al., 2018). Additionally, due to the need for substantial capital investment,

the government has been subsidising interface infrastructures and other services to support the establishment of science parks and incubators (Jacob et al., 2003; Phan et al., 2005; Sternberg, 2014).

On the industry's side, their resources, opportunities, corporate practices, and concentration are relevant factors that must be considered (Rothaermel et al., 2007). De Fuentes and Dutrénit (2016) add other variables, such as the companies' sectors, their age and size, the intensity and type of R&D carried out by these companies, and their strategic availability to get involved. Bercovitz and Feldman (2003) found that an intense industry and university expenditure concentration is strongly related to regional innovation. However, while much of the literature shows that geographical proximity has a significant impact in encouraging all forms of collaboration (Crescenzi et al., 2017), other authors found that companies that invest highly in R&D seek to engage with high-quality universities, regardless of their location (Laursen et al., 2011).

The university's organisational elements pertain to its organisational design structure, which can hinder or enhance the commercialisation of research results (Rothaermel et al., 2007). It encompasses the status of the university, size and age, its incentive system, both financial and non-financial (Markman et al., 2004), the culture and past experiences (Bergmann et al., 2018; Braunerhjelm, 2007; O'Shea et al., 2007). According to Thursby et al. (2001), the status of the university refers to whether it is public or private, the university's prestige, and which university departments are represented. Other authors add the presence of a university hospital as an input factor within the university factor (Fini et al., 2017; Giuri et al., 2019). Secondly, the support measures include infrastructure, entrepreneurial courses, and policies and regulations (Benneworth and Charles, 2005; Nosella and Grimaldi, 2009). At last, Rothaermel et al. (2007) further note the relevance of the technology's nature and marketability (Thursby et al., 2001).

While the factors mentioned above comprise internal elements, the literature has recognised that the external environmental factors, both industry and government and regional conditions, influence the university organisational elements and, subsequently, the overall process (Friedman and Silberman, 2003; Gulbrandsen and Smeby, 2005; Mowery et al., 2001).

Lastly, the individual factor is an essential element of this process. Academics are the "agents who recognise opportunities, mobilise resources, and create value" (Guerrero

et al., 2016, p. 109). This process of knowledge valorisation from academia to the market would not be achievable without them (Miller, Alexander, et al., 2018). Therefore, it is essential to know who the academic is, their role, and their motivations to get involved within the university's Third Mission.

Entrepreneurship research acknowledges that intentions can predict engagement in entrepreneurial behaviour (Lee et al., 2011; Liñán and Fayolle, 2015). Thus, it demands a more detailed explanation of academics' intent to engage in entrepreneurial activities (Bird, 1988; Krueger, 1993). Notwithstanding its relevance, this topic has gradually attracted scholarly curiosity. Scholars have recently started to explore research scientists' entrepreneurial intentions (for instance, D'Este and Perkmann, 2011; Mosey et al., 2012; Perkmann et al., 2013).

As per Stam (2015) and Agarwal, Audretsch and Sarkar (2007), output considers the different forms of results from the university activity, while outcomes refer to the aggregate impact effect of the activities. The former represents the three university missions: teaching, research and entrepreneurial activities. The value that the university creates and contributes to the society beyond the academic environment. This thesis focuses on entrepreneurial activities, specifically on the outputs of spin-offs, patents, and collaboration with industry. The latter measures the impacts created from those three missions.

Universities must look at the inputs to find the best combinations of resources, identify their distinguishing feature, adapt to support their strategy, and consecutively influence the outputs they intend to achieve.

1.3 Research problem and questions

Universities are nowadays more eager to outshine in academic and commercial fields (Heaton et al., 2020). At the same time, the potential value provided by such knowledge valorisation activities has been widely acknowledged (Lehmann et al., 2021), and the general society recognises it as legitimate (Budyldina, 2018). Knowledge valorisation, that is, converting scientific research into practical application, is a complex process (Hayter et al., 2020; Wright and Phan, 2018). It demands the involvement of multiple actors, giving rise to a multi-channel and multi-directional knowledge exchange (Kalar and Antoncic, 2015). Having this into consideration and recognizing that university

entrepreneurship is a current issue on political agendas, there is evidence that this topic has several valuable research areas to be further explored (Secundo, Ndou, et al., 2019).

Following a comprehensive review of the literature, we found that knowledge valorisation activities need to be led bottom-up from the university to be articulated within its context (Clauss, Moussa, et al., 2018). Whilst not diminishing the significance of the context, the focus of the universities' strategy and policies should also rely on their academics, the creator of the knowledge (Balven et al., 2018). There is an interest to understand the individual factors that may stimulate engagement in entrepreneurial activities (Filippetti and Savona, 2017). This position is also shared by Cunningham and O'Reilly (2018) that suggest "some further micro-level studies are needed that examine more of the antecedent factors that shape individual perspectives and behaviours prior to engaging with a technology transfer process" (p.552).

Moreover, with the involvement of more stakeholders in academic entrepreneurship, scholars have argued that universities must assume a more strategic approach (Siegel and Wright, 2015), based on clear objectives for their initiatives (Klofsten et al., 2019), and adjusting the strategic path to their characteristics (Giuri et al., 2019). In brief, entrepreneurship policy strategy should be tailored to and based on specific institutional context and actors (Fini et al., 2020), avoiding the "one-size-fits-all" approach (Horner et al., 2019). Mosey, Guerrero and Greenman (2017) call for more studies exploring the interaction between different levels of analysis. Similarly, Wang et al. (2021) believe that to have comprehensive research in academic entrepreneurship, individual, organisational and environmental factors should be considered. Hence, our research problem and research questions are:

Research Problem: How does the university enhance the development of knowledge-based value creation?

Research question 1: How does the university configuration promote the engagement of faculty members and researchers in knowledge valorisation activities?

Research question 2: How does the university configuration can foster the process of knowledge transformation into value?

1.4 Research methodology

Based on the research problem and research questions described above, quantitative and qualitative approaches were developed.

The first paper proposes to unravel the drivers at an individual level and answers to 'What are the drivers of academic entrepreneurial intentions?'. The paper follows a Systematic Literature Review process (Tranfield et al., 2003). It adopts a four-step process format from previous systematic literature reviews within the entrepreneurship context (Miller, Alexander, et al., 2018). A systematic review reduces subjective bias, diminishes the risk of overlooking relevant literature (Ankrah and Al-Tabbaa, 2015) and allows a structured analysis of a large volume of literature (Vick and Robertson, 2018). The research was initiated with rigorous and comprehensive search terms identification in Scopus and Web of Science bibliographical databases. Secondly, inclusion and exclusion criteria were set up to narrow the search and guarantee a validated sample. In the third stage, titles and abstracts were reviewed and validated. This step included setting three questions to guide the inclusion and exclusion criteria and browsing the full texts whenever necessary to ensure the inclusion of all relevant papers that met the research objective. The sixty-six remaining papers underwent a careful reading process in the final step, and major findings were synthesised.

The second paper is quantitative in nature. The research proposes to understand the academics' intention to engage in academic entrepreneurship activities (individual factor), considering their perceived university support from the university (organisational factor) and pondering the strategy of the universities where they are embedded. A survey was developed to gather individual data and empirically test the research framework. The empirical research involved a survey collection from 466 academics at three Portuguese universities (the University of Aveiro, the University of Minho, and the University of Porto). The study employed a Partial Least Square - Structural Equation Modeling technique and analysed what motivations, social capital, human capital, and support perception drive the academics intentions for different activities: spin-off creation, patenting, engagement in joint research with industry, engagement in research contracts with industry, and consulting. This technique has grown in notoriety due to the method's capacity to evaluate the measurement of multi-item latent variables, not directly observable, while simultaneously testing relationships between them and those defined

by the conceptual model, directly observed (Babin et al., 2008; Hair et al., 2014). Further, the research also used secondary data to assess the universities' macro-level variables. With the support of the software QDA Miner Wordstat 8, the study analysed the content of the universities' strategic policies reports using text mining tools to uncover universities focus and strategic objectives.

The third paper acknowledges that the university needs to manage its internal environment, but it should also consider various external characteristics and stakeholders (Etzkowitz, 2017). The research explores regional and university variables and their relationship to entrepreneurial activities. The study's framework considered three entrepreneurial activities: spin-off creation, patenting, and collaboration with industry. On the university side, the research collected secondary data from European Tertiary Education Register, Times Higher Education Ranking, InCites Clarivate Analytics, CWTS Leiden Ranking and European Patent Office. The research also included data referring to R&D expenditure from public and private sectors (European Commission Regional Innovation Scoreboard) and regional gross domestic product per capita (Eurostat and UK Office for National Statistics).

Recently, as Perkmann et al. (2021) revealed, there is scope for more comparisons of academic entrepreneurship patterns across countries with different institutional structures. The empirical analysis is conducted on twelve universities across eleven regions from four European countries: France, Germany, Portugal and the United Kingdom. Given the small number of universities under study, the present research performs correlations between variables. Spearman's rank correlation coefficient is a nonparametric rank statistic proposed to measure the strength of an association between two variables (Hauke and Kossowski, 2011). This quantitative analysis is complemented with a qualitative assessment, particularly an exploratory study using Contrast Table (Miles et al., 2014).

1.5 Thesis outline

We have chosen to elaborate this thesis as a collection of papers, published or submitted in international peer-reviewed journals and presented at an international conference. This format has the advantage of reporting some work that was already subject to peer review and improvements. The drawback is that some of the introductory parts may be repetitive.

Besides this introduction, the thesis is structured into four chapters. Each of the chapters 2 to 4 corresponds to a paper. The numbering of their sections is based on the chapter number and not on the numbering used for publication. The final chapter encompasses a comprehensive conclusion of the thesis research.

Figure 1.2 provides an overview of how the chapters articulate with each other in the context of the complete research project conducted to this thesis.

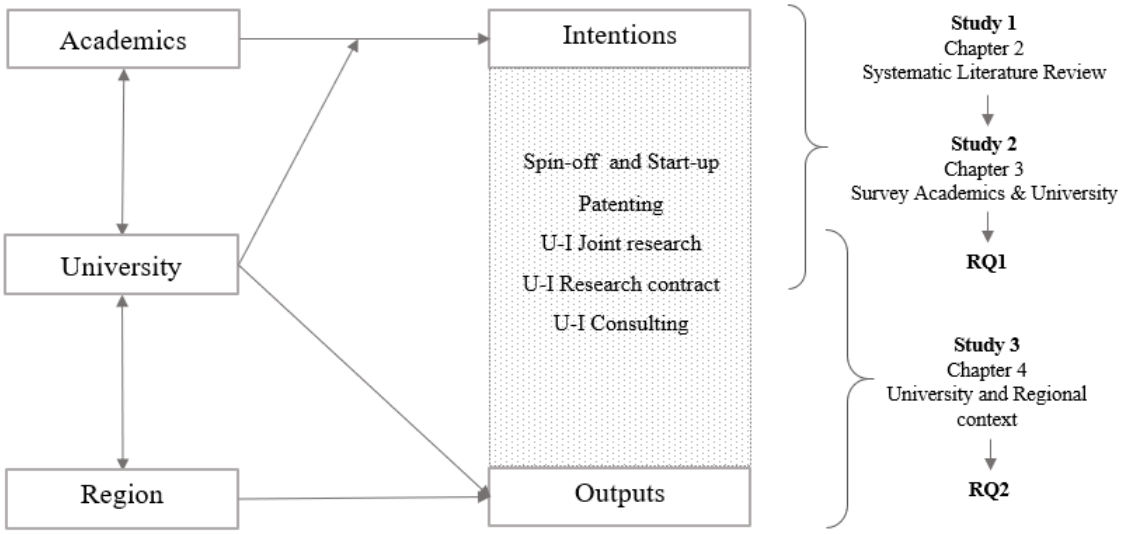

Figure 1.2 Thesis framework and chapters overview

CHAPTER 2

Academic entrepreneurship intentions: a systematic literature review

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Abstract

Purpose: The objective of this research is to have an up-to-date and comprehensive assessment of the current knowledge regarding the variables that encourage the individuals, within the academic community, to get involved in knowledge exploitation activities. It is influenced by the observation that there is a need for more systematic scrutiny of micro-level processes to deepen our understanding of academic entrepreneurship (Balven et al., 2018; Wright and Phan, 2018). The study proposes to answer to 'What are the drivers of academic entrepreneurial intentions?' and 'What are the emerging topics for future research?

Design/methodology/approach: The paper follows a Systematic Literature Review (SLR) process (Tranfield et al., 2003) and adopts a four-step process format from previous systematic literature reviews within the entrepreneurship context (Miller et al., 2018).

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From the results within Scopus and Web of Science databases, this research selected, evaluated, summarised and synthesised 66 relevant papers.

Findings: This study provides a factor-listed representation of the individual, organisational and institutional variables that should be considered in the strategies defined by the university. Moreover, the study concludes that the push factors behind the intentions are multiple, context-dependent, hierarchy-dependent, heterogeneous and, at the same time, dependent on each other and against each other. Lastly, the study contributes to academic entrepreneurship literature, especially entrepreneurial intention literature, that has recently received more researchers' attention.

Originality/value: The study corroborates that the individual factors, directly and indirectly via Theory of Planned Behaviour, strongly impact the academics' intentions. While the focus of the papers under review was an in-depth analysis of a selected group of factors, this SLR sought to compile the factors that were identified and provide a broader picture of all those factors to be considered by the university management. It contributes to the identification and clustering of the drivers that encourage academics to engage in knowledge valorisation activities, differentiating them by activity. For the practitioners, this list can be used by university managers, TTOs and department managers, and policymakers to guide questionnaires or interviews to analyse their academics' intentions and adequately support its academic engagement strategy. Lastly, this study also suggests worthwhile avenues for future research.

Keywords: Knowledge transfer, Academic entrepreneurship, Literature review, Entrepreneurial university, Academic spin-off, Academics intention

Paper type: Literature review

2.1 Introduction

The mission of universities has evolved over the last few decades, and today the scope of these universities goes well beyond traditional teaching and research activities (Etzkowitz et al., 2000). Encouragement by government and public policy to promote economic development (Benneworth and Charles, 2005; Mian et al., 2016; Miller et al., 2016) as well as the demand for a technology-based economy (Markuerkiaga et al., 2014)

have forced universities to undergo significant transformations to become entrepreneurial (Ivanova and Leydesdorff, 2014). Etzkowitz (1983) and Clark (1998) were the first to explore the concept of the entrepreneurial university. For Etzkowitz (1983), the entrepreneurial university is the classic university model with an additional third mission. That third mission is the university contributing to economic and social development (Davey, 2017) through the production and dissemination of knowledge outside the academic environment (Rothaermel et al., 2007). Later, Etzkowitz extended the concept and included "university's financial advantage and that of its faculty" as an internal pressure in becoming an entrepreneurial institution (Etzkowitz et al., 2000, p. 833). According to Clark (1998), the entrepreneurial university is a process where the university seeks to innovate the way they manage their business. Although frequently used interchangeably, the literature on the entrepreneurial university focuses on policy issues at an institutional and national level, while academic entrepreneurship emphasises management and entrepreneurship disciplines (Yusof and Jain, 2010).

Academic entrepreneurship encompasses the exploration of knowledge that academics (students, faculty and researchers) create via patents, licenses, start-ups, spin-offs and industry collaboration (Guerrero and Urbano, 2012, 2014). To better explore these knowledge valorisation activities, the literature increasingly acknowledges the vital role of the individual academic (Wright and Phan, 2018). It proves that knowledge transfer is led bottom-up from the student or scientist to the university (Al-Tabbaa and Ankrah, 2019). Individual-level motives have been pointed out to be the best predictors of academic entrepreneurship (Clarysse et al., 2011). Consequently, to better outline entrepreneurship support and policies (Balven et al., 2018; Walter et al., 2018), attention is dedicated to understanding the factors that shape academic entrepreneurial intention (Trivedi, 2016) and the actors involved (Berggren, 2017). Bird (1988) defines intentionality as a state of mind that guides personal attention, experience and behaviour towards a specific goal. In her framework to implement entrepreneurial ideas, Bird suggests that individuals are driven to entrepreneurial intentions based upon a combination of both personal and contextual factors (Boyd and Vozikis, 1994). In this conceptual study framework, entrepreneurial intentions represent the researchers' engage in activities that commercially explore their knowledge (Ozgul and Kunday, 2015).

To understand academics' intentions, the research demands a psychological (Carland et al., 1988) and an economic approach. From the psychological perspective, two fundamental research strands emerge from the literature: Shapero's (1984) Entrepreneurial Event Model and Ajzen's (1991) Theory of Planned Behaviour (TPB). This research adopts the TPB framework given its numerous advantages (Cantner et al., 2017; Lortie and Castogiovanni, 2015; Sieger and Monsen, 2015), in particular its applicability to the academic context (Goethner et al., 2012; Obschonka et al., 2012, 2015). Equally important, when setting up a conceptual model of academic entrepreneurial intentions, it is essential to include the economic perspective (Goethner et al., 2012; Huyghe and Knockaert, 2016; Würmseher, 2017). This conceptual research model (Figure 2.1) recognizes that the economic variables (individual, organisational and institutional-level) may have an impact on the psychological variables (TPB), which then may influence the academics' intention to engage in knowledge valorisation activities.

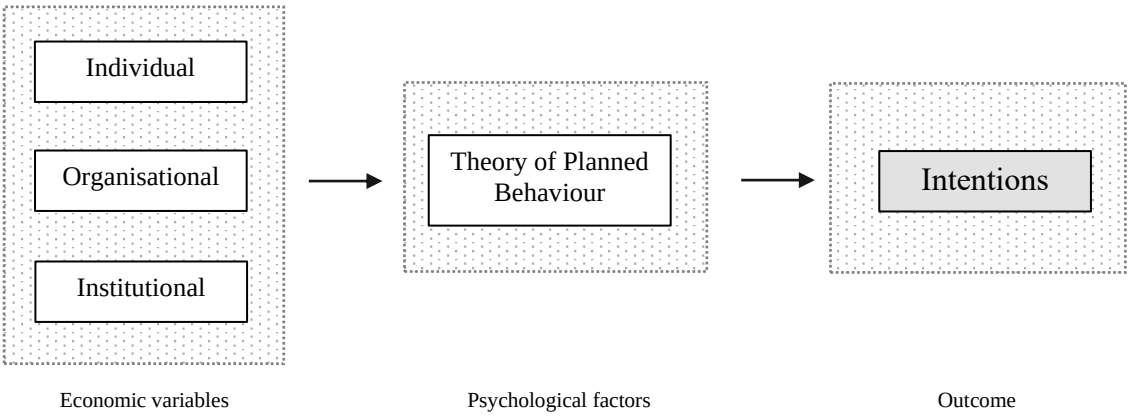

Figure 2.1 Conceptual Framework

The authors observed that even though there is an increasing amount of research on academics' intentions, it has mainly focused on one knowledge transfer activity, such as spin-off creation (Fini and Toschi, 2016; Hesse and Brünjes, 2018), patent and licensing activities (Baldini et al., 2007; Walter et al., 2018) or collaboration with the industry (Bodas Freitas and Verspagen, 2017). These topics are widespread and yet cover a limited scope (Huyghe and Knockaert, 2016; Miranda, Chamorro-Mera, et al., 2017). Currently,

Balven et al. (2018) argue for more systematic scrutiny of micro-level processes to deepen our understanding of academic entrepreneurship (Wright and Phan, 2018).

Therefore, through a systematic review of the literature, an up-to-date and comprehensive assessment of the current knowledge is appropriate. This research will help answer the questions: 'What are the drivers of academic entrepreneurial intentions?' and 'What are the emerging topics for future research?' In sum, the research focuses on assembling existing literature to identify the drivers that encourage academics to engage in entrepreneurial activities as well as uncover future research avenues. The study answers the call for research that disentangles entrepreneurial intentions (Huyghe and Knockaert, 2016) within the academic community (Antonioli et al., 2016). The practical contribution of this study is that it gives guidelines for building a scale of intentions assessment. This, in turn, could help universities that are investing in programmes and funding to stimulate entrepreneurship activities to implement effective and value-driven policies (Balven et al., 2018).

The paper is structured as follows. In the following section, the authors explain the systematic literature review methodology and the steps undertaken. Then, the main results of the review analysis are presented. The research concludes by offering some research avenues.

2.2 Methodology

Systematic reviews are gradually being implemented in the management field (Galvão et al., 2018; Schmitz et al., 2017) as they encompass a precise and repeatable process that ensures rigour to the research (Tranfield et al., 2003). A systematic review reduces subjective bias, diminishes the risk of overlooking relevant literature (Ankrah and Al-Tabbaa, 2015) and allows a structured analysis of a large volume of literature (Vick and Robertson, 2018). The literature generally follows the guidelines of Tranfield's framework (Liñán and Fayolle, 2015) while slightly customising some steps. This study pursues the same principles and adopts a four-step process format from previous systematic literature reviews within the entrepreneurship context (Miller et al., 2018).

2.2.1 Search terms identification

The first step involved search terms identification. The keyword search strategy started with a brainstorm, as suggested in the work by Pittaway et al. (2004). The keywords identified by the authors fell into three clusters: context (university and academy), activities (for example, knowledge transfer, spin-off, industry collaboration, patents) and academic action (for example, intention, behaviour, engagement). After this, a search on Scopus was performed using the same keywords as in Liñán and Fayolle (2015) 'entrepren*' and 'intent*' in combination with 'academ*' and 'universit*.' Highest citations sorted the results. The final step included the extraction of the titles and abstracts of the one hundred most cited papers to an online word count software to adjust and validate the previously identified keywords.

After the initial search terms identification, a search for titles, abstracts and keywords was conducted in April 2019 in Scopus and Web of Science bibliographical databases. From the results of the previous step, the search used a combination of different keywords: 'university' and 'academy.' The same terms were selected as keywords in the reviews from Hayter et al. (2018) and Perkmann et al. (2013): 'entrepreneurship', 'start- up', 'spin-off' and 'spinout' (Djokovic and Souitaris, 2008; Sandström et al., 2018). To capture the university-industry activities, the keywords 'industry,' 'business' and 'firm' were jointly selected with 'interaction,' 'collaboration' and 'cooperation' following a similar approach as adopted by Sjöö and Hellström (2019). Moreover, as performed in the systematic review by Zavale and Langa (2018), the keywords 'partnership' and 'relationship' were added.

Furthermore, the terms 'technology,' 'research' and 'knowledge' were included in combination with the terms 'transfer,' 'commercialisation' and 'patent' (Gerbin and Drnovsek, 2016), plus 'license' (Rothaermel et al., 2007), 'joint' and 'contract' (Perkmann et al., 2013).

Finally, as the research goal is to comprehend the intentions, the equivalent keywords 'intention,' 'attitude,' 'behaviour,' 'motivation' and 'engagement' were counted in. The search strings using Boolean 'and' to join main terms and 'or' to include synonyms were constructed (for the full list of keywords strings see Appendix 2A).

The timescale limits the period to 2007 - 2018 (Clauss et al., 2018; Pittaway and Cope, 2007). Papers that include the mentioned combination of keywords in Title, Abstract, or Keywords constitute the research target.

2.2.2 Inclusion and exclusion criteria

Secondly, inclusion and exclusion criteria were set up to narrow the search and guarantee a validated sample of papers. A paper had to meet the following requirements: (1) Document type: Article (2) Language: English (3) Subject Area: Business Management and Accounting; Social Science; Economics, Econometrics and Finance; and Engineering, and (4) Source type: Journal. Only peer-reviewed papers were included to ensure validity and to cover the main contributions of the research discipline (Ankrah and Al-Tabbaa, 2015). Conference papers, editorials, books, books chapters, books reviews, and other reports were excluded (Belitski and Heron, 2017; Coviello and Jones, 2004). At this stage, the sample was 1814 papers. The research team removed 395 papers due to duplication in the databases (1419).

2.2.3 Data validation and extraction

In the third stage, titles and abstracts were reviewed and validated. This step included browsing the full texts whenever necessary to ensure the inclusion of all relevant papers that met the research objective.

The research set three questions to guide the inclusion and exclusion criteria: (1) does the study address knowledge valorisation activities (spin-offs, patents and licensing or any given activity in collaboration with the industry) as a central inquiry? (2) does the study address academic intentions? (3) does the study include empirical research?

Drawing on these criteria, the authors excluded reviews (Gerbin and Drnovsek, 2016; Guerrero et al., 2006; Perkmann et al., 2013) and papers that investigated intentions not within a university ecosystem (Lamine et al., 2014). Consistent with Snijders and Bosker (2011) and Balven et al. (2018), the authors define micro-level variables as those that measure phenomena regarding the elementary unit of analysis for a given academic entrepreneurial ecosystem. Papers that explored the macro-level were also left out of the

research (Audretsch, 2014; Bercovitz et al., 2001), as were studies that looked into intentions from the industry side (López et al., 2015).

To confirm the reliability of the selection, the sample was simultaneously examined by both authors. Those with contradictory decisions were re-analysed jointly for a final decision.

Papers with simultaneously empirical research exploring the intentions of the academics, researchers or faculty to engage in knowledge valorisation activities specifically within the university context were included in the final database. This database to be analysed totalled 66 papers.

2.2.4 Conducting the review

In the final step, the sixty-six remaining papers underwent a careful reading process, and major findings were synthesised in a tabular form with the following information: (1) Authors; (2) Design and data; (3) Knowledge valorisation activity (selection between venture creation, patents and licensing, and industry-collaboration), (4) Variables, (5) Research questions and (6) Findings (for the full list of the analysed papers with summarized findings, see Appendix 2B).

2.3 Findings

2.3.1 Descriptive characteristics

The number of papers per year has been increasing, and in recent years there has been an even greater number of papers, suggesting that the study of academic intentions is currently an appealing topic for researchers (Table 2.1). Concerning the number of citations, the years 2007 and 2011 are worth noting. The 2007 paper by D'Este and Patel presents 529 citations, revealing itself as a reference in this subject. As for 2011, with an exceptionally high number of papers, more than 130 citations can be found in three of the seven papers.

Table 2.1 Number of papers and citations by year

Year	N. of Papers	N. of Citations
2007	2	774
2008	2	340
2009	3	232
2010	4	209
2011	7	687
2012	6	196
2013	3	154
2014	5	99
2015	8	139
2016	7	89
2017	12	63
2018	7	15

As for the sources, the authors verify two patterns. There is a large number of journals with a single paper under analysis, that is, 32 papers are from 32 different journals, while the other 34 papers belong to 5 journals. *Journal of Technology Transfer* and *Research Policy* are the most frequent sources (37.88% of the total) with 13 and 12 papers respectively. Furthermore, *Technovation* includes five papers, *Industrial and Corporate Change* has two papers and *Science and Public Policy* has two others (Table 2.2)

Table 2.2 Number of papers by journal

Journal Title	N. of Papers
Journal of Technology Transfer	13
Research Policy	12
Technovation	5
Industrial and Corporate Change	2
Science and Public Policy	2
Others	32

The selected papers are exclusively empirical analyses, in which 51 papers utilise quantitative data and just 13 papers follow qualitative data collection (Table 2.3).

Most papers collected their data sample from one country (60 papers). There are some examples with data from different countries; namely, three papers with data from two countries, two papers with data from three countries and one paper with data from five countries. The countries most often analysed are Germany (12 papers), followed by

the United Kingdom and Spain (11 papers). The fourth position goes to the United States of America, with a total of 9 papers. Due to the particularity of professor privilege (Damsgaard and Thursby, 2013), Sweden is also a well-exploited case (5 papers).

Table 2.3 Summary of papers by type of data and country analysed

Study characteristics	Nr. of papers	% of papers
Quantitative data	51	77.27
Qualitative data	13	19.70
Mixed data	2	3.03
Germany	12	15.58
United Kingdom	11	14.29
Spain	11	14.29
Italy	10	12.99
United States of America	9	11.69
Sweden	5	6.49
Other Europe	10	12.99
Other countries	9	11.69

Academics can participate in different activities to commercialise their knowledge: activities related to venture creation, activities related to patent and licensing, and lastly those activities that require closer collaboration with the industry. Within our results (Figure 2.2), there is an acute interest in addressing the academic's intentions to create a company (30 papers).

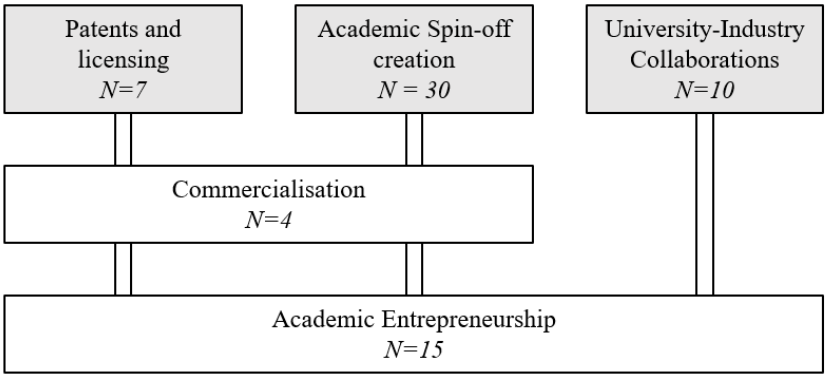

Figure 2.2 Knowledge valorisation activities under study (frequency)

The intentions to engage in patenting is under research in 7 papers. Moreover, 10 papers from the 66 under review explore the academic's intention to collaborate in university-industry partnerships (10 papers). This last topic embraces a broad spectrum of activities,

such as personnel mobility, informal contracts, consulting, joint research activities (D'Este and Patel, 2007) and establishment of facilities such as research centres (Boardman and Ponomariov, 2009). Some papers address more than one activity at a time. Commercialisation bundles spin-off creation and patenting and licensing activities (Brettel et al., 2013; Gulbrandsen and Thune, 2017; Perkmann et al., 2013) and is analysed in 4 papers. Lastly, following Abreu and Grinevich (2013) and Erikson et al. (2015), the authors define academic entrepreneurship (15 papers) as the combination of all the activities that go beyond teaching and research including all entrepreneurial intent (Foo et al., 2016).

2.3.2 Content analysis

In this section, the study uncovers the drivers identified in the literature (Figure 2.3). In addition to their identification, and clustering, it also considers what impacts were reported in the empirical studies. The papers reviewed conducted surveys and interviews to assess what drivers (independent variables) impact the academics' entrepreneurial intentions (dependent variables). By consolidating the systematic literature review results, the study is able to identify the observed impact (positive, negative, mixed or non-significant) for each independent variable.

Economic Variables

Demographic background

The construct of Demographic background includes age, gender and family background (Table 2.4). The variable age, measured as the older the academic faculty, has ambiguous effects. The majority of the studies find a negative relationship between age and academic entrepreneurship intentions. For spin-off intentions, Prodan and Drnovsek (2010) evaluate the intention at seven faculties from the University of Ljubljana and five technical departments from the University of Cambridge and conclude that age has a negative effect. Karlsson and Wigren (2012) arrive at the same conclusion with their national survey to Swedish researchers. This negative relationship is also recognised for university-industry collaboration (D'Este and Patel, 2007; Tartari and Breschi, 2012).

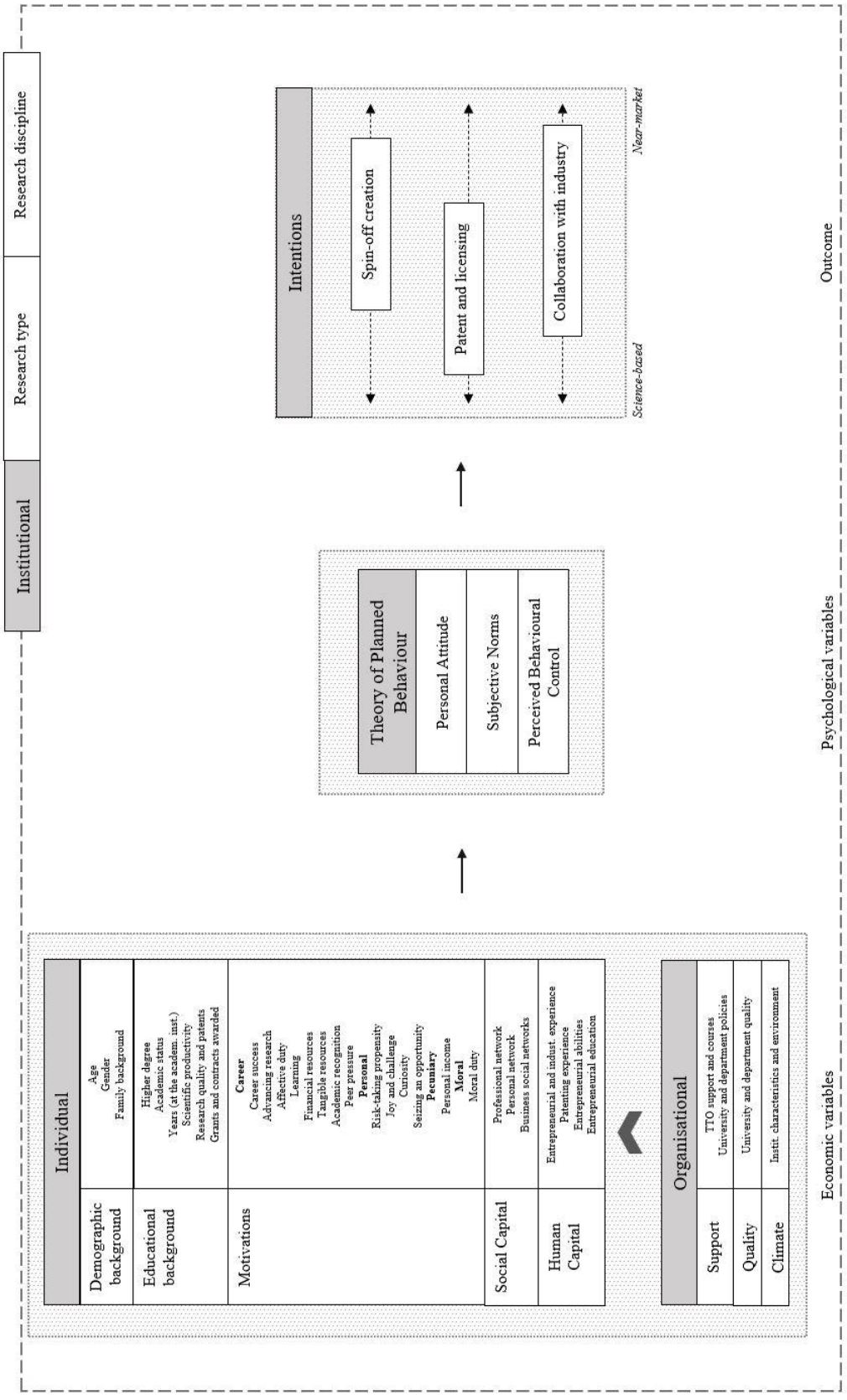

Figure 2.3 Economic and Psychological drivers of academics' intentions

On the other hand, some studies find a positive relationship. The results by Bercovitz and Feldman (2008) indicate that older academics are more likely to explore their reputation and knowledge commercially; Lam (2011) finds that commercialisation activities are more likely to be performed by academics over forty. Concerning university-industry collaboration, Giuliani et al. (2010) cross-country study similarly prove this positive influence. Their findings further disclose that academics' background (age and gender) are foremost more relevant than the academics' degrees or number of publications. Abreu and Grinevich (2013) claim that senior academics are more predisposed to engage in knowledge transfer activities, but they tend to focus on a few portfolios of activities.

Table 2.4 Tabular summary with the individual demographic background effect, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
INDIVIDUAL				
Demographic background				
Age	**Positive** Lam (2011) **Negative** Prodan and Drnovsek (2010) Karlsson and Wigren (2012) **Non-significant** Aldridge and Audretsch (2011) Bourelos et al. (2012) Goethner et al. (2012)	**Positive** Lam (2011) **Non-significant** Bourelos et al. (2012)	**Positive** Giuliani et al. (2010) **Negative** D'Este and Patel (2007) Tartari and Breschi (2012) **Non-significant** Link et al. (2007)	**Positive** Abreu and Grinevich (2013) **Mixed** Boardman and Ponomariov (2009)
Gender	**Positive** Link et al. (2007) Goethner et al. (2012) Miranda et al. (2017) **Non-significant** Aldridge and Audretsch (2011)		**Positive** Link et al. (2007) Giuliani et al. (2010) Tartari and Breschi (2012)	**Positive** Abreu and Grinevich (2014) Iorio et al. (2017)
Family Background	**Positive** Obschonka et al. (2015) Foo et al. (2016)			

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

Still, other studies find no significant relationship (Aldridge and Audretsch, 2011; Bourelos et al., 2012; Goethner et al., 2012; Link et al., 2007) or even mixed results (Boardman and Ponomariov, 2009) between demographic background and academic

entrepreneurship intentions. This is supported through the observation that most research is done by PhD students (Bourelos et al., 2012) and that age can be a consequence of other factors. Younger academics are possibly educated in a social environment that appreciates closer collaboration between science and industry. In comparison, older academics have a more extensive network, higher expertise, and more time to develop work applicable to the industry context (Boardman and Ponomariov, 2009).

Entrepreneurial intentions to create a venture, to patent knowledge and to collaborate within the industry are more substantially seen for male academics (Miranda, Chamorro-Mera, et al., 2017) or academics with parents that have owned a business (Foo et al., 2016; Obschonka et al., 2015). The research by Link et al. (2007) finds a positive and significant effect for being male and participating in formal technology transfer (venture creation and patenting) as well as in informal technology transfer (transfer or commercialise a technology, joint publications, and consulting). Similarly, Abreu and Grinevich (2014) confirm that female academics are less likely to be involved in entrepreneurial activities. It is even more pronounced in informal activities such as consultancy (Abreu and Grinevich, 2013).

Educational background

The construct of education background consists of: Higher degree; Academic status; Years at the academic institution; Scientific productivity; Research quality and patents; Grants or contracts awarded (Table 2.5).

Academics' intentions to commercialise knowledge is positively tied with their academic education degree (Balven et al., 2018; Bercovitz and Feldman, 2008) and research quality (Fini and Toschi, 2016; Morales-Gualdrón et al., 2009). Prodan and Drnovsek (2010) find that researchers who had, in the prior three years, applied for or were granted patents are more likely to create a venture. The authors add that it is through patents that collaboration with industry indirectly impacts intentions. In addition to the number of patents, Tartari and Breschi (2012) acknowledge that the number of scientific publications also influences intentions to collaborate within the industry. The findings by Bourelos et al. (2012), from a survey to Swedish researchers, show that it is common that researchers who publish more also commercialise more.

Table 2.5 Tabular summary with the individual educational background effect, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
INDIVIDUAL				
Educational Background				
Higher degree	**Positive** Balven et al. (2018)	**Positive** Bercovitz and Feldman (2008) Balven et al. (2018)	**Non-significant** Giuliani et al. (2010)	
Academic status	**Negative** Karlsson and Wigren (2012)		**Positive** Link et al. (2007) D'Este and Patel (2007) Tartari and Breschi (2012) Tartari et al. (2014)	**Positive** Abreu and Grinevich (2013)
Years at the academic institution	**Negative** Prodan and Drnovsek (2010)	**Negative** Bercovitz and Feldman (2008)		**Positive** Abreu and Grinevich (2013)
Scientific productivity	**Positive** Bourelos et al. (2012) **Negative** Erikson et al. (2015) **Non-significant** Aldridge and Audretsch (2011) Karlsson and Wigren (2012) **Mixed** Miranda et al. (2017)	**Positive** Bercovitz and Feldman (2008) Bourelos et al. (2012) **Negative** Erikson et al. (2015) **Non-significant** Halilem et al. (2017)	**Positive** Tartari and Breschi (2012) Erikson et al. (2015) **Non-significant** Giuliani et al. (2010)	
Research quality and patents	**Positive** Morales-Gualdrón et al. (2009) Prodan and Drnovsek (2010) Fini and Toschi (2016)	**Positive** Erikson et al. (2015)	**Positive** Tartari and Breschi (2012) **Non-significant** D'Este and Patel (2007)	
Grants or contracts awarded	**Positive** Aldridge and Audretsch (2011) **Non-significant** Bourelos et al. (2012)	**Non-significant** Bourelos et al. (2012) Wu et al. (2015)	**Positive** Link et al. (2007)	

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

Nevertheless, the literature so far remains uncertain on the impact of scientific productivity. Erikson et al. (2015) explores the effects of scientific productivity on knowledge transfer aspirations and finds only significant and positive validation for university-industry interactions. The authors substantiated this finding, suggesting that the novelty and breakthrough nature of the academics' research makes them feel more confident with its value to the industry. The fact that, after publishing, the knowledge

becomes part of the public domain may justify why the findings lack support in linking scientific publications and the intentions to create a spin-off.

Lastly, several authors' findings are non-significant, to either create a spin-off (Aldridge and Audretsch, 2011; Karlsson and Wigren, 2012), to patent (Halilem et al., 2017) or to collaborate with the industry (Giuliani et al., 2010). Miranda, Chamorro, et al. (2017) findings are mixed; that is, it is positive when the unit of analysis is the research group, but individually the productivity (publications) show no relationship with entrepreneurial intention. Taking all this discrepancy into consideration, this is a research topic requiring further investigation.

Our results identify other variables within the educational background. For instance, academic status tends to have a positive effect, especially on the intentions to work with the industry (D'Este and Patel, 2007; Link et al., 2007; Tartari et al., 2014). Years at the academic institution follow the same pattern found with the academics' age (Bercovitz and Feldman, 2008; Prodan and Drnovsek, 2010). And finally, contracts or grants awarded commonly act as intentions predictors (Aldridge and Audretsch, 2011; Link et al., 2007).

Motivations

The entrepreneurial intention is a consequence of a combination of intrinsic and extrinsic motivations or benefits that the individual expects to gain (Ryan and Deci, 2000). Within our findings, we categorise this motivation into four themes: Career, Personal, Pecuniary and Moral (Table 2.6).

The motivations linked with career promotion are significantly investigated in the literature for the different technology transfer activities (Johnson et al., 2017). The expectation that academic engagement will enhance career success is cited as significantly influencing academics to create spin-offs (Fini et al., 2009; Hayter, 2011), patent (Walter et al., 2018) and collaborate with the industry as well (Tartari et al., 2014). Other authors identify the possibility to advance research (Abreu and Grinevich, 2014; Baldini, 2011) and to learn as drivers of academic entrepreneurial intention (D'Este and Perkmann, 2011; Fini et al., 2009). Llopis et al. (2018) research of 1,295 Spanish scientists' motivations find that the advancement of research positively predicts the involvement of the academic in spin-off creation and patenting. On the contrary, there is

no corroboration of such impact for activities with the industry. In their factor analysis, advancing research comprises three motivations: obtain information or material to develop current research, explore additional research topics, and have access to equipment and infrastructures to perform research. This latter motivation reflects the fact that academics are equally driven by utilitarian reasons (Fini et al., 2009) such as getting tangible resources like equipment, materials or facilities (Baldini, 2011; Ramos-Vielba et al., 2016).

Table 2.6 Tabular summary with the individual motivation's effects, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
INDIVIDUAL				
Motivations				
Career				
Career success	**Positive** Fini et al. (2009) Hayter (2011)	**Positive** Walter et al. (2018)	**Positive** Tartari et al. (2014)	**Positive** Bicknell et al. (2010) Johnson et al. (2017)
Advancing research	**Positive** Llopis et al. (2018)	**Positive** Baldini (2011) Llopis et al. (2018) Walter et al. (2018)	**Non-significant** Llopis et al. (2018)	**Positive** Abreu and Grinevich (2014) **Non-significant** D'Este and Patel (2007)
Affective duty	**Positive** Hayter (2011) Hayter (2015) Huyghe et al. (2016)	**Positive** Baldini (2011)	**Positive** Villasana (2011)	**Positive** Abreu and Grinevich (2014) **Non-significant** D'Este and Patel (2007)
Learning	**Positive** Fini et al. (2009)		**Positive** D'Este and Perkmann (2011)	**Non-significant** Iorio et al. (2017)
Financial resources	**Positive** Fini et al. (2009) Baldini (2011) Hayter (2011) Hayter (2015)	**Positive** Baldini (2011) Bodas Freitas and Nuvolari (2012) Halilem et al. (2017) Walter et al. (2018)	**Positive** D'Este and Perkmann (2011) Tartari and Breschi (2012) Ankrah et al. (2013) Ramos-Vielba et al. (2016) Bodas Freitas and Verspagen (2017) Llopis et al. (2018)	**Positive** Holley and Watson (2017) Iorio et al. (2017) **Non-significant** Abreu and Grinevich (2014)
Tangible resources	**Positive** Fini et al. (2009)	**Positive** Baldini (2011)	**Positive** D'Este and Perkmann (2011) Ramos-Vielba et al. (2016)	
Academic recognition	**Positive** Fini et al. (2009) Goethner et al. (2012) Lam (2011)	**Positive** Göktepe-Hulten and Mahagaonkar (2010) Baldini (2011)		**Positive** Bicknell et al. (2010) (Foo et al., 2016)

	Hesse and Brünjes (2018)	Lam (2011) Bodas Freitas and Nuvolari (2012)		
Peer pressure	**Positive** Hayter (2011) Obschonka et al. (2015) **Mixed** Brettel et al. (2013)	**Positive** Bercovitz and Feldman (2008) **Mixed** Brettel et al. (2013)	**Positive** Tartari et al. (2014)	**Mixed** Johnson et al. (2017)
Personal				
Risk-taking propensity	**Positive** Fini and Toschi (2016) Zollo et al. (2017) Zahari et al. (2018)			
Joy and challenge	**Positive** Morales-Gualdrón et al. (2009) Lam (2011) Zahari et al. (2018)	**Positive** Lam (2011)		**Positive** Bicknell et al. (2010)
Curiosity	**Positive** Hayter (2011) Hayter (2015) Huyghe et al. (2016) Foo et al. (2016)			**Positive** Bicknell et al. (2010)
Seizing an opportunity	**Positive** Clarysse et al. (2011) Hayter (2015) (Miranda, Chamorro, et al., 2017) García-Rodríguez et al. (2017) **Non-significant** Morales-Gualdrón et al. (2009)		**Positive** Bodas Freitas and Verspagen (2017)	
Pecuniary				
Personal income	**Positive** D'Este and Perkmann (2011) Hayter (2011) **Mixed** Lam (2011) Goethner et al. (2012) **Non-significant** Morales-Gualdrón et al. (2009) Hayter (2015)	**Positive** Göktepe-Hulten and Mahagaonkar (2010) D'Este and Perkmann (2011) Baldini (2011) Walter et al. (2018)	**Positive** D'Este and Perkmann (2011) Ramos-Vielba et al. (2016) Llopis et al. (2018)	**Non-significant** Abreu and Grinevich (2014)
Moral				
Moral duty	**Positive** Hayter (2011)		**Positive** Villasana (2011) Ankrah et al. (2013) Ramos-Vielba et al. (2016)	**Positive** Iorio et al. (2017)

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting, and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

Access to funding, for the university and research, is the reason most frequently described stimulus for entrepreneurial intentions (Ankrah et al., 2013; Bodas Freitas and Verspagen, 2017). Hayter's (2011) research of a sample of academic spin-offs with formal intellectual property agreements, confirms that academics often consider spin-offs to be a platform that provides access to fund research. Later, the same author reconfirms the results. Academics are primarily motivated to use the spin-off to apply for awards, industry research contracts or consulting (Hayter, 2015). This result is in line with the work of Walter et al. (2018). The authors propose a triad of incentives to patenting – 'gold', 'grace' and 'glory' - and demonstrate that 'gold' (direct and indirect financial benefits) account for roughly two-thirds of the total impact. Similarly, a study of academic engagement intentions in Australia highlights that all individuals interviewed mentioned funding needs as the primary driver to commercialise research (Holley and Watson, 2017).

To conclude the career-related motivations, this study also identifies the academics' affective duty (Huyghe and Knockaert, 2015), academic and social recognition (Goethner et al., 2012) and peer pressure (Obschonka et al., 2015) as entrepreneurial intention drivers. The affective sense of duty is cited as the opportunity to find job placements for their students and material for teaching (Abreu and Grinevich, 2014). It can also be expressed as learning opportunities from real-life cases (Villasana, 2011) or as an organisational commitment (Huyghe et al., 2016). Furthermore, academics with high academic and social recognition expectations are more likely to patent (Göktepe-Hulten and Mahagaonkar, 2010) or create a spin-off (Hesse and Brünjes, 2018). The incentives and strategies of universities should consider these academics as they are especially interested in engaging in entrepreneurial activities (Foo et al., 2016; Johnson et al., 2017).

Concerning personal motivations, the results show that the literature proves their importance, particularly the academics' risk-taking propensity (Zahari et al., 2018; Zollo et al., 2017), challenge (Morales-Gualdrón et al., 2009), curiosity (Huyghe et al., 2016), and seizing an opportunity (Miranda, Chamorro-Mera, et al., 2017), on different knowledge valorisation activities. Though some authors recognise the importance of personal motivations on patents and industry collaboration intentions (Bicknell et al.,

2010; Bodas Freitas and Verspagen, 2017; Lam, 2011), the literature focuses on its impact on spin-off intention. Future work is needed to explore this topic.

It has been shown that for the academics' spin-offs, the impact of entrepreneurial risk-taking propensity largely influences entrepreneurial intention (Zollo et al., 2017). It becomes substantially stronger when compared to the non-academic start-up (Fini and Toschi, 2016). Along the same lines, Lam's (2011) research from five major UK universities suggests that there are other motivations besides 'gold' (personal income) and 'ribbon' (career reputation) and highlights the more decisive role of 'puzzle' (knowledge application and curiosity) to commercialise science.

Lastly, in knowledge contexts like the university, academics who excel in their research are more likely to identify breakthrough opportunities (Erikson et al., 2015). They are more skilled to identify market niches and adapt their discoveries accordingly (Fernández-Pérez et al., 2014). These academics are also more likely to enhance their opportunity beliefs, a key driver in the entrepreneurial process (Bergmann et al., 2018; Miranda, Chamorro-Mera, et al., 2017). A large-scale panel of UK academics from diverse scientific disciplines shows that "the opportunity recognition capacity of an academic is by far the most important variable to predict whether an academic will get involved in entrepreneurial activities or not" (Clarysse et al., 2011, p. 1092).

Access to personal income is often claimed to impact intentions, but its impact may have a lower significance in comparison to other variables (Baldini, 2011; Hayter, 2015) or it varies as a function of the knowledge transfer activity. D'Este and Perkmann's (2011) questionnaire to researchers in the physical and engineering sciences demonstrates that personal payoffs primarily push the intentions to patenting and spin-off creation. Conversely, it assumes a lower significance for the intentions to cooperate through joint research and contract research with the industry. Likewise, research groups within the Spanish context report that their motivations to work with the industry are expanding networks and access equipment, address socio-economic needs, and access personal and group financial benefits (Ramos-Vielba et al., 2016). Despite this, the literature also demonstrates that, to some academics, financial gain does not motivate them to create a spin-off (Morales-Gualdrón et al., 2009). Even if interested in financial rewards, it is embraced as a payoff for the time they spend away from their academic activity.

The fourth and final group of motivations outlined in this literature review is moral duty. The academics may feel that their research output should have a social impact on public service (Ankrah et al., 2013; Villasana, 2011). Iorio et al. (2017) emphasise that academics' social motivation to make a difference for society predicts their engagement in academics' entrepreneurship activities.

Social Capital

Social capital comprises the academics' social networks to individuals, organisations and groups providing them with information, recommendations, resources, and support (Prodan and Drnovsek, 2010). Networks positively increase the researcher's propensity to become a spin-off entrepreneur (Aldridge and Audretsch, 2011) and to patent (Wu et al., 2015). Specifically, Fernández-Pérez et al. (2015) research on the influence of social networks on academic entrepreneurial intentions finds support for all three variables under study: professional networks, personal networks and mentors. Karlsson and Wigren (2012) empirically prove that cooperation with industry networks have a direct effect on entrepreneurial intention. They advocate that the best academics are those that can exploit benefits from their professional networks. Another study in Sweden produces mixed results. Doctoral students from Linköping University recognise the impact of information received from the business social network, however only for a supervisor or department level, stressing that the university is not homogenous (Bienkowska et al., 2016). In this respect, Trivedi (2016) recommends that the university create a strong network of alumni entrepreneurs, technical and business experts, and mentors, and match them with students.

Finally, in the same vein as professional networks, personal networks and family environment can encourage academics to have higher entrepreneurial intentions (Foo et al., 2016; Tartari and Breschi, 2012) (see Table 2.7).

Human Capital

In addition to social capital, the economic perspective considers human capital as directly effecting intentions (Goethner et al., 2012). Within the findings, human capital is constructed by the academics' knowledge and skills acquired through prior

entrepreneurial and industrial experience, prior patenting experience, entrepreneurial abilities, and entrepreneurial education. Previous entrepreneurial and industrial experience is found to have a positive impact on all knowledge valorisation intentions (Abreu and Grinevich, 2013). Recently, Gulbrandsen and Thune's (2017) survey of 4,400 Norwegian academics reveals that non-academic work experience has a positive effect on venture creation, patenting and licensing, and external collaboration intention.

Table 2.7 Tabular summary with the individual social capital effects, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
INDIVIDUAL				
Social Capital				
Professional networks	**Positive** Aldridge and Audretsch (2011) Goethner et al. (2012) Karlsson and Wigren (2012) Fernández-Pérez et al. (2014) Fernández-Pérez et al. (2015) **Non-significant** Prodan and Drnovsek (2010)	**Positive** Wu et al. (2015)		
Personal networks	**Positive** Fernández-Pérez et al. (2015) **Mixed** Fernández-Pérez et al. (2014)		**Positive** Tartari and Breschi (2012)	
Business social networks	**Positive** Goethner et al. (2012) Fernández-Pérez et al. (2015)		**Positive** Ankrah et al. (2013)	**Mixed** Bienkowska et al. (2016)

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

With a focus exclusively on the intentions of creating spin-offs, studies by Obschonka et al. (2015), Bergmann (2017) and Miranda, Chamorro-Mera, et al. (2017) corroborate the fundamental role played by past entrepreneurial behaviour. Notwithstanding, Erikson et al. (2015, p.271) observe that intentions "among scientists differ according to the levels and types of previous experience." Their results show a positive relationship between prior entrepreneurial experience and intentions to create a spin-off, as well as between prior patenting experience and the intention to patent again. However, their findings do not support the assumption that prior industrial work has an effect on future external collaboration intentions.

To conclude, the lack of entrepreneurial skills pulls academics not to exploit all of their opportunities (Guerrero and Urbano, 2014). Hence, due to their capacity to

transform attitudes, researchers with diverse entrepreneurial abilities (Miranda, Chamorro, et al., 2017; Moog et al., 2015) and entrepreneurial education (García-Rodríguez et al., 2017; Passaro et al., 2018) have higher entrepreneurial intentions.

Other individual factors emerge from the literature review, yet due to their low representativity, this research does not include them on the table of entrepreneurial intentions (Table 2.8). For example, there are times when academics are pushed to engage in knowledge valorisation activities because they have funding constraints (Rizzo, 2015) or government pressure (Ankrah et al., 2013). Some wish to retain their research autonomy by ensuring a cross-fertilisation between the academy and industry collaboration (Pablo D'Este and Perkmann, 2011), or they simply want their invention protected (Bodas Freitas and Nuvolari, 2012; Tartari and Breschi, 2012).

Table 2.8 Tabular summary with the individual human capital effects, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
INDIVIDUAL				
Human Capital				
Entrepreneurial and industrial experience	**Positive** Clarysse et al. (2011) Goethner et al. (2012) Karlsson and Wigren (2012) Erikson et al. (2015) Obschonka et al. (2015) (Miranda, Chamorro, et al., 2017) Gulbrandsen and Thune (2017) **Mixed** Bergmann (2017)	**Positive** Gulbrandsen and Thune (2017)	**Positive** D'Este and Patel (2007); Gulbrandsen and Thune (2017) **Non-significant** Erikson et al. (2015)	**Positive** Abreu and Grinevich (2013) (Gulbrandsen and Thune, 2017)
Patenting experience	**Positive** Prodan and Drnovsek (2010) Goethner et al. (2012)	**Positive** Erikson et al. (2015)		
Entrepreneurial abilities	**Positive** Moog et al. (2015) Miranda et al. (2017)			
Entrepreneurial education	**Positive** García-Rodríguez et al. (2017) **Mixed** Bergmann (2017) Passaro et al. (2018)			

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

Organisational and Institutional

The literature claims that the activities of an entrepreneurial university are a function of individual, organisational and institutional factors and that the latter two influence the former (Perkmann et al., 2013).

Under the organisational factor, we note the influence exerted by two variables: technology transfer office (TTO) support and courses, and university and department policies (Table 2.9). The Brettel et al. (2013) survey to scientists from nine technical universities in Germany, reports that a well-running TTO is imperative not only to stimulate academics to patent their knowledge but also to create spin-offs. A similar effect is detected in the research by Bourelos et al. (2012). The researchers not only confirm that the use of TTO has a positive effect but so do the courses in entrepreneurship and commercialisation fields. This view is contested by other studies that argue that academics perceive TTO as irrelevant (Clarysse et al., 2011; Fini et al., 2009). Others even find mixed results. TTO has a positive impact as a cost-saving practice, but there is no support for TTO effectiveness (Wu et al., 2015).

Regarding department and university policies that promote research commercialisation, they should be oriented to a wide variety of activities (Bercovitz and Feldman, 2008) and adapted to the individual intention's predictors (Lam, 2011). A favourable regulatory environment is identified through a national survey of Italian students and professors as impacting the intentions to collaborate with the industry, particularly in research and development contracts. Furthermore, although the topic of rewards is developed more in-depth in the individual motivation section, the entrepreneurial university can exploit its knowledge when allocating monetary rewards (Francis-Smythe, 2008; Huyghe and Knockaert, 2015) and other rewards to the academics, such as access to university laboratories, scientific facilities and academic incubators (Muscio et al., 2016). To sum up, as demonstrated in the in-depth study of 62 Italian universities, the academic commercial output is more significant for those universities that design a clear strategy (Muscio et al., 2016).

The contextual characteristics may have different impacts depending on academics' backgrounds (Bergmann et al., 2018). If there is a perception of a positive environment, it can be a strong supporter of commercial activity (Trivedi, 2016) and participation in research contracts with industry (Escobar et al., 2017).

The institutional level exerts influence on activities and performances at the organisational level and, subsequently, at the individual level. The academics' degree of engagement and activities choice varies according to the scientific discipline, namely the type of research, from basic research to applied research, and research discipline, either life and medicine science, engineering, technology and computer science; or economics, law and social science (Huyghe and Knockaert, 2015). Within our sample, to empirically study the university settings, the literature frequently used institutional variables as control variables (Brettel et al., 2013; Goethner et al., 2012; Guerrero and Urbano, 2014; Moog et al., 2015; Ramos-Vielba et al., 2016). The evidence is that some scientific disciplines have been shown to influence academics' propensity towards entrepreneurship. Academics from applied research are more active in research collaboration and commercialization, especially those from engineering (Iorio et al., 2017) than their colleagues from other disciplines. Gulbrandsen and Thune (2017) came to a similar conclusion, from the analysis of 4400 survey results from Norwegian universities, the authors conclude that those academics in applied research are more influenced to create a spin-off, patent their research or to collaborate with the industry. The justification may lie in the expected outcome of the research, that is whether the research is more science-based or more market-oriented. It is known that some basic disciplines (mathematics, chemistry, and physics) are less requested by industry (Tartari and Salter, 2015) but more likely to disclose (Bercovitz and Feldman, 2008).

Table 2.9 Tabular summary with the organisational and institutional effects, by knowledge valorisation activity

	Knowledge valorisation activities			
Economic Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
ORGANISATIONAL				
Support				
TTO support and courses	**Positive** Bourelos et al. (2012) Brettel et al. (2013) **Non-significant** Fini et al. (2009) Clarysse et al. (2011)	**Positive** Bercovitz and Feldman (2008) Bourelos et al. (2012) Brettel et al. (2013) **Mixed** Wu et al. (2015)	**Negative** Escobar et al. (2017)	
University and department policies	**Positive** Guerrero and Urbano (2014) Huyghe and Knockaert (2015)	**Positive** Erikson et al. (2015) Huyghe and Knockaert (2015)	**Positive** Erikson et al. (2015) Escobar et al. (2017) **Negative**	**Positive** Francis-Smythe (2008) Holley and Watson (2017)

	Negative Erikson et al. (2015) **Mixed** Muscio et al. (2016) **Non-significant** Zahari et al. (2018)		Huyghe and Knockaert (2015)	
Quality				
University and department quality	**Positive** Miranda et al. (2017)	**Positive** Bercovitz and Feldman (2008)		
Climate				
Institution characteristics and environment	**Positive** Nelson (2014) Moog et al. (2015) Muscio et al. (2016) Trivedi (2016) **Negative** Fini et al. (2009) **Mixed** Bergmann et al. (2018) **Non-significant** Miranda et al. (2017) Zollo et al. (2017)		**Positive** Escobar et al. (2017)	**Positive** Huyghe and Knockaert (2015)
INSTITUTIONAL				
Scientific discipline				
Research type	**Positive** Clarysse et al. (2011) Fini and Toschi (2016) Gulbrandsen and Thune (2017)	**Positive** Gulbrandsen and Thune (2017)	**Positive** Villasana (2011) Ankrah et al. (2013) Gulbrandsen and Thune (2017)	**Positive** Abreu and Grinevich (2013) Iorio et al. (2017)
Research discipline	**Positive** Prodan and Drnovsek (2010) **Negative** Boardman and Ponomariov (2009)		**Positive** Boardman and Ponomariov (2009) Tartari and Breschi (2012) Abreu and Grinevich (2013)	

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

Psychological Variables

Theory of Planned Behaviour

TPB is a widespread model used to analyse entrepreneurial intention and claims that intention can be predicted from attitudes toward behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). Personal attitude refers to the intensity in which a person has a favourable or unfavourable evaluation of a given behaviour. Subjective norms refer to the perceived social influence to engage or not to engage in a specific behaviour. Lastly, the degree of perceived behavioural control, also referred to

as self-efficacy, refers to the perceived ease or difficulty of performing the behaviour, and it is assumed to reflect experience as well as anticipated impediments and obstacles. This review notices that the literature predominantly focuses on academic spin-off creation intentions. Obschonka et al. (2012) and Obschonka et al. (2015) find positive support of all three variables on spin-off intentions and Brettel et al. (2013) on patenting intentions. Other studies only find an influence regarding personal attitude and perceived behavioural control, and not on subjective norms (Fernández-Pérez et al., 2014, 2015; Trivedi, 2016) (see Table 2.10).

Table 2.10 Tabular summary with the Theory of Planned Behaviour effects, by knowledge valorisation activity

	Knowledge valorisation activities			
Psychological Variable	**Spin-off creation**	**Patent and Licensing**	**Industry collaboration**	**Academic Entrepreneurship**
Theory of Planned Behaviour				
Personal Attitude	**Positive** Obschonka et al. (2012) Fernández-Pérez et al. (2015) Trivedi (2016) Zollo et al. (2017) Fernández-Pérez et al. (2014) García-Rodríguez et al. (2017) Obschonka et al. (2015)	**Positive** Brettel et al. (2013) Wu et al. (2015)		
Subjective Norms	**Positive** Obschonka et al. (2012) Obschonka et al. (2015)	**Positive** Brettel et al. (2013)		
Perceived Behavioural Control	**Positive** Prodan and Drnovsek (2010) Obschonka et al. (2012) Guerrero and Urbano (2014) Huyghe et al. (2016) Fernández-Pérez et al. (2015) Trivedi (2016) Fernández-Pérez et al. (2014) Zahari et al. (2018) Obschonka et al. (2015)	**Positive** Brettel et al. (2013)		

Note: Academic entrepreneurship refers to the combination of the three activities: spin-off creation, patenting and industry collaboration. Those papers that explored the academic entrepreneurship as a whole were included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column.

2.4 Conclusions and future research avenues

The commercialisation of knowledge is a complex process (Wright and Phan, 2018) as it requires the management of several actors, mechanisms, in a dynamic system. In this process, one of the critical challenges face by university managers is the ability to influence academics attitudes (Dabic et al., 2015), and align or adapt them to the university strategic interest (Sandström et al., 2018). In other words, to become successful, university management decisions demands an informed and strategic effort on academics' intentions (Brescia et al., 2016). Through a rigorous methodology and analysis, the research identifies and clusters the individual, organisational and institutional factors that impact academics to engage in knowledge valorisation activities. Following suggestions to include social capital (Fini and Toschi, 2016) and human capital (Moog et al., 2015) as determinants of entrepreneurship, this study's conceptual model is more robust. While the focus of the papers under review was an in-depth analysis of a selected group of factors, this systematic literature review sought to compile the factors that were identified and therefore provide a broader picture of all those factors to be considered by the university management. The study, after collecting all the drivers, compiled the different terminologies used for the same driver and therefore displayed the bundled group of variables impacting academics' intention. Although outside the scope of this investigation, it would be interesting for future research to enhance this list with measurable items and validate a scale. For the practitioners, this list can be used by university managers, TTOs and department managers, and policymakers to guide questionnaires or interviews to analyse their academics' intentions and adequately support its academic engagement strategy.

Secondly, this investigation has confirmed that the creation of spin-offs, patents and collaboration with industry are a consequence of scholars engagement who, in turn, are influenced by the organisational and institutional structure. These findings deduce that the university partially controls its outcomes. For the university managers, this indicates that they can adopt different organisational mechanisms and supports depending on the goal they are pursuing (Bercovitz et al., 2001; Markman, Gianiodis, et al., 2005; Markman, Phan, et al., 2005).

Lastly, the review acknowledges that there are various drivers of academic intentions, and there is no single combination that will lead to the same outcome.

Meaning, even when the same drivers are analysed, the impacts on intentions are often distinct or even opposite. Everything considered the study concludes that the drivers behind the intentions are multiple, context-dependent, hierarchy-dependent, heterogeneous and, at the same time, dependent on each other and against each other.

From the findings in this study, there is a lack of coherence in the literature, and it is worth studying whether, as age increases, academics' intentions also increase. The authors believe that studying age together with networks, scientific productivity and entrepreneurial experience may offer clarifications on age behaviour. Secondly, further clarification is also required regarding the concept of scientific productivity. The literature empirically demonstrates positive, negative and mixed outcomes. It would be interesting to devote some research within different contexts to understand if the academics who excel in scientific domains are also the most entrepreneurial. This factor is indirectly linked with academics' personal attitude and perceived behavioural control. Lastly, the research subject on academic entrepreneurship could benefit from a deeper understanding of the effects of moral motivations, either the moral duty to society, welfare, well-being or community, in intentions.

This systematic review provides a background to pinpoint gaps in current literature, from 2015 onwards, and to suggest worthwhile avenues for future research. Individual variables remain an emerging topic. The cultural factor is stressed by Huyghe and Knockaert (2015, p.155) as future research to explore: 'How to make research scientists optimally aware of the organizational culture to direct their behaviour towards entrepreneurial activities?;' and 'How can the culture and climate be promoted within the research group, department, and/or university?'. Bergmann et al. (2018) suggest the long-term effects of entrepreneurial climate as a worthwhile research avenue. Other authors indicate considering the time-factor (García-Rodríguez et al., 2017) to follow how over time intentions are transformed into new technology, new products and also into new markets (Erikson et al., 2015). Future research should focus on longitudinal studies, to outline the course from being an academic to becoming an entrepreneur academic (Hesse and Brünjes, 2018). As well as to follow them over time from the moment they have an intention to the moment they take action and engage in entrepreneurial activities (Bergmann, 2017; Kirchberger and Pohl, 2016).

Regarding the organisational variables, future research could explore the impact of department/university regulation in entrepreneurial intentions, and how they distinguish themselves among different entrepreneurial activities (Muscio et al., 2016) or among academics from different scientific disciplines (Trivedi, 2016). Lastly, Balven et al. (2018, p.32) call for studies that clarify how academic departments actively build entrepreneurial identities among faculty members. Given that organisational variables have an impact on individual variables, it is suggested that research should take a multi-level analysis (Foo et al., 2016) and assess which individual-level and organisational-level determinants reinforce each other (Huyghe and Knockaert, 2015).

References

Abreu, M. and Grinevich, V. (2013), "The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities", *Research Policy*, Vol. 42 No. 2, pp. 408–422.

Abreu, M. and Grinevich, V. (2014), "Academic entrepreneurship in the creative arts", *Environment and Planning C: Government and Policy*, Vol. 32 No. 3, pp. 451–470.

Ajzen, I. (1991), "The Theory of Planned Behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50, pp. 179–211.

Al-Tabbaa, O. and Ankrah, S. (2019), "'Engineered' University-Industry Collaboration: A Social Capital Perspective", *European Management Review*, Vol. 16 No. 3, pp. 543–565.

Aldridge, T.T. and Audretsch, D. (2011), "The Bayh-Dole act and scientist entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1058–1068.

Ankrah, S. and Al-Tabbaa, O. (2015), "Universities-industry collaboration: A systematic review", *Scandinavian Journal of Management*, Vol. 31 No. 3, pp. 387–408.

Ankrah, S.N., Burgess, T.F., Grimshaw, P. and Shaw, N.E. (2013), "Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit", *Technovation*, Vol. 33 No. 2–3, pp. 50–65.

Antonioli, D., Nicolli, F., Ramaciotti, L. and Rizzo, U. (2016), "The Effect of Intrinsic and Extrinsic Motivations on Academics' Entrepreneurial Intention", *Administrative Sciences*, Vol. 6 No. 4, p. 15.

Audretsch, D.B. (2014), "From the entrepreneurial university to the university for the entrepreneurial society", *Journal of Technology Transfer*, Vol. 39 No. 3, pp. 313–321.

Baldini, N. (2011), "University patenting: Patterns of faculty motivations", *Technology Analysis and Strategic Management*, Vol. 23 No. 2, pp. 103–121.

Baldini, N., Grimaldi, R. and Sobrero, M. (2007), "To patent or not to patent? A survey of Italian inventors on motivations, incentives, and obstacles to university patenting", *Scientometrics*, Vol. 70 No. 2, pp. 333–354.

Balven, R., Fenters, V., Siegel, D.S. and Waldman, D. (2018), "Academic Entrepreneurship : the roles of identity, motivation, championing, education, work-life balance, and organizational justice", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 21–42.

Belitski, M. and Heron, K. (2017), "Expanding entrepreneurship education ecosystems", *Journal of Management Development*, Vol. 36 No. 2, pp. 163–177.

Benneworth, P. and Charles, D. (2005), "University spin-off policies and economic development in less successful regions: Learning from two decades of policy practice", *European Planning Studies*, Vol. 13 No. 4, pp. 537–557.

Bercovitz, J., Feldman, M., Feller, I. and Burton, R. (2001), "Organizational Structure as a Determinant of Academic Patent and Licensing Behavior: An Exploratory Study of Duke, Johns Hopkins, and Pennsylvania State Universities", *Journal of Technology Transfer*, Vol. 26 No. 1/2, pp. 21–35.

Bercovitz, J. and Feldman, M.P. (2008), "Academic Entrepreneurs: Organizational Change at the Individual Level", *Organization Science*, Vol. 19 No. 1, pp. 69–89.

Berggren, E. (2017), "Researchers as enablers of commercialization at an entrepreneurial university", *Journal of Management Development*, Vol. 36 No. 2, pp. 217–232.

Bergmann, H. (2017), "The formation of opportunity beliefs among university entrepreneurs: an empirical study of research- and non-research-driven venture ideas", *Journal of Technology Transfer*, Vol. 42 No. 1, pp. 116–140.

Bergmann, H., Geissler, M., Hundt, C. and Grave, B. (2018), "The climate for entrepreneurship at higher education institutions", *Research Policy*, Vol. 47 No. 4, pp. 700–716.

Bicknell, A., Francis-Smythe, J. and Arthur, J. (2010), "Knowledge transfer: de-constructing the entrepreneurial academic", *International Journal of Entrepreneurial Behavior & Research*, Vol. 16 No. 6, pp. 485–501.

Bienkowska, D., Klofsten, M. and Rasmussen, E. (2016), "PhD Students in the Entrepreneurial University - Perceived Support for Academic Entrepreneurship", *European Journal of Education*, Vol. 51 No. 1, pp. 56–72.

Bird, B. (1988), "Implementing Entrepreneurial Ideas: The Case for Intention", *Academy of Management Review*, Vol. 13 No. 3, pp. 442–453.

Boardman, P.C. (2009), "Government centrality to university-industry interactions: University research centers and the industry involvement of academic researchers", *Research Policy*, Vol. 38 No. 10, pp. 1505–1516.

Boardman, P.C. and Ponomariov, B.L. (2009), "University researchers working with private companies", *Technovation*, Vol. 29 No. 2, pp. 142–153.

Bodas Freitas, I.M. and Nuvolari, A. (2012), "Traditional Versus Heterodox Motives for Academic Patenting: Evidence from the Netherlands", *Industry and Innovation*, Vol. 19 No. 8, pp. 671–695.

Bodas Freitas, I.M. and Verspagen, B. (2017), "The motivations, institutions and organization of university-industry collaborations in the Netherlands", Journal of Evolutionary Economics, *Journal of Evolutionary Economics*, Vol. 27 No. 3, pp. 379–412.

Bourelos, E., Magnusson, M. and Mckelvey, M. (2012), "Investigating the complexity facing academic entrepreneurs in science and engineering: The complementarities of research performance, networks and support structures in commercialisation", *Cambridge Journal of Economics*, Vol. 36 No. 3, pp. 751–780.

Boyd, N.G. and Vozikis, G.S. (1994), "The Influence of Self-Efficacy on the Development of Entrepreneurial Intentions and Actions", *Entrepreneurship Theory and Practice*, Vol. 18 No. 4, pp. 63–77.

Brescia, F., Colombo, G. and Landoni, P. (2016), "Organizational structures of Knowledge Transfer Offices: an analysis of the world's top-ranked universities", *Journal of Technology Transfer*, Vol. 41 No. 1, pp. 132–151.

Brettel, M., Mauer, R. and Walter, T. (2013), "High-profile employees at universities and their intentions of commercializing research results", *Journal of Business Economics*, Vol. 83 No. 4, pp. 357–382.

Cantner, U., Goethner, M. and Silbereisen, R.K. (2017), "Schumpeter's entrepreneur - A rare case", Journal of Evolutionary Economics, *Journal of Evolutionary Economics*, Vol. 27 No. 1, pp. 187–214.

Carland, J., Hoy, F. and Carland, J.A. (1988), "'Who is an Entrepreneur?' Is a Question Worth Asking", *American Journal of Small Business*, Vol. 12 No. 4, pp. 33–40.

Clark, B.R. (1998), "The entrepreneurial university: Demand and response", *Tertiary Education and Management*, Vol. 4 No. 1, pp. 5–16.

Clarysse, B., Tartari, V. and Salter, A. (2011), "The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1084–1093.

Clauss, T., Kesting, T., Miller, K. and Meerman, A. (2018), "Editorial: Quo vadis entrepreneurial university? The need for multi-levels of analysis", *International Journal of Technology Management*, Vol. 77 No. 1/2, pp. 1–9.

Coviello, N.E. and Jones, M. V. (2004), "Methodological issues in international entrepreneurship research", *Journal of Business Venturing*, Vol. 19 No. 4, pp. 485–508.

D'Este, P. and Patel, P. (2007), "University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?", *Research Policy*, Vol. 36 No. 9, pp. 1295–1313.

D'Este, P. and Perkmann, M. (2011), "Why do academics engage with industry? The entrepreneurial university and individual motivations", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 316–339.

Dabic, M., González-Loureiro, M. and Daim, T.U. (2015), "Unraveling the attitudes on entrepreneurial universities: The case of Croatian and Spanish universities", *Technology in Society*, Vol. 42, pp. 167–178.

Damsgaard, E.F. and Thursby, M.C. (2013), "University entrepreneurship and professor privilege", *Industrial and Corporate Change*, Vol. 22 No. 1, pp. 183–218.

Davey, T. (2017), "Converting university knowledge into value. How conceptual frameworks contribute to the understanding of the third mission role of European universities", *International Journal of Technology Transfer and Commercialisation*, Vol. 15 No. 1, pp. 65–96.

Djokovic, D. and Souitaris, V. (2008), "Spinouts from academic institutions: A literature review with suggestions for further research", *Journal of Technology Transfer*, Vol. 33 No. 3, pp. 225–247.

Erikson, T., Knockaert, M. and Foo, M. Der. (2015), "Enterprising scientists: The shaping role of norms, experience and scientific productivity", *Technological Forecasting and Social Change*, Elsevier B.V., Vol. 99, pp. 211–221.

Escobar, E.S.O., Berbegal-Mirabent, J., Alegre, I. and Velasco, O.G.D. (2017), "Researchers' willingness to engage in knowledge and technology transfer activities: an exploration of the underlying motivations", *R and D Management*, Vol. 47 No. 5, pp. 715–726.

Etzkowitz, H. (1983), "Entrepreneurial scientists and entrepreneurial universities in American academic science", *Minerva*, Vol. 21 No. 2–3, pp. 198–233.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000), "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, Vol. 29 No. 2, pp. 313–330.

Fernández-Pérez, V., Alonso-Galicia, P.E., Fuentes-Fuentes, M.D.M. and Rodriguez-Ariza, L. (2014), "Business social networks and academics' entrepreneurial intentions", *Industrial Management and Data Systems*, Vol. 114 No. 2, pp. 292–320.

Fernández-Pérez, V., Alonso-Galicia, P.E., Rodríquez-Ariza, L. and Fuentes-Fuentes, M. del M. (2015), "Professional and personal social networks: A bridge to entrepreneurship for academics?", *European Management Journal*, Vol. 33 No. 1, pp. 37–47.

Fini, R., Grimaldi, R. and Sobrero, M. (2009), "Factors fostering academics to start up new ventures: An assessment of Italian founders' incentives", *Journal of Technology Transfer*, Vol. 34 No. 4, pp. 380–402.

Fini, R. and Toschi, L. (2016), "Academic logic and corporate entrepreneurial intentions: A study of the interaction between cognitive and institutional factors in new firms", *International Small Business Journal: Researching Entrepreneurship*, Vol. 34 No. 5, pp. 637–659.

Foo, M. Der, Knockaert, M., Chan, E.T. and Erikson, T. (2016), "The Individual Environment Nexus: Impact of Promotion Focus and the Environment on Academic Scientists' Entrepreneurial Intentions", *IEEE Transactions on Engineering Management*, Vol. 63 No. 2, pp. 213–222.

Francis-Smythe, J. (2008), "Enhancing academic engagement in knowledge transfer activity in the UK", *Perspectives: Policy and Practice in Higher Education*, Vol. 12 No. 3, pp. 68–72.

Galvão, A., Ferreira, J.J. and Marques, C.S. (2018), "Entrepreneurship education and training as facilitators of regional development: A systematic literature review", *Journal of Small Business and Enterprise Development*, Vol. 25 No. 1, pp. 17–40.

García-Rodríguez, F.J., Gil-Soto, E., Ruiz-Rosa, I. and Gutiérrez-Taño, D. (2017), "Entrepreneurial process in peripheral regions: the role of motivation and culture", *European Planning Studies*, Vol. 25 No. 11, pp. 2037–2056.

Gerbin, A. and Drnovsek, M. (2016), "Determinants and public policy implications of academic-industry knowledge transfer in life sciences: a review and a conceptual framework", *Journal of Technology Transfer*, Vol. 41 No. 5, pp. 979–1076.

Giuliani, E., Morrison, A., Pietrobelli, C. and Rabellotti, R. (2010), "Who are the researchers that are collaborating with industry? An analysis of the wine sectors in Chile, South Africa and Italy", *Research Policy*, Vol. 39 No. 6, pp. 748–761.

Goethner, M., Obschonka, M., Silbereisen, R.K. and Cantner, U. (2012), "Scientists' transition to academic entrepreneurship: Economic and psychological determinants", *Journal of Economic Psychology*, Vol. 33 No. 3, pp. 628–641.

Göktepe-Hulten, D. and Mahagaonkar, P. (2010), "Inventing and patenting activities of scientists: In the expectation of money or reputation?", *Journal of Technology Transfer*, Vol. 35 No. 4, pp. 401–423.

Guerrero, M., Kirby, D. and Urbano, D. (2006), A Literature Review on Entrepreneurial Universities: An Institutional Approach. Working Paper Series 06/8, Business Economics Department, University of Barcelona.

Guerrero, M. and Urbano, D. (2012), "The development of an entrepreneurial university", *Journal of Technology Transfer*, Vol. 37 No. 1, pp. 43–74.

Guerrero, M. and Urbano, D. (2014), "Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 43 No. 1, pp. 57–74.

Gulbrandsen, M. and Thune, T. (2017), "The effects of non-academic work experience on external interaction and research performance", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 795–813.

Halilem, N., Amara, N., Olmos-Peñuela, J. and Mohiuddin, M. (2017), "'To Own, or not to Own?' A multilevel analysis of intellectual property right policies' on academic entrepreneurship", *Research Policy*, Vol. 46 No. 8, pp. 1479–1489.

Hayter, C.S. (2011), "In search of the profit-maximizing actor: Motivations and definitions of success from nascent academic entrepreneurs", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 340–352.

Hayter, C.S. (2015), "Public or private entrepreneurship? Revisiting motivations and definitions of success among academic entrepreneurs", *Journal of Technology Transfer*, Vol. 40 No. 6, pp. 1003–1015.

Hayter, C.S., Nelson, A.J., Zayed, S. and O'Connor, A.C. (2018), "Conceptualizing academic entrepreneurship ecosystems: a review, analysis and extension of the literature", *Journal of Technology Transfer*, Vol. 43 No. 4, pp. 1039–1082.

Hesse, N. and Brünjes, J. (2018), "How entrepreneurial are students who intend to become academics? – A study of career motives", *Review of Regional Research*, Vol. 38 No. 1, pp. 27–52.

Holley, A.C. and Watson, J. (2017), "Academic Entrepreneurial Behavior: Birds of more than one feather", *Technovation*, Vol. 64, pp. 50–57.

Huyghe, A. and Knockaert, M. (2015), "The influence of organizational culture and climate on entrepreneurial intentions among research scientists", *Journal of Technology Transfer*, Vol. 40 No. 1, pp. 138–160.

Huyghe, A. and Knockaert, M. (2016), "The Relationship Between University Culture and Climate and Research Scientists' Spin-off Intentions", in Audretsch, D., Lehmann, E.E., Meoli, M. and Vismara, S. (Eds.), *University Evolution, Entrepreneurial Activity and Regional Competitiveness*, 32nd ed., Springer, Cham, pp. 3-.

Huyghe, A., Knockaert, M. and Obschonka, M. (2016), "Unraveling the 'passion orchestra' in academia", *Journal of Business Venturing*, Vol. 31 No. 3, pp. 344–364.

Iorio, R., Labory, S. and Rentocchini, F. (2017), "The importance of pro-social behaviour for the breadth and depth of knowledge transfer activities: An analysis of Italian academic scientists", *Research Policy*, Vol. 46 No. 2, pp. 497–509.

Ivanova, I.A. and Leydesdorff, L. (2014), "Rotational symmetry and the transformation of innovation systems in a Triple Helix of university-industry-government relations", *Technological Forecasting and Social Change*, Vol. 86, pp. 143–156.

Johnson, M., Monsen, E.W. and MacKenzie, N.G. (2017), "Follow the Leader or the Pack? Regulatory Focus and Academic Entrepreneurial Intentions", *Journal of Product Innovation Management*, Vol. 34 No. 2, pp. 181–200.

Karlsson, T. and Wigren, C. (2012), "Start-ups among university employees: The influence of legitimacy, human capital and social capital", *Journal of Technology Transfer*, Vol. 37 No. 3, pp. 297–312.

Kirchberger, M.A. and Pohl, L. (2016), "Technology commercialization: a literature review of success factors and antecedents across different contexts", *Journal of Technology Transfer*, Vol. 41 No. 5, pp. 1077–1112.

Lam, A. (2011), "What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'?", *Research Policy*, Vol. 40 No. 10, pp. 1354–1368.

Lamine, W., Mian, S. and Fayolle, A. (2014), "How do social skills enable nascent entrepreneurs to enact perseverance strategies in the face of challenges? A comparative case study of success and failure", *International Journal of Entrepreneurial Behaviour and Research*, Vol. 20 No. 6, pp. 517–541.

Liñán, F. and Fayolle, A. (2015), "A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda", *International Entrepreneurship and Management Journal*, Vol. 11 No. 4, pp. 907–933.

Link, A.N., Siegel, D.S. and Bozeman, B. (2007), "An empirical analysis of the propensity of academics to engage in informal university technology transfer", *Universities and the Entrepreneurial Ecosystem*, Vol. 16 No. 4, pp. 97–111.

Llopis, O., Sánchez-Barrioluengo, M., Olmos-Peñuela, J. and Castro-Martínez, E. (2018), "Scientists' engagement in knowledge transfer and exchange: individual factors, variety of mechanisms and users", *Science and Public Policy*, Vol. 45 No. March, pp. 790–803.

López, S.F., Astray, B.P., Pazos, D.R. and Calvo, N. (2015), "Are firms interested in collaborating with universities? An open-innovation perspective in countries of the South West European Space", *Service Business*, Vol. 9 No. 4, pp. 637–662.

Lortie, J. and Castogiovanni, G. (2015), "The theory of planned behavior in entrepreneurship research: what we know and future directions", *International Entrepreneurship and Management Journal*, Vol. 11 No. 4, pp. 935–957.

Markman, G.D., Gianiodis, P.T., Phan, P.H. and Balkin, D.B. (2005), "Innovation speed: Transferring university technology to market", *Research Policy*, Vol. 34 No. 7, pp. 1058–1075.

Markman, G.D., Phan, P.H., Balkin, D.B. and Gianiodis, P.T. (2005), "Entrepreneurship and university-based technology transfer", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 241–263.

Markuerkiaga, L., Errasti, N. and Igartua, J.I. (2014), "Success Factors for Managing an Entrepreneurial University: Developing an Integrative Framework", *Industry and Higher Education*, Vol. 28 No. 4, pp. 233–244.

Mian, S., Lamine, W. and Fayolle, A. (2016), "Technology Business Incubation: An overview of the state of knowledge", *Technovation*, Vol. 50–51, pp. 1–12.

Miller, K., Alexander, A., Cunningham, J.A. and Albats, E. (2018), "Entrepreneurial academics and academic entrepreneurs: a systematic literature review", *International Journal of Technology Management*, Vol. 77 No. 1/2/3, pp. 9–36.

Miller, K., McAdam, R., Moffett, S., Alexander, A. and Puthusserry, P. (2016), "Knowledge transfer in university quadruple helix ecosystems: An absorptive capacity perspective", *R&D Management*, Vol. 46 No. 2, pp. 383–399.

Miranda, F.J., Chamorro-Mera, A. and Rubio, S. (2017), "Academic entrepreneurship in Spanish universities: An analysis of the determinants of entrepreneurial intention",

European Research on Management and Business Economics, Vol. 23 No. 2, pp. 113–122.

Miranda, F.J., Chamorro, A. and Rubio, S. (2017), "Determinants of the intention to create a spin-off in Spanish universities", *International Journal of Entrepreneurship and Innovation Management*, Vol. 21 No. 4/5, pp. 299–317.

Moog, P., Werner, A., Houweling, S. and Backes-Gellner, U. (2015), "The impact of skills, working time allocation and peer effects on the entrepreneurial intentions of scientists", *Journal of Technology Transfer*, Vol. 40 No. 3, pp. 493–511.

Morales-Gualdrón, S.T., Gutiérrez-Gracia, A. and Dobón, S.R. (2009), "The entrepreneurial motivation in academia: A multidimensional construct", *International Entrepreneurship and Management Journal*, Vol. 5 No. 3, pp. 301–317.

Muscio, A., Quaglione, D. and Ramaciotti, L. (2016), "The effects of university rules on spinoff creation: The case of academia in Italy", *Research Policy*, Vol. 45 No. 7, pp. 1386–1396.

Nelson, A.J. (2014), "From the ivory tower to the startup garage: Organizational context and commercialization processes", *Research Policy*, Vol. 43 No. 7, pp. 1144–1156.

Obschonka, M., Goethner, M., Silbereisen, R.K. and Cantner, U. (2012), "Social identity and the transition to entrepreneurship: The role of group identification with workplace peers", *Journal of Vocational Behavior*, Vol. 80 No. 1, pp. 137–147.

Obschonka, M., Silbereisen, R.K., Cantner, U. and Goethner, M. (2015), "Entrepreneurial Self-Identity: Predictors and Effects Within the Theory of Planned Behavior Framework", *Journal of Business and Psychology*, Vol. 30 No. 4, pp. 773–794.

Ozgul, U. and Kunday, O. (2015), "Conceptual Development of Academic Entrepreneurial Intentions Scale", *Procedia - Social and Behavioral Sciences*, Vol. 195, pp. 881–887.

Passaro, R., Quinto, I. and Thomas, A. (2018), "The impact of higher education on entrepreneurial intention and human capital", *Journal of Intellectual Capital*, Vol. 19 No. 1, pp. 135–156.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., et al. (2013), "Academic engagement and commercialisation: A review of the literature on university-industry relations", *Research Policy*, Vol. 42 No. 2, pp. 423–442.

Pittaway, L. and Cope, J. (2007), "Entrepreneurship education: A systematic review of the evidence", *International Small Business Journal*, Vol. 25 No. 5, pp. 479–510.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. and Neely, A. (2004), "Networking and innovation: a systematic review of the evidence", *International Journal of Management Reviews*, Vol. 5–6 No. 3–4, pp. 137–168.

Prodan, I. and Drnovsek, M. (2010), "Conceptualizing academic-entrepreneurial intentions: An empirical test", *Technovation*, Vol. 30 No. 5–6, pp. 332–347.

Ramos-Vielba, I., Sánchez-Barrioluengo, M. and Woolley, R. (2016), "Scientific research groups' cooperation with firms and government agencies: motivations and barriers", *Journal of Technology Transfer*, Vol. 41 No. 3, pp. 558–585.

Rizzo, U. (2015), "Why do scientists create academic spin-offs? The influence of the context", *Journal of Technology Transfer*, Vol. 40 No. 2, pp. 198–226.

Rothaermel, F.T., Agung, S.D. and Jiang, L. (2007), "University entrepreneurship: A taxonomy of the literature", *Industrial and Corporate Change*, Vol. 16 No. 4, pp. 691–791.

Ryan, R.M. and Deci, E.L. (2000), "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions", *Contemporary Educational Psychology*, Vol. 25 No. 1, pp. 54–67.

Sandström, C., Wennberg, K., Wallin, M.W. and Zherlygina, Y. (2018), "Public policy for academic entrepreneurship initiatives: a review and critical discussion", *Journal of Technology Transfer*, Vol. 43 No. 5, pp. 1232–1256.

Schmitz, A., Urbano, D., Dandolini, G.A., de Souza, J.A. and Guerrero, M. (2017), "Innovation and entrepreneurship in the academic setting: a systematic literature review", *International Entrepreneurship and Management Journal*, *International Entrepreneurship and Management Journal*, Vol. 13 No. 2, pp. 369–395.

Shapero, A. (1984), "The entrepreneurial event", in C. A. Kent (Ed.), *The Environment for Entrepreneurship*, Lexington: Lexington Books.

Sieger, P. and Monsen, E. (2015), "Founder, Academic, or Employee? A Nuanced Study of Career Choice Intentions", *Journal of Small Business Management*, Vol. 53, pp. 30–57.

Sjöö, K. and Hellström, T. (2019), "University–industry collaboration: A literature review and synthesis", *Industry and Higher Education*, Vol. 33 No. 4, pp. 275–285.

Snijders, T.A. and Bosker, R.J. (2011), *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*, Sage Publications, London.

Tartari, V. and Breschi, S. (2012), "Set them free: scientists' evaluations of the benefits and costs of university-industry research collaboration", *Industrial and Corporate Change*, Vol. 21 No. 5, pp. 1117–1147.

Tartari, V., Perkmann, M. and Salter, A. (2014), "In good company: The influence of peers on industry engagement by academic scientists", *Research Policy*, Vol. 43 No. 7, pp. 1189–1203.

Tartari, V. and Salter, A. (2015), "The engagement gap: Exploring gender differences in University-Industry collaboration activities", *Research Policy*, Vol. 44 No. 6, pp. 1176–1191.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review", *British Journal of Management*, Vol. 14 No. 3, pp. 207–222.

Trivedi, R. (2016), "Does university play significant role in shaping entrepreneurial intention? A cross-country comparative analysis", *Journal of Small Business and Enterprise Development*, Vol. 23 No. 3, pp. 790–811.

Vick, T.E. and Robertson, M. (2018), "A systematic literature review of UK university-industry collaboration for knowledge transfer: A future research agenda", *Science and Public Policy*, Vol. 45 No. 4, pp. 579–590.

Villasana, M. (2011), "Fostering university-industry interactions under a triple helix model: The case of Nuevo Leon, Mexico", *Science and Public Policy*, Vol. 38 No. 1, pp. 43–53.

Walter, T., Ihl, C., Mauer, R. and Brettel, M. (2018), "Grace, gold, or glory? Exploring incentives for invention disclosure in the university context", *Journal of Technology Transfer*, Vol. 43 No. 6, pp. 1725–1759.

Wright, M. and Phan, P. (2018), "The Commercialization of Science: From Determinants to Impact", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 1–3.

Wu, Y., Welch, E.W. and Huang, W.L. (2015), "Commercialization of university inventions: Individual and institutional factors affecting licensing of university patents", *Technovation*, Vol. 36, pp. 12–25.

Würmseher, M. (2017), "To each his own: Matching different entrepreneurial models to the academic scientist's individual needs", *Technovation*, Vol. 59, pp. 1–17.

Yusof, M. and Jain, K.K. (2010), "Categories of university-level entrepreneurship: A literature survey", *International Entrepreneurship and Management Journal*, Vol. 6 No. 1, pp. 81–96.

Zahari, A.R., Tamyez, P.F.M., Azizan, N.A. and Hashim, F. (2018), "Student spin-off intentions in malaysian higher educational institutions: Founders' characteristics and university roles", *Journal of Entrepreneurship Education*, Vol. 21 No. 3, pp. 1–15.

Zavale, N.C. and Langa, P.V. (2018), "University-industry linkages' literature on Sub-Saharan Africa: systematic literature review and bibliometric account", *Scientometrics*, Vol. 116 No. 1, pp. 1–49.

Zollo, L., Laudano, M.C., Ciappei, C. and Zampi, V. (2017), "Factors affecting universities' ability to foster students' entrepreneurial behaviour: An empirical investigation", *Journal of Management Development*, Vol. 36 No. 2, pp. 268–285.

Appendices

Appendix 2A

Intent OR Intention* OR Attitude* OR Behaviour* OR Behavior* OR Motivat* OR Engage*	AND	Universit* OR Academ*	AND	Entrepreneur* OR Start* OR Spin*	Universit* Entrepreneur* Entrepreneur Universit* Academ* Entrepreneur* Entrepreneur* Academ* Universit* Startup* | Start-up* | Start up* Startup* | Start-up* | Start up* Universit* Academ* Startup* | Start-up* | Start up* Startup* | Start-up* | Start up* Academ* Univer* Spinoff* | Spin-off* | Spin off* | Spin-out* | Spin out* | Spinout* Spinoff* | Spin-off* | Spin off* | Spin-out* | Spin out* | Spinout* Univer* Academ* Spinoff* | Spin-off* | Spin off* | Spin-out* | Spin out* | Spinout* Spinoff* | Spin-off* | Spin off* | Spin-out* | Spin out* | Spinout* Academ*		
			AND	Industr* OR Business* OR Firm	AND	Interact* OR Collaborat* OR Cooperat* OR Partner* OR Relation*	universit* industr* industr* universit* universit* business* business* universit* universit* firm* firm* universit* academ* industr* industr* academ* academ* business* business* academ* academ* firm* firm* academ*
			AND	Technolog* OR Research* OR Knowledge	AND	Transf* OR Commerc* OR Patent* OR Licenc* OR Licens*	

Notes:
Universit* capturing university and universities; Academ* capturing academic, academics, academicals, academy and academically; Entrepreneur* capturing entrepreneur, entrepreneurs, entrepreneurial and entrepreneurship; intent* capturing intent, intention, intentions and intentionality; attitude* capturing attitude and attitudes; behaviour* capturing behaviour, behaviours, behavioural and behaviourally; behavior* capturing behavior, behaviors, behavioral and behaviourally; orientat* capturing orientation and orientations; engag* capturing engage, engages, engagement, engagements and engaging, collab* capturing collaboration, collaborations and collaborative; spin* all combination of spinoff but also spinout.

Appendix 2B

Papers selected in the systematic literature review

Author(s)	Location	Knowledge Valorisation	Research Questions	Findings
Abreu and Grinevich (2013)	UK	AE	(1) Do the determinants of academic entrepreneurship are the same across different university-industry activities?	(1) The demographic characteristics that determine the engagement degree in patenting and venture creation are the same for involvement in informal commercialisation activities with the industry; (2) Senior academics are more likely than their younger peers to be involved in all types of entrepreneurial activities; (3) Academics working on 1) user-inspired or applied topics or 2) with past entrepreneurial experience are more likely to engage in academic entrepreneurship and informal non-commercial activities.
Abreu and Grinevich (2014)	UK	AE	(1) How do the academics' context, motivations and activities influence their engagement in formal, informal, and non-commercial activities?	(1) Several scholars in the creative arts engage with external organisations; (2) The dominant pattern of academic entrepreneurship is within the less formalised activities, such as organising exhibitions, giving public lectures, sitting on advisory boards, and organising student placements; (3) Personal characteristics are in general more relevant in determining involvement than institutional traits; (4) The main motivations for the engagement is related with gaining insights from the business world, keep up to date, material for teaching and student placement; (5) Personal income and access to funding have a low relevance in their motivations.
Aldridge and Audretsch (2011)	USA	University Spin-off	(1) Which factors are conducive to scientist entrepreneurship?	(1) Scientists with higher: 1) levels of social capital, and 2) financial resources provided thought grants, exhibit a systematically higher propensity to become an entrepreneur; (3) The results found no evidence that personal characteristics or human capital play an essential role in the decision to become an entrepreneur.
Ankrah et al. (2013)	UK	Industry collaboration	(1) What is the relationship between the motivations (academy and industry) and government-sponsored UIC?	(1) Stability is the most common factor for engagement in UIC. Ensure that research is more useful and relevant; expose students and faculty to practical problems, test application of ideas, and explain and sell ideas to industry were the most frequent motivations; (2) Follows legitimacy: service to the industrial community or society and promotion of innovation through KTT; and (3) Efficiency (access funding for research) and necessity (responsiveness to government or institutional policies) were cited as motivation by 100% of the university actors.
Baldini (2011)	Italy	Patents and licences	(1) Why do researchers participate in university patenting activities?	(1) Faculty's primary motivations to copyright relate with indirect rewards more than direct economic rewards; (2) Patents are not perceived by non-inventors as inappropriate to academic activities or as obstacles to publications and conferences; (3) Previous patenting activities at the individual level do not affect the inventors' opinions.
Balven et al. (2018)	USA	Patents and licences University Spin-off	(1) Why do faculty members engage in technology transfer, especially informal practices?	(1) The micro-processes that can enhance the faculty engagement in entrepreneurial activities are identity, motivation, leadership/ championing, TTO communication and education efforts, work-life balance, and organisational justice; (2) The policymakers focus should be on the intra-individual dimension and should emphasize the human aspect, especially more attention should be given to the faculty member.
Bercovitz and Feldman (2008)	USA	Patents and licences	(1) Who discloses in the faculty, what are their characteristics, and to what types of incentives do they respond?	(1) The propensity to disclose is related to the number of publications; department quality; researchers' higher education degree; (2) Individuals are more likely to disclose inventions if trained at institutions that have long-established and successful technology transfer operations; (3) the longer the elapsed time since graduate training, the less likely the adoption of the new commercialisation norm; (4) Social Environment: if the chair of the department is active in KTT, other members of the department are also likely to disclose (Leadership), and KTT behaviour is calibrated by the experience of those in a similar position, in terms of academic rank and departmental affiliation (Peers).
Bergmann et al. (2018)	Germany	University Spin-off	(1) What are the drivers of students'	(1) Individual and contextual factors influence climate perceptions; (2) Contextual characteristics have a different impact depending on students' background and gender. The

			perceptions of the entrepreneurial climate?	entrepreneurial climate depends on what the university does to support entrepreneurship but also on who is admitted to the university; (3) In this research, general university characteristics have the most substantial influence on climate perceptions.
Bergmann (2017)	Germany	University Spin-off	(1) How entrepreneurs form opportunity beliefs? (2) How they relate to entrepreneurial action?	(1) The academic entrepreneurial action is directly influenced by the entrepreneurial learning and indirectly, through opportunity beliefs, by professional experience; (2) There is no evidence for a relationship between: 1) professional experience and entrepreneurial action; and 2) formal learning about entrepreneurship on opportunity beliefs.
Bicknell et al. (2010)	UK	AE	(1) What are the academics motivations to engage in KTT activities?	(1) Seven thematic areas were inducted: values-in-practice, motivations and "buzz moments", purposive activities, the academic context, the journey, pedagogy and perceptions of risk; (2) Academics value industry relevance, enjoy challenges from the "real world", they are career-oriented and appreciate recognition for their effort.
Bienkowska et al. (2016)	Sweden	AE	(1) How does support vary between faculties and hierarchical levels? (2) How do individual factors influence the perceptions of support?	(1) Receiving information about the commercialisation of research results was positive for perceived support at all three hierarchical level; (2) Perceived support is not interpreted the same across hierarchies and disciplines, meaning that the university cannot be seen as homogeneous; (3) Collaboration with firms is correlated with higher perceived support for commercialisation at supervisor and department level, but not at central administration.
Boardman (2009)	USA	AE	(1) What are the academics' personal and professional characteristics that correlate the interaction with the industry?	(1) The authors find little evidence of conflict between interactions with industry and more traditional academic roles; (2) Scientists affiliated with university research centres are more likely to interact with the private sector, but not in activities where the academic is the founder of a venture; (3) The results imply mixed effects for age: younger scientists are more receptive to contacts with industrial partners, while older scientists (tenured scientist) have had more time to develop skills and to produce valuable work for industry, as well as to establish networks. (4) The results suggest a synergy between traditional academic activities and roles and interactions with the private sector.
Bodas Freitas and Nuvolari (2012)	Netherlands	Patents and licences	(1) What motivates university researchers to patent the results of collaborative research?	(1) The results prove the existence of three types of motivations: an industry-driven related to traditional-market motives (protection of inventions); a university-driven domain driven by 'heterodox' motives linked to signalling research competencies, attracting industrial partners and accessing research funds; a 'hybrid' publicly driven domain related to projects aligned to the research agendas of public sponsors; (2) Heterodox motivations are more common on innovations that are proof of concept; radical substitutes for existing technologies; and publicly financed research.
Bodas Freitas and Verspagen (2017)	Netherlands	Industry collaboration	(1) How organisational structures and institutional incentives compete to influence UIC?	(1) The university researchers are motivated to collaborate to obtain insights into the industrial applicability of previous research; maintain contact with industry; access additional funding; and increase opportunities for future collaborative research; (2) The technological objective and organisational structure of collaboration are flexible variables allowing the integration of both partners' goals and expectations.
Bourelos et al. (2012)	Sweden	Patents and licences University Spin-off	(1) How research performance, networks and support structure explain commercialisation?	(1) Commercialisation, measured as patents and start-up companies, is positively correlated with research performance in terms of peer-reviewed articles, the use of TTOs, courses in the fields of entrepreneurship and commercialisation (support structures); (2) The empirical test show no support for research performance in terms of the number of grants and show ambiguous results for network time allocation.
Brettel et al. (2013)	Germany	Patents and licences	(1) What types of incentives, mediated by	(1) Attitude, subjective norm and perceived behavioural control influence high-profile employee's intention to disclose an invention; (2) Only two factors, from eleven tested, positive and

		University Spin-off	attitude, subjective norm and perceived behavioural control, influence star scientists to disclose an invention?	significant influence academics' attitude: new contacts to technology transfer experts, self-realization and long-term development of university and region; (3) Regarding peers and their influence on subjective norms, the influence of the university administration and superiors is significant, whereas the influence of colleagues is not; (4) a well-functioning technology transfer infrastructure is vital to drive university scientists' into commercialising their research.
Clarysse et al. (2011)	UK	University Spin-off	(1) How an academics' entrepreneurial capacity and prior experience shape their involvement in a USO?	(1) Individual attributes, especially the academics' opportunity recognition capacity and previous involvement in entrepreneurial activities, are the main predictors to found a spin-off (2) Social norms did not have the influence expected by the authors; (3) Academic quality, reputation and entrepreneurial activity are all interconnected; (4) Presence of a TTO plays little role in shaping academic venture creation.
D'Este and Patel (2007)	UK	Industry collaboration	(1) Which are the channels through which researchers interact with the industry? (2) What are the factors that influence their engagement?	(1) The characteristics of the researcher have a stronger impact than those of the department or the university; (2) Previous experience of collaborative research plays a significant role: those researchers with a record of past interaction are more likely to be involved in a greater variety of interactions with industry, and also to engage more frequently across a broader set of interaction channels; (3) Academic status has a significant and positive impact on the variety of interactions; (4) The older the researcher, the narrower the variety of interactions; (5) The research quality of the department has no impact on the probability of a university researcher engaging in a wide variety of interactions.
D'Este and Perkmann (2011)	UK	AE	(1) What are the motivational drivers underpinning various forms of engagement?	(1) The authors identified four main motivations; commercialisation, learning, access to funding and access to in-kind resources; (2) Involvement in patenting and spin-off is primarily derived to personal payoffs (commercialisation); for joint research and contract research the motivations mainly research-driven [learning, access to funding and access to in-kind resources] and commercialisation plays no role; Consulting is an exception to this pattern, it is driven by both commercialisation and research-related motivations; (3) Universities policies should consider that differentiated activities are enhanced by distinct motivations.
Erikson et al. (2015)	Norway	AE	(1) What individual and organisational characteristics determining the entrepreneurial aspirations of university research scientists?	(1) At an individual level: 1) start-up experience positively affects start-up aspirations, 2) patenting experience foster patenting and licensing aspirations, 3) there is no evidence for the relationship between prior industry experience and UIC aspiration; (2) At an organisational level, the research department enterprise norms positively affect the aspirations to engage in IUC and patenting activities but not to create a start-up; (3) Scientific productivity positively mediates the relationship between industry experience and interaction aspirations, but negatively influences the relationship between patenting experience and patenting aspirations.
Escobar et al. (2017)	Spain	Industry collaboration	(1) What are the factors, individual and university level, which influence the development of KTT activities?	(1) University-industry R&D contracts are motivated by the researchers' commitment to the organisation's mission and by a favourable regulatory environment; (2) On the contrary, a positive attitude towards KTT is negatively affecting R&D contracts. Those researchers that display a natural predisposition for conducting KTT activities take part in a reduced number of projects, either because they are selective or because they choose project complex in nature.
Fernández-Pérez et al. (2014)	Spain	University Spin-off	(1) How business networks and personal social networks, via TPB, can influence academics' intentions to start a venture?	(1) Personal social networks influence entrepreneurial attitude and opportunity recognition self-efficacy, but not on entrepreneurial intention; (2) Industrial, financial, and social networks were found to exert a positive influence; (3) entrepreneurial attitude and opportunity recognition self-efficacy are significant mediators of the social networks; (4) Gender difference is only perceived with relation to industrial and financial social networks; there are no significant differences in psychological variables.
Fernández-Pérez et al. (2015)	Spain	University Spin-off	(1) How do personal and professional	(1) Mentors, business networks and personal networks have a decisive role in promoting academics' interest in new business

			networks influence entrepreneurial intentions?	ventures; (2) In this relationship, entrepreneurial attitudes and self-efficacy play significant mediator roles.
Fini and Toschi (2016)	Italy	University Spin-off	(1) How cognitive and contextual dimensions influence entrepreneurship in spin-offs?	(1) Results show that cognitive and institutional domains are tightly interrelated, and the latter domain sets the context for the former to foster value-creation; (2) Academic entrepreneurial action is predicted by technical skills; and field-specific, cutting-edge, technical knowledge is critical for entrepreneurship; (3) Entrepreneurial risk-taking propensity has a substantial impact.
Fini et al. (2009)	Italy	University Spin-off	(1) Why do researchers decide to create a start-up? (2) What factors influence such a decision? (3) To what extent specific policies are relevant in this process?	(1) Nine factors were extracted as the motivations for academics to create a venture: Support from the external context, Technology commercialisation potential, Contagion effect (Environmental influences); University patent protection, University support services, Access to university infrastructures (University level); University-related benefits, Economic and technological contribution and Personal related benefits (Individual level); (2) The academics' decision to found a venture is strongly influenced by academic-related expected outcomes, such as the generation of further stimuli for research activities, the gain of prestige and reputation as leading academics, the creation of funding opportunities, or the possibility to get new infrastructure and facilities for academic research activities; (3) Institutional characteristics do not encourage academics' entrepreneurial attitude; (4) Among university level mechanisms, the existence of TTO and the availability of a patent regulation turn out to be irrelevant.
Foo et al. (2016)	Norway	AE	(1) How do family, work environment and academics promotion focus influence entrepreneurial intentions?	(1) Scientists' promotion focus interacts with the work and family environments to predict academic scientists' entrepreneurial intentions; (2) Academic scientists are more likely to have higher entrepreneurial intentions when they are high in promotion focus and are in family environments that encourage entrepreneurship (parents own a business).
Francis-Smythe (2008)	UK	AE	(1) What are the institutional and individual barriers to academics' engagement in knowledge transfer?	(1) Lack of reward and incentives appears in the top three at both the institutional and individual levels barriers; (2) At an institutional level, the other two barriers are lack of investment in core academic/research and bureaucracy required to engage; (3) At an individual level, three of the top four barriers relate to time: time available to pursue KTT is too fragmented; lack of time to engage in KTT; mismatch of academic and commercial timescales.
García-Rodríguez et al. (2017)	Spain	University Spin-off	(1) How does motivation, opportunity and ability, influence entrepreneurial intentions?	(1) Motivation influences intentions directly and indirectly through an individual's attitude towards entrepreneurial behaviour; (2) The perception of business opportunities is also a significant antecedent of entrepreneurial motivation; (3) The results expose that investments in entrepreneurship training could have a high impact on intentions, once it has the capacity to transform the students' attitudes.
Giuliani et al. (2010)	Italy, Chile and South Africa	Industry collaboration	(1) What is the importance of researchers' individual features and researchers' organisational contexts in UIC?	(1) The findings reveal that researchers' individual characteristics (age, gender and centrality in the academic system) are of greater relevance than the researchers' degree and the number of publications; (2) Researchers who are more central within the academic research system (interface centres) tend to connect more with the industry actors.
Goethner et al. (2012)	Germany	University Spin-off	(1) How do the economic variables (human capital, social capital, expected entrepreneurial benefits) and the psychological variables (attitudes, social	(1) Attitudes and perceived control predicted entrepreneurial intentions; social norms turned out not to be relevant; (2) As regards the economic factors, entrepreneurial experience (human capital) and cooperation linkage with the industry (social capital) prove to have a direct effect on academic entrepreneurial intention and an indirect effect through attitudes and perceived behavioural effect; (3) Public support institutions (social capital) has a direct effect on academic entrepreneurial intention and indirect through perceived behavioural control (4) Patenting experience (human capital) and expected reputational gains have an indirect effect on academic entrepreneurial intention through attitudes (5) Expected financial gain only

			norms, perceived behaviour control) predict academic entrepreneurial intentions?	showed indirect effects on intentions via attitudes and perceived control.
Göktepe-Hulten and Mahagaonkar (2010)	Germany	Patents and licences	(1) How do scientist expectations concerning the outcomes of commercial activities influence their engagement in patenting?	(1) Scientists with high reputation expectations from commercial activities will more likely to patent; (2) The financial prospects are balanced against the cost of giving up norms and expected rewards associated with their identity as scientists.
Guerrero and Urbano (2014)	Spain	University Spin-off	(1) How motivational factors act as a knowledge filter? (2) How social norms and entrepreneurial policies influence intentions?	(1) Perceived behavioural control acts as a knowledge filter in the start-up intentions; (2) University policies are relevant to transform academics' actions via motivational factors; (3) Although not all entrepreneurial universities are intensive in knowledge generation and commercialisation, their spill-over contribution is relevant; (4) University policies should take into consideration 'intangibles' such as intentions, role models, and leadership.
Gulbrandsen and Thune (2017)	Norway	AE	(1) How does the academics' engagement with external parties is influenced by their non-academic work experience?	(1) The non-academic work has a positive effect on external research collaboration, commercialisation [patents and licensing, and venture creation], dissemination and training activities; (2) Academics from applied research are more active in research collaboration and commercialisation.
Halilem et al. (2017)	Canada	Patents and licences	(2) How do the institutional IPR regimes increase or decrease the commercialisation of research?	(1) The results suggest contrary evidence to most of the literature, academic inventors' behaviour is not influenced by the invention ownership regime but by the control rights in place and the sharing of income; (2) A higher rate of income to the university will motivate the academic entrepreneur to engage on informal commercialisation activities.
Hayter (2011)	USA	University Spin-off	(1) What are the motivations to establish an academic venture? How do academics define success?	(1) Academic entrepreneurs established their ventures for multiple reasons, including technology development, personal financial rewards, public service, career enhancement, job creation, and skill enhancement; (2) Unique to motivations is the influence of peers, often outside the university, on academic entrepreneurs; (3) Academic entrepreneurs are interested in financial gain but is not their primary goal. It is seen as a reward for the time they employ away from their academic work (4) Not all spin-offs are created to maximize profit. They are a platform for consulting and access to government grants.
Hayter (2015)	USA	University Spin-off	(1) What are the motivations to establish an academic venture? (2) How they evolve and why?	(1) Academic entrepreneurs are primarily motivated by the ability to use university spin-offs as a platform to apply for business awards, industry R&D contracts or consulting, (2) Academics are motivated by commercialisation and product development. Spin-offs are seen as a vehicle for disseminating new knowledge; (3) Concern for students and employees was the third most commonly reported motivation; (4) Fewer academics are also motivated by the possibility to enhance traditional teaching and research responsibilities; to pursue more applied projects and sources of funding, and to enhance teaching and mentoring skills; (5) Financial motivations are the most infrequently reported motivation.
Hesse and Brünjes (2018)	Germany	University Spin-off	(1) How students differ in their entrepreneurial attitudes and career?	(1) Students' intention to become an entrepreneur or an academic is indeed influenced similarly by some career motives; (2) Students with academic career intentions, compared to students with entrepreneurial career intentions, tend to lack entrepreneurial attitudes, have a lower aspiration to

				achieve financial success but are more motivated to receive recognition in their future career.
Holley and Watson (2017)	Australia	AE	(1) How do academics' entrepreneurial behaviours evolve?	(1) The results indicate the presence of four distinct categories of academic entrepreneurial behaviour: non-entrepreneurial, semi-entrepreneurial, pre-entrepreneurial and entrepreneurial; (2) Funding needs was identified as the primary driver of research commercialisation; followed by institutional policies.
Huyghe and Knockaert (2015)	Germany and Sweden	AE	(1) What is the impact of university culture and climate on intentions?	(1) Universities can shape research scientists' intentions to engage in spin-off creation, intellectual property rights and industry-science interaction by offering an institutional environment that promotes AE; (2) Presence of role models leads to stronger intention on all AE activities; (3) Universities that emphasize AE in their mission and that allocate rewards, show more significant scientists' intentions to engage in spin-off creation and intellectual property rights, but there is no evidence for the same relationship with UIC.
Huyghe et al. (2016)	Sweden, Spain, Slovenia, Germany , Belgium	University Spin-off	(1) How do the researchers' entrepreneurial and scientific passions are related to their intentions to spin-off / start-up?	(1) The study confirms that spin-off and start-up intentions have distinct constructs, while entrepreneurial passion is positively related to both; researchers with obsessive scientific passion show higher intentions in creating a spin-off and lower start-up intentions; (2) Entrepreneurial self-efficacy and affective organisational commitment are relevant mediators; (3) Spin-off intentions can be reinforced by both passions, the entrepreneurial and scientific.
Iorio et al. (2017)	Italy	AE	(1) What motivates academics to engage with industry actors?	(1) Receive funding and social mission are drivers for the academics engagement; (2) The results found no significant evidence that learning is a motivation driver; (2) Male academics are more likely to engage with external partners; (3) Regarding scientific field, working in Engineering (applied field) has a positive and significant correlation with the entrepreneurial academic activities.
Johnson et al. (2017)	Scotland	AE	(1) Why do academics engage in formal and informal activities?	(1) The stronger the academics' promotion focus (maximal goals), the stronger their intentions to engage in formal (technology licensing and venture creation) and informal (collaborative research, contract research, consultancy) activities; (2) Leader and peers can have mixed influence on academics intention: 1) for those that are promotion focus, the peers can have a positive effect, and 2) for those that are more prevention focus (avoid risk), leader and peers can weaken their intention.
Karlsson and Wigren (2012)	Sweden	University Spin-off	(1) How legitimacy, social and human capital influence the faculty' start-up propensity?	(1) Scientific legitimacy (number of peer and conference papers) did not affect intentions to create a venture. Scientific legitimacy (publications in non-peer review journals) even had a negative effect; (2) Popular legitimacy showed mixed results, popular science publications showed positive correlations, but public media appearances had a non-significant effect; (3) Regarding human capital, individual's knowledge in start-up experience had a positive impact on start-up propensity, while explicit human capital variables such as academic position and age had negative correlations; (4) All social capital variables were significant, this is, involvement in product development; involvement in contract research and involvement in research project with externally employed collaborators.
Lam (2011)	UK	Patents and licences University Spin-off	(1) What are the academics' personal motivations for pursuing commercial activities (2) How is this influenced by their values and beliefs?	(1) Academics are driven by peer recognition in the form of publications, citations and prizes – 'Ribbon'" - in their commercial pursuits; (2) Personal income is seen as relevant only by a small minority of academics and (3) the study highlights the role of intrinsic motivation, as in puzzle-solving, in driving the commercial endeavours of many of the scientists studied; (4) Policies designed to promote research commercialisation should consider that academics are motivated by a complex mix of extrinsic and intrinsic rewards.
Link et al. (2007)	USA	Industry collaboration	(1) What are the faculty's determinants to engage in informal technology	(1) Age is not statistically significant predicting the faculty involvement; (2) Regarding gender, female faculty members to engage in informal commercial knowledge transfer and consulting; (3) High number of years as tenured faculty and high percentage of grants-related research time, means that they are more likely to engage in the transfer of commercial technology.

			transfer activities?	
Llopis et al. (2018)	Spain	AE	(1) What are the individual factors behind scientists' involvement in knowledge transfer and exchange activities?	(1) Researchers with higher levels of interdisciplinarity and multitasking are more willing to get involved in a wide range of entrepreneurial activities and with diverse types of users (private, public or non-governmental); (2) Regarding motivations, obtaining income is related to informal mechanisms (UIC) while advancing research to formal ones (Spin-offs and Patents).
Miranda, Chamorro, et al. (2017)	Spain	University Spin-off	(1) How do demographic, psychological and environmental factors influence academics' intention create a spin-off?	(1) The results show that entrepreneurial personality is the variable influencing intention to be an entrepreneur, with the highest importance, followed by gender, academic experience and the entrepreneurial abilities of the individual. The perceived utility, the understanding of the economic prospect and research group patent productivity are also variables positively affecting the academics intention. (2) The result shows no relationship for productivity (publications), regional environment; university environment, self-confidence, creativity; with entrepreneurial intentions
Miranda, Chamorro-Mera, et al. (2017)	Spain	University Spin-off	(1) How do subjective norms; attitudes and perceived control influence intentions to spin-off?	(1) The entrepreneurial attitude is dependent primarily on the academic personality, particularly on their Creativity, Business Experience and Perceived utility; (2) Attitude has a direct effect on their Entrepreneurial Intention; (3) Subjective Norms has an insufficient influence on Intentions and (4) Perceived Control showed no significant relationship whit Intentions.
Moog et al. (2015)	Switzerland and Germany	University Spin-off	(1) How does scientist's skills affect their intention to become an entrepreneur?	(1) Researchers with more diverse and balanced skills develop stronger intentions of becoming academic entrepreneurs; but only if they also balance their working time and are in a peer-supported entrepreneurial environment.
Morales-Gualdrón et al. (2009)	Spain	University Spin-off	(1) Why researchers create academic spin-offs?	(1) Entrepreneurial motivation is a multidimensional construct; (2) The results show that entrepreneurial opportunity is not part of the entrepreneurial motivation; (3) Scientific Knowledge is the most essential dimension, followed by personal motivation (need for achievement and need for independence); (4) Desire for personal wealth does not motivate the academics to create a spin-off.
Muscio et al. (2016)	Italy	University Spin-off	(1) What is the relative impact of institutional and individual characteristics in stimulating academic spin-off creation?	(1) The empirical research proofs that university institutional capability has an effect into generating new academic ventures; (2) Internal rules on spin-off creation is positively associated with generating spin-offs; (3) Rules reducing conflicts of interests reduce opportunistic behaviour from researchers; (4) Universities adopting the 'minimum capital share' increase academic engagement and there is a positive relationship between this involvement and the creation of spin-off.
Nelson (2014)	USA	University Spin-off	(1) How organisational context shapes entrepreneurs' behaviours and perceptions?	(1) Entrepreneurial behaviours are shaped by individual-level characteristics as well as organisational contextual; (2) organisational context might not be easily malleable, and it can be complex to change a context to be more conducive to commercialisation activities
Obschonka et al. (2012)	Germany	University Spin-off	(1) What role does social identity have in the transition to entrepreneurship?	(1) Entrepreneurial intentions are predicted by attitude, social norms, and perceived control; (2) Group identification is negatively associated with perceived control; (3) Academics with low group identification based their entrepreneurial intention less on social norms and attitudes but on their control beliefs; (4) Among academics with high group identification, entrepreneurial intentions were essential a function of social norms.
Obschonka et al. (2015)	Germany	University Spin-off	(1) What are the predictors of self-identify? What are the predictors of academic entrepreneurial intentions?	(1) Self-identity, measured by the past entrepreneurial behavioural, entrepreneurial personality structure, early entrepreneurial competence in adolescence and self-employed parents plays a vital role as a driver of entrepreneurial intentions; (2) Social norms appeared as a valid and relevant predictor of academic intentions.

Passaro et al. (2018)	Italy	University Spin-off	(1) How does higher education impact entrepreneurial intention and human capital?	(1) Entrepreneurial education does not influence students' entrepreneurial intention, but it influences the academics who participated in Business Plans Competition; (2) The results indicate that there are significant differences between the two considered samples: students and academics.
Prodan and Drnovsek (2010)	Slovenia and UK	University Spin-off	(1) What are the determinants and processes that determine the academics' entrepreneurial intention to create a spin-off?	(1) The results identify: entrepreneurial self-efficacy, type of research, perceived role models, number of years spent at an academic institution, and patents as significantly related to the formation of academic-entrepreneurial intentions; (2) Entrepreneurial self-efficacy had the highest path coefficient among all predictors of academics' entrepreneurial intentions (3) Industry cooperation has no direct influence on entrepreneurial intentions, however, it is related to academic-entrepreneurial intentions through Type of research and Patents; (4) Type of research and Patents are two significant predictors of academic-entrepreneurial intentions; (5) Greater numbers of years spent at an academic institution hinder the formation of academic-entrepreneurial intentions
Ramos-Vielba et al. (2016)	Spain	Industry collaboration	(1) What are the underlying factors which motivate or hinder researchers' cooperation with different types of external partners?	(1) When participating in knowledge transfer processes, research groups seem to be driven by extrinsic and intrinsic rewards; (2) Research groups are motivated to cooperate as a means to expand networks and access equipment in the interests of advancing their research; secondly to address socio-economic needs and societal expectations by applying their knowledge; and lastly to access personal and group opportunities to obtain financial benefits.
Rizzo (2015)	Italy	University Spin-off	(1) How do personal reasons explain why scientists create academic spin-offs? (2) How the creation process unfolds?	(1) Individual motivation of scientists to engage in the creation of a spin-off is conditioned by the academic environment funding constraints, the low demand for doctorate holders (public and private sector), and the presence of favourable supporting policy tools in the region under analysis; (2) In regions where there is a bottleneck in the academic system, the creation of academic spin-off allows the researchers to work in their field of expertise
Tartari and Breschi (2012)	Italy	Industry collaboration	(1) How does academics' intention to collaborate with the industry is influenced by personal and departmental characteristics?	(1) The academics intention to engage in IUC activities are stronger for those that are male (Gender), full professor (Academic position), more experienced academics that may have larger personal networks; (2) Age has a negative and significant effect, representing a decline of 2% for every additional year; (3) Scientific publications, number of patents, and applied research field have a positive and significant effect; (4) The results show that the intentions to collaborate are mainly driven by the motivation to get funding, and also to protect their research; the perception that this collaboration may restrict academics freedom is one of the barriers for collaboration.
Tartari et al. (2014)	UK	Industry collaboration	(1) To what extent academics engagement is influenced by the behaviour of the social context?	(1) Academics' engagement with Industry is influenced by the behaviour of their peers, in similar seniority; this influence is stronger for junior faculty.
Trivedi (2016)	India, Malaysia and Singapore	University Spin-off	(1) What is the role played by the university environment and support to foster entrepreneurship?	(1) Positive university environment can be a strong support network, and influencer in augmenting entrepreneurial activity among students, primarily through perceived behavioural control; (2) Findings also suggest that Attitude has a positive and highly significant effect on entrepreneurial intention
Villasana (2011)	Mexico	Industry collaboration	(1) What are the motivations of academic researchers to develop	(1) The three main motivations for participation in projects with industry are the social impact of their research outputs; the learning opportunities for their students from real-life situations; and the nature of the research involved in a project.

			working relationships with the industry?	
Walter et al. (2018)	Germany	Patents and licences	(1) What motivates university scientists to identify practical applications for their research results and consider having them patent-protected?	(1) University incentives raise the probabilities for invention disclosure considerably, but to increase their effectiveness, they should be considered in a bundle and not as single incentives; (2) Direct and indirect financial incentives are dominant drivers and account for roughly two-thirds of total impact; (3) Authors propose a triad of incentives: 'Grace', freedom to pursue academic endeavours undisturbed by commercialisation efforts; 'Gold', financial participation in the outcome; and 'Glory' technology transfer achievements and subsequent career advancement
Wu et al. (2015)	USA	Patents and licences	(1) How individual and institutional factors affect the licensing of university patents?	(1) The results highlight that individual factors play a more critical role in university licensing than institutional factors; (2) Licensing patents is influenced by three individual-level factors: attitude towards research commercialisation, engagement in follow-up work on patent application and collaboration with industry scientists; (2) Among the institutional factors, the results found support for one institutional factor – TTO cost-saving practices; (3) There is no support industry funding and TTO service effectiveness
Zahari et al. (2018)	Malaysia	University Spin-off	(1) Do the founders' characteristics contribute to spin-off intentions? (2) What is the effect of university roles on spin-off intentions?	(1) The results prove that four from five variables within the founders' characteristics positively influence the student spin-off intentions, namely, need for achievement, innovativeness, a propensity for risk-taking and self-efficacy. There was no evidence support for the locus of control; (2) The study had no support to demonstrate that university roles are significant to student spin-off intentions.
Zollo et al. (2017)	Italy	University Spin-off	(1) What behavioural and contextual factors affect entrepreneurial attitude and entrepreneurial intention?	(1) Students' entrepreneurial intention is determined mainly by Entrepreneurial attitude, which is in turn influenced by the personality traits, in particular, risk-taking propensity and locus of control; (2) Contextual variable expressed by the University slightly influences students' attitude and intention

Abbreviations: Academic Entrepreneurship (AE); Knowledge and Technology Transfer (KTT); Technology Transfer Office (TTO); Theory of Planned Behaviour (TPB); United Kingdom (UK); United States of America (USA); University-Industry Collaboration (UIC)

CHAPTER 3

Academic Entrepreneurship: The drivers of academics' engagement in spin-offs creation, patenting, and university-industry collaboration

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Abstract Universities have been committed to valorising knowledge outside academia. A key element in this process involves understanding what drives academics to engage in entrepreneurship activities. This research explores the academics' intentions by considering the characteristics and strategies of the universities where they are embedded. The empirical research involved a survey collection from 466 academics at three Portuguese universities (the University of Aveiro, the University of Minho, and the University of Porto) regarding their entrepreneurial intentions and perceived university support. The study employed a Partial Least Square - Structural Equation Modeling (PLS-SEM) technique and analysed what motivations, social capital, human capital, support

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perception drive the academics entrepreneurial intentions for different activities: spin-off creation, patenting, engagement in joint research with industry, engagement in research contracts with industry, and consulting.

Further, the research also used secondary data to assess the universities' macro-level variables. With the support of the software QDA Miner Wordstat 8, the research included an analysis of the content of the universities' strategic policies reports using text mining tools to uncover universities focus and strategic objectives.

Keywords Academic entrepreneurship · Technology transfer · University-industry collaboration · Academic spin-offs · University patents · Structural Equation Model.

3.1 Introduction

Universities are well-recognised sources of knowledge (Miller et al., 2018). They are expected to create, transfer, and commercialise knowledge created from scientific research (Hayter et al., 2020). Over the last few decades, as a response to the growing demands of the knowledge-based economy (Blankesteijn et al., 2019) and reduction of public funding (Sam and van der Sijde, 2014), universities have undertaken significant transformation. This revolution led them to redefine their mission, restructure their organisation and research spectrum, and adapt the interaction with external stakeholders (Etzkowitz et al., 2019; Good et al., 2020). The new redefined mission incorporates the traditional teaching and research activities side-by-side with the so-called third mission, which encompasses innovation and entrepreneurship (Etzkowitz et al., 2000). Etzkowitz (1983) and Clark (1998) are among the first researchers to address the concept of Entrepreneurial University. For Etzkowitz (1983), the entrepreneurial university embraces the activities through which research outputs can be applied to the commercial environment. Clark (1998) describes entrepreneurial universities as those engaged in the inclusion of more useful knowledge through processes aimed at innovating how they manage their organisations.

In this context, universities currently face the challenge to determine the best way to integrate the three missions, making commercialisation a valuable contribution rather than just a burden on teaching and research (Rasmussen et al., 2006). The concepts of

"academic entrepreneurship" (Grimaldi et al., 2011; Hayter et al., 2017; Mathisen and Rasmussen, 2019) and "university technology transfer" (Lafuente and Berbegal-Mirabent, 2019; Siegel et al., 2003; Wright et al., 2004) are closely related to the concept of "entrepreneurial university". Nevertheless, the literature on the latter focuses on policy issues, while academic entrepreneurship emphasises management and entrepreneurship disciplines (Yusof and Jain, 2010).

The increasing number of scientific publications reveals that academic entrepreneurship is a vibrant research topic (Neves and Brito, 2020). Furthermore, scholars have argued that universities must assume a more strategic approach (Siegel and Wright, 2015), based on clear objectives for their initiatives (Klofsten et al., 2019), and adjust the strategic path to their characteristics (Giuri et al., 2019). In brief, it should reflect universities heterogeneity, avoiding the "one-size-fits-all" approach (Horner et al., 2019). This research recognises that entrepreneurship policy strategy should be tailored to and based on specific institutional contexts and actors (Fini et al., 2020). This research explores the academics' intentions to engage in academic entrepreneurship activities by taking into account the characteristics and strategies of the universities where they are embedded.

Academics, namely faculty members and researchers, are a critical element. The university management must be prepared to influence their intentions and attitudes (Dabic et al., 2015). Equally important, academic entrepreneurship is a multi-stage process model where universities must provide them with support systems within each phase (Markuerkiaga et al., 2019). Given this background, this research pretends to unveil the academic entrepreneurship black box by collecting data from both academics (individual level) and the university (organisational level). The empirical study involved a survey collection from 466 academics at three universities (the University of Aveiro, the University of Minho, and the University of Porto) regarding their entrepreneurial intentions and perceived university support. This individual-level data was further complemented with university-level data. We analysed the universities' strategic policies reports using text mining tools to uncover universities focus and strategic objectives. Additionally, to understand the university environment, other datasets were consulted, namely, the European Tertiary Education Register, Times Higher Education Ranking and InCites Clarivate Analytics.

In short, the study's main contribution is that it responds to calls to provide more corroboration of the interplay between different analysis levels (Abreu et al., 2016; Mosey et al., 2017) and to fill the research gap between the relationship. Extending the university's influence on academics (Gümüsay and Bohné, 2018), this paper pursued the recommendation of Balven et al. (2018) to scrutinise the micro-level processes. The study's framework is not restricted to only one knowledge transfer activity (Wang et al., 2021). Neither assumed the academic entrepreneurial intentions are the same regardless of the activity under consideration (Erikson et al., 2015). Therefore, we analysed motivations, social capital, human capital and support perception influence on academics' entrepreneurial intention considering different activities: spin-off creation, patenting, engagement in joint research with industry, engagement in research contracts with industry, and consulting. In conclusion, the paper meets the research gap to unravel entrepreneurial intentions within academia (Antonioli et al., 2016; Huyghe and Knockaert, 2016).

The paper is structured as follows. The following section focuses on the theoretical background. The evolution of entrepreneurial university is reviewed, and special attention is paid to the actors of this process and the activities that valorise the research results. Section 3.3 outlines the methodology for data collection and data analysis. Section 3.4 presents the findings and discusses the results. The paper ends with a synthesis of the main contributions, along with the limitations of the study and future research avenues.

3.2 Theoretical Background

3.2.1 Academic entrepreneurship

Academic entrepreneurship is the process where an academic or group of academics explore the knowledge created inside the university and mutually transfer it to organisations and the community in general (Bicknell et al., 2010; Francis-Smythe, 2008). Following Abreu and Grinevich (2013) and Wright et al. (2008), we consider academic entrepreneurship as the exploration of knowledge through academic spin-offs, patents and licensing activities or other activities that include collaboration with industry (Guerrero and Urbano, 2014). A University spin-off describes a new venture based on technology from research results, where the commercialisation process is initiated inside

the university (Rasmussen, 2011; Rippa and Secundo, 2019). The spin-off can also be created in patented technology (Baglieri et al., 2018; Phan and Siegel, 2006). Patenting research results provides a temporary monopoly to the commercial exploitation of knowledge (Bodas Freitas and Nuvolari, 2012). It has been consistently proven to predict a subsequent spin-off foundation (Krabel and Mueller, 2009; Stuart and Ding, 2006).

University-Industry (U-I) collaboration, sometimes referred to as informal channels (Halilem et al., 2017; Link et al., 2007), include joint research, research contract, and consulting (D'Este and Patel, 2007; Huyghe and Knockaert, 2015; Klofsten and Jones-Evans, 2000). Joint research is the research developed by the university and the industry; in contrast, a research contract is contracted by the industry and conducted solely by the university. These two activities create new knowledge. In turn, consulting is a contract from the industry, usually provided individually by academics (Perkmann and Walsh, 2008), and it does not require the creation of original research (D'Este and Patel, 2007). The knowledge derived from collaborations may expand the scientific knowledge base or focus on economic value production (Bozeman et al., 2013). Alongside the three main activities, other authors also include training company employees, creation of facilities, and meetings and conferences (Huyghe and Knockaert, 2015), student placement (Abreu and Grinevich, 2014; Sjöö and Hellström, 2019), exchange of equipment and purchase of prototypes developed at universities (Lee et al., 2000; Schartinger et al., 2002) within the university-industry collaboration activities (UIC) (Rasmussen et al., 2006).

Research findings of factors influencing academic entrepreneurship often point to individual factors, namely, personal characteristics (Hayter et al., 2018), educational background (Fini and Toschi, 2016), career, personal and pecuniary motivations (Antonioli et al., 2016; van de Burgwal et al., 2019; Perkmann et al., 2021) and academics human and social capital (Dietz and Bozeman, 2005; Mosey et al., 2012). A research stream has recently explored how the university shapes entrepreneurial intentions among academics. In this matter, research results underline the impact of support structures and climate (Bergmann et al., 2018; Moray and Clarysse, 2005), university quality (Di Gregorio and Shane, 2003), and strategy (Lockett et al., 2003).

3.2.2 Academics' intention and university orientation

The knowledge valorisation process is led bottom-up (Al-Tabbaa and Ankrah, 2019), under which academics play a vital role (Wright and Phan, 2018). The entrepreneurial academic is the individual who can generate new knowledge and who can better take the returns from that knowledge (Audretsch, 2004). Understanding their intentions is relevant, as intentions will allow academics to recognise the value of knowledge created (Qian and Acs, 2013). Additionally, they influence the decision to convert it into economically valuable knowledge (Guerrero and Urbano, 2014).

Entrepreneurial intention is the outcome of intrinsic and extrinsic motivations or benefits that the person expects to gain (Ryan and Deci, 2000). In a recent literature review, Neves and Brito (2020) categorise academic motivations into four topics: career, personal, pecuniary and moral. Among the various categories and especially within the career subtopic, advancing research is often singled out as a strong motivator for engaging in knowledge valorisation activities (Abreu and Grinevich, 2014; Baldini, 2011; Llopis et al., 2018). The academics' hybrid role pushes them to apply knowledge. In return, they expect to continue their research and publish (Dornbusch and Neuhäusler, 2015; Jain et al., 2009). Closely related, access to funding for their investigation is the most frequently suggested motivation within the literature (Ankrah et al., 2013; Hayter, 2011). In research to Australian academics, Holley and Watson (2017) reinforce that it is the leading motivator to commercialise research. Taking part in such entrepreneurial activities also brings additional motivations: access to equipment and facilities (Baldini, 2011; Ramos-Vielba et al., 2016), the possibility to apply for awards (Hayter, 2015), receiving feedback and information from industry (D'Este and Perkmann, 2011) and becoming part of a network (Lam, 2011).

The possibility of gaining a reputation, especially among the academic community, can make academics willing to participate (Civera et al., 2020; Goethner et al., 2012). Merton (1973) emphasised that peer recognition is the extrinsic reward of traditional scientific research (Goel et al., 2017). Peer and role models can help support and increase entrepreneurial intentions (O'Shea et al., 2005; Perkmann et al., 2013).

Lam's (2011) research suggests that besides personal income *'gold'* and career reputation *'ribbon'*, knowledge application and curiosity *'puzzle'* play a more decisive role in commercialising science. Therefore, access to personal income is a financial

motivation (D'Este and Perkmann, 2011), and *'puzzle'* comprises motivations as curiosity, joy and challenge (Bodas Freitas and Verspagen, 2017; Morales-Gualdrón et al., 2009).

Acknowledging that motivations can be an explanatory factor in entrepreneurial intention (cf. Liñán and Fayolle, 2015), we propose that:

Hypothesis 1: Motivations positively influence academics' entrepreneurial intentions.

Entrepreneurship research has considered the individual's social capital (Kim and Aldrich, 2005; Liñán and Santos, 2007) and human capital (Mosey et al., 2012; Unger et al., 2011) as antecedents of entrepreneurial intentions (Goethner et al., 2012; Karlsson and Wigren, 2012).

Social capital comprises the academics' networks to individuals, organisations and groups established through professional, personal or business social contacts (Foo et al., 2016; Tartari et al., 2012). It can benefit the academic by providing them with information, resources, and support (Prodan and Drnovsek, 2010). Further, it can also give them access to talent (Alvedalen and Boschma, 2017), to new potential markets (Spigel and Harrison, 2018) and act as an external stimulus (Al-Tabbaa and Ankrah, 2019; Fernández-Pérez et al., 2014). The literature has recognised that social capital plays a significant role in academics intention to: create a venture (Aldridge and Audretsch, 2011; Borges and Filion, 2013; Fernández-Pérez et al., 2015); patent research results (Wu et al., 2015) and engage in activities with industry partners (Maietta, 2015; Thune and Gulbrandsen, 2014).

The human capital theory argues that an individual's knowledge and skills improve their competence and productivity (Becker, 1980). Goethner et al. (2012) declare that human capital influences academics' intention via prior entrepreneurial and industrial experience, prior patenting experience and entrepreneurial education. A survey of Norwegian academics recently reveals that non-academic work experience has an encouraging effect on spin-off creation, patenting, and industry collaboration (Gulbrandsen and Thune, 2017).

In this context, we suggest the following hypotheses:

Hypothesis 2: Social capital positively influences academics' entrepreneurial intentions.

Hypothesis 3: Human capital positively influences academics' entrepreneurial intentions.

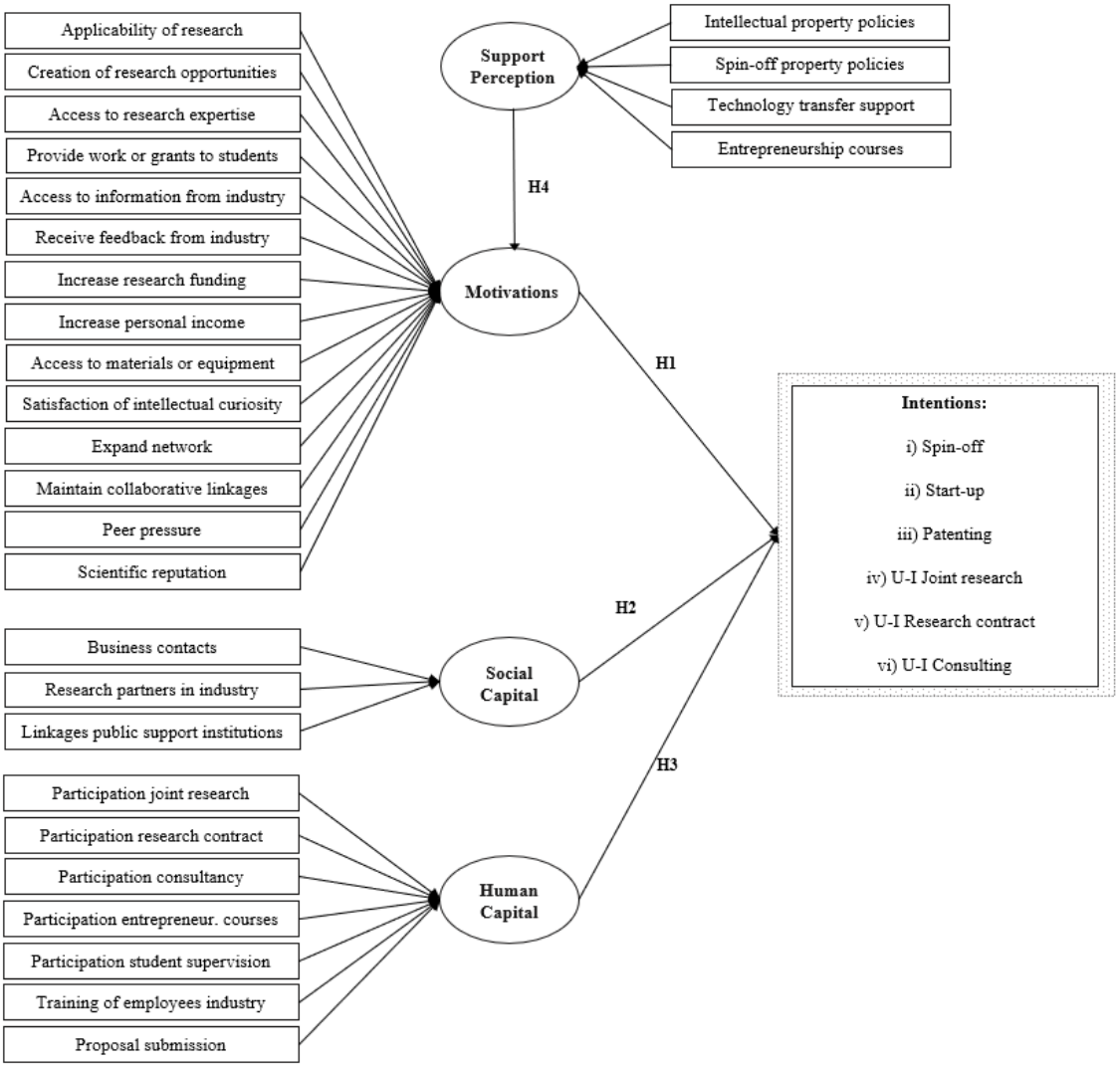
As previously stated, the university environment can shape entrepreneurial behaviour (Nelson, 2014). In this respect, universities have put in place structures to support the commercialisation of research results. The establishment of a technology transfer office represents one of the most common initiatives to stimulate entrepreneurial activities (Muscio et al., 2016). Universities have also established incubators and accelerators (Guerrero et al., 2017; Pauwels et al., 2016) and science and technology parks (Löfsten and Lindelöf, 2002; Phan et al., 2005). Aside from the infrastructures, universities can offer courses, training, and seminars. This entrepreneurship education develops the academics' entrepreneurial skills, increasing human capital (Passaro et al., 2018) while creating an entrepreneurial culture (Prodan and Drnovsek, 2010).

The literature provides evidence of other determinants. It has been claimed that intellectual property policy and spin-off policy positively affect academics' support perception (Munari et al., 2016) and their positive or negative attitude towards knowledge valorisation activities (Trivedi, 2016). Muscio et al. (2016), with data from 62 universities, empirically demonstrated that the academic entrepreneurial output is more significant for those universities that design a clear strategy. In this way, the following hypothesEs emerges:

Hypothesis 4: Support perception positively influences academics' motivation.

According to the literature review and stated hypotheses, we propose the following research framework (Figure 3.1).

Figure 3.1 Research Framework



3.3 Research Methodology

3.3.1 Data collection

Data collection was conducted at different levels by using various techniques, mitigating common method bias. A web survey was developed using the LimeSurvey platform to gather individual data and empirically test the research framework. Before implementing the survey, a pilot study was conducted (Dillman et al., 2011). Based on the comments, minor revisions were considered and incorporated in the design of the final version. The web survey was disseminated through e-mail to academics (lecturers, researchers, and

doctoral students) enrolled in four selected universities in Portugal's northwest region. The e-mail guarantees anonymity to mitigate the tendency to provide socially desirable answers (Podsakoff et al., 2003). Data collection took place between November and December 2020 in four Portuguese universities: University of Aveiro (hereafter referred to as UA), University of Minho (UM), University of Porto (UP) and University of Trás-os-Montes and Alto Douro.

The research also used secondary data to assess the universities' macro-level variables (Holstein et al., 2018). With the support of the software QDA Miner Wordstat 8, we analysed the content of the universities' strategic policies reports using text mining tools to uncover universities focus and strategic objectives. Additionally, other sources were consulted. European Tertiary Education Register (ETER) dataset to gather information regarding university characteristics, Times Higher Education (THE) Ranking to collect data on teaching quality and InCites Clarivate Analytics tool to compile records regarding research quality indicators such as publications, citations, number of doctoral graduates and research income from industry.

3.3.2 Measures

The survey compiled 30 variables clustered under five constructs. All variables have theoretical support in the literature (see Appendix 3A).

To understand academics' motivational factors to engage in knowledge transfer activities, they were asked to rate the importance, on a 7-point Likert scale, of several reasons: 1. Applicability of research; 2. Creation of future research opportunities; 3. Access to research expertise; 4. Provide work placement or grants to students; 5. Access to information on industry problems and research; 6. Receive feedback from the industry; 7. Increase funding for research; 8. Increase personal income; 9. Access to materials and equipment; 10. Satisfaction of intellectual curiosity; 11. Expand network; 12. Peer-pressure; 13. Maintain collaborative contacts, and 14. Gain additional scientific reputation. To analyse behaviour, studies recommend a 7-to-10-point Likert scale (Guerrero and Urbano, 2014).

To capture Social Capital, the survey applied three variables from Goethner et al. (2012) study. In a 7-point Likert scale, the variables undercover the academics' agreement with: "I have business contacts in the industry "; "I have contacts with research partners

in the industry" (original scale from Krabel and Mueller (2009)); and "I have contacts of public agencies that support technology transfer and the valorisation of research results" (adapted from the original scale from Liao and Welsch (2005)).

Lastly, to assess Human Capital, the survey asked about the frequency of participation for seven activities in the last three years: 1. New joint research contract; 2. New contract research; 3. New consultancy contract; 4. Training of employees from the industry sector; 5. Supervision of students of post-graduate studies undertaken within a corporate context; 6. Participation in courses and training on entrepreneurship; and 7. Submission of proposals, in partnership with business sector entities, to international funding programmes.

As perceived support can influence climate and intentions (Clauss et al., 2018; Filippetti and Savona, 2017), and this research investigates academics intentions from different universities, one additional question was added. As recommended in Guerrero and Urbano (2014), the survey questioned academics' agreement, in a 7-point Likert scale, if their organisation: 1. Has clear rules for intellectual property; 2. Has clear rules for the creation of spin-offs; 3. Offers support for technology transfer; and 4. Offers entrepreneurship courses for students and researchers.

Finally, the dependent variables for Intentions (7-point Likert) were measured with the question "How likely is that, in the foreseen future, you will…" and included two items for venture creation: 1. Create a spin-off?; and 2. Create a start-up? (Krueger et al., 2000); Patenting intentions: 3. Apply for a patent resulting from research? and three questions for university-industry collaboration: 4. Engage in joint research with the industry?; and 5. Engage in contract research with the industry? and 6. Engage in consulting activities with the industry?" (Huyghe and Knockaert, 2015). Although Krueger et al. (2000) did not discriminate spin-off from start-up intentions, this study considers that spin-off describes a firm based upon research results. In contrast, the start-up represents any company (Huyghe et al., 2016).

3.4. Findings and Discussion

3.4.1 Descriptive statistics

Complying with Goldstein (2010) and Hox (2010) recommendations, the research excluded one university as it did not fulfil a minimum of 50 respondents. Even though PLS-SEM allows complex models to be estimated with small sample sizes, Hair et al. (2017, p. 22) noted that "small sample size is probably the most often abused argument with some researchers using PLS-SEM with unacceptably low sample sizes (…) these researchers oftentimes believe that there is some «magic» in the PLS-SEM approach that allows them to use a very small sample".

From 587 respondents, the analysis excluded respondents from that university (34), respondents who did not identify their university (11) and those with other missing data (76). The final sample consisted of 466 academics from the three universities mentioned before: University of Aveiro (N = 116), University of Minho (N = 133) and University of Porto (N = 217).

IBM SPSS Statistics 27 was used for descriptive analysis and cross-tabulation. In general terms, 54.5% of the academics were male, 79.8% had a doctoral degree, and 63.7% simultaneously were enrolled in teaching and research activities. The majority were in the age range of 41 and 50 years old (26.6%) or between 31 and 40 years old (25.8%). The largest group worked in Engineering and exact sciences (44%), whereas 27.9% worked in Social science and humanities.

Taking a closer look at each university separately, the University of Aveiro has a greater representation of male academics (65.5%) than the other two universities (UM = 50.4% and UP = 51.2%). The University of Porto holds 44.3% of academics under 40 years old. In contrast, 55.7% of the academics from the University of Minho declare they have between 40 and 60 years. Detailed data per university are presented in Table 3.1.

The intentions to research commercialisation (spin-off, start-up, and patenting) are less frequent than the intentions to engage with the industry (joint research, research contract and consulting). Overall, the academics revealed a moderate likelihood for creating ventures (14.2% for spin-off and 17.2% for start-up) and slightly higher for patenting (19.1%). On the other hand, the proportion of academics who say they wish to engage in UIC activities is significantly higher: 56.4% intent to engage in joint research, 51.3% in consulting activities and 44.7% in research contracts the industry.

Table 3.1 Descriptive statistics

	University of Aveiro	University of Minho	University of Porto
Respondents	116	133	217
Gender (%)			
Male	65.5	50.4	51.2
Female	34.5	49.6	48.8
Age (%)			
≤ 30 years	9.5	15.8	18.0
31 - 40 years	30.2	21.1	26.3
41 - 50 years	31.9	28.6	22.6
51 - 60 years	11.2	27.1	20.7
> 60 years	17.2	7.5	12.4
Activities (%)			
Teaching	1.7	2.3	6.5
Research	27.6	24.1	39.6
Teaching and research	70.7	73.7	53.9
Scientific discipline (%)			
Engineering and exact sciences	50.9	42.9	41.0
Life and health sciences	19.8	19.5	18.0
Natural and environmental sciences	13.8	9.0	6.9
Social science and humanities	15.5	28.6	34.1
Degree (%)			
Phd	90.5	82.7	72.4

Regarding the gender of the academic, males demonstrate a greater predisposition to get involved whatever the mechanism. For example, on average, 42.3% of women reveal they are likely to participate in IUC activities, while males' frequency rises to 57.9%. As regarding age, younger academics exhibit a greater predisposition to create spin-offs than the elder. 23.3% of academics between 31 and 40 years and 15.5% of academics under 30 years, compared with 7.0% for academics over 60 years old. In the same line, start-up intentions are more frequent among younger academics. They have a greater probability than spin-offs (23.94% for academics under 30 years and 20% between 31 and 40 years old).

Lastly, all ages display a higher predisposition to UIC activities than the remaining three activities. The age range between 31 and 40 has a higher expression of intention likelihood, with an average of 58.3% (64.2% for joint research, 51.7% for research

contract and 59.2% for consulting). The results for the influence of academics' scientific discipline on intentions are consistent with the literature (Gulbrandsen and Thune, 2017; Iorio et al., 2017; Moog et al., 2015). Academics from Social studies and humanities are the ones who exhibit the slightest intention in patenting yet are the ones who display the strongest intention in consulting (57.7%). Life and health science academics are more likely to create companies, whether spin-off (20.4%) or start-up (18.2%). To conclude, patenting intentions are more expressed among academics in Natural and environmental science (37.2%), followed by engineering and exact science (22.9%) (for a comprehensive view of data, see Appendix 3B).

Entrepreneurial universities are committed to providing the necessary conditions and reinforcing the support that enables academics to achieve multiple objectives, from research excellence to industry engagement and public engagement (Dolan et al., 2019). The research explored the academics' perception of the support provided by their university. The results reveal differences among the support mechanisms, and the perception differed depending on the academic's scientific discipline. Natural and environmental science academics strongly agreed that their universities have clear spin-off policies (48.6%). On the other hand, academics from the Social science and humanities field disagree (36.4%). Surprisingly, approximately one-third of academics neither agree nor disagree regardless of their scientific area. It would be interesting to look into this further to determine if the academics are not engaging with these institutions that promote and support spin-off creation, whether the universities are falling short of communicating, or even if there is a whole other explanation. The ratings are more favourable on the perception that the university offers support for technology transfer. Almost half of the academics from Engineering and exact sciences (49.7%, with 16.2% saying that they strongly agree) and from Natural and environmental sciences (48.6%) agree on this matter. Lastly, regarding the offer of entrepreneurship courses by the university, the perceptions are significantly split and without differentiation between scientific areas. In general, 38.4% considers their university does not offer entrepreneurship courses, and 36.6% believes that it does.

The literature claims that organisational factors (university-level) influence individual factors (academic-level) (Fini et al., 2020; Wright et al., 2017). Table 3.2 provides information on the universities' structure, climate, quality, and strategy.

Table 3.2 University structure, climate, strategy and quality

	University of Aveiro	University of Minho	University of Porto
(a) University Structure			
Year foundation	1973	1973	1911
Size [1]	1543	1334	3140
(b) Climate (%)			
Commercial orientation [2]	38.06	57.60	35.55
(c) University strategy focus (%)			
Teaching	43.28	47.85	45.38
Research	39.52	27.98	35.29
Entrepreneurial Activities	17.2	24.16	19.33
(d) Quality			
Papers per academic and research staff, normalised [3]	72.79	26.54	53.5
Doctoral degree per academic staff, normalised [3]	59.09	51.98	48.29
Category normalised citation impact [3 ' 4]	1.11	1.13	1.4
Teaching quality [5]	4.13	5.3	15.3

Note: [1] Academic staff headcount, data from 2016. Source: ETER; [2] The institution's research income from industry is divided by the number of academic staff ($\bar{x}$ 2016-2020); Source: Incites. [3] Data representing the mean value between 2016 and 2020. Source: Incites; [4] Calculated by dividing the actual count of citing items by the expected citation rate for documents with the same document type, year of publication and subject area ($\bar{x}$ 2016-2020); [5] Source: Times Higher Education (THE), mean values between 2016 and 2020.

The University of Porto is older and has more academic staff than the other two. Commercial orientation, expressed as the universities' research income from industry, has a greater weight in the University of Minho (57.6%); the other two have more moderate values (UA = 38.1% and UP = 35.6%). The economics literature argues that research quality may be a driver of entrepreneurship (Renault, 2006). In this field, the percentages of doctoral degree holders are similar among the universities under study; the number of papers published is higher at the University of Aveiro, yet the citations' impact and teaching quality are considerably higher at the University of Porto.

Lastly, the study analysed the content of the universities strategic reports through a text mining approach. Data mining identifies patterns in large and complex data sets (Hand and Adams, 2014). Text mining is the discovery of knowledge from textual data (Berry, 2004). Following Miner et al. (2012), the first step is the collection of documents. For each university, we use the report preceding the current one. There is a time lag between two and five years since the strategy implementation and its effect on academics' behaviour (Guerrero et al., 2015). Secondly, we proceeded to data preparation and transformation and indexed it to QDA Miner Wordstat 8 software. QDA Miner is a software for computer-assisted qualitative data analysis, to which WordStat is an add-on

program that provides a meaningful quantitative addition (Pollach, 2011). The software identified words that share semantic meaning through concept extraction in the context in which the words appear (Miner et al., 2012) and grouped the text into three clusters (Teaching and Education, Research activities and Third Mission), featuring their frequency in the text. A higher frequency can represent an increased focus of that cluster in the university's strategy (see above Table 3.2). Teaching and research assume the principal role in the objectives of each university. Together they assume an average of 79.8% (UA = 82.8%, UM = 75.8% and UP = 80.7%). The University of Minho places less emphasis on research matters (28%) but has the highest frequency for entrepreneurial activities (24.2%).

3.4.2 Empirical analysis

Over many years, social science scholars have relied on factor analysis and multiple regressions to analyse their research variables' relationships. More recently, this tendency has been inverted as an increasing body of authors turn to Composited-based Structural Equation Modeling (CB-SEM) (Audretsch and Belitski, 2017; Bergmann, 2017; Urban and Chantson, 2019) and Partial Least Squares - Structural Equation Modeling (PLS-SEM) (Hair et al., 2017). PLS-SEM was introduced by Wold (1980) as a complement to CB-SEM, focusing on prediction while lowering the constraints on data and relationship specification (Hair et al., 2017). When estimating the model, PLS-SEM considers the overall variance of the indicators (Tenenhaus et al., 2005), so its purpose is to generate latent variables scores that minimize the residuals of the models' Ordinary Least Squares (OLS). Richter's et al. (2016) remarks encapsulate well the definition and goal of this method: "PLS-SEM is a variance-based method that estimates composites representing latent variables in path models" (p. 589).

Structural Equation Modeling has grown in notoriety due to the method's capacity to evaluate the measurement of multi-item latent variables, not directly observable, while simultaneously testing relationships between them and those defined by the conceptual model, directly observed (Babin et al., 2008; Hair et al., 2014). Hair et al. (2017) emphasised that this is particularly interesting in the management field, which typically examines unobservable phenomena such as attitudes, perceptions, and intentions.

The analysis is divided into two phases. First, we used factor analysis to assess the measurement scale's validity and reliability. Second, we used PLS-SEM to examine which factors best explain academics' intention to entrepreneurial activities.

Before starting the first phase, the study underwent a thorough data treatment and addressed potential inconsistencies that would limit the PLS-SEM's correct execution. Our data included 14 variables to measure Motivations and seven variables to measure Human Capital. The high number of arrows pointing to a construct will likely yield inappropriate and mismatched results (Cohen, 1992).

Accordingly, we conducted a preliminary factor analysis with Varimax rotation to determine the required number of factors to comply with this requirement. Intentions, Social Capital and Support Perception, remained as a single factor. As expected, modifications were made to Motivations and Human Capital constructs. Secondly, we assessed the potential multicollinearity between the variables using a bivariate correlation matrix. To cross-check the results from the bivariate correlation, we calculated the variance inflation factor (VIF), a related indicator of collinearity. The conservative approach recommends withdrawing those VIF scores above three (Hair et al., 2016).

Considering these two procedures, we eliminated two motivation items: access to information from industry and motivation to maintain collaborative linkages; one item from support perception: clear IPR policies; and one item from intentions: intention to start-up. Even though we believed that we could encounter variations between the intentions to create a start-up and a spin-off, we found a high correlation between these two variables. In this manner, we shall agree with Krueger et al. (2000), mentioned in the Theoretical Background chapter, and refrain from discriminating between spin-off and start-up intentions.

After eliminating the four variables, the most accurate approach is to conduct a new factor analysis. This new factorial analysis revealed that our 30 variables could be arranged into eight components, explaining 64.5 per cent of the variance after retaining only those factors whose eigenvalues were above one. Table 3.3 displays the results, along with the percentage of variance extracted and the loadings from those items (for complete data, see Appendix 3C).

Table 3.3 Matrix of the eight components extracted using the principal component analysis and the varimax rotation.

	1	2	3	4	5	6	7	8
Int4	0.788							
Int1	0.785							
Int5	0.755							
Int3	0.744							
Int6	0.644							
Mot10		0.751						
Mot11		0.748						
Mot3		0.639						
Mot2		0.619						
Mot1		0.481						
Mot6		0.448						
Mot7			0.820					
Mot4			0.746					
Mot9			0.646					
HC2				0.769				
HC1				0.758				
HC7				0.588				
HC3				0.517				
Supp3					0.885			
Supp2					0.812			
Supp4					0.809			
SC3						0.778		
SC2						0.715		
SC1						0.691		
HC4							0.742	
HC5							0.715	
HC6							0.629	
Mot13								0.827
Mot14								0.527
Mot8								0.493
% variance explained	21.65	13.64	6.96	5.72	5.03	4.00	3.88	3.58

We analysed Barlett's test of sphericity. Our data shows that we obtained $\chi^2 = 6148.414$ with 435 degrees of freedom. Since the *P*-value = 0.000, we reject the null hypothesis, reiterating that the data set was suitable for factor analysis. The Kaiser-Meyer-Olkin value tests also confirmed the factor analysis methodology's suitability as a sampling methodology (KMO = 0.793 at a significance of 0.000).

Validation of the scale

We conducted eight factors analyses, one for each factor, to scrutinize the multi-item factors' one-dimensionality. The analyses extracted only one factor in all cases,

confirming that our approach was adequate. Further, the reliability analysis results are shown in Table 3.4. The factors demonstrated good values of Cronbach's alpha (Hair et al., 2017), exception made for two factors (Cronbach's alpha = 0.663), even so, they are is still within an acceptable range ($\alpha > 0.5$). Composite Reliabilities and Average Variances Extracted were above recommended thresholds, of 0.70 and 0.50, respectively (Fornell and Larcker, 1981).

Table 3.4 Reliability of the scales

Factor	Item	Loadings	Reliability analysis
Intentions	Int1	0.769	Cronbach's alpha: 0.849
	Int3	0.687	Composite reliability: 0.893
	Int4	0.868	Average variance extracted (AVE): 0.628
	Int5	0.857	
	Int6	0.767	
Motivation knowledge-exchange	Mot1	0.713	Cronbach's alpha: 0.800
	Mot2	0.812	Composite reliability: 0.861
	Mot3	0.709	Average variance extracted (AVE): 0.510
	Mot6	0.656	
	Mot10	0.684	
	Mot11	0.699	
Motivation support-to-research	Mot4	0.825	Cronbach's alpha: 0.761
	Mot7	0.856	Composite reliability: 0.867
	Mot9	0.803	Average variance extracted (AVE): 0.686
Human Capital Industry	HC1	0.765	Cronbach's alpha: 0.663
	HC2	0.797	Composite reliability: 0.816
	HC3	0.620	Average variance extracted (AVE): 0.528
	HC7	0.711	
Support Perception	Supp2	0.844	Cronbach's alpha: 0.805
	Supp3	0.903	Composite reliability: 0.887
	Supp4	0.802	Average variance extracted (AVE): 0.724
Social Capital	SC1	0.873	Cronbach's alpha: 0.779
	SC2	0.896	Composite reliability: 0.874
	SC3	0.730	Average variance extracted (AVE): 0.699
Human Capital Academia	HC4	0.713	Cronbach's alpha: 0.585
	HC5	0.801	Composite reliability: 0.792
	HC6	0.728	Average variance extracted (AVE): 0.560
Motivation personal benefits	Mot8	0.754	Cronbach's alpha: 0.662
	Mot13	0.785	Composite reliability: 0.820
	Mot14	0.789	Average variance extracted (AVE): 0.602

The names of the three motivational factors were inspired by Baldini's (2011) work.

PLS-SEM Path Modeling

The research framework presented above (Figure 3.1) was reformulated to encompass the factors that resulted from the factorial analysis. This change has led to the creation of

higher-order constructs in the path model under SmartPLS software (Figure 3.2). Higher-order constructs allow scholars to summarize the independent constructs in a higher-order construct and "provide a means for reducing collinearity among formative indicators by offering a vehicle to re-arrange the indicators and/or constructs across different concrete subdimensions of the more abstract construct" (Sarstedt et al., 2019, p. 198).

We adopted the two-stage approach (Ringle et al., 2012; Wetzels et al., 2009), particularly the disjoint two-stage approach (Sarstedt et al., 2019), and built a formative-formative type IV model (Becker et al., 2012).

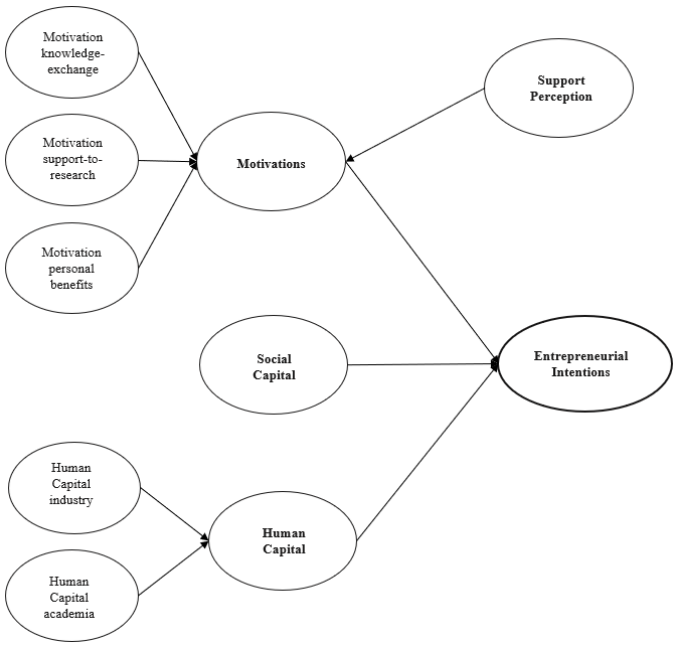


Figure 3.2 Revised Framework

After constructing the path model, we reviewed the measurement model through collinearity and the relevance of formative indicators. According to the PLS algorithm results, collinearity was not a concern. Later, we assessed the significance of formative indicators' outer weights and loadings to determine their relevance. Table 3.5 displays the size and significance of the weights generated using the bootstrapping procedure. Following Streukens and Leroi-Werelds (2016) recommendation, we performed the bootstrapping procedure with 10.000 subsamples.

Table 3.5 Statistical properties of formative constructs

Higher-order constructs	Lower-order constructs / items	Weights	VIF
Motivations	*Motivation knowledge-exchange*	0.891***	1.120
	Mot1: Applicability of research	0.404***	2.029
	Mot2: Creation of future research opportunities	0.251*	2.291
	Mot3: Access to research expertise	0.009	1.612
	Mot6: Receive feedback from industry	0.696***	1.550
	Mot10: Satisfaction of intellectual curiosity	0.045	1.711
	Mot11: Expand network	0.197*	1.681
	Motivation support-to-research	0.182*	1.131
	Mot4: Provide work placement or grants to students	0.563*	1.585
	Mot7: Increase research funding	0.255**	1.726
	Mot9: Access to materials or equipment	0.416**	1.487
	Motivation personal benefits	0.225**	1.113
	Mot8: Increase personal income	0.195*	1.263
	Mot13: Peer pressure	0.422***	1.323
	Mot14: Gain additional scientific reputation	0.544***	1.331
Human Capital	*Human Capital Industry*	0.773***	1.155
	HC1: Joint research contract	0.272*	1.436
	HC2: Contract research	0.229***	1.500
	HC3: Consultancy	0.838***	1.186
	HC7: Submission of proposals	0.495***	1.289
	Human Capital Academia	0.411***	1.155
	HC4: Training of employees	0.221*	1.179
	HC5: Supervision of students	0.470***	1.292
	HC6: Participation in courses on entrepreneurship	0.604***	1.198
	Social Capital		
	SC1: Business contacts	0.320***	2.135
	SC2: Research partners in industry	0.554***	2.283
	SC3: Linkage public support institutions	0.302***	1.323
	Support Perception		
	Supp2: Rules for the creation of spin-offs	0.587**	1.874
	Supp3: Supports for technology transfer	0.196*	2.304
	Supp4: Offers entrepreneurship courses	0.410*	1.589
	Intentions		
	Int1: Create a spin-off	0.248***	1.898
	Int3: Apply for a patent	0.129	1.699
	Int4: Engage in joint research with industry	0.320***	2.688
	Int5: Engage in contract research with industry	0.314***	2.704
	Int6: Engage in consulting activities with industry	0.310***	1.946

Note: Significance level: * $p < 0.1$: ** $p < 0.05$; *** $p < 0.01$; VIF = Variance Inflation Factor

Lastly, after assessing and evaluating the formative measurement model, this study pursued the steps outlined by Hair et al. (2016) to evaluate the Structural Model. We examined the structural model for collinearity, applying the same measure we used to measure the formative measurement models (VIF values), which were all below the

threshold. Afterwards, we confirmed that the standardized root mean square residual (SRMR) fulfilled the requirements of being lower than 0.08 (SRMR = 0.068) (Henseler et al., 2016). The SRMR is a model fit commonly used in CB-SEM and has been revealed to be effective with PLS-SEM (Henseler et al., 2014). Further, we assessed the patch coefficients, the level of R^2, the f^2 effect, and the predictive relevance of Q^2.

We checked the results for the coefficient of determination (R^2 value = 0.416) and for f^2 effect size (all values were above the threshold) (Chin. 2010). Values below 0.02 indicate no effect (Hair et al., 2019; Chin, 1998).

Higher path coefficients are more powerful predictors (Manley et al., 2020), yet values above 0.2 are good indicators within management topics (Hair et al., 2016). As confirmed in Figure 3.3, all hypothesized relationships among the constructs were above the reference value.

The predictive relevance of Q^2 was obtained by using the blindfolding procedure (Hair et al. 2016) and calculated by the cross-validated redundancy approach (Sarstedt et al., 2014). The value of Q^2 suggests that the model has predictive relevance ($Q^2 = 0.222$).

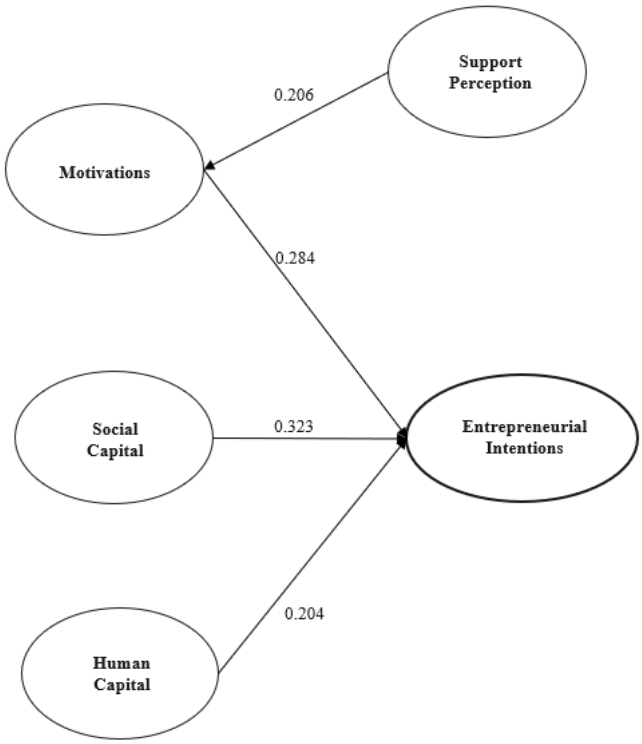


Figure 3.3 Path Coefficients (Complete sample)

The structural paths from Motivation, Social Capital and Human Capital to Entrepreneurial Intentions were validated. We found a significant and positive relationship between intentions and motivations (β = 0.284, $p < 0.01$), social capital (β = 0.323, $p < 0.01$), and human capital (β = 0.204, $p < 0.01$), thus supporting H1, H2 and H3. We also find support for H4, with a significant, positive relationship between support perception and intentions (β = 0.206, $p < 0.01$).

This research also aimed to validate this model for each of the three different universities. Table 3.6 presents the summary of the hypothesized relationships and the path coefficients for all universities under study (complete path coefficients, including lower-order variables, see Appendix 3D).

Table 3.6 Summary of PLS-SEM results and hypotheses confirmation

Hypothesized relationships	β	Hypothesis supported
U. Aveiro		
H1: Motivations → Intentions	0.378***	Yes
H2: Social Capital → Intentions	0.201**	Yes
H3: Human Capital → Intentions	0.264***	Yes
H4: Support perception → Motivations	0.294	No
U. Minho		
H1: Motivations → Intentions	0.383***	Yes
H2: Social Capital → Intentions	0.445***	Yes
H3: Human Capital → Intentions	0.010	No
H4: Support perception → Motivations	0.365***	Yes
U. Porto		
H1: Motivations → Intentions	0.231***	Yes
H2: Social Capital → Intentions	0.278***	Yes
H3: Human Capital → Intentions	0.290***	Yes
H4: Support perception → Motivations	0.200	No
Complete (all three universities combined)		
H1: Motivations → Intentions	0.284***	Yes
H2: Social Capital → Intentions	0.323***	Yes
H3: Human Capital → Intentions	0.204***	Yes
H4: Support perception → Motivations	0.206***	Yes

Note: Significance level: ** p < 0.05; *** p < 0.01; β = path coefficient.

As shown in Table 3.6 we did not find support perception to positively affect academics' entrepreneurial intentions at the University of Aveiro (β = 0.294, $p = 0.253$) and the University of Porto (β = 0.200, $p = 0.287$). As for the University of Minho, we could not

confirm that Human Capital positively impacts entrepreneurial intentions ($\beta = 0.010$, $p = 0.952$).

Regarding Motivation, the lower-construct motivation for knowledge-exchange accounted greatly for the higher-construct Motivations in all three universities (UA: $\beta = 0.347, p < 0.01$; UM: $\beta = 0.338, p < 0.01$; UP: $\beta = 0.414, p < 0.01$). Notwithstanding, the University of Minho presented a significant and higher power for motivations associated with supporting research ($\beta = 0.382, p < 0.01$). It may represent a new attitude towards the figures reported above in Table 3.2. UM was among the three universities with the lowest number of papers per academic and research staff. In addition, Research also featured the smallest proportion within this university's strategic focus. Remarkably, the University of Minho is the only university where we could confirm that Support perception positively impacts motivation intentions ($\beta = 0.365, p < 0.01$).

In the case of these universities and considering the significant and positive effects, our data revealed interesting insights. Concerning the academics at the University of Aveiro, the highest significant positive effect is between motivations and intentions ($\beta = 0.378, p < 0.01$). Despite the effect of social capital ($\beta = 0.201, p < 0.05$) and human capital ($0.264, p < 0.1$), their entrepreneurial intentions are intensely influenced by motivations linked to the opportunity to knowledge-exchange (in particular, the motivation to receive industry feedback: $w = 0.776, p < 0.01$) and moderately influence by prospect of personal benefits ($\beta = 0.217, p < 0.05$). The construct score for entrepreneurial intentions at UA is greatly explained by the intention to create a spin-off ($w = 0.511, p < 0.05$).

From the University of Minho dataset, we realise that the highest significant positive effect is from social capital to intentions ($\beta = 0.445, p < 0.01$). In other words, the academics' businesses networks and partnerships have a high effect on their entrepreneurial intentions. This academics' network, especially having research partners working in the industry ($w = 0.621, p < 0.01$), strongly supported the social capital construct. The entrepreneurial intention construct is significantly explained by the intention to engage in joint research with the industry.

When analysing the samples of the three universities separately, as already stated, this university was the only one where we could support Hypothesis 4 which states that the university support perception has a positive and significant effect on the academics

entrepreneurial intentions. This university also exhibited a considerably higher commercial orientation, research income by academic staff (Table 3.2), than the other two. In the future, we consider this a point to be explored.

Lastly, at the University of Porto, we found that the highest significant positive effect is from human capital to intentions ($\beta = 0.390$, $p < 0.01$). The academics' past experience, both in the industry ($\beta = 0.573$, $p < 0.01$) and academia ($\beta = 0.396$, $p < 0.01$), is an explanatory force on their entrepreneurial intentions. In some detail, their experience with the submission of proposals, in partnership with business sector entities, to international funding programmes ($w = 0.506$; $p < 0.01$) is the item that most explains the Human Capital Industry construct. On the other hand, for Human Capital Academia is the supervision of students of post-graduate studies undertaken within a corporate context ($w = 0.558$; $p < 0.01$). This university shows similar weights for three entrepreneurial activities portraying their entrepreneurial intentions: intention to engage in consultancy activities ($w = 0.385$; $p < 0.05$), intention to engage in joint research ($w = 0.376$; $p < 0.05$) and intention to engage in research contract with industry ($w = 0.330$; $p < 0.05$). The three activities fall within the so-called university-industry collaboration activities.

Considering these findings, it confirms that different reasons affect the academics' entrepreneurial intentions and strengthen the university's necessity to adapt to its academics with the more appropriate tools.

3.5 Conclusions

Universities have a complex range of purposes to accomplish. One of them is the commitment to valorising knowledge outside academia. Considering that understanding the academics' involvement is crucial, this study sought to explore the statement that academics have distinct motivations, social capital and human capital, which influence their intentions.

We found theoretical validation for all four Hypotheses. With this research, we put in evidence that motivations, social capital, human capital and the perception of support from their universities affect academics' intentions. In the survey results from 466 academics from three universities, we demonstrated that motivations consistently

influence the academics' intentions (Hypothesis 1). Secondly, social capital also has a positive impact on academics' intentions (Hypothesis 2). As documented in the literature (Muscio et al., 2021; Wu et al., 2015), we observe that academics with higher social capital tend to report higher entrepreneurial intentions. Our findings indicate that the university management could undertake some actions to facilitate the leverage of social capital among their researchers and, indirectly, exert a positive influence on intentions. We propose some networking events, establishing a network of alumni entrepreneurs and a mentoring network.

We find support for Hypothesis 3, which proposed that human capital influences academics' intentions. Hypothesis 4, which claimed that the academics' perception of university support could affect motivations, has also been supported.

Academics are the backbone of the university's entrepreneurial transformation, and we have opened up this black box slightly to demonstrate what is driving academics to engage. In addition to further exploring the drivers behind academics' engagement in the university's third mission (Balven et al., 2018), another contribution of this research is that we have adopted an extensive view of academic entrepreneurship, including several entrepreneurial activities: spin-offs, patenting, joint research, research contract and consultancy. Policies that intend to bring out more empowered science and technology linkages must consider various knowledge transfer activities (D'Este and Patel, 2007). The conceptual model became even more robust after keeping with recommendations to include social capital (Fini and Toschi, 2016) and human capital (Moog et al., 2015) as determining entrepreneurship factors.

This framework was designed with literature-based survey questions and scales, which can now be applied by other scholars in new research avenues or by university managers in practical use. Standardised measures that ensure academic-level data collection allow policymakers to reach an improved judgement on academics profiles and channels of collaborations (Perkmann et al., 2013, 2021)

In practice, university policymakers successful decisions demand informed knowledge about what the academics seek, so the university can tailor entrepreneurial strategies to specific organisational contexts (Fini et al., 2020) and operationalise strategic priorities (Horner et al., 2019). Moreover, this information regarding what drives

academics' intentions allows informing the university managers when and how to support academic entrepreneurship (Sandström et al., 2018).

Future research could use the scale to broaden it and pilot it in other universities and other countries. This study adds to the growing body of literature on academic entrepreneurship by exploring academics' intentions, currently an appealing topic for scholars and literature. Although the study was developed in a specific context, the scale can be adapted to other university contexts and other countries. Moreover, since the university is a multi-layered organisation, future research could benefit from more refined approaches that consider differences within universities instead of between universities (Bienkowska et al., 2016; Erikson et al., 2015).

Since time and resources are limited, an additional research avenue might extend academics' entrepreneurial intentions as either complementary to or conflicting with their traditional role as researchers. Following on from this, and particularly for patents, scholars have mixed perceptions on the role of scientific productivity on intentions. More research is required to clarify whether the academic's scientific productivity hinders or facilitate academics intentions to patent. Future work could incorporate horizon and explore academics intentions due to changes at the university strategic level. Lastly, we would encourage more exploration on the passage from intentions to actions.

References

Abreu, M. and Grinevich, V. (2013), "The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities", *Research Policy*, Vol. 42 No. 2, pp. 408–422.

Abreu, M. and Grinevich, V. (2014), "Academic entrepreneurship in the creative arts", *Environment and Planning C: Government and Policy*, Vol. 32 No. 3, pp. 451–470.

Abreu, M., Demirel, P., Grinevich, V. and Karataş-Özkan, M. (2016), "Entrepreneurial practices in research-intensive and teaching-led universities", *Small Business Economics*, Vol. 47 No. 3, pp. 695–717.

Aldridge, T.T. and Audretsch, D. (2011), "The Bayh-Dole act and scientist entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1058–1068.

Al-Tabbaa, O. and Ankrah, S. (2019), "'Engineered' University-Industry Collaboration: A Social Capital Perspective", *European Management Review*, Vol. 16 No. 3, pp. 543–565.

Alvedalen, J. and Boschma, R. (2017), "A critical review of entrepreneurial ecosystems research: towards a future research agenda", *European Planning Studies*, Vol. 25 No. 6, pp. 887–903.

Anderson, J.C. and Gerbing, D.W. (1988), "Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach", *Psychological Bulletin*, Vol. 103 No. 3, pp. 411–423.

Ankrah, S.N., Burgess, T.F., Grimshaw, P. and Shaw, N.E. (2013), "Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit", *Technovation*, Vol. 33 No. 2–3, pp. 50–65.

Antonioli, D., Nicolli, F., Ramaciotti, L. and Rizzo, U. (2016), "The Effect of Intrinsic and Extrinsic Motivations on Academics' Entrepreneurial Intention", *Administrative Sciences*, Vol. 6 No. 4, p. 15.

Audretsch, D.B. (2004), "Sustaining innovation and growth: Public policy support for entrepreneurship", *Industry and Innovation*, Vol. 11 No. 3, pp. 167–191.

Audretsch, D.B. and Belitski, M. (2017), "Entrepreneurial ecosystems in cities: establishing the framework conditions", *Journal of Technology Transfer*, Vol. 42 No. 5, pp. 1030–1051.

Babin, B.J., Hair, J.F. and Boles, J.S. (2008), "Publishing research in marketing journals using structural equation modeling", *Journal of Marketing Theory and Practice*, Vol. 16 No. 4, pp. 279–286.

Baglieri, D., Baldi, F. and Tucci, C.L. (2018), "University technology transfer office business models: One size does not fit all", *Technovation*, Vol. 76–77, pp. 51–63.

Baldini, N. (2011), "University patenting: Patterns of faculty motivations", *Technology Analysis and Strategic Management*, Vol. 23 No. 2, pp. 103–121.

Balven, R., Fenters, V., Siegel, D.S. and Waldman, D. (2018), "Academic Entrepreneurship: the roles of identity, motivation, championing, education, work-life balance, and organizational justice", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 21–42.

Becker, G.S. (1980), *Human Capital*, University of Chicago press.

Becker, J.M., Klein, K. and Wetzels, M. (2012), "Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models", *Long Range Planning*, Vol. 45 No. 5–6, pp. 359–394.

Bercovitz, J. and Feldman, M.P. (2008), "Academic Entrepreneurs: Organizational Change at the Individual Level", *Organization Science*, Vol. 19 No. 1, pp. 69–89.

Bergmann, H. (2017), "The formation of opportunity beliefs among university entrepreneurs: an empirical study of research- and non-research-driven venture ideas", *Journal of Technology Transfer*, Vol. 42 No. 1, pp. 116–140.

Bergmann, H., Geissler, M., Hundt, C. and Grave, B. (2018), "The climate for entrepreneurship at higher education institutions", *Research Policy*, Vol. 47 No. 4, pp. 700–716.

Berry, M.W. (2004), *Survey of Text Mining: Clustering, Classification, and Retrieval*, edited by Berry, M.W., Springer-Verlag New York Copyright.

Bicknell, A., Francis-Smythe, J. and Arthur, J. (2010), "Knowledge transfer: de-constructing the entrepreneurial academic", *International Journal of Entrepreneurial Behavior & Research*, Vol. 16 No. 6, pp. 485–501.

Bienkowska, D., Klofsten, M. and Rasmussen, E. (2016), "PhD Students in the Entrepreneurial University - Perceived Support for Academic Entrepreneurship", *European Journal of Education*, Vol. 51 No. 1, pp. 56–72.

Blankesteijn, M., Sam, C. and van der Sijde, P. (2019), "Understanding the Governance of the Engaged and Entrepreneurial University in the Twenty-First Century: Towards a New Research and Policy Agenda", in Kliewe, T., Kesting, T., Plewa, C. and Baaken, T. (Eds.), *Developing Engaged and Entrepreneurial Universities. Theories, Concepts and Empirical Findings*, Springer Singapore, pp. 43–53.

Bodas Freitas, I.M. and Nuvolari, A. (2012), "Traditional Versus Heterodox Motives for Academic Patenting: Evidence from the Netherlands", *Industry and Innovation*, Vol. 19 No. 8, pp. 671–695.

Bodas Freitas, I.M. and Verspagen, B. (2017), "The motivations, institutions and organization of university-industry collaborations in the Netherlands", *Journal of Evolutionary Economics*, Vol. 27 No. 3, pp. 379–412.

Borges, C. and Filion, L.J. (2013), "Spin-off Process and the Development of Academic Entrepreneur's Social Capital", *Journal of Technology Management and Innovation*, Vol. 8 No. 1, pp. 21–34.

Bozeman, B., Fay, D. and Slade, C.P. (2013), "Research collaboration in universities and academic entrepreneurship: the-state-of-the-art", *Journal of Technology Transfer*, Vol. 38 No. 1, pp. 1–67.

Brettel, M., Mauer, R. and Walter, T. (2013), "High-profile employees at universities and their intentions of commercializing research results", *Journal of Business Economics*, Vol. 83 No. 4, pp. 357–382.

Browne, M.W. and Cudeck, R. (1992), "Alternative ways of assessing model fit", *Sociological Methods & Research*, Vol. 21 No. 2, pp. 230–258.

Byrne, B.M. (2016), *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. Routledge.

Chen, F., Curran, P.J., Bollen, K.A., Kirby, J. and Paxton, P. (2008), "An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models", *Sociological Methods and Research*, Vol. 36 No. 4, pp. 462–494.

Chin, W.W. (1998), *The Partial Least Squares Approach for Structural Equation Modeling*, edited by Marcoulides, G. Modern Methods for Business Research, Lawrence Erlbaum Associates, Publisher.

Chin, W.W. (2010), "How to write up and report PLS analyses", in Vinzi, V.E., Chin, W.W., Henseler, J. and Wang, H. (Eds.), *Handbook of Partial Least Squares*, Springer: Berlin, Heidelberg, pp. 655–690.

Civera, A., Meoli, M. and Vismara, S. (2020), "Engagement of academics in university technology transfer: Opportunity and necessity academic entrepreneurship", *European Economic Review*, Vol. 123, p. 103376.

Clark, B.R. (1998), "The entrepreneurial university: Demand and response", *Tertiary Education and Management*, Vol. 4 No. 1, pp. 5–16.

Clarysse, B., Tartari, V. and Salter, A. (2011), "The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1084–1093.

Clarysse, B., Wright, M. and Van de Velde, E. (2011), "Entrepreneurial Origin, Technological Knowledge, and the Growth of Spin-Off Companies", *Journal of Management Studies*, Vol. 48 No. 6, pp. 1420–1442.

Clauss, T., Kesting, T., Miller, K. and Meerman, A. (2018), "Editorial: Quo vadis entrepreneurial university? The need for multi-levels of analysis", *International Journal of Technology Management*, Vol. 77 No. 1/2, pp. 1–9.

Cohen, J. (1992), "A power primer", *Psychological Bulletin*, Vol. 112 No. 1, pp. 155–159.

Dabic, M., González-Loureiro, M. and Daim, T.U. (2015), "Unraveling the attitudes on entrepreneurial universities: The case of Croatian and Spanish universities", *Technology in Society*, Vol. 42, pp. 167–178.

D'Este, P. and Patel, P. (2007), "University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?", *Research Policy*, Vol. 36 No. 9, pp. 1295–1313.

D'Este, P. and Perkmann, M. (2011), "Why do academics engage with industry? The entrepreneurial university and individual motivations", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 316–339.

Di Gregorio, D. and Shane, S. (2003), "Why do some universities generate more start-ups than others?", *Research Policy*, Vol. 32 No. 2, pp. 209–227.

Dietz, J.S. and Bozeman, B. (2005), "Academic careers, patents, and productivity: Industry experience as scientific and technical human capital", *Research Policy*, Vol. 34 No. 3, pp. 349–367.

Dillman, D.A., Smyth, J.D. and Christian, L.M. (2011), Int*ernet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*, John Wiley & Sons.

Dolan, B., Cunningham, J.A., Menter, M. and Mcgregor, C. (2019), "The role and function of cooperative research centers in entrepreneurial universities A micro level perspective", *Management Decision*, Vol. 57 No. 12, pp. 3406–3425.

Dornbusch, F. and Neuhäusler, P. (2015), "Composition of inventor teams and technological progress - The role of collaboration between academia and industry", *Research Policy*, Vol. 44 No. 7, pp. 1360–1375.

Erikson, T., Knockaert, M. and Foo, M. Der. (2015), "Enterprising scientists: The shaping role of norms, experience and scientific productivity", *Technological Forecasting and Social Change*, Vol. 99, pp. 211–221.

Etzkowitz, H. (1983), "Entrepreneurial scientists and entrepreneurial universities in American academic science", *Minerva*, Vol. 21 No. 2–3, pp. 198–233.

Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K.N. and Albats, E. (2019), "Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system", *Technological Forecasting and Social Change*, Vol. 141, pp. 159–171.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000), "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, Vol. 29 No. 2, pp. 313–330.

Fernández-Pérez, V., Alonso-Galicia, P.E., Fuentes-Fuentes, M.D.M. and Rodriguez-Ariza, L. (2014), "Business social networks and academics' entrepreneurial intentions", *Industrial Management and Data Systems*, Vol. 114 No. 2, pp. 292–320.

Fernández-Pérez, V., Alonso-Galicia, P.E., Rodríquez-Ariza, L. and Fuentes-Fuentes, M. del M. (2015), "Professional and personal social networks: A bridge to entrepreneurship for academics?", *European Management Journal*, Vol. 33 No. 1, pp. 37–47.

Filippetti, A. and Savona, M. (2017), "University-industry linkages and academic engagements: individual behaviours and firms' barriers. Introduction to the special section", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 719–729.

Fini, R. and Toschi, L. (2016), "Academic logic and corporate entrepreneurial intentions: A study of the interaction between cognitive and institutional factors in new firms", *International Small Business Journal: Researching Entrepreneurship*, Vol. 34 No. 5, pp. 637–659.

Fini, R., Grimaldi, R. and Meoli, A. (2020), "The Effectiveness of University Regulations to Foster Science-Based Entrepreneurship", *Research Policy*, Vol. 49 No. 10.

Foo, M. Der, Knockaert, M., Chan, E.T. and Erikson, T. (2016), "The Individual Environment Nexus: Impact of Promotion Focus and the Environment on Academic Scientists' Entrepreneurial Intentions", *IEEE Transactions on Engineering Management*, Vol. 63 No. 2, pp. 213–222.

Fornell, C. and Larcker, D.F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", *Journal of Marketing Research*, Vol. 18 No. 1, p. 39.

Francis-Smythe, J. (2008), "Enhancing academic engagement in knowledge transfer activity in the UK", *Perspectives: Policy and Practice in Higher Education*, Vol. 12 No. 3, pp. 68–72.

Giuri, P., Munari, F., Scandura, A. and Toschi, L. (2019), "The strategic orientation of universities in knowledge transfer activities", *Technological Forecasting and Social Change*, Vol. 138, pp. 261–278.

Goel, R.K., Göktepe-Hultén, D. and Grimpe, C. (2017), "Who instigates university-industry collaborations? University scientists versus firm employees", *Small Business Economics*, Vol. 48 No. 3, pp. 503–524.

Goethner, M., Obschonka, M., Silbereisen, R.K. and Cantner, U. (2012), "Scientists' transition to academic entrepreneurship: Economic and psychological determinants", *Journal of Economic Psychology*, Vol. 33 No. 3, pp. 628–641.

Göktepe-Hulten, D. and Mahagaonkar, P. (2010), "Inventing and patenting activities of scientists: In the expectation of money or reputation?", *Journal of Technology Transfer*, Vol. 35 No. 4, pp. 401–423.

Goldstein, H.A. (2010), *Multilevel Statistical Models*, 4th Edition., Kendall's Library of Statistics, London, UK.

Good, M., Knockaert, M. and Soppe, B. (2020), "A typology of technology transfer ecosystems: how structure affects interactions at the science–market divide", *Journal of Technology Transfer*, Vol. 45, pp. 1405–1431.

Grimaldi, R., Kenney, M., Siegel, D.S. and Wright, M. (2011), "30 years after Bayh-Dole: Reassessing academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1045–1057.

Guerrero, M. and Urbano, D. (2014), "Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 43 No. 1, pp. 57–74.

Guerrero, M., Cunningham, J.A. and Urbano, D. (2015), "Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom", *Research Policy*, Vol. 44 No. 3, pp. 748–764.

Guerrero, M., Urbano, D. and Gajon, E. (2017), "Higher Education Entrepreneurial Ecosystems: Exploring the Role of Business Incubators in an Emerging Economy", *International Review of Entrepreneurship*, Vol. 15 No. 2, pp. 175–202.

Gulbrandsen, M. and Thune, T. (2017), "The effects of non-academic work experience on external interaction and research performance", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 795–813.

Gümüsay, A.A. and Bohné, T.M. (2018), "Individual and organizational inhibitors to the development of entrepreneurial competencies in universities", *Research Policy*, Vol. 47 No. 2, pp. 363–378.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2016), *A Primer on Partial Least Squares Structural Equation Modeling* (PLS-SEM), Sage.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review*, Vol. 31 No. 1, pp. 2–24.

Hair, J.F., Sarstedt, M., Hopkins, L. and Kuppelwieser, V.G. (2014), "Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research", *European Business Review*, Vol. 26 No. 2, pp. 106–121.

Halilem, N., Amara, N., Olmos-Peñuela, J. and Mohiuddin, M. (2017), "'To Own, or not to Own?' A multilevel analysis of intellectual property right policies' on academic entrepreneurship", *Research Policy*, Vol. 46 No. 8, pp. 1479–1489.

Hand, D. and Adams, N. (2014), Data Mining, Wiley StatsRef: Statistics Reference Online.

Hayter, C.S. (2011), "In search of the profit-maximizing actor: Motivations and definitions of success from nascent academic entrepreneurs", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 340–352.

Hayter, C.S. (2015), "Public or private entrepreneurship? Revisiting motivations and definitions of success among academic entrepreneurs", *Journal of Technology Transfer*, Vol. 40 No. 6, pp. 1003–1015.

Hayter, C.S., Lubynsky, R. and Maroulis, S. (2017), "Who is the academic entrepreneur? The role of graduate students in the development of university spinoffs", *Journal of Technology Transfer*, Vol. 42 No. 6, pp. 1237–1254.

Hayter, C.S., Nelson, A.J., Zayed, S. and O'Connor, A.C. (2018), "Conceptualizing academic entrepreneurship ecosystems: a review, analysis and extension of the literature", *Journal of Technology Transfer*, Vol. 43 No. 4, pp. 1039–1082.

Hayter, C.S., Rasmussen, E. and Rooksby, J.H. (2020), "Beyond formal university technology transfer: innovative pathways for knowledge exchange", *Journal of Technology Transfer*, Vol. 45 No. 1, pp. 1–8.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen, D.J., et al. (2014), "Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013)", *Organizational Research Methods*, Vol. 17 No. 2, pp. 182–209.

Henseler, J., Hubona, G. and Ray, P.A. (2016), "Using PLS path modeling in new technology research: Updated guidelines", *Industrial Management and Data Systems*, Vol. 116 No. 1, pp. 2–20.

Holley, A.C. and Watson, J. (2017), "Academic Entrepreneurial Behavior: Birds of more than one feather", *Technovation*, Vol. 64, pp. 50–57.

Holstein, J., Starkey, K. and Wright, M. (2018), "Strategy and narrative in higher education", *Strategic Organization*, Vol. 16 No. 1, pp. 61–91.

Horner, S., Jayawarna, D., Giordano, B. and Jones, O. (2019), "Strategic choice in universities: Managerial agency and effective technology transfer", *Research Policy*, Vol. 48 No. 5, pp. 1297–1309.

Hox, J.J. (2010), *Multilevel Analysis: Techniques and Applications*, Routledge, New York, NY.

Hu, L.T. and Bentler, P.M. (1999), "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives", *Structural Equation Modeling*, Vol. 6 No. 1, pp. 1–55.

Huyghe, A. and Knockaert, M. (2015), "The influence of organizational culture and climate on entrepreneurial intentions among research scientists", *Journal of Technology Transfer*, Vol. 40 No. 1, pp. 138–160.

Huyghe, A. and Knockaert, M. (2016), "The Relationship Between University Culture and Climate and Research Scientists' Spin-off Intentions", in Audretsch, D., Lehmann, E.E., Meoli, M. and Vismara, S. (Eds.), *University Evolution, Entrepreneurial Activity and Regional Competitiveness*, 32nd ed., Springer, Cham.

Huyghe, A., Knockaert, M. and Obschonka, M. (2016), "Unraveling the ‘passion orchestra' in academia", *Journal of Business Venturing*, Vol. 31 No. 3, pp. 344–364.

Iorio, R., Labory, S. and Rentocchini, F. (2017), "The importance of pro-social behaviour for the breadth and depth of knowledge transfer activities: An analysis of Italian academic scientists", *Research Policy*, Vol. 46 No. 2, pp. 497–509.

Jain, S., George, G. and Maltarich, M. (2009), "Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity", *Research Policy*, Vol. 38 No. 6, pp. 922–935.

Johnson, M., Monsen, E.W. and MacKenzie, N.G. (2017), "Follow the Leader or the Pack? Regulatory Focus and Academic Entrepreneurial Intentions", *Journal of Product Innovation Management*, Vol. 34 No. 2, pp. 181–200.

Karlsson, T. and Wigren, C. (2012), "Start-ups among university employees: The influence of legitimacy, human capital and social capital", *Journal of Technology Transfer*, Vol. 37 No. 3, pp. 297–312.

Kim, P.H. and Aldrich, H.E. (2005), "Social capital and entrepreneurship", *Foundations and Trends in Entrepreneurship*, Vol. 1 No. 2, pp. 55–104.

Kline, R.B. (2015), *Principles and Practice of Structural Equation Modeling*, Guilford Publications.

Klofsten, M. and Jones-Evans, D. (2000), "Comparing Academic Entrepreneurship in Europe - The Case of Sweden and Ireland", *Small Business Economics*, Vol. 14 No. 4, pp. 299–309.

Klofsten, M., Fayolle, A., Guerrero, M., Mian, S., Urbano, D. and Wright, M. (2019), "The entrepreneurial university as driver for economic growth and social change - Key strategic challenges", *Technological Forecasting and Social Change*,. 141, pp. 149–158.

Krabel, S. and Mueller, P. (2009), "What drives scientists to start their own company? An empirical investigation of Max Planck Society scientists", *Research Policy*, Vol. 38 No. 6, pp. 947–956.

Krueger, N.F., Reilly, M.D. and Carsrud, A.L. (2000), "Competing models of entrepreneurial intentions", *Journal of Business Venturing*, Vol. 15 No. 5–6, pp. 411–432.

Lafuente, E. and Berbegal-Mirabent, J. (2019), "Assessing the productivity of technology transfer offices: an analysis of the relevance of aspiration performance and portfolio complexity", *Journal of Technology Transfer*, Vol. 44 No. 3, pp. 778–801.

Lam, A. (2011), "What motivates academic scientists to engage in research commercialization: ‘Gold', ‘ribbon' or ‘puzzle'?", *Research Policy*, Vol. 40 No. 10, pp. 1354–1368.

Lee, Y., Raimondi, S.C., Downing, J.R., Baker, S.D., Ribeiro, R.C. and Rubnitz, J.E. (2000), "The Sustainability of University-Industry Research Collaboration: An Empirical Assessment", *Journal of Technology Transfer*, Vol. 25, pp. 111–133.

Liao, J. and Welsch, H. (2005), "Roles of Social Capital in Venture Creation: Key Dimensions and Research Implications", *Journal of Small Business Management*, Vol. 43 No. 4, pp. 345–362.

Liñán, F. and Fayolle, A. (2015), "A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda", *International Entrepreneurship and Management Journa*l, Vol. 11 No. 4, pp. 907–933.

Liñán, F. and Santos, F.J. (2007), "Does social capital affect entrepreneurial intentions?", *International Advances in Economic Research*, Vol. 13 No. 4, pp. 443–453.

Link, A.N., Siegel, D.S. and Bozeman, B. (2007), "An empirical analysis of the propensity of academics to engage in informal university technology transfer", *Universities and the Entrepreneurial Ecosystem*, Vol. 16 No. 4, pp. 97–111.

Llopis, O., Sánchez-Barrioluengo, M., Olmos-Peñuela, J. and Castro-Martínez, E. (2018), "Scientists' engagement in knowledge transfer and exchange: individual factors, variety of mechanisms and users", *Science and Public Policy*, Vol. 45, pp. 790–803.

Lockett, A., Wright, M. and Franklin, S. (2003), "Technology Transfer and Universities' Spin-Out Strategies", *Small Business Economics*, Vol. 20 No. 2, pp. 185–200.

Löfsten, H. and Lindelöf, P. (2002), "Science Parks and the growth of new technology-based firms - academic-industry links, innovation and markets", *Research Policy*, Vol. 31 No. 6, pp. 859–876.

MacCallum, R.C., Browne, M.W. and Sugawara, H.M. (1996), "Power analysis and determination of sample size for covariance structure modeling", *Psychological Methods*, Vol. 1 No. 2, pp. 130–149.

Maietta, O.W. (2015), "Determinants of university-firm R&D collaboration and its impact on innovation: A perspective from a low-tech industry", *Research Policy*, Vol. 44 No. 7, pp. 1341–1359.

Manley, S.C., Hair, J.F., Williams, R.I. and McDowell, W.C. (2020), "Essential new PLS-SEM analysis methods for your entrepreneurship analytical toolbox", *International Entrepreneurship and Management Journal*, Vol. 17 No. 4, pp. 1805–1825.

Markuerkiaga, L., Errasti, N. and Igartua, J.I. (2019), "An Entrepreneurial University Taxonomy Proposal", in Kliewe, T., Kesting, T., Plewa, C. and Baaken, T. (Eds.),

Developing Engaged and Entrepreneurial Universities. Theories, Concepts and Empirical Findings, Springer Singapore, pp. 191–210.

Mathisen, M.T. and Rasmussen, E. (2019), "The Development, Growth, and Performance of University Spin-Offs: A Critical Review", *Journal of Technology Transfer*, Vol. 44, pp. 1891–1938

Merton, R.K. (1973), *The Sociology of Science: Theoretical and Empirical Investigation*s, University of Chicago press.

Miller, K., Alexander, A., Cunningham, J. and Albats, E. (2018), "Entrepreneurial academics and academic entrepreneurs: a systematic literature review", *International Journal of Technology Management*, Vol. 77 No. 1/2/3, pp. 9–36.

Miner, G.D., Elder, J., Fast, A., Hill, T., Nisbet, R.A. and Delen, D. (2012), *Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications*, Academic Press, Academic Press.

Moog, P., Werner, A., Houweling, S. and Backes-Gellner, U. (2015), "The impact of skills, working time allocation and peer effects on the entrepreneurial intentions of scientists", *Journal of Technology Transfer*, Vol. 40 No. 3, pp. 493–511.

Morales-Gualdrón, S.T., Gutiérrez-Gracia, A. and Dobón, S.R. (2009), "The entrepreneurial motivation in academia: A multidimensional construct", *International Entrepreneurship and Management Journal*, Vol. 5 No. 3, pp. 301–317.

Moray, N. and Clarysse, B. (2005), "Institutional change and resource endowments to science-based entrepreneurial firms", *Research Policy*, Vol. 34 No. 7, pp. 1010–1027.

Mosey, S., Guerrero, M. and Greenman, A. (2017), "Technology entrepreneurship research opportunities: insights from across Europe", *Journal of Technology Transfer*, Springer US, Vol. 42 No. 1, pp. 1–9.

Mosey, S., Noke, H. and Binks, M. (2012), "The influence of human and social capital upon the entrepreneurial intentions and destinations of academics", *Technology Analysis and Strategic Management*, Vol. 24 No. 9, pp. 893–910.

Munari, F., Rasmussen, E., Toschi, L. and Villani, E. (2016), "Determinants of the university technology transfer policy-mix: a cross-national analysis of gap-funding instruments", *Journal of Technology Transfer*, Vol. 41 No. 6, pp. 1377–1405.

Muscio, A., Quaglione, D. and Ramaciotti, L. (2016), "The effects of university rules on spinoff creation: The case of academia in Italy", *Research Policy*, Vol. 45 No. 7, pp. 1386–1396.

Muscio, A., Shibayama, S. and Ramaciotti, L. (2021), "Universities and start-up creation by Ph.D. graduates: the role of scientific and social capital of academic laboratories", *Journal of Technology Transfer*.

Nelson, A.J. (2014), "From the ivory tower to the startup garage: Organizational context and commercialization processes", *Research Policy*, Vol. 43 No. 7, pp. 1144–1156.

Neves, S. and Brito, C. (2020), "Academic entrepreneurship intentions: a systematic literature review", *Journal of Management Development*, Vol. 39 No. 5, pp. 645–704.

O'Shea, R.P., Allen, T.J., Chevalier, A. and Roche, F. (2005), "Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities", *Research Policy*, Vol. 34 No. 7, pp. 994–1009.

Passaro, R., Quinto, I. and Thomas, A. (2018), "The impact of higher education on entrepreneurial intention and human capital", *Journal of Intellectual Capital*, Vol. 19 No. 1, pp. 135–156.

Pauwels, C., Clarysse, B., Wright, M. and Van Hove, J. (2016), "Understanding a new generation incubation model: The accelerator", *Technovation*, Vol. 50–51, pp. 13–24.

Perkmann, M. and Walsh, K. (2008), "Engaging the scholar: Three types of academic consulting and their impact on universities and industry", *Research Policy*, Vol. 37 No. 10, pp. 1884–1891.

Perkmann, M., Salandra, R., Tartari, V., Mckelvey, M. and Hughes, A. (2021), "Academic engagement: A review of the literature 2011-2019", *Research Policy*, Vol. 50 No. 1, p. 104114.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., et al. (2013), "Academic engagement and commercialisation: A review of the literature on university-industry relations", *Research Policy*, Vol. 42 No. 2, pp. 423–442.

Phan, P. and Siegel, D. (2006), "The Effectiveness of University Technology Transfer", *Foundations and Trends® in Entrepreneurship*, Vol. 2 No. 2, pp. 77–144.

Phan, P.H., Siegel, D.S. and Wright, M. (2005), "Science parks and incubators: Observations, synthesis and future research", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 165–182.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003), "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879–903.

Pollach, I. (2011), "Software Review: WordStat 5.0", *Organizational Research Methods*, Vol. 14 No. 4, pp. 741–744.

Prodan, I. and Drnovsek, M. (2010), "Conceptualizing academic-entrepreneurial intentions: An empirical test", *Technovation*, Vol. 30 No. 5–6, pp. 332–347.

Qian, H. and Acs, Z.J. (2013), "An absorptive capacity theory of knowledge spillover entrepreneurship", *Small Business Economics*, Vol. 40 No. 2, pp. 185–197.

Ramos-Vielba, I., Sánchez-Barrioluengo, M. and Woolley, R. (2016), "Scientific research groups' cooperation with firms and government agencies: motivations and barriers", *Journal of Technology Transfer*, Vol. 41 No. 3, pp. 558–585.

Rasmussen, E. (2011), "Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories", *International Small Business Journal*, Vol. 29 No. 5, pp. 448–471.

Rasmussen, E., Moen, Ø. and Gulbrandsen, M. (2006), "Initiatives to promote commercialization of university knowledge", *Technovation*, Vol. 26 No. 4, pp. 518–533.

Renault, C.S. (2006), "Academic capitalism and university incentives for faculty entrepreneurship", *Journal of Technology Transfer*, Vol. 31 No. 2, pp. 227–239.

Richter, N.F., Cepeda, G., Roldán, J.L. and Ringle, C.M. (2016), "European management research using partial least squares structural equation modeling (PLS-SEM)", *European Management Journal*, Vol. 34 No. 6, pp. 589–597.

Ringle, C.M., Sarstedt, M. and Straub, D.W. (2012), "Editor's comments: a critical look at the use of PLS-SEM in MIS Quarterly", *MIS Quarterly*, Vol. 36 No. 1, pp. iii–xiv.

Rippa, P. and Secundo, G. (2019), "Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship", *Technological Forecasting and Social Change*, Vol. 146, pp. 900–911.

Ryan, R.M. and Deci, E.L. (2000), "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions", *Contemporary Educational Psychology*, Vol. 25 No. 1, pp. 54–67.

Sam, C. and van der Sijde, P. (2014), "Understanding the concept of the entrepreneurial university from the perspective of higher education models", *Higher Education*, Vol. 68 No. 6, pp. 891–908.

Sandström, C., Wennberg, K., Wallin, M.W. and Zherlygina, Y. (2018), "Public policy for academic entrepreneurship initiatives: a review and critical discussion", *Journal of Technology Transfer*, Vol. 43 No. 5, pp. 1232–1256.

Sarstedt, M., Hair, J.F., Cheah, J.H., Becker, J.M. and Ringle, C.M. (2019), "How to specify, estimate, and validate higher-order constructs in PLS-SEM", *Australasian Marketing Journal*, Vol. 27 No. 3, pp. 197–211.

Schartinger, D., Rammer, C., Fischer, M.M. and Fröhlich, J. (2002), "Knowledge interactions between universities and industry in Austria: sectorial patterns and determinants", *Research Policy*, Vol. 31 No. 3, pp. 303–328.

Siegel, D.S. and Wright, M. (2015), "Academic Entrepreneurship: Time for a Rethink?", *British Journal of Management*, Vol. 26 No. 4, pp. 582–595.

Siegel, D.S., Waldman, D. and Link, A.N. (2003), "Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy*, Vol. 32 No. 1, pp. 27–48.

Sjöö, K. and Hellström, T. (2019), "University–industry collaboration: A literature review and synthesis", *Industry and Higher Education*, Vol. 33 No. 4, pp. 275–285.

Spigel, B. and Harrison, R. (2018), "Toward a process theory of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12 No. 1, pp. 151–168.

Streukens, S. and Leroi-Werelds, S. (2016), "Bootstrapping and PLS-SEM: A step-by-step guide to get more out of your bootstrap results", *European Management Journal*, Elsevier Ltd, Vol. 34 No. 6, pp. 618–632.

Stuart, T.E. and Ding, W.W. (2006), "When Do Scientists Become Entrepreneurs? The Social Structural Antecedents of Commercial Activity in the Academic Life Sciences", *American Journal of Sociology*, Vol. 112 No. 1, pp. 97–144.

Tabachnick, B.G. and Fidell, L.S. (1996), *Using Multivariate Statistics*, New York: Harper Collins.

Tartari, V., Perkmann, M. and Salter, A. (2014), "In good company: The influence of peers on industry engagement by academic scientists", *Research Policy*, Vol. 43 No. 7, pp. 1189–1203.

Tartari, V., Salter, A. and D'Este, P. (2012), "Crossing the rubicon: Exploring the factors that shape academics' perceptions of the barriers to working with industry", *Cambridge Journal of Economics*, Vol. 36 No. 3, pp. 655–677.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M. and Lauro, C. (2005), "PLS path modelling", *Computational Statistics and Data Analysis*, Vol. 48 No. 1, pp. 159–205.

Thune, T. and Gulbrandsen, M. (2014), "Dynamics of collaboration in university-industry partnerships: do initial conditions explain development patterns?", *Journal of Technology Transfer*, Vol. 39 No. 6, pp. 977–993.

Trivedi, R. (2016), "Does university play significant role in shaping entrepreneurial intention? A cross-country comparative analysis", *Journal of Small Business and Enterprise Development*, Vol. 23 No. 3, pp. 790–811.

Unger, J.M., Rauch, A., Frese, M. and Rosenbusch, N. (2011), "Human capital and entrepreneurial success: A meta-analytical review", *Journal of Business Venturing*, Vol. 26 No. 3, pp. 341–358.

Urban, B. and Chantson, J. (2019), "Academic entrepreneurship in South Africa: testing for entrepreneurial intentions", *Journal of Technology Transfer*, Vol. 44 No. 3, pp. 948–980.

van de Burgwal, L.H.M., Dias, A. and Claassen, E. (2019), "Incentives for knowledge valorisation: a European benchmark", *Journal of Technology Transfer*, Vol. 44 No. 1, pp. 1–20.

Wang, M., Soetanto, D., Cai, J. and Munir, H. (2021), "Scientist or Entrepreneur? Identity centrality, university entrepreneurial mission, and academic entrepreneurial intention", *Journal of Technology Transfer*.

Wetzels, M., Odekerken-Schröder, G. and Van Oppen, C. (2009), "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration Service Design for Innovation View project", *MIS Quarterly*, Vol. 33 No. 1, March 2009, pp. 177–195.

Wright, M. and Phan, P. (2018), "The Commercialization of Science: From Determinants to Impact", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 1–3.

Wright, M., Birley, S. and Mosey, S. (2004), "Entrepreneurship and university technology transfer", *Journal of Technology Transfer*, Vol. 29 No. 3–4, pp. 235–246.

Wright, M., Clarysse, B., Lockett, A. and Knockaert, M. (2008), "Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries", *Research Policy*, Vol. 37 No. 8, pp. 1205–1223.

Wright, M., Siegel, D.S. and Mustar, P. (2017), "An emerging ecosystem for student start-ups", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 909–922.

Wu, Y., Welch, E.W. and Huang, W.L. (2015), "Commercialization of university inventions: Individual and institutional factors affecting licensing of university patents", *Technovation*, Vol. 36, pp. 12–25.

Yusof, M. and Jain, K.K. (2010), "Categories of university-level entrepreneurship: A literature survey", *International Entrepreneurship and Management Journal*, Vol. 6 No. 1, pp. 81–96.

Appendices

Appendix 3A

Variable	Item	Label	Source
Intentions: "How likely is it that, in the foreseeable future, you will…	Create a spin-off?" (venture based in research results)	Int1	Krueger et al. (2000)
	Create a start-up?" (venture of any other type)	Int2*	
	Apply for a patent resulting from research?"	Int3	Huyghe and Knockaert (2015)
	Engage in joint research with industry?" (original research carried out by the university in partnership with the industry)	Int4	
	Engage in contract research with industry?" (original research contracted by the industry and conducted solely by the university)	Int5	
	Engage in consulting activities with industry?" (services provided to the industry, without the creation of new knowledge/original research)	Int6	
Motivations: "Rank the following reasons, according to their importance, for your involvement with the industry:	Applicability of research	Mot1	D'Este and Perkmann (2011); Lam (2011)
	Creation of future research opportunities	Mot2	Bodas Freitas and Verspagen (2017)
	Access to research expertise	Mot3	D'Este and Perkmann (2011)
	Provide work placement or grants to students	Mot4	Lam (2011); Llopis et al. (2018)
	Access information from industry	Mot5*	D'Este and Perkmann (2011)
	Receive feedback from industry	Mot6	
	Increase research funding	Mot7	Lam (2011); Bodas Freitas and Verspagen (2017)
	Increase personal income	Mot8	D'Este and Perkmann (2011); Lam (2011)
	Access to materials or equipment	Mot9	D'Este and Perkmann (2011);
	Satisfaction of intellectual curiosity	Mot10	Lam (2011)
	Expand network	Mot11	D'Este and Perkmann (2011) Lam (2011);
	Maintain collaborative linkages	Mot12*	Bodas Freitas and Verspagen (2017)
	Peer pressure	Mot13	Bercovitz and Feldman (2008)
	Gain additional scientific reputation	Mot14	Göktepe-Hulten and Mahagaonkar (2010)
Social Capital: "Please indicate your degree of agreement with the following statements:	I have business contacts in industry"	SC1	Krabel and Mueller (2009); Goethner et al. (2012)
	I have contact with research partners in industry"	SC2	
	I have contact with public agencies that support the transfer of technology and research results valorisation"	SC3	Liao and Welsch (2005); Goethner et al. (2012)

Human Capital: How often did you engage in the following activities in the last three years (2018-2020)?	New joint research contract (original research carried out by the university in partnership with the industry)	HC1	D'Este and Patel (2007); Llopis et al. (2018)
	New contract research (original research contracted by the industry and conducted solely by the university)	HC2	
	New consultancy contract (services provided to the industry, without the creation of new knowledge/original research)	HC3	
	Training of employees from the industry sector (e.g. in-company courses or temporary exchange of employees)	HC4	
	Supervision of students of post-graduate studies undertaken within a corporate context (e.g. joint supervision of PhD students)	HC5	
	Participation in courses and training on entrepreneurship	HC6	
	Submission of proposals, in partnership with business sector entities, to international funding programmes (e.g. H2020, Interreg, EEA Grants)	HC7	
Support Perception: "Please indicate your degree of agreement with the following statements:	My organisation…		Guerrero and Urbano (2014)
	Has clear rules for intellectual property?"	Supp1*	
	Has clear rules for the creation of spin-offs?"	Supp2	
	Supports for technology transfer?"	Supp3	
	Offers entrepreneurship courses?"	Supp4	

* items that were initially in the model but were subsequently removed.

Appendix 3B

Gender	Intentions to/ Likelihood	Spin-off	Start-up	Patenting	U-I Joint research	U-I Research contract	U-I Consulting
Male	Extremely unlikely	30,31%	29,53%	34,25%	8,66%	10,63%	9,45%
	Unlikely	24,02%	25,20%	19,69%	7,48%	9,06%	9,06%
	Slightly unlikely	13,39%	12,99%	11,42%	5,91%	7,09%	6,69%
	Neutral	16,54%	14,96%	13,39%	15,75%	21,26%	15,35%
	Slightly likely	11,42%	9,84%	10,24%	27,95%	19,29%	16,54%
	Likely	3,94%	5,91%	6,30%	20,47%	24,41%	24,80%
	Extremely likely	0,39%	1,57%	4,72%	13,78%	8,27%	18,11%
Female	Extremely unlikely	48,58%	43,87%	46,70%	17,92%	28,30%	19,34%
	Unlikely	16,04%	12,74%	14,15%	12,26%	12,74%	8,96%
	Slightly unlikely	6,60%	12,74%	11,32%	5,66%	8,96%	15,57%
	Neutral	13,68%	13,68%	11,32%	14,62%	14,15%	14,62%
	Slightly likely	12,26%	15,57%	7,55%	23,58%	18,40%	19,81%
	Likely	2,83%	1,42%	5,19%	14,62%	13,68%	14,15%
	Extremely likely	0,00%	0,00%	3,77%	11,32%	3,77%	7,55%

Age	Intentions to/ Likelihood	Spin-off	Start-up	Patenting	U-I Joint research	U-I Research contract	U-I Consulting
Under 30 years	Extremely unlikely	33,80%	32,39%	36,62%	14,08%	22,54%	18,31%
	Unlikely	18,31%	15,49%	21,13%	9,86%	11,27%	11,27%
	Slightly unlikely	12,68%	12,68%	8,45%	8,45%	1,41%	2,82%
	Neutral	19,72%	15,49%	18,31%	15,49%	15,49%	19,72%
	Slightly likely	14,08%	15,49%	7,04%	23,94%	22,54%	14,08%
	Likely	1,41%	8,45%	7,04%	23,94%	23,94%	22,54%
	Extremely likely	0,00%	0,00%	1,41%	4,23%	2,82%	11,27%
Between 31 and 40 years	Extremely unlikely	33,33%	31,67%	35,83%	10,83%	14,17%	11,67%
	Unlikely	25,83%	22,50%	15,83%	3,33%	6,67%	5,00%
	Slightly unlikely	7,50%	14,17%	15,00%	8,33%	12,50%	10,00%
	Neutral	10,00%	11,67%	7,50%	13,33%	15,00%	14,17%
	Slightly likely	16,67%	11,67%	12,50%	21,67%	12,50%	22,50%
	Likely	5,83%	5,00%	11,67%	24,17%	25,00%	19,17%
	Extremely likely	0,83%	3,33%	1,67%	18,33%	14,17%	17,50%
Between 41 and 50 years	Extremely unlikely	36,29%	35,48%	44,35%	13,71%	19,35%	13,71%
	Unlikely	18,55%	13,71%	16,94%	13,71%	12,10%	8,87%
	Slightly unlikely	12,10%	14,52%	8,87%	5,65%	8,06%	16,13%
	Neutral	19,35%	19,35%	17,74%	12,90%	17,74%	8,87%
	Slightly likely	10,48%	14,52%	5,65%	27,42%	17,74%	16,13%
	Likely	3,23%	2,42%	1,61%	12,90%	23,39%	20,16%
	Extremely likely	0,00%	0,00%	4,84%	13,71%	1,61%	16,13%
Between 51 and 60 years	Extremely unlikely	41,49%	31,91%	37,23%	11,70%	18,09%	9,57%
	Unlikely	14,89%	25,53%	17,02%	10,64%	15,96%	11,70%
	Slightly unlikely	10,64%	12,77%	11,70%	2,13%	5,32%	10,64%
	Neutral	20,21%	13,83%	9,57%	15,96%	14,89%	18,09%
	Slightly likely	8,51%	12,77%	9,57%	31,91%	25,53%	18,09%
	Likely	4,26%	3,19%	4,26%	14,89%	13,83%	21,28%
	Extremely likely	0,00%	0,00%	10,64%	12,77%	6,38%	10,64%

More than 60 years	Extremely unlikely	56,14%	57,89%	47,37%	15,79%	22,81%	21,05%
	Unlikely	24,56%	21,05%	15,79%	12,28%	7,02%	10,53%
	Slightly unlikely	8,77%	7,02%	12,28%	3,51%	10,53%	10,53%
	Neutral	3,51%	8,77%	8,77%	22,81%	33,33%	19,30%
	Slightly likely	7,02%	5,26%	10,53%	24,56%	19,30%	17,54%
	Likely	0,00%	0,00%	3,51%	12,28%	3,51%	15,79%
	Extremely likely	0,00%	0,00%	1,75%	8,77%	3,51%	5,26%

Scientific Discipline	Intentions to/ Likelihood	Spin-off	Start-up	Patenting	U-I Joint research	U-I Research contract	U-I Consulting
Engineering and exact sciences	Extremely unlikely	34,63%	34,63%	33,17%	10,24%	12,68%	12,20%
	Unlikely	24,88%	25,37%	21,46%	7,80%	8,29%	8,78%
	Slightly unlikely	8,78%	8,29%	11,22%	4,39%	9,27%	14,15%
	Neutral	16,10%	15,12%	11,22%	14,63%	13,66%	11,22%
	Slightly likely	14,15%	12,68%	8,78%	24,88%	20,49%	16,10%
	Likely	1,46%	3,90%	7,32%	22,44%	25,37%	24,39%
	Extremely likely	0,00%	0,00%	6,83%	15,61%	10,24%	13,17%
Life and health sciences	Extremely unlikely	44,32%	42,05%	36,36%	17,05%	29,55%	21,59%
	Unlikely	11,36%	10,23%	13,64%	13,64%	14,77%	10,23%
	Slightly unlikely	9,09%	13,64%	13,64%	11,36%	6,82%	13,64%
	Neutral	14,77%	15,91%	20,45%	11,36%	13,64%	15,91%
	Slightly likely	13,64%	11,36%	5,68%	17,05%	13,64%	13,64%
	Likely	6,82%	6,82%	7,95%	21,59%	21,59%	19,32%
	Extremely likely	0,00%	0,00%	2,27%	7,95%	0,00%	5,68%
Natural and environmental sciences	Extremely unlikely	41,86%	34,88%	32,56%	6,98%	13,95%	23,26%
	Unlikely	18,60%	9,30%	4,65%	0,00%	4,65%	2,33%
	Slightly unlikely	9,30%	25,58%	11,63%	4,65%	4,65%	0,00%
	Neutral	16,28%	9,30%	13,95%	18,60%	32,56%	27,91%
	Slightly likely	13,95%	20,93%	25,58%	41,86%	32,56%	18,60%
	Likely	0,00%	0,00%	6,98%	16,28%	9,30%	16,28%
	Extremely likely	0,00%	0,00%	4,65%	11,63%	2,33%	11,63%
Social science and humanities	Extremely unlikely	40,00%	34,62%	55,38%	16,15%	22,31%	8,46%
	Unlikely	20,00%	20,00%	16,92%	13,08%	13,85%	10,77%
	Slightly unlikely	13,85%	15,38%	10,00%	4,62%	7,69%	6,92%
	Neutral	13,85%	13,85%	8,46%	17,69%	23,08%	16,15%
	Slightly likely	6,15%	10,00%	6,15%	28,46%	15,38%	23,85%
	Likely	5,38%	3,08%	1,54%	8,46%	12,31%	14,62%
	Extremely likely	0,77%	3,08%	1,54%	11,54%	5,38%	19,23%

Support perception		Engineering and exact sciences	Life and health sciences	Natural and environmental sciences	Social science and humanities
Spin-off policies	Strongly disagree	7,9%	6,9%	8,1%	18,5%
	Disagree	5,2%	6,9%	5,4%	7,9%
	Somewhat disagree	5,2%	10,3%	5,4%	9,9%
	Neither agree or disagree	36,6%	34,5%	32,4%	33,1%
	Somewhat agree	14,7%	16,1%	5,4%	9,3%
	Agree	19,9%	11,5%	21,6%	12,6%
	Strongly agree	10,5%	13,8%	21,6%	8,6%
Technology transfer	Strongly disagree	9,4%	8,0%	10,8%	15,2%
	Disagree	6,8%	8,0%	8,1%	13,2%
	Somewhat disagree	3,1%	13,8%	0,0%	3,3%
	Neither agree or disagree	30,9%	31,0%	32,4%	25,2%
	Somewhat agree	16,2%	13,8%	13,5%	23,2%
	Agree	17,3%	14,9%	27,0%	9,3%
	Strongly agree	16,2%	10,3%	8,1%	10,6%
Entrepreneurship courses	Strongly disagree	16,8%	18,4%	24,3%	16,6%
	Disagree	6,8%	14,9%	8,1%	11,3%
	Somewhat disagree	9,4%	6,9%	10,8%	9,3%
	Neither agree or disagree	30,9%	23,0%	18,9%	27,2%
	Somewhat agree	8,4%	12,6%	18,9%	7,9%
	Agree	12,6%	13,8%	13,5%	14,6%
	Strongly agree	15,2%	10,3%	5,4%	13,2%

Appendix 3C

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	6,495	21,651	21,651	6,495	21,651	21,651	3,367	11,224	11,224
2	4,091	13,636	35,287	4,091	13,636	35,287	3,322	11,073	22,297
3	2,089	6,964	42,251	2,089	6,964	42,251	2,465	8,215	30,512
4	1,716	5,720	47,971	1,716	5,720	47,971	2,397	7,990	38,502
5	1,509	5,030	53,001	1,509	5,030	53,001	2,272	7,574	46,076
6	1,200	3,999	57,000	1,200	3,999	57,000	1,972	6,574	52,650
7	1,165	3,885	60,885	1,165	3,885	60,885	1,951	6,503	59,153
8	1,073	3,576	64,460	1,073	3,576	64,460	1,592	5,307	64,460
9	,997	3,323	67,783						
10	,908	3,026	70,809						
11	,879	2,931	73,740						
12	,745	2,484	76,224						
13	,724	2,413	78,637						
14	,683	2,275	80,912						
15	,630	2,101	83,013						
16	,564	1,879	84,892						
17	,519	1,729	86,620						
18	,482	1,605	88,226						
19	,438	1,459	89,684						
20	,405	1,351	91,035						
21	,396	1,321	92,357						
22	,352	1,173	93,530						
23	,322	1,073	94,603						
24	,308	1,026	95,629						
25	,287	,957	96,586						
26	,259	,863	97,448						
27	,237	,789	98,237						
28	,182	,608	98,845						
29	,180	,599	99,444						
30	,167	,556	100,000						

Extraction Method: Principal Component Analysis.

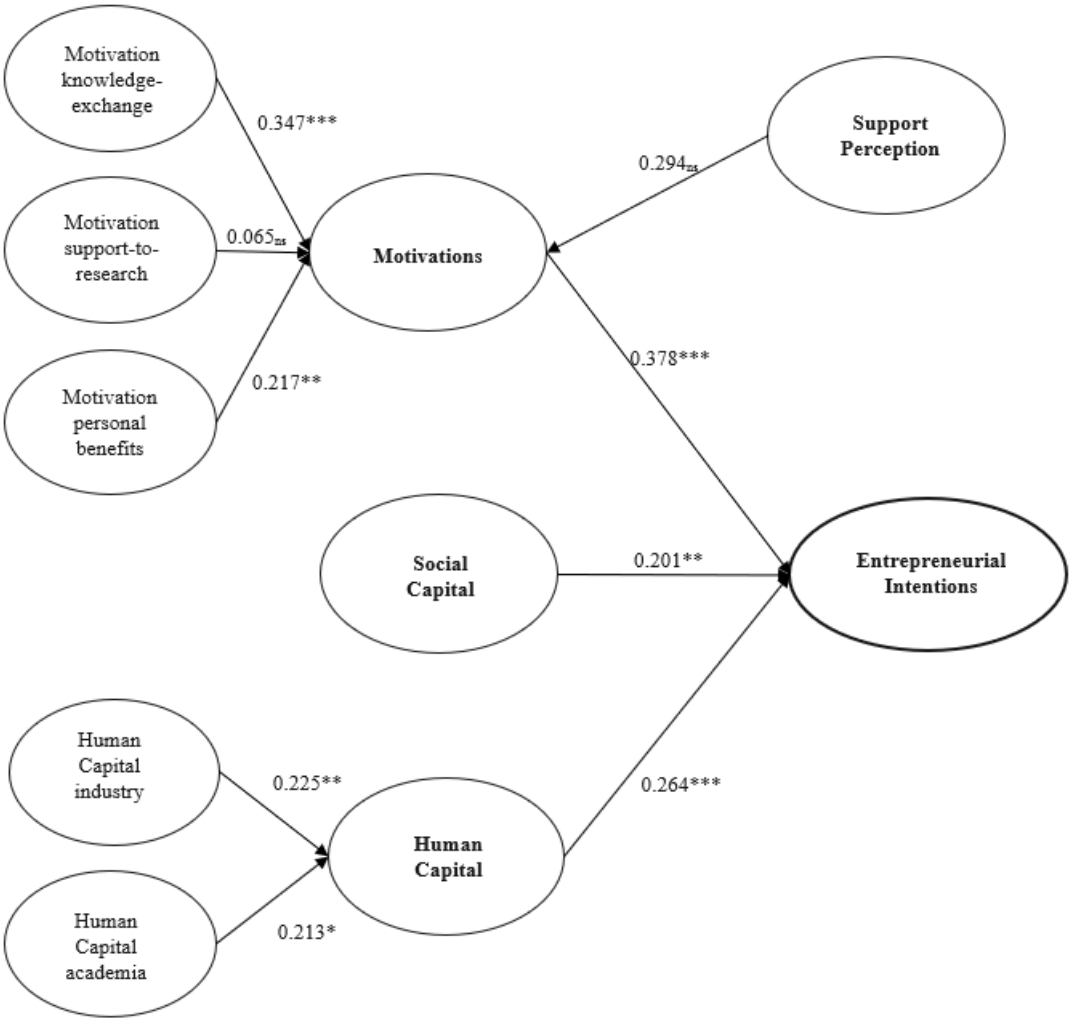
Rotated Component Matrix [a]

	Component							
	1	2	3	4	5	6	7	8
HC1: Joint research contract	,126	-,045	,063	,758	,094	,112	,020	-,136
HC2: Research contract	,090	,139	-,141	,769	,018	,197	,014	,005
HC3: Consultancy	,110	-,062	-,135	,517	-,043	,028	,379	,198
HC4: Trainign of employees industı	,014	,054	-,136	,142	,002	-,047	,742	,087
HC6: Entrepreneurship courses	,166	,140	,020	-,043	,092	,176	,629	-,015
HC7: Proposals submission	,139	-,077	,165	,588	,036	,077	,281	,013
Mot1: Applicability of research	,338	,481	,333	,286	,049	,009	-,014	-,112
Mot2: Creation of future researc opportunities	,227	,619	,447	,118	,004	-,091	-,015	-,059
Mot3: Access to research expertise	,045	,639	,302	-,009	-,095	-,025	-,006	,208
Mot4: Provide work placement grants to students	,065	,275	,746	-,024	-,086	,129	,033	,005
Mot6: Receive feedback fro industry	,338	,448	,266	,311	,174	-,157	,009	,152
Mot7: Increase research funding	,057	,223	,820	,043	,057	-,056	-,028	,063
Mot8: Increase personal income	,077	,434	,353	-,033	-,092	,004	-,102	,493
Mot9: Access to materials equipment	,078	,297	,646	-,080	,023	,029	-,060	,362
Mot10: Satisfaction of intellectual curiosity	,039	,751	,108	-,170	-,073	,005	,172	,089
Mot11: Expand network	,004	,748	,153	,020	,092	,146	,048	,046
Mot13: Peer pressure	,096	,121	,115	-,001	,066	,002	,040	,827
Mot14: Gain additional scientific reputation	,077	,597	-,001	-,014	-,021	,194	,002	,527
Supp2: Clear spin-off policies	,118	,026	-,016	,091	,812	,105	,074	-,008
Supp3: Technology transfer	,031	-,011	,008	,050	,885	,094	-,054	,033
Supp4: Entrepreneurship courses	,070	-,031	-,007	-,015	,809	,049	,073	,005
SC1: Business contacts	,236	,257	-,141	,235	,052	,691	,229	,021
SC2: Research partners in industry	,283	,081	,000	,346	,098	,715	,128	,058
SC3: Public agencies that support the transfer of technology	,177	-,097	,146	,027	,180	,778	,067	,013
Int1: Intention spin-off	,785	,228	-,044	,010	,039	,074	,044	,021
Int3: Intention patenting	,744	,110	,123	-,013	,013	,061	-,086	-,088
Int4: Intention joint research	,788	,001	,071	,188	,120	,182	,128	,112
Int5: Intention research contract	,755	-,007	,100	,219	,102	,227	,127	,084
Int6: Intention consultancy	,644	,003	,023	,204	,035	,165	,303	,214
HC5: Students supervision	,058	-,028	,102	,227	,020	,176	,715	-,127

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

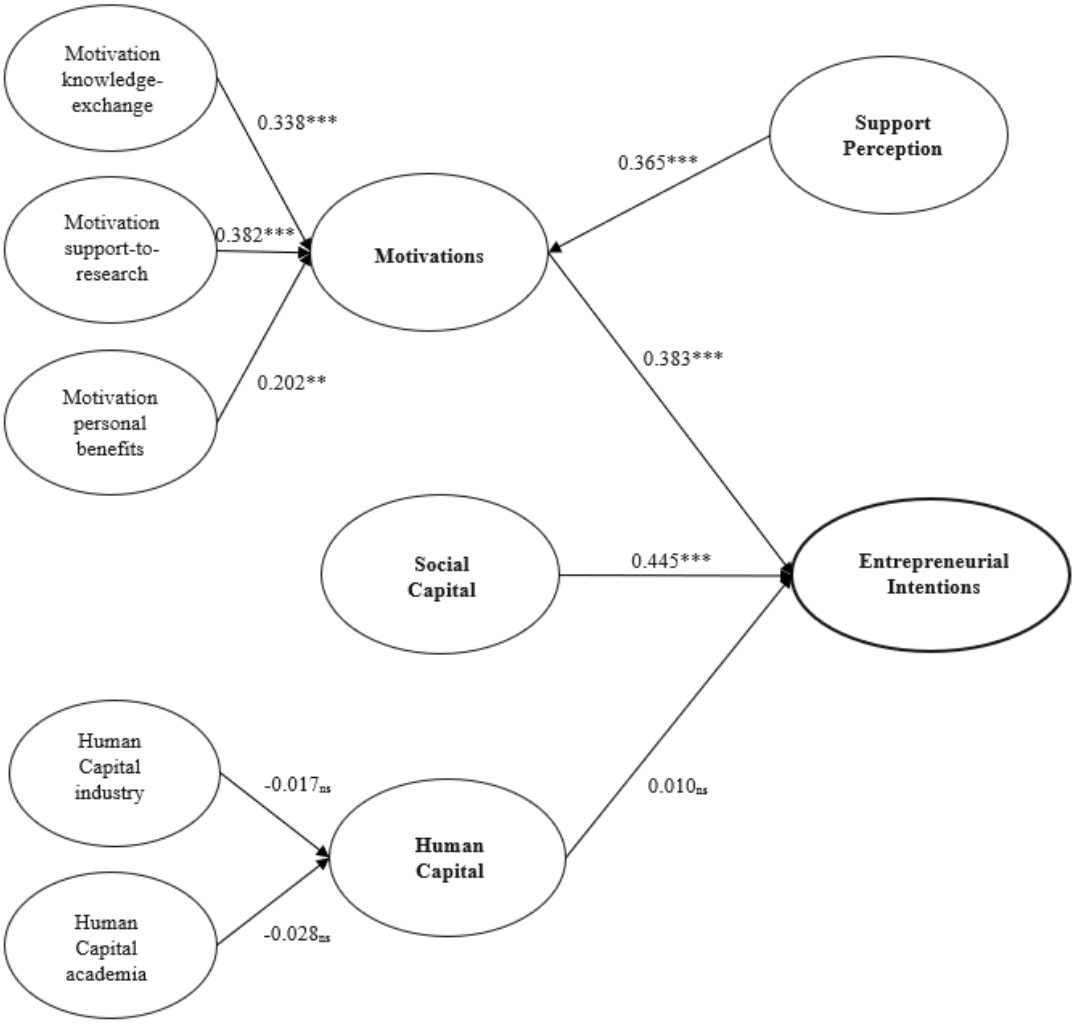
Appendix 3D

University of Aveiro



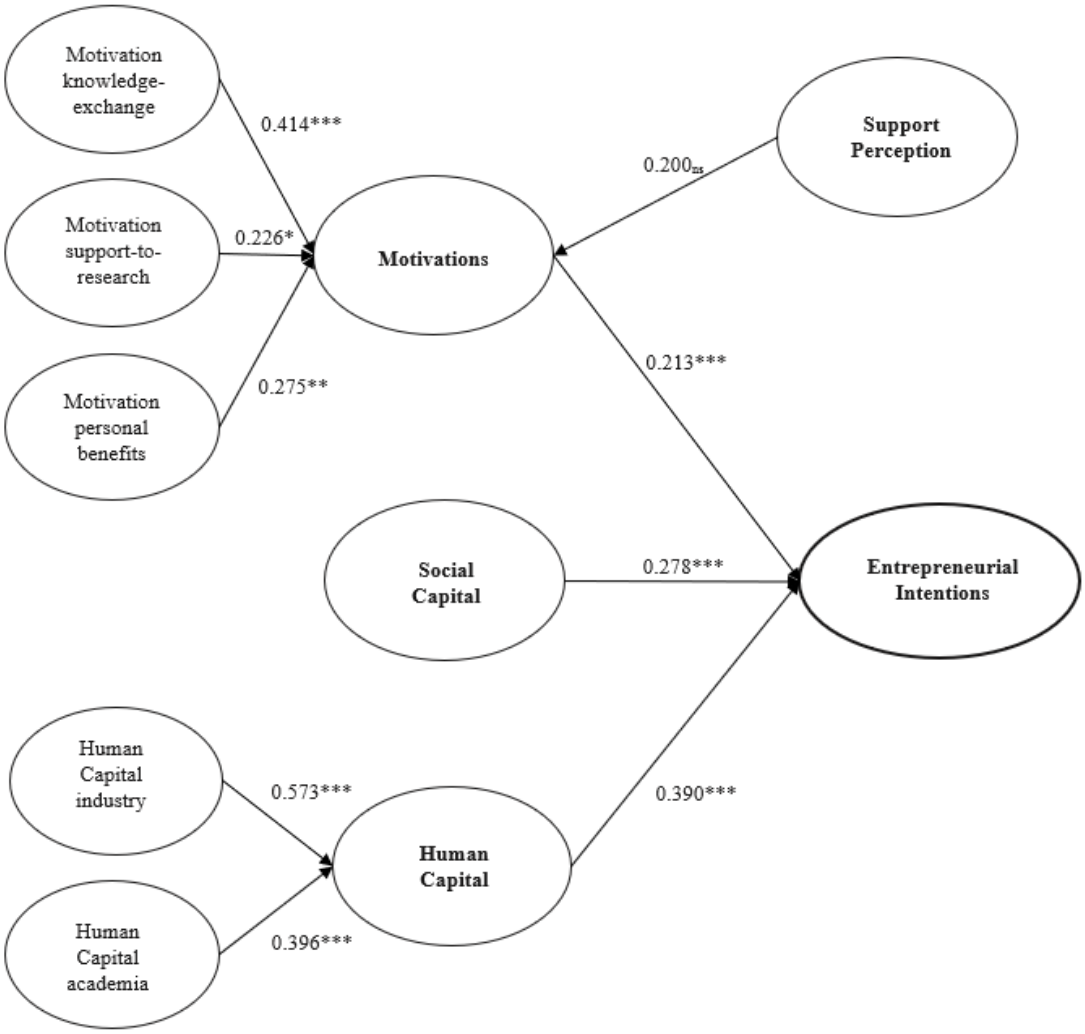
Note: * $p < 0.1$: ** $p < 0.05$; *** $p < 0.01$; ns = not significant

University of Minho



Note: * $p < 0.1$: ** $p < 0.05$; *** $p < 0.01$; $_{ns}$ = not significant

University of Porto



Note: * $p < 0.1$: ** $p < 0.05$; *** $p < 0.01$; $_{ns}$ = not significant

CHAPTER 4

The value creation within the entrepreneurial university: An empirical study of European universities

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This chapter is an extended version of a paper submitted and presented at the R&D Management Conference: Innovation in an Era of Disruption. University of Strathclyde, Glasgow, Scotland. 6-8 July, 2021.

Abstract: In an emerging innovation ecosystem, the university has evolved from a science partner to a key stakeholder (Hayter et al., 2020), contributing to the region's economic and social development (Guerrero et al., 2015; Klofsten et al., 2019). Acknowledging that the university needs to manage its internal environment, it also should consider various external characteristics and stakeholders (Etzkowitz, 2017; Mainardes et al., 2014); this research explores regional and university variables and their relationship towards entrepreneurial activities. The study's framework considered three entrepreneurial activities: spin-off creation, patenting, and collaboration with industry.

This research collected university-level and regional-level data. On the University side, the research collected secondary data from European Tertiary Education Register, Times Higher Education Ranking, InCites Clarivate Analytics, CWTS Leiden Ranking

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and European Patent Office. The study also included data referring to Research and Development (R&D) Expenditure from both public and private sectors (European Commission Regional Innovation Scoreboard) and Regional Gross Domestic Product *per capita*, (Eurostat and UK Office for National Statistics). The empirical analysis is conducted on twelve universities located across eleven Nomenclature of Territorial Units for Statistics-2 (NUTS-2) regions from four European countries: France, Germany, Portugal and the United Kingdom.

The creation of spin-offs found a moderate positive correlation with the private sector expenditure and a moderate positive correlation with the research quality variable: citation impact. While private-sector R&D expenditure is significantly correlated with the creation of spin-offs, public expenditure on R&D reveals a strong positive correlation with patenting. The university size and age also evidences a robust positive correlation. Lastly, biomedical fields have a moderate positive correlation, while the social sciences have a strong negative correlation with patenting. The university collaboration with the industry strongly correlates with physical science and engineering. Despite the expected, all variables regarding research quality showed a strong negative correlation with university-industry collaboration.

4.1 Introduction

For many centuries, the university's role centred on teaching and research; it served society by educating students and being a knowledge producer (Guerrero and Urbano, 2012; Wood, 2009). However, due to financial and policy pressure (Holstein et al., 2018), the university responded with shifts in its strategy, fostering economic development (Kirby et al., 2011) and emerging within a complex ecosystem of regional stakeholders (Miller et al., 2018). Universities are tasked with the mission of creating, transferring, and commercialising knowledge derived from academic research (Hayter et al., 2020). Moreover, as the link between investment in knowledge creation and growth is entrepreneurship (Audretsch and Keilbach, 2007), the university has transformed itself into an entrepreneurial university.

With the addition of an entrepreneurial mission, alongside teaching and research, universities will require to have novel management approaches to effectively carry out their roles (Secundo et al., 2019). The literature has been devoted to this theme.

At a micro-level, empirical and conceptual research has addressed the multiple actors involved (Ankrah et al., 2013), from academics' intentions (Perkmann et al., 2013), their drivers and barriers to engagement (Escobar et al., 2017), the role of the principal investigators (Cunningham et al., 2018), to the perceived support and culture of the mechanisms provided by their universities (Meyer, 2003).

Furthermore, at a meso-level, some literature has deepened the knowledge regarding the activities under academic entrepreneurship scope (Kalar and Antoncic, 2015), the universities' business models (Miller et al., 2014; O'Shea et al., 2007) and orientation (Todorovic et al., 2011). The university's strategy (meso-level) influences and is influenced by its academics (micro-level) and by the external regional and national context (macro-level). Transversal to various scholars is the view that this system is complex, involving several stakeholders, in which universities' actions are contingent upon a wide range of dynamic organisational capabilities (Klofsten et al., 2019).

The current literature is fragmented and lacks coherent conceptualisation that fully undercover the new entrepreneurial university archetypes (Gaus and Raith, 2016) and the relationship between knowledge outcomes and regional development (Secundo et al., 2019). Acknowledging that the university management should tailor their entrepreneurship policy strategy to its institutional context and actors (Fini et al., 2020), this research follows Hayter et al. (2018) recommendation of linking different levels of analysis.

This current study explores regional context and university's general structure and their relationship to entrepreneurial activities. On top of that, the study's framework addresses other gaps within the literature: the entrepreneurial output is not restricted to only one knowledge transfer activity (Wang et al., 2021) and considered three entrepreneurial activities to be analysed independently: spin-off creation, patenting, and collaboration with industry. Further, acknowledging a lack of cross country comparison studies (Cunningham and O'Reilly, 2018), the empirical analysis is conducted on twelve universities from four European countries: France, Germany, Portugal and the United Kingdom.

The paper is structured as follows. The following section focuses on the theoretical background. Section 4.3 outlines the methodology for data collection and data analysis.

Section 4.4 presents the findings and discusses the results. The paper ends with a synthesis of the main contributions, limitations of the study, and future research avenues.

4.2 Theoretical Background

Clark (1998, p. 4) coined the term entrepreneurial university to identify a social system that "actively seeks to innovate in how it goes about its business, to work out a substantial shift in organisational character so as to arrive at a more promising posture for the future". As per Etzkowitz (1998), an entrepreneurial university pursues new sources of revenue obtained by the transformation of knowledge into economic and social value. It is argued more recently that the entrepreneurial university's role extends beyond knowledge production and transfer (Guerrero and Urbano, 2012). It should further include a contribution to the creation of entrepreneurial thinking, actors and institutions (Audretsch, 2014). The concept has been intensively revised and discussed in the literature (Etzkowitz, 2003; Etzkowitz et al., 2000; Sam and van der Sijde, 2014).

Knowledge is created within the university, transferred to and from industry and government, and then adopted. The knowledge transfer process, in which technology transfer is one of the activities, paired with knowledge adoption, is referred to as knowledge exploitation (Lockett et al., 2008). Following Abreu and Grinevich (2013) and Wright et al. (2008), the authors consider academic entrepreneurship as the exploitation of knowledge through academic spin-offs, patenting, and collaborative activities with industry, most notably joint-research, research contract and consulting (Etzkowitz and Klofsten, 2005; Klofsten and Jones-Evans, 2000; Siegel, Waldman, Atwater, et al., 2003).

When establishing the strategy, university policymaking has to consider the role of academics (students, researchers and faculty), the university organisational context, and the region characteristics where they are located. At the organisational level, the literature has listed several variables, namely the university governance, size (Bronstein and Reihlen, 2014), technology transfer office presence and autonomy (Fini et al., 2020), and previous entrepreneurial experience (Kirchberger and Pohl, 2016; Moutinho et al., 2016). Moreover, such a strategy must be consistent with the transformation phase in which the university finds itself (Markuerkiaga et al., 2019) and dynamic to keep adapting to the ever-changing environment (Bekkers and Freitas, 2008; Hossinger et al., 2020).

It is well recognised that the science commercialisation process is challenging (Wright and Phan, 2018), the universities need to seek opportunities to move towards the market needs (Audretsch et al., 2015). The literature has also proven that some universities are better than others at tackling certain entrepreneurial activities (Di Gregorio and Shane, 2003). Siegel and Wright (2015) state that universities strategic choice should reflect their scientific base, technological emphasis, and resource allocation. Considering all this, it is understandable that although universities promote academic entrepreneurship, few of them are genuinely firing the right bullet in the right direction (Sandström et al., 2018).

Several scholars argue that the university needs to embed its approach according to the regional environment (Berbegal-Mirabent et al., 2013; Cunningham, Harney, et al., 2020). Policies and support structures must adapt to the unique regional contexts (Hossinger et al., 2020). It has to consider the industry presence, venture capital presence, economic characteristics of the region (Hayter et al., 2018), type of company, cultural barriers (Kirchberger and Pohl, 2016), high-growth or low-growth dynamic (Bronstein and Reihlen, 2014). In other words, universities have to foresee and adjust to political, economic, social, technological and legal changes (Galan-Muros and Davey, 2019).

Universities, through academic entrepreneurship, create value for themselves. They can attract new and better students and faculty (Siegel and Leih, 2018), it raises their research visibility and enhances the potential of new funding opportunities provided by enterprises from the private sector (Coupet and Ba, 2021; Munari et al., 2018), increase giving from alumni entrepreneurs (Berggren, 2017), and enhances cross-campus coherence (Heaton et al., 2020). There is also value-added to the regions and the industry. It stimulates entrepreneurship within local economies, generates highly educated students to the labour market, publishes papers with practical applications, promotes an entrepreneurial culture, drives the knowledge transfer through patent and licencing, and their spin-off and start-up generate jobs.

The entrepreneurial university wants the academics to explore their research beyond the options for publications (Brettel et al., 2013), creating a virtuous cycle between science and technology (Owen-Smith, 2003). Nevertheless, this process has some criticisms that will generate some detrimental effects on scientific knowledge in the long term. The reasoning behind the allegations is that industry actors could undermine

universities (Vallas and Kleinman, 2008). Making the universities shift from basic research towards more applied to market topics (Behrens and Gray, 2001), increasing secrecy and reducing open knowledge diffusion (Czarnitzki et al., 2015; Tartari and Breschi, 2012) and even led to an academic 'brain drain' (Toole and Czarnitzki, 2010).

To make sense of this complex organisational phenomenon, social science, particularly organisational theory (Scott and Davis, 2015), is essential to support universities in establishing and implementing plans and strategies that align their teaching, research, and entrepreneurial missions (Mazzei et al., 2017). Stemming from contingency theory, which claims that institutional effectiveness is contingent on matching organisational variables with environmental conditions (Betts, 2011), the research framework proposes that both the general university structure and the regional characteristics impact the university strategic structure, which will, in turn, shape the universities outputs (Figure 4.1). In this paper, the empirical analysis will focus on the inputs and outputs of this system.

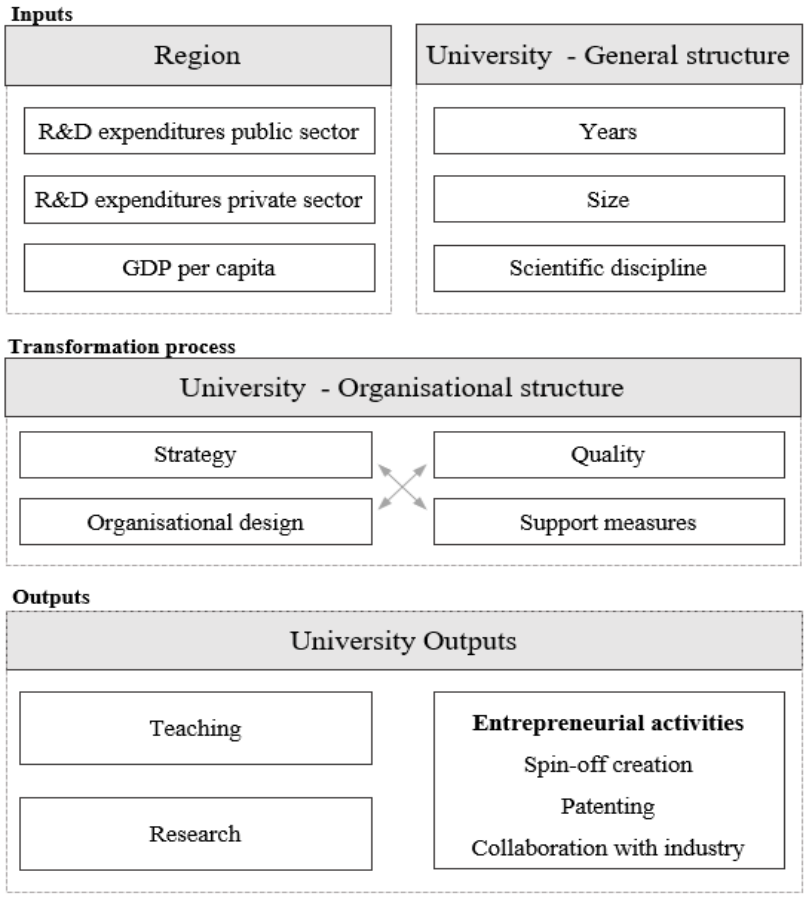

Figure 4.1 Research Framework

4.3 Methodology

4.3.1 Data collection

This research collected university-level and regional-level data. To control for some effects of regional heterogeneity, the authors selected universities from regions with a similar level of innovation. Thus, employing the Regional Innovation Scoreboard (RIS) that assesses European regions' innovation performance, this study analysed twelve universities in regions classified as "Strong Innovators".

On the university side, the research collected secondary data from European Tertiary Education Register (ETER), Times Higher Education (THE) Ranking, InCites Clarivate Analytics (Incites), CWTS Leiden Ranking (Leiden) and European Patent Office (EPO).

The universities examined are from four different European countries: France, Germany, Portugal and United Kingdom (UK). From France, the paper studied the University of Nantes (U.Nantes), the University of Bordeaux (U.Bordeaux) and the Aix-Marseille University (U.Aix-Marseille). As for Germany, the paper explored the University of Hannover (U.Hannover), the University of Münster (U.Münster) and Kiel University (U.Kiel). In addition, the University of Porto (U.Porto), the University of Minho (U.Minho) and the University of Aveiro (U.Aveiro) are the Portuguese universities under analysis. Lastly, the English universities are Durham University (U.Durham), Lancaster University (U.Lancaster) and Queen's University Belfast (U.Belfast) (see Appendix 4A).

The university structure comprises data regarding the number of students, year of foundation, ancestry year, and the frequency of students attending different scientific disciplines. THE ranking provided a measure for teaching quality. It is a pre-weighted indicator obtained by computing five variables: the results of Elsevier reputation survey, conducted to perceive the prestige of universities in teaching; academic staff to student ratio; Doctorates-awarded to bachelor-degrees-awarded ratio; Doctorates-awarded-to-academic-staff ratio; and institutional income per staff, that reveals a universities' overall status and provides an impression of the infrastructure and resources available. Apart from the survey, the other variables were normalised after calculation. To develop an understanding of the quality of university research, the authors collected data regarding scientific publications, namely the percentage of papers in Q1 journals, the ratio of

publication in the top 10%, and category normalised citation impact. The number of publications is frequently trusted to measure scientific productivity (Callaert et al., 2015; D'Este et al., 2019; Vick and Robertson, 2018). This research has replied to the request of Erikson et al. (2015), who invited future work to incorporate more fine-grained measures of quality of scientific work by featuring the number of citations.

Lastly, the authors considered three dimensions of the commercial valorisation activities performed by the universities. First, the number of patents was accessed at the EPO Global Patent Index. The researchers searched and totalled all patents granted in the years 2018, 2019 and 2020. This process included searching the universities by their native language names as well as in English. Second, the authors extracted data concerning the number of ventures created from a rigorous examination of universities official reports from 2020. The British universities venture creation data was obtained from the Higher Education Statistics Agency (HESA). Third, university-industry collaborations were proxied by the indicator Industry Income provided by THE. This variable denotes the research income from industry and commerce, on a function of the number of academic staff (for detailed data, see Appendix 4B).

To support the conceptual model, the research collected data referring to R&D expenditure from both public and private sectors (RIS) and regional gross domestic product per capita (Eurostat Regional Yearbook 2019 and UK Official for National Statistics). Additionally, to provide a more detailed portrait of the region, the proportion population with completed tertiary education and non-R&D innovation expenditures as a percentage of total turnover were included (RIS).

4.3.2 Data analysis

The data analysis will comprise both quantitative and qualitative components. Given the small number of universities under study ($N = 12$), the present research will perform correlations between variables. Spearman's rank correlation coefficient is a nonparametric rank statistic proposed to measure the strength of an association between two variables (Hauke and Kossowski, 2011). It is preferred to Pearson's correlation because the variables are not required to have a normal distribution, and it is not as sensitive to potential outliers (Kassab, 2019). IBM SPSS Statistics 27 was used for descriptive statistics and correlations. This quantitative analysis is complemented with a

qualitative assessment, particularly an exploratory study using Contrast Table (Miles et al., 2014).

4.4 Findings and Discussion

The universities have a heterogeneous structure, distinct teaching and research quality rankings, and varying entrepreneurial activities outcomes. Additionally, they are embedded in geographical contexts and entrepreneurial ecosystems with unique characteristics.

Table 4.1 features regional data at a NUTS-2 level. It is noticeable that the German and the British regions have the most significant proportion of the population with tertiary education. Out of the 11 regions, the top five belong to these countries. The regions where the University of Kiel (public = 0.692; private = 0.635) and the University of Nantes (public = 0.680; private = 0.619) are located record high values of R&D expenditure, as a percentage of Gross Domestic Product (GDP), from both the public and the private sector.

Table 4.1 Regional indicators

University	Regions NUTS-2	Population with tertiary education	R&D expenditure public sector	R&D expenditure private sector	Non-R&D innovation expenditures	GDP per capita
U. Nantes	Alsace	0.320	0.680	0.619	0.361	29433
U. Bordeaux	Aquitaine	0.244	0.501	0.380	0.660	28700
U. Aix-Marseille	Provence	0.212	0.585	0.437	0.402	33600
U. Hannover	Hannover	0.422	0.535	0.410	0.592	39700
U. Münster	Münster	0.530	0.482	0.453	0.682	34100
U. Kiel	Schleswig-Holstein	0.510	0.692	0.635	0.487	33900
U. Porto U. Minho	Norte	0.300	0.566	0.412	0.831	17700
U. Aveiro	Centro	0.395	0.527	0.402	0.795	18000
U. Durham	Tees Valley	0.445	0.474	0.356	0.605	27757.53
U. Lancaster	Lancashire	0.528	0.440	0.571	0.587	33437.51
U. Belfast	Northern Ireland	0.377	0.416	0.546	0.569	29588.97

Notes: Alsace = Alsace, Champagne-Ardenne, Lorraine; Aquitaine = Aquitaine, Limousin, Poitou-Charentes; Provence = Provence, Alpes-Côte d'Azur; Tees Valley = Tees Valley and Durham. GDP value in Euros. Data in Pound Sterling was converted to Euro at the exchange rates of the 6th of May, 2021 (£ 1 = € 1.15)

Curiously, all three UK regions report the lowest value of a public investment in R&D. This could either be the reason or result of more substantial private investment in these regions (especially in Lancashire = 0.571 and Northern Ireland = 0.546). The highest expenditures on non-R&D innovation characterise the Portuguese North and Centre regions. Regional GDP follows a national GDP dynamic, meaning that the same

country's regions are to some degree homogenous. The German regions have the highest GDP per capita. All three German regional areas are ranked highest among all regions. The Hannover region is notably superior (GDP *per capita* = €39.700) if compared with the northern region of Portugal, where both U.Porto and U.Minho are located (GDP *per capita* = €17.700). The French and the English regions have close values (with the lowest value at €27.757,53 for Tees Valley and the highest value of €33.600 for the region of Provence), and the averages for each country's three regions are likewise fairly similar (France = €30.577,66 and UK = €30.261,34).

The review of the universities' general structure reveals that they differ from one another. From the data, five universities have over 30.000 students, with two having over 50.000 students. The universities with more students (U.Aix-Marseille and U.Bordeaux) are also the most long-established universities, with ancestry dating from the 15th century. The youngest and smaller universities cluster is represented by U.Aveiro, U.Lancaster and U.Minho (Figure 4.2)

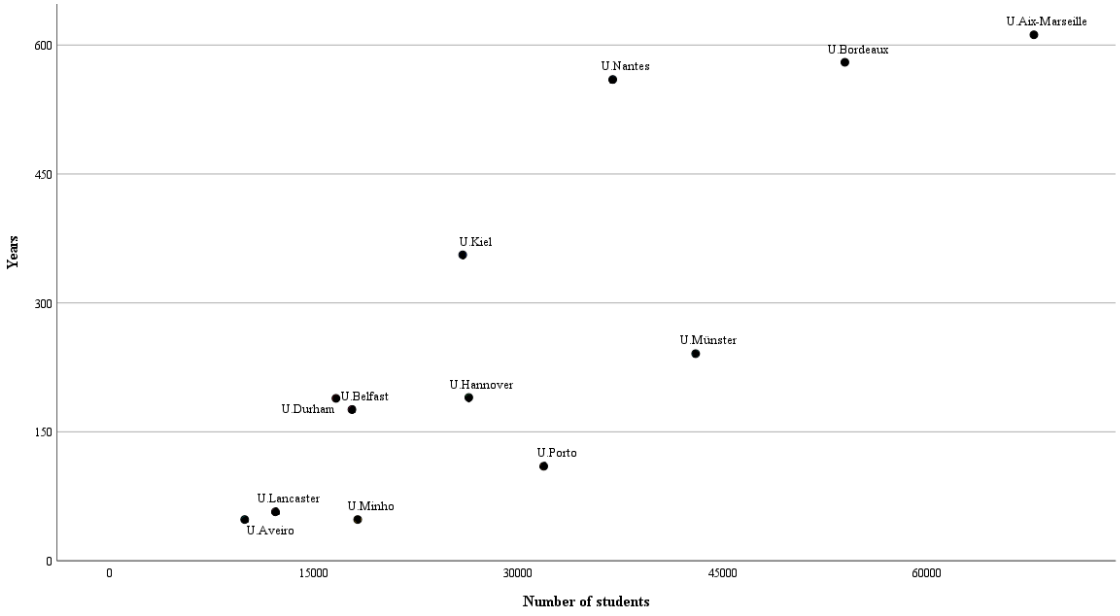

Figure 4.2 Universities number of students and ancestry year

Regarding scientific discipline (Table 4.2), U.Aveiro (53.5%), U.Hannover (53.3%), and U. Durham (46.9%) feature a high frequency of students in physical sciences and engineering. This field and biomedical and health science are heavily represented in French institutions, with over 70% of graduates pursuing degrees in these fields

(U.Nantes = 81.1%; U.Bordeaux = 75.2%; and U.Aix-Marseille = 72.4%). On the other hand, mathematics and computer science (μ = 8.5%) and Social science and humanities (μ = 9.2%) are the scientific fields with the fewest students, on average, throughout the twelve universities. Nevertheless, social science is moderately represented by the students at two universities: Lancaster University (30.1%) and Durham University (20.5%).

Table 4.2 University general structure

			Scientific discipline (% students)				
University	**Year Foundation**	**Nr. Students**	Biomedical & health sciences	Life & earth sciences	Math. & computer science	Physical sciences & engineering	Social sciences & humanities
U. Nantes	1961	36.943	45.6%	10%	7.2%	35.5%	1.6%
U. Bordeaux	2014	53.992	40.6%	14.4%	6.5%	34.6%	3.9%
U. Aix-Marseille	2012	67.876	48.6%	17.9%	5.5%	23.8%	4.2%
U. Hannover	1831	26.368	6.7%	19.1%	14.2%	53.2%	6.9%
U. Münster	1780	43.032	44.4%	11.1%	6.6%	30%	7.9%
U. Kiel	1665	25.920	41.6%	18%	5.5%	26.5%	8.0%
U. Porto	1911	31.873	38.6%	22.5%	4.9%	30.1%	3.9%
U. Minho	1973	18.207	22.4%	20.5%	11.1%	38.6%	7.3%
U. Aveiro	1973	9.907	9.7%	23.1%	9%	53.5%	4.7%
U. Durham	1832	16.613	10.9%	16.7%	5%	46.9%	20.5%
U. Lancaster	1964	12.165	12.1%	23%	17.7%	17.1%	30.1%
U. Belfast	1845	17.784	39.4%	14.1%	8.9%	26.9%	10.7%

Notes: All universities, except for the French, have the same founding year and ancestral year: U.Nantes ascendancy year is 1461; U.Bordeaux: 1441 and U.Aix-Marseille: 1409.

The outcomes of the entrepreneurial activity (Figure 4.3 and Appendix 4C) reveals that universities are performing differently between them and even between the activities. U.Aix-Marseille, U.Bordeaux and U.Nantes excel when it comes to patents (N = 226; 192 and 133, respectively). U.Nantes also experiences high industry revenues (52.1). Similarly, U.Münster (53.3) and U.Hannover (52.2) report extraordinary industry collaboration results. Outstandingly, U.Minho is the leading university in this activity (62.7), despite featuring small numbers of spin-offs (N = 7) and relatively a small amount of patents (N = 32). U.Kiel does not follow the same pattern as the other German universities. It records shallow collaboration with industry and the creation of spin-offs and moderates for patents granted. U.Aveiro entrepreneurial outcomes are nearly identical to those of U.Kiel. Finally, U.Belfast (N = 30) and U.Lancaster (N = 30) stand out by the number of spin-offs created, only losing first place to U.Hannover (N = 32).

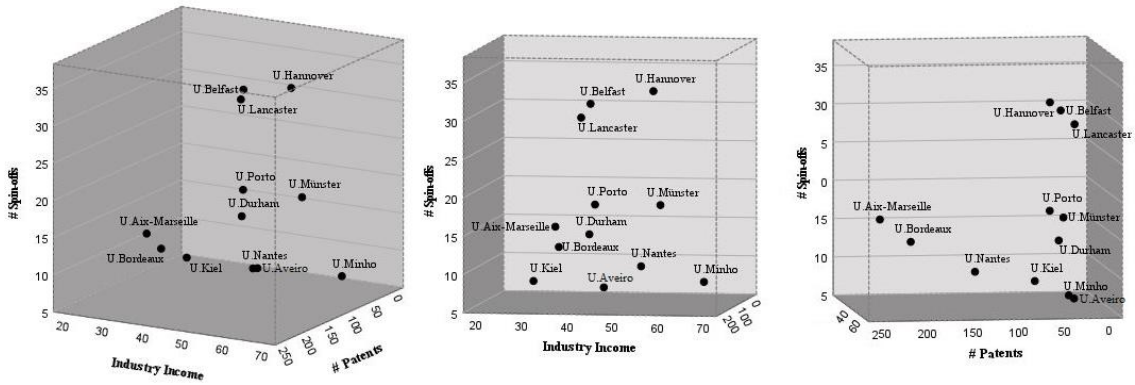

Figure 4.3 Entrepreneurial activities outcomes

The authors used Spearman correlations to test the correlations between the independent regional and general university structure variables and the dependent entrepreneurial activities variables (Table 4.3)

The creation of spin-offs found a moderate positive correlation with the amount of expenditure from the private sector (0.504, $p < 0.1$) and also a moderate positive correlation with the research quality variable: citation impact (0.524, $p < 0.1$). While private-sector R&D expenditure is significantly correlated with the creation of spin-offs, public expenditure on R&D reveals a strong positive correlation with patenting (0.637, $p < 0.05$). Likewise, the Regional GDP displays a positive correlation with patenting (0.553, $p < 0.1$). These findings support earlier work highlighting that regions with a high investment in new knowledge also tend to have more significant entrepreneurial activity (Acs et al., 2009; Guerrero and Urbano, 2014). In addition, the results demonstrate that the source of the investment, whether public or private, relates to different activities, patenting and venture creation, respectively.

Further concerning patents, the university size (0.895, $p < 0.01$) and age (0.851, $p < 0.001$) both evidence an extreme positive correlation. The correlation between the size and the number of patents can be a scope effect, meaning that a university with a high number of academics increases the probability of making relevant scientific advancements. Then concerning age, the fact that older universities are also those with more granted patents could be the result of multiple factors. The authors explored and found that the older universities have a robust positive correlation with Biomedical and Health Science fields (0.718, sig < 0.01). This scientific field is generally one in which it is standard practice to patent. It is also one where there is a high demand from major

industry stakeholders and national governments (Chatterjee and Sankaran, 2015; Coupet and Ba, 2021).

Lastly, the findings are consistent with the existing literature as far as the scientific areas are concerned. Biomedical and health science fields have a moderate positive correlation (0.587, $p < 0.05$), while the social sciences have a strong negative correlation with patenting (-0.678, $p < 0.05$).

Table 4.3 Correlations

	Spin-off creation	**Patenting**	**Collaboration with industry**
University general structure			
Age	0.065	0.851***	-0.315
Size	0.137	0.895***	0.056
Scientific discipline			
Biomedical and health science	-0.116	0.587**	-0.168
Life and earth science	-0.130	-0.434	-0.098
Mathematics and computer science	0.169	-0.420	0.308
Physical science and engineering	-0.323	-0.063	0.587**
Social science and humanities	0.239	-0.678**	-0.273
Region			
Regional GDP per capita	0.049	0.553*	-0.501
R&D expenditure from the public sector	-0.187	0.637**	0.179
R&D expenditure from the private sector	0.504*	0.315	-0.368
Teaching and Research			
Teaching quality	0.262	0.030	-0.491
Research quality			
Category normalised citation impact	0.524*	0.077	-0.601**
Ratio of documents in the top 10%	0.266	-0.144	-0.564*
Ratio of documents in Q1 journals	0.207	-0.259	-0.503*

Note: Significance level: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

The university-industry collaboration strongly correlates with physical science and engineering (0.587, $p < 0.05$). Despite the expected linear relationship between scientific productivity and collaboration with industry (Erikson et al., 2015), all variables regarding research quality showed a strong negative correlation with university-industry collaboration (citation impact = -0.601, $p < 0.05$; documents in the top 10% = -0.564, $p < 0.01$; and documents in Q1 journals = -0.503, $p < 0.1$).

This negative correlation may be linked to the ambidextrous nature of universities and the fact that the published research and the joint or collaborative research with

industry may have different grounds (Centobelli et al., 2019). Under Stoke's Pasteur Quadrant Mode, the research performed by the universities may either be pure basic research, use-inspired basic research or pure applied research (Stokes, 1997; Tijssen, 2018). Most academic research conducted at universities is basic and does not generate an immediate economic value (Guerrero and Urbano, 2014). Thus, there might be the case that the research papers published and the research demanded by the industry may be different. Another possible interpretation is that academics in universities that excel in research are less favourable to engage with industry actors because they are concerned that it may restrict their academic freedom (D'Este and Perkmann, 2011). Nevertheless, research performance is claimed to positively affect academic venture creation (Clarysse et al., 2011; Fuller and Pickernell, 2018) and patenting activities (Bercovitz and Feldman, 2008). Yet, this research findings only found a significant positive correlation between the citation impact and spin-off creation (0.524, $p < 0.01$).

To conclude, the knowledge valorisation activities and values for the twelve universities under analysis are summarised in Table 4.4.

Table 4.4 University outcomes

	Teaching	**Research quality**					
	quality	Citations	Top 10%	Q1	**Spin-off**	**Patents**	**UIC**
U. Nantes	Low	Low	Low	Medium	Low	High	High
U. Bordeaux	Medium	Medium	Medium	High	Medium	High	Low
U. Aix-Marseille	Very High	High	Medium	Medium	Medium	Very High	Low
U. Hannover	High	Medium	Low	Very Low	Very High	Medium	High
U. Münster	Very High	High	High	Medium	Medium	Medium	High
U. Kiel	Medium	High	High	Medium	Low	Medium	Very Low
U. Porto	Low	Medium	Low	Low	Medium	Medium	Medium
U. Minho	Very Low	Very Low	Low	Low	Low	Low	Very High
U. Aveiro	Low	Very Low	Very Low	Low	Low	Low	Medium
U. Durham	Medium	Medium	High	Very High	Medium	Low	Medium
U. Lancaster	High	Very High	Very High	High	High	Low	Low
U. Belfast	Medium	Medium	Medium	High	High	Low	Medium

4.5 Conclusions

The performance of the twelve European universities' entrepreneurial activities (outputs) is partly linked with regional and institutional factors (inputs). Overall, the study proved that academic spin-offs correlate with regional expenditure in R&D from the private sector and with research quality. The findings show there are five positive and one negative factor when it comes to patents. With a positive correlation, granted patents are correlated with two regional factors, namely regional GDP as well as R&D expenditures from the public sector. The institutional drivers' university age and size were only found to be correlated with patents. At the same time, no significant effect was observed on the number of spin-offs or collaboration with the industry.

Meanwhile, regarding the relationship between patenting and scientific discipline, biomedical and health science exert a positive influence. In contrast, there is a negative interaction with the social science and humanities. Lastly, the university-industry collaborations are most strongly linked to the physical science and engineering disciplines.

Alongside the aforementioned factors, some additional elements may account for university entrepreneurial performances. The universities may be at distinct commercialisation stages (Markuerkiaga et al., 2019). It may be worthwhile pursuing research to understand with the rectors, senior TTO's and department leaders the current phase in which their universities are. The transformation phase, the university level of experience (Giuri et al., 2019) and evolution over time (Wright et al., 2017) can ascertain the extent of a university's engagement in the Third Mission.

The differences encountered could also result from the region knowledge infrastructure or industry composition (O'Shea et al., 2005). While this research has considered R&D expenditure, there is scope for additional research to unravel the link.

Some universities are more predisposed to knowledge valorisation activities because the local governments encourage political support. In the United Kingdom, higher education institutions are encouraged to take responsibility for supporting economic development (Abreu et al., 2016).

Although the organisational structure of universities was beyond this research's scope, it calls to be explored under future research. How universities strategically orchestrate their inputs (Daraio et al., 2011; Secundo et al., 2019), what rules and policies

they develop in accordance to meet the goal of the academic entrepreneurship initiative (Gümüsay and Bohné, 2018), how can the university organise their support mechanisms: from incentive programmes (O'Kane et al., 2020), to entrepreneurship education (Blankesteijn et al., 2021), infrastructures (Sjöö and Hellström, 2019), and expand its networking base (Hossinger et al., 2020) are some research areas that can be further explored conceptually and empirically.

Further, although we assume that universities adapt their strategy to their context and academics, a recent review by Romero et al. (2021) found that the literature finds two clusters debating this issue. They found that some authors argue that the "transformation is isomorphic". In contrast, other authors advocate that "each university's response is different and conditioned by contextual factors such as its condition as a public or private university, its organizational culture, the country's government policies, or the need to seek funding" (p.1191). We also suggest further research on this topic.

Lastly, although there is no standard model of the entrepreneurial university, a successful programme must align the university unique structures and systems with the interests of the external stakeholders, including government, industry and society, with those of its students, academics and researchers. While also considering the regional and national context in which the university is located.

References

Abreu, M., Demirel, P., Grinevich, V. and Karataş-Özkan, M. (2016), "Entrepreneurial practices in research-intensive and teaching-led universities", *Small Business Economics*, Vol. 47 No. 3, pp. 695–717.

Abreu, M. and Grinevich, V. (2013), "The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities", *Research Policy*, Vol. 42 No. 2, pp. 408–422.

Acs, Z., Braunerhjelm, P., Audretsch, D.B. and Carlsson, B. (2009), "The knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 32 No. 1, pp. 15–30.

Ankrah, S.N., Burgess, T.F., Grimshaw, P. and Shaw, N.E. (2013), "Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit", *Technovation*, Vol. 33 No. 2–3, pp. 50–65.

Audretsch, D.B. (2014), "From the entrepreneurial university to the university for the entrepreneurial society", *Journal of Technology Transfer*, Vol. 39 No. 3, pp. 313–321.

Audretsch, D.B. and Keilbach, M. (2007), "The theory of knowledge spillover entrepreneurship", *Journal of Management Studies*, Vol. 44 No. 7, pp. 1242–1254.

Audretsch, D.B., Lehmann, E.E. and Paleari, S. (2015), "Academic policy and entrepreneurship: a European perspective", *Journal of Technology Transfer*, Vol. 40 No. 3, pp. 363–368.

Behrens, T.R. and Gray, D.O. (2001), "Unintended consequences of cooperative research: Impact of industry sponsorship on climate for academic freedom and other graduate student outcome", *Research Policy*, Vol. 30 No. 2, pp. 179–199.

Bekkers, R. and Freitas, I.M.B. (2008), "Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter?", *Research Policy*, Vol. 37 No. 10, pp. 1837–1853.

Berbegal-Mirabent, J., Lafuente, E. and Solé, F. (2013), "The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities", *Journal of Business Research*, Vol. 66 No. 10, pp. 2051–2059.

Bercovitz, J. and Feldman, M.P. (2008), "Academic Entrepreneurs: Organizational Change at the Individual Level", *Organization Science*, Vol. 19 No. 1, pp. 69–89.

Berggren, E. (2017), "Researchers as enablers of commercialization at an entrepreneurial university", *Journal of Management Development*, Vol. 36 No. 2, pp. 217–232.

Betts, S.C. (2011), "Contingency Theory: Science Or Technology?", *Journal of Business & Economics Research*, Vol. 1 No. 8.

Blankesteijn, M., Bossink, B. and van der Sijde, P. (2021), "Science-based entrepreneurship education as a means for university-industry technology transfer", *International Entrepreneurship and Management Journal*, Vol. 17, pp. 779–808.

Brettel, M., Mauer, R. and Walter, T. (2013), "High-profile employees at universities and their intentions of commercializing research results", *Journal of Business Economics*, Vol. 83 No. 4, pp. 357–382.

Bronstein, J. and Reihlen, M. (2014), "Entrepreneurial University Archetypes: A Meta-Synthesis of Case Study Literature", *Industry and Higher Education*, Vol. 28 No. 4, pp. 245–262.

Callaert, J., Landoni, P., Van Looy, B. and Verganti, R. (2015), "Scientific yield from collaboration with industry: The relevance of researchers' strategic approaches", *Research Policy*, Vol. 44 No. 4, pp. 990–998.

Centobelli, P., Cerchione, R., Esposito, E. and Shashi. (2019), "Exploration and exploitation in the development of more entrepreneurial universities: A twisting learning path model of ambidexterity", *Technological Forecasting and Social Change*, Vol. 141, pp. 172–194.

Chang, Y.C., Yang, P.Y., Martin, B.R., Chi, H.R. and Tsai-Lin, T.F. (2016), "Entrepreneurial universities and research ambidexterity: A multilevel analysis", *Technovation*, Vol. 54, pp. 7–21.

Chatterjee, D. and Sankaran, B. (2015), "Commercializing academic research in emerging economies: Do organizational identities matter?", *Science and Public Policy*, Vol. 42 No. 5, pp. 599–613.

Clark, B.R. (1998), *Creating Entrepreneurial Universities: Organisational Pathways of Transformation*, Pergamon Press, New York.

Clarysse, B., Tartari, V. and Salter, A. (2011), "The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1084–1093.

Coupet, J. and Ba, Y. (2021), "Benchmarking university technology transfer performance with external research funding: a stochastic frontier analysis", Jo*urnal of Technology Transfer*.

Cunningham, J.A., Harney, B. and Fitzgerald, C. (2020), "University Research Commercialisation: Contextual Factors", *Effective Technology Transfer Offices, Springer*, Cham, pp. 15–31.

Cunningham, J.A., Menter, M. and O'Kane, C. (2018), "Value creation in the quadruple helix: a micro level conceptual model of principal investigators as value creators", *R & D Management*, Vol. 48 No. 1, pp. 136–147.

Cunningham, J.A. and O'Reilly, P. (2018), "Macro, meso and micro perspectives of technology transfer", *Journal of Technology Transfer*, Vol. 43 No. 3, pp. 545–557.

Czarnitzki, D., Grimpe, C. and Pellens, M. (2015), "Access to research inputs: open science versus the entrepreneurial university", *Journal of Technology Transfer*, Vol. 40 No. 6, pp. 1050–1063.

D'Este, P., Llopis, O., Rentocchini, F. and Yegros, A. (2019), "The relationship between interdisciplinarity and distinct modes of university-industry interaction", *Research Policy*, Vol. 48 No. 9, p. 103799.

D'Este, P. and Perkmann, M. (2011), "Why do academics engage with industry? The entrepreneurial university and individual motivations", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 316–339.

Daraio, C., Bonaccorsi, A., Geuna, A., Lepori, B., Bach, L., Bogetoft, P., Cardoso, M.F., et al. (2011), "The European university landscape: A micro characterization based on evidence from the Aquameth project", *Research Policy*, Vol. 40 No. 1, pp. 148–164.

Erikson, T., Knockaert, M. and Foo, M. Der. (2015), "Enterprising scientists: The shaping role of norms, experience and scientific productivity", *Technological Forecasting and Social Change*, Vol. 99, pp. 211–221.

Escobar, E.S.O., Berbegal-Mirabent, J., Alegre, I. and Velasco, O.G.D. (2017), "Researchers' willingness to engage in knowledge and technology transfer activities: an exploration of the underlying motivations", *R and D Management*, Vol. 47 No. 5, pp. 715–726.

Etzkowitz, H. (1998), "The norms of entrepreneurial science: Cognitive effects of the new university-industry linkages", *Research Policy*, Vol. 27 No. 8, pp. 823–833.

Etzkowitz, H. (2003), "Research groups as 'quasi-firms': The invention of the entrepreneurial university", *Research Policy*, Vol. 32 No. 1, pp. 109–121.

Etzkowitz, H. (2017), "Innovation Lodestar: The entrepreneurial university in a stellar knowledge firmament", *Technological Forecasting and Social Change*, Vol. 123 No. 4, pp. 122–129.

Etzkowitz, H. and Klofsten, M. (2005), "The innovating region: Toward a theory of knowledge-based regional development", *R and D Management*, Vol. 35 No. 3, pp. 243–255.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000), "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, Vol. 29 No. 2, pp. 313–330.

Fini, R., Grimaldi, R. and Meoli, A. (2020), "The Effectiveness of University Regulations to Foster Science-Based Entrepreneurship", *Research Policy*, Vol. 49 No. 10.

Fuller, D. and Pickernell, D. (2018), "Identifying groups of entrepreneurial activities at universities", *International Journal of Entrepreneurial Behavior & Research*, Vol. 24 No. 1, pp. 171–190.

Galan-Muros, V. and Davey, T. (2019), "The UBC ecosystem: putting together a comprehensive framework for university-business cooperation", *Journal of Technology Transfer*, Vol. 44, pp. 1131–1346.

Gaus, O. and Raith, M.G. (2016), "Commercial transfer – A business model innovation for the entrepreneurial university", *Industry and Higher Education*, Vol. 30 No. 3, pp. 183–201.

Giuri, P., Munari, F., Scandura, A. and Toschi, L. (2019), "The strategic orientation of universities in knowledge transfer activities", *Technological Forecasting and Social Change*, Vol. 138, pp. 261–278.

Di Gregorio, D. and Shane, S. (2003), "Why do some universities generate more start-ups than others?", *Research Policy*, Vol. 32 No. 2, pp. 209–227.

Guerrero, M., Cunningham, J.A. and Urbano, D. (2015), "Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom", *Research Policy*, Vol. 44 No. 3, pp. 748–764.

Guerrero, M. and Urbano, D. (2012), "The development of an entrepreneurial university", *Journal of Technology Transfer*, Vol. 37 No. 1, pp. 43–74.

Guerrero, M. and Urbano, D. (2014), "Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 43 No. 1, pp. 57–74.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M. and Mian, S. (2016), "Entrepreneurial universities: emerging models in the new social and economic landscape", *Small Business Economics*, Vol. 47 No. 3, pp. 551–563.

Gümüsay, A.A. and Bohné, T.M. (2018), "Individual and organizational inhibitors to the development of entrepreneurial competencies in universities", *Research Policy*, Vol. 47 No. 2, pp. 363–378.

Hauke, J. and Kossowski, T. (2011), "Comparison of values of pearson's and spearman's correlation coefficients on the same sets of data", *Quaestiones Geographicae*, Vol. 30 No. 2, pp. 87–93.

Hayter, C.S., Nelson, A.J., Zayed, S. and O'Connor, A.C. (2018), "Conceptualizing academic entrepreneurship ecosystems: a review, analysis and extension of the literature", *Journal of Technology Transfer*, Vol. 43 No. 4, pp. 1039–1082.

Hayter, C.S., Rasmussen, E. and Rooksby, J.H. (2020), "Beyond formal university technology transfer: innovative pathways for knowledge exchange", *Journal of Technology Transfer*, Vol. 45 No. 1, pp. 1–8.

Heaton, S., Lewin, D. and Teece, D.J. (2020), "Managing campus entrepreneurship: Dynamic capabilities and university leadership", *Managerial and Decision Economics*, Vol. 41 No. 6, pp. 1126–1140.

Holstein, J., Starkey, K. and Wright, M. (2018), "Strategy and narrative in higher education", *Strategic Organization*, Vol. 16 No. 1, pp. 61–91.

Horner, S., Jayawarna, D., Giordano, B. and Jones, O. (2019), "Strategic choice in universities: Managerial agency and effective technology transfer", *Research Policy*, Vol. 48 No. 5, pp. 1297–1309.

Hossinger, S.M., Chen, X. and Werner, A. (2020), "Drivers, barriers and success factors of academic spin-offs: a systematic literature review", *Management Review Quarterly*, Vol. 70, pp.97–134.

Kalar, B. and Antoncic, B. (2015), "The entrepreneurial university, academic activities and technology and knowledge transfer in four European countries", *Technovation*, Vol. 36, pp. 1–11.

Kassab, O. (2019), "Does public outreach impede research performance? Exploring the 'researcher's dilemma' in a sustainability research center", *Science and Public Policy*, Vol. 46 No. 5, pp. 710–720.

Kirby, D.A., Guerrero, M. and Urbano, D. (2011), "Making universities more entrepreneurial: Development of a model", *Canadian Journal of Administrative Sciences*, Vol. 28 No. 3, pp. 302–316.

Kirchberger, M.A. and Pohl, L. (2016), "Technology commercialization: a literature review of success factors and antecedents across different contexts", *Journal of Technology Transfer*, Vol. 41 No. 5, pp. 1077–1112.

Klofsten, M., Fayolle, A., Guerrero, M., Mian, S., Urbano, D. and Wright, M. (2019), "The entrepreneurial university as driver for economic growth and social change - Key strategic challenges", *Technological Forecasting and Social Change*, Vol. 141, pp. 149–158.

Klofsten, M. and Jones-Evans, D. (2000), "Comparing Academic Entrepreneurship in Europe - The Case of Sweden and Ireland", *Small Business Economics*, Vol. 14 No. 4, pp. 299–309.

Lockett, N., Kerr, R. and Robinson, S. (2008), "Multiple Perspectives on the Challenges for Knowledge Transfer between Higher Education Institutions and Industry", *International Small Business Journal*, Vol. 26 No. 6, pp. 661–681.

Mainardes, E.W., Raposo, M. and Alves, H. (2014), "Universities Need a Market Orientation to Attract Non-Traditional Stakeholders as New Financing Sources", *Public Organization Review*, Vol. 14 No. 2, pp. 159–171.

Markuerkiaga, L., Errasti, N. and Igartua, J.I. (2019), "An Entrepreneurial University Taxonomy Proposal", in Kliewe, T., Kesting, T., Plewa, C. and Baaken, T. (Eds.), *Developing Engaged and Entrepreneurial Universities. Theories, Concepts and Empirical Findings*, Springer Singapore, pp. 191–210.

Mazzei, M.J., Ketchen, D.J. and Shook, C.L. (2017), "Understanding strategic entrepreneurship: a 'theoretical toolbox' approach", International Entrepreneurship and Management Journal, *International Entrepreneurship and Management Journal*, Vol. 13 No. 2, pp. 631–663.

Meyer, M. (2003), "Academic entrepreneurs or entrepreneurial academics? research-based ventures and public support mechanisms", *R and D Management*, Vol. 33 No. 2, pp. 107–115.

Miles, M.B., Huberman, A.M. and Saldaña, J. (2014), *Qualitative Data Analysis: A Methods Sourcebook*, Sage publications.

Miller, K., McAdam, M. and McAdam, R. (2014), "The changing university business model: a stakeholder perspective", *R&D Management*, Vol. 44 No. 3, pp. 265–287.

Miller, K., McAdam, R. and McAdam, M. (2018), "A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda", *R and D Management*, Vol. 48 No. 1, pp. 7–24.

Moutinho, R., Au-Yong-Oliveira, M., Coelho, A. and Manso, J.P. (2016), "Determinants of knowledge-based entrepreneurship: an exploratory approach", *International Entrepreneurship and Management Journal*, Vol. 12 No. 1, pp. 171–197.

Munari, F., Sobrero, M. and Toschi, L. (2018), "The university as a venture capitalist? Gap funding instruments for technology transfer", *Technological Forecasting and Social Change*, Vol. 127, pp. 70–84.

O'Kane, C., Cunningham, J.A., Menter, M. and Walton, S. (2020), The Brokering Role of Technology Transfer Offices within Entrepreneurial Ecosystems: An Investigation of Macro–Meso–Micro Factors, *Journal of Technology Transfer*.

O'Shea, R.P., Allen, T., Morse, K., O'Gorman, C. and Roche, F. (2007), "Delineating the anatomy of an entrepreneurial university: the Massachusetts Institute of Technology experience", *R&D Management*, Vol. 37 No. 1, p. 16.

O'Shea, R.P., Allen, T.J., Chevalier, A. and Roche, F. (2005), "Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities", *Research Policy*, Vol. 34 No. 7, pp. 994–1009.

Owen-Smith, J. (2003), "From separate systems to a hybrid order: Accumulative advantage across public and private science at Research One universities", *Research Policy*, Vol. 32 No. 6, pp. 1081–1104.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., et al. (2013), "Academic engagement and commercialisation: A review of the literature on university-industry relations", *Research Policy*, Vol. 42 No. 2, pp. 423–442.

Rasmussen, E., Moen, Ø. and Gulbrandsen, M. (2006), "Initiatives to promote commercialization of university knowledge", *Technovation*, Vol. 26 No. 4, pp. 518–533.

Rasmussen, E. and Wright, M. (2015), "How can universities facilitate academic spin-offs? An entrepreneurial competency perspective", *Journal of Technology Transfer*, Vol. 40 No. 5, pp. 782–799.

Romero, E.C., Ferreira, J.J.M. and Fernandes, C.I. (2021), "The multiple faces of the entrepreneurial university: a review of the prevailing theoretical approaches", *Journal of Technology Transfer*, Vol. 46 No. 4, pp. 1173–1195.

Rossi, F. and Rosli, A. (2014), "Indicators of university-industry knowledge transfer performance and their implications for universities: Evidence from the United Kingdom", *Studies in Higher Education*, Vol. 40 No. 10, pp. 1970–1991.

Sam, C. and van der Sijde, P. (2014), "Understanding the concept of the entrepreneurial university from the perspective of higher education models", *Higher Education*, Vol. 68 No. 6, pp. 891–908.

Sandström, C., Wennberg, K., Wallin, M.W. and Zherlygina, Y. (2018), "Public policy for academic entrepreneurship initiatives: a review and critical discussion", *Journal of Technology Transfer*, Vol. 43 No. 5, pp. 1232–1256.

Scott, R. and Davis, G.F. (2015), *Organizations and Organizing: Rational, Natural and Open Systems Perspectives*, Routledge.

Secundo, G., Schiuma, G. and Jones, P. (2019), "Strategic knowledge management models and tools for entrepreneurial universities", *Management Decision*, Vol. 57 No. 12, pp. 3217–3225.

Siegel, D.S. and Leih, S. (2018), "Strategic management theory and universities: An overview of the Special Issue", *Strategic Organization*, Vol. 16 No. 1, pp. 6–11.

Siegel, D.S., Waldman, D.A., Atwater, L.E. and Link, A.N. (2003), "Commercial knowledge transfers from universities to firms: Improving the effectiveness of university-industry collaboration", *Journal of High Technology Management Research*, Vol. 14 No. 1, pp. 111–133.

Siegel, D.S. and Wright, M. (2015), "Academic Entrepreneurship: Time for a Rethink?", *British Journal of Management*, Vol. 26 No. 4, pp. 582–595.

Sjöö, K. and Hellström, T. (2019), "University–industry collaboration: A literature review and synthesis", *Industry and Higher Education*, Vol. 33 No. 4, pp. 275–285.

Stokes, D. (1997), *Pasteur's Quadrant: Basic Science and Technological Innovation*, Brookings Institution Press.

Tartari, V. and Breschi, S. (2012), "Set them free: scientists' evaluations of the benefits and costs of university-industry research collaboration", *Industrial and Corporate Change*, Vol. 21 No. 5, pp. 1117–1147.

Tijssen, R.J.W. (2018), "Anatomy of use-inspired researchers: From Pasteur's Quadrant to Pasteur's Cube model", *Research Policy*, Vol. 47 No. 9, pp. 1626–1638.

Todorovic, Z.W., McNaughton, R.B. and Guild, P. (2011), "ENTRE-U: An entrepreneurial orientation scale for universities", *Technovation*, Vol. 31 No. 2–3, pp. 128–137.

Toole, A.A. and Czarnitzki, D. (2010), "Commercializing Science: Is There a University 'Brain Drain' from Academic Entrepreneurship?", *Management Science*, Vol. 56 No. 9, pp. 1599–1614.

Vallas, S.P. and Kleinman, D.L. (2008), "Contradiction, convergence and the knowledge economy: The confluence of academic and commercial biotechnology", *Socio-Economic Review*, Vol. 6 No. 2, pp. 283–311.

Vick, T.E. and Robertson, M. (2018), "A systematic literature review of UK university-industry collaboration for knowledge transfer: A future research agenda", *Science and Public Policy*, Vol. 45 No. 4, pp. 579–590.

Wang, M., Soetanto, D., Cai, J. and Munir, H. (2021), "Scientist or Entrepreneur? Identity centrality, university entrepreneurial mission, and academic entrepreneurial intention", *Journal of Technology Transfer*.

Wood, M.S. (2009), "Does one Size fit all? The multiple organizational forms leading to successful academic entrepreneurship", *Entrepreneurship: Theory and Practice*, Vol. 33 No. 4, pp. 929–947.

Wright, M., Clarysse, B., Lockett, A. and Knockaert, M. (2008), "Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries", *Research Policy*, Vol. 37 No. 8, pp. 1205–1223.

Wright, M. and Phan, P. (2018), "The Commercialization of Science: From Determinants to Impact", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 1–3.

Wright, M., Siegel, D.S. and Mustar, P. (2017), "An emerging ecosystem for student start-ups", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 909–922.

Appendices

Appendix 4A

List of universities by country

Country	University (international name)	University (national name)	Abbreviation	Region NUTS II
France	University of Nantes	Université de Nantes	U.Nantes	Alsace - Champagne-Ardenne - Lorraine
	University of Bordeaux	Université de Bordeaux	U.Bordeaux	Aquitaine - Limousin - Poitou-Charentes
	Aix-Marseille University	Aix-Marseille Université	U.Aix-Marseille	Provence-Alpes-Côte d'Azur
Germany	University of Hannover	Gottfried Wilhelm Leibniz Universität Hannover	U.Hannover	Hannover
	University of Münster	Westfälische Wilhelms-Universität Münster	U.Münster	Münster
	Kiel University	Christian-Albrechts-Universität zu Kiel	U.Kiel	Schleswig-Holstein
Portugal	University of Porto	Universidade do Porto	U.Porto	Norte
	University of Minho	Universidade do Minho	U.Minho	Norte
	University of Aveiro	Universidade de Aveiro	U.Aveiro	Centro
United Kingdom	Durham University	Durham University	U.Durham	Tees Valley and Durham
	Lancaster University	Lancaster University	U.Lancaster	Lancashire
	Queen's University Belfast	Queen's University Belfast	U.Belfast	Northern Ireland

Appendix 4B

Variables under research, explanation and source

Factor	Variable	Explanation	Source
University structure	Foundation year	Year the university first existed in its current form	ETER
	Ancestor year	Year the university can be traced back. Ancestor year should precede the foundation year.	ETER
	Size	Number of full-time equivalent students.μ 2018-2020	THE
	Students scientific discipline (%)	- Biomedical and health science - Life and earth science - Mathematics and computer science - Physical science and engineering - Social science The authors presented the mean value for 2018-2020	Leiden
Region	R&D expenditure public sector	R&D expenditure in the public sector as a percentage of GDP	RIS
	R&D expenditure private sector	R&D expenditure in the private sector as a percentage of GDP	RIS
	Regional GDP per capita	Regional GDP per capita (2019)	Eurostat and UK Office for National statistics
Teaching	Teaching quality ranking	- Elsevier reputation survey - Academic-staff-to-student ratio (normalised) -Doctorates-awarded-to-bachelor-degrees-awarded ratio (normalised)	THE

		- Doctorates-awarded-to-academic-staff ratio (normalised) - Institutional income per staff (normalised) The authors presented the mean value for 2018-2020	
Research	Category Normalised Citation Impact	Category Normalised Citation Impact of a document is calculated by dividing the actual count of citing items by the expected citation rate for documents with the same document type, year of publication and subject area.	Incites
	Proportion of publication in the top 10%	Percentage of publications in the top 10% based on citations by category, year, and document type.	Incites
	Percentage of papers in Q1 journals	Percentage of documents that appear in a journal in a particular Journal Impact Factor Quartile in a given year.	Incites
Outcomes Entrepreneurial University	Spin-off or Start-up	Number of spin-off or start-up created, with or without equity, during the year 2019.	University official reports, HESA
	Patents	Patents granted where the university was the Applicant or Proprietor. Search for the university in the native and international name. Total number of granted patents fro the years of 2018, 2019 and 2020	EPO
	University-industry collaborations	Variable was proxied by the indicator Industry Income. The indicator seeks to capture such knowledge-transfer activity by looking at how much research income an institution earns from industry (adjusted for PPP), divided by the total number of FTE academic staff it employs. This variable is normalised after calculation.	THE

EPO: https://www.epo.org/; https://data.epo.org/expert-services/ ETER: https://www.eter-project.com/ | Eurostat Regional Yearbook 2020: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Eurostat_regional_yearbook/ | UK National Statistics: https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/regionaleconomicactivitybygrossdomesticproductuk/1998to2019 | HESA: https://www.hesa.ac.uk/ | Incites: https://incites.clarivate.com/ | Leiden: https://www.leidenranking.com/ | RIS: https://ec.europa.eu/growth/industry/policy/innovation/regional_en/ | THE: https://www.timeshighereducation.com/world-university-rankings/

Appendix 4C

Teaching, research and entrepreneurial activity

	Teaching	**Research**		**Entrepreneurial activity**		
	Teaching quality ranking	Category Citation Impact	% of papers in top 10%	% of papers in Q1 journals	Spin-off or Start-up	Patents granted	University-industry collaborations
U. Nantes	24.1	1.29	12.92	56.84	10	133	52.1
U. Bordeaux	30.7	1.47	13.78	59.13	13	192	35.9
U. Aix-Marseille	40.7	1.59	13.78	58.21	16	226	36.8
U. Hannover	36.8	1.51	12.06	50.88	32	51	52.2
U. Münster	40.7	1.56	15.27	58.41	17	37	53.3
U. Kiel	31.0	1.58	15.75	56.10	7	49	25.8
U. Porto	27.3	1.37	11.93	52.46	17	42	39.1
U. Minho	22.4	1.12	12.01	52.10	7	32	62.7
U. Aveiro	25.8	1.15	11.79	53.12	6	22	40.4
U. Durham	45	1.45	14.99	62.44	13	31	37.5
U. Lancaster	36.1	1.88	18.06	60.72	28	12	35.1
U. Belfast	29	1.53	14.46	61.08	30	29	37.7

CHAPTER 5

Conclusion

The thesis conclusions are presented in this chapter. In each of the three studies, the primary focus lies on specific individual and contextual aspects of the academic entrepreneurial process. Moreover, whereas the first paper draws upon a systematic literature review, the other two papers use a quantitative research design. This final chapter summarizes the main findings of the three studies and highlights the main contributions to advancing knowledge and practice. Furthermore, we conclude with limitations and provide future research directions.

5.1 Main findings

Throughout the last two decades, the creation, transformation, and valorisation of research-based knowledge have become an attractive topic for scholars, policymakers and practitioners (Mosey et al., 2017). Several universities are currently in transition; they are expected to teach and do research while also engaging with external stakeholders and creating value through entrepreneurial initiatives. This university progression has been referred to as an "Evolution of ivory tower to entrepreneurial paradigm" (Etzkowitz et al., 2000, pp. 325).

The literature has progressed in tandem with the growing evolution. Recently, there has been an increasing recognition that this new paradigm calls for studies supporting university actions. Our thesis responds to calls to provide more corroboration at different analysis levels (Abreu et al., 2016; Foo et al., 2016). Secondly, with the acknowledgement that the knowledge valorisation activities take several forms and that they matter simultaneously (Wagner et al., 2021), our framework considered several activities: spin-off creation, start-up creation, patenting, and three avenues of collaboration with the industry, namely, joint research, research contract and consulting.

5.2 Contributions

5.2.1 Theoretical contributions

In this transformation process, university managers' critical challenges are influencing academics' attitudes (Dabic et al., 2015) and aligning or adapting them to the university strategic interest (Sandström et al., 2018). In other words, to become successful, university management decisions demands an informed and strategic effort on academics' intentions (Brescia et al., 2016). Accordingly, the *first research question* of this thesis is to advance our understanding of how the university can enhance engagement in knowledge valorisation activities. Specifically, we study academics' entrepreneurial intentions, which have received increased attention in the literature.

The *first paper* emerged from the observation that there was a need for more systematic scrutiny of micro-level processes to deepen our understanding of academic entrepreneurship (Balven et al., 2018; Wright and Phan, 2018). The study proposed to answer 'What are the drivers of academic entrepreneurial intentions?'. It aimed to have an up-to-date and comprehensive assessment of the current knowledge regarding the variables that encourage academics to engage in knowledge exploitation activities.

Previous efforts to structure this research are characterised by at least one of two shortcomings: 1. meta-studies tend to view the main topics but overlook the details on the variables analysed (Sjöö and Hellström, 2019); and 2. cover a limited scope as they focused on one entrepreneurial activity, such as spin-off and start-up creation, patenting or collaboration with the industry (Miranda et al., 2018; Vick and Robertson, 2018; de Wit-de Vries et al., 2019). This research contributed to academic entrepreneurship literature by taking a broad view and assuming that the various activities make part of this entrepreneurial mission.

Another strength of this study is that it responds to calls to include the economic variables of social capital (Fini and Toschi, 2016) and human capital (Moog et al., 2015) as determinants of entrepreneurship, making this study's conceptual model more robust.

As such, we performed a Systematic Literature Review and selected, evaluated, summarised and synthesised 66 relevant papers. Through a rigorous methodology and analysis, the research identifies and clusters the individual, organisational and institutional factors that impact academics to engage in knowledge valorisation activities,

signalling the motivations that should be considered in the strategies defined by the university.

Our findings highlighted that the creation of spin-offs, patents, and collaboration with industry results from scholars' engagement, who, in turn, are influenced by the organisational and institutional structure. These findings deduce that the university partially controls its outcomes. For the university managers, this indicates that they can adopt different organisational mechanisms and supports depending on the goal they are pursuing (Bercovitz et al., 2001; Markman, Phan, et al., 2005).

Lastly, the review acknowledges various drivers of academic intentions, and there is no single combination that will lead to the same outcome. Even when the same drivers are analysed, the impacts on intentions are often distinct or even opposite. Everything considered the study concludes that the drivers behind the intentions are multiple, context-dependent, hierarchy-dependent, heterogeneous and, at the same time, dependent on each other and against each other.

After the conceptual review of academics' intentions, our *second paper* undertook an empirical examination of what drives academics to engage in entrepreneurship activities. This research explores the academics' intentions by considering the characteristics and strategies of the universities where they are embedded. The empirical study involved a survey collection from 466 academics at three Portuguese universities (the University of Aveiro, the University of Minho, and the University of Porto).

Extending the university's influence on academics (Gümüsay and Bohné, 2018), this paper pursued the recommendation of Balven et al. (2018) to scrutinise the micro-level processes. Our empirical analysis meets the research gap to unravel entrepreneurial intentions within academia (Antonioli et al., 2016; Huyghe and Knockaert, 2016).

We tested 12 independent variables representing academics' motivations to knowledge exchange, to support research and motivations related to personal benefits. Additionally, our model included three variables linked to Social Capital and seven variables to Human Capital. Our model included 3 variables that captured the academics' support perception from the university side.

We find theoretical validation for all four Hypotheses. The survey results demonstrated that motivations consistently influence the academics' intentions (Hypothesis 1). Secondly, social capital also positively impacts academics' intentions

(Hypothesis 2). We find support for Hypothesis 3, which proposed that human capital influences academics' intentions. Hypothesis 4, which claimed that the academics' perception of university support could affect motivations, has also been supported.

Our *second research question* implies that the university pursues entrepreneurial activities, bringing them beyond the walls of the universities and creating value. As previously mentioned, the university needs to manage its internal environment. In this study, we add that it should also consider various external characteristics and stakeholders (Etzkowitz, 2017). Finally, we enrich the literature with this research to explore regional and university variables and their relationship to entrepreneurial activities.

Our *third paper* contributes to university entrepreneurship. In particular, we deepen the understanding of the relationship between knowledge outputs and regional development. We respond to recent calls to overcome the current lack of cross country comparison studies (Cunningham and O'Reilly, 2018).

Overall, the study was able to prove that academic spin-offs correlate with regional expenditure in R&D from the private sector and research quality. The findings show there are five positive and one negative factor when it comes to patents. With a positive correlation, granted patents are correlated with two regional factors, namely regional GDP as well as R&D expenditures from the public sector. The institutional drivers' university age and size were only found to be correlated with patents. At the same time, no significant effect was observed on the number of spin-offs or collaboration with the industry.

Meanwhile, regarding the relationship between patenting and scientific discipline, biomedical and health science exert a positive influence. In contrast, there is a negative interaction with the social science and humanities. Lastly, the university-industry collaborations are most strongly linked to the physical science and engineering disciplines.

Lastly, this thesis makes contributions as it integrates several conceptual frameworks. For the environmental factors, it considers the *institutional economic theory*; from the psychology field, we employed the *theory of planned behaviour;* and to make sense of the complex organisational phenomenon, we draw from the social science, notable the *organisational theory*.

5.2.2 Practical contributions

The findings presented in the three studies enable us to reveal policy issues and develop grounded recommendations for different stakeholders involved in the academic entrepreneurship phenomenon. This final section sets out the thesis practical implications for university managers, department heads, and public policymakers.

First, from the perspective of the university management, we advocate that the definition of the entrepreneurial strategy should be delineated towards the university structural architecture and, most importantly, take into account the academics' behaviour. Our thesis extends strategic management insights by providing multiple dimension drivers. The paper *Academic entrepreneurship intentions: a systematic literature review* created the ground for us to develop and test a scale of the academics' drivers to engage in entrepreneurial activities. This scale can be used by university managers and technology transfer offices managers to guide questionnaires and interviews to analyse the academics' intention and adequately supports its academic engagement strategy. The university management and the rector role is to understand the weight of each of these motivations. Essentially, an efficient effort on the university's side requires knowing which motivation leads to increased entrepreneurial intentions. Lastly, the thesis results demonstrated the vital role of academics.

Additionally, there is a need to understand that the strategy takes time. We recommend that the development of strategic plans, which usually happen every three to five years, have this factor considered. We also recommend that the effectiveness of policy instruments, incentives and support measures should be accessed among academics and head departments with this time lag.

We reinforce that the university to be successful requires a focused strategy, with leadership and active intervention at both departmental and university levels. We suggest that the university should engage favourably with the department heads, research centres administrators, and some Principal Investigators. They can either reinforce or constrain entrepreneurial practices within their departments and teams.

Furthermore, the university should promote the interest of the industry. The university has to prove its alignment with industry concerns, demonstrate its ability to become an outstanding partner and illustrate the benefits that it can bring. This is dissemination, networking and a "bringing the industry into the academy" activity.

Lastly, this thesis offers insights to policymakers who aim to boost the volume of commercial outcomes arising from publicly funded research.

We begin by strengthening the argument that policy intervention should simultaneously consider all three universities missions. Identifying entrepreneurial and innovative breakthroughs is more like to be done by academics that excel in their research areas (Sjöö and Hellström, 2019). So, besides providing funds to promote entrepreneurial activities, there is a need to provide additional funds for academics to pursue research. Furthermore, policymakers could stimulate entrepreneurial activities with prudence by incorporating them as a component in their reward system. Finally, despite being beyond the research focus, we would like to emphasise the essential role of investments in programmes. They promote an environment and climate for academic entrepreneurship (TTOs, science and technology parks, business and accelerations programmes seed-fundings), which then transposes into a favourable culture for non-academic entrepreneurs regionally.

5.3 Limitations and future research

Regarding the study *Academic entrepreneurship intentions: a systematic literature revi*ew, some limitations are identified. From the findings, we recognised that there is a lack of coherence in the literature, and it is worth studying whether, as age increases, academics' intentions also increase. The authors believe that studying age and networks, scientific productivity, and entrepreneurial experience may clarify age behaviour. Secondly, further clarification is also required regarding the concept of scientific productivity. The literature empirically demonstrates positive, negative and mixed outcomes. It would be interesting to devote some research within different contexts to understand if the academics who excel in scientific domains are also the most entrepreneurial. This factor is indirectly linked with academics' personal attitude and perceived behavioural control. Lastly, the research subject on academic entrepreneurship could benefit from a deeper understanding of the effects of moral motivations, either the moral duty to society, welfare, well-being or community, in intentions.

From A*cademic Entrepreneurship: The drivers of academics' engagement in spin-offs creation, patenting, and university-industry collaboration*, we can suggest that new studies could use the scale to broaden it and pilot it in other universities and in other

countries. This study adds to the growing body of literature on academic entrepreneurship by exploring academics' intentions, currently an appealing topic for scholars and literature. Although the study was developed in a specific context, the scale can be adapted to other university contexts and other countries.

Moreover, since the university is a multi-layered organisation, future research could benefit from more refined approaches that consider differences within universities instead of between universities (Bienkowska et al., 2016; Erikson et al., 2015).

Since time and resources are limited, an additional research avenue might extend academics' entrepreneurial intentions as either complementary to or conflicting with their traditional role as researchers. Following on from this, and particularly for patents, scholars have mixed perceptions on the role of scientific productivity on intentions. More research is required to clarify whether the academic's scientific productivity hinders or facilitate academics intentions to patent. Future work could incorporate horizon and explore academics intentions due to changes at the university strategic level.

Lastly, we would encourage more exploration on the passage from intentions to actions.

Finally, the study *The value creation within the entrepreneurial university: an empirical study of European universities* recognised that some additional factors, besides the one under the research framework, may account for university entrepreneurial performances. It may be worthwhile pursuing research to understand the transformation phase, the university level of experience (Giuri et al., 2019) and evolution over time (Wright et al., 2017), among other factors.

Although the organisational structure of universities was beyond the research's scope, it calls to be explored under future research. How universities strategically orchestrate their inputs (Secundo, Schiuma, et al., 2019), what rules and policies they develop in accordance to meet the goal of the academic entrepreneurship initiative (Gümüsay and Bohné, 2018), how can the university organise their support mechanisms: from incentive programmes (O'Kane et al., 2020), to entrepreneurship education (Blankesteijn et al., 2021), infrastructures (Sjöö and Hellström, 2019), and expand its networking base (Hossinger et al., 2020) are some research areas that can be further explored conceptually and empirically.

Throughout the development of this thesis, we have encountered some research opportunities that we believe deserve the attention of researchers.

On the input side, there are some research directions that the most up-to-date literature points to as worthy of more extensive research. The academic is expected to execute two roles, to perform research while at the same time it should be able to recognise opportunities to valorise its research (Chang et al., 2016). There is an exciting research avenue to bring more understanding of these hybrid academic-entrepreneur identities (Skute et al., 2019). In the same line of thought, Wang et al. (2021) stress the need also to investigate how academics allocate their limited resources, such as time; and how this role changes can be a result of the university efforts to become more entrepreneurial (Miller, Alexander, et al., 2018). Moreover, upcoming research could interrogate how university policies influence the work-life and academic-entrepreneur role balance (Balven et al., 2018).

More detailed research on students, particularly how the university can stimulate academic entrepreneurship activities among junior researchers and female academics, can provide valuable insights (Miller, Alexander, et al., 2018; Rivero and Ubierna, 2021). Some research questions are proposed: how does the entrepreneurship programmes impact the students' entrepreneurial outcomes? (Secundo et al., 2020) and what pedagogical approaches and curricular support better assist students in high-technology entrepreneurship (Cunningham and Menter, 2021). Further research on the focus and role of networks is recommended (Sormani et al., 2021), particularly the alumni network's impact on students (Cruz et al., 2021).

Two more academics also deserve our focus. Firstly, the doctoral students who represent an increasing source of entrepreneurship (Muscio et al., 2021). Muscio and Ramaciotti (2019) highlight the distinct characteristics of doctoral students, which are also worth further in-depth research, namely, how do the university-level factors influence PhD spin-off activity. Secondly, the role of Principal Investigators (Pi's) (Cunningham, Dolan, et al., 2020), as they are the lead researchers (O'Kane et al., 2017). Lastly, O'Kane et al. (2020) remark that a focus on individual actors such as technology transfer office directors, technology transfer executives and other professional supports can bring fruitful knowledge.

Some research has already been conducted concerning quality, whether it is the quality of academics, their publications, or the university itself. Nevertheless, Perkmann et al. (2021) raise the question of how the quality of the university or department affect the volume and type of engagement by their academics. These authors come up with a great observation that academics in high ranked quality institutions have two pushing factors. On the one hand, they have what we call the research push; they have the funding and resources to focus on their research. On the other hand, they also have an entrepreneurial push, as they have vaster opportunities to engage with the industry since their quality attracts these external stakeholders. Then, in the reverse direction, additional research is called to explore the effects of engagement in knowledge valorisation activities on the nature and quality of academics' scientific performance (Fini et al., 2020).

At the university and department level, there is a calling for research that focuses on the development of effective support mechanisms (Skute, 2019), along with a future line of research that could analyse how the TTO's objectives fit with the university provided support and also simultaneously its strategy (Fernandez-Alles et al., 2019).

We also recommend that future research, especially among UIC, scrutinize industry partner's traits. Van Rijnsoever and Hessels (2020) suggest the exploration of industry reputation or experience, and Link and Sarala (2019) add their knowledge and capabilities. Furthermore, Gretsch et al. (2019) stated, "it would be fruitful to learn more about internal conditions concerning firms' innovation cultures and their impacts on collaboration activities" (pp. 845). Lastly, further studies should also cover the review of small and medium-sized enterprises (O'Reilly and Cunningham, 2017) or university-industry research centres (Dolan et al., 2019; Gibson et al., 2019).

To conclude, more research could explore how digital transformation shape academic knowledge and technology transfer activities (Forliano et al., 2021), as the novelty of the phenomena of digital entrepreneurship, offers multiple research opportunities (Rippa and Secundo, 2019).

References

Abreu, M. and Grinevich, V. (2013), "The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities", *Research Policy*, Vol. 42 No. 2, pp. 408–422.

Abreu, M. and Grinevich, V. (2014), "Academic entrepreneurship in the creative arts", *Environment and Planning C: Government and Policy*, Vol. 32 No. 3, pp. 451–470.

Abreu, M., Demirel, P., Grinevich, V. and Karataş-Özkan, M. (2016), "Entrepreneurial practices in research-intensive and teaching-led universities", *Small Business Economics*, Vol. 47 No. 3, pp. 695–717.

Acs, Z., Braunerhjelm, P., Audretsch, D.B. and Carlsson, B. (2009), "The knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 32 No. 1, pp. 15–30.

Agarwal, R., Audretsch, D. and Sarkar, M.B. (2007), "The process of creative construction: knowledge spillovers, entrepreneurship, and economic growth", *Strategic Entrepreneurship Journal*, Vol. 1, pp. 263–286.

Ajzen, I. (1991), "The Theory of Planned Behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50, pp. 179–211.

Aldridge, T.T. and Audretsch, D. (2011), "The Bayh-Dole act and scientist entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1058–1068.

Al-Tabbaa, O. and Ankrah, S. (2019), " 'Engineered' University-Industry Collaboration: A Social Capital Perspective", *European Management Review*, Vol. 16 No. 3, pp. 543–565.

Alvedalen, J. and Boschma, R. (2017), "A critical review of entrepreneurial ecosystems research: towards a future research agenda", *European Planning Studies*, Vol. 25 No. 6, pp. 887–903.

Amara, N., Landry, R. and Halilem, N. (2013), "Faculty consulting in natural sciences and engineering: Between formal and informal knowledge transfer", *Higher Education*, Vol. 65 No. 3, pp. 359–384.

Ambos, T.C., Mäkelä, K., Birkinshaw, J. and D'Este, P. (2008), "When Does University Research Get Commercialized? Creating Ambidexterity in Research Institutions", *Journal of Management Studies*, Vol. 45 No. 8, pp. 1424–1447.

Anderson, J.C. and Gerbing, D.W. (1988), "Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach", *Psychological Bulletin*, Vol. 103 No. 3, pp. 411–423.

Ankrah, S. and Al-Tabbaa, O. (2015), "Universities-industry collaboration: A systematic review", *Scandinavian Journal of Management*, Vol. 31 No. 3, pp. 387–408.

Ankrah, S.N., Burgess, T.F., Grimshaw, P. and Shaw, N.E. (2013), "Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit", *Technovation*, Vol. 33 No. 2–3, pp. 50–65.

Antonioli, D., Nicolli, F., Ramaciotti, L. and Rizzo, U. (2016), "The Effect of Intrinsic and Extrinsic Motivations on Academics' Entrepreneurial Intention", *Administrative Sciences*, Vol. 6 No. 4, p. 15.

Audretsch, D.B. (2004), "Sustaining innovation and growth: Public policy support for entrepreneurship", *Industry and Innovation*, Vol. 11 No. 3, pp. 167–191.

Audretsch, D.B. (2014), "From the entrepreneurial university to the university for the entrepreneurial society", *Journal of Technology Transfer*, Vol. 39 No. 3, pp. 313–321.

Audretsch, D.B. and Belitski, M. (2017), "Entrepreneurial ecosystems in cities: establishing the framework conditions", *Journal of Technology Transfer*, Vol. 42 No. 5, pp. 1030–1051.

Audretsch, D.B. and Belitski, M. (2021), "Three-ring entrepreneurial university: in search of a new business model", *Studies in Higher Education*, Vol. 46 No. 5, pp. 977–987.

Audretsch, D.B. and Keilbach, M. (2007), "The theory of knowledge spillover entrepreneurship", *Journal of Management Studies*, Vol. 44 No. 7, pp. 1242–1254.

Audretsch, D.B., Belitski, M. and Caiazza, R. (2021), "Start-ups, Innovation and Knowledge Spillovers", *Journal of Technology Transfer*.

Audretsch, D.B., Lehmann, E.E. and Paleari, S. (2015), "Academic policy and entrepreneurship: a European perspective", *Journal of Technology Transfer*, Vol. 40 No. 3, pp. 363–368.

Azagra-Caro, J.M., Archontakis, F., Gutiérrez-Gracia, A. and Fernández-de-Lucio, I. (2006), "Faculty support for the objectives of university-industry relations versus degree of R&D cooperation: The importance of regional absorptive capacity", *Research Policy*, Vol. 35 No. 1, pp. 37–55.

Babin, B.J., Hair, J.F. and Boles, J.S. (2008), "Publishing research in marketing journals using structural equation modeling", *Journal of Marketing Theory and Practice*, Vol. 16 No. 4, pp. 279–286.

Baglieri, D., Baldi, F. and Tucci, C.L. (2018), "University technology transfer office business models: One size does not fit all", *Technovation*, Vol. 76–77, pp. 51–63.

Baldini, N. (2006), "The Act on inventions at public research institutions: Danish universities' patenting activity", *Scientometrics*, Vol. 69 No. 2, pp. 387–407.

Baldini, N. (2011), "University patenting: Patterns of faculty motivations", *Technology Analysis and Strategic Management*, Vol. 23 No. 2, pp. 103–121.

Baldini, N., Fini, R., Grimaldi, R. and Sobrero, M. (2014), "Organisational Change and the Institutionalisation of University Patenting Activity in Italy", *Minerva*, Vol. 52 No. 1, pp. 27–53.

Baldini, N., Grimaldi, R. and Sobrero, M. (2007), "To patent or not to patent? A survey of Italian inventors on motivations, incentives, and obstacles to university patenting", *Scientometrics*, Vol. 70 No. 2, pp. 333–354.

Balven, R., Fenters, V., Siegel, D.S. and Waldman, D. (2018), "Academic Entrepreneurship: the roles of identity, motivation, championing, education, work-life balance, and organizational justice", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 21–42.

Becker, G.S. (1980), *Human Capital*, University of Chicago press.

Becker, J.M., Klein, K. and Wetzels, M. (2012), "Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models", Long Range Planning, Vol. 45 No. 5–6, pp. 359–394.

Behrens, T.R. and Gray, D.O. (2001), "Unintended consequences of cooperative research: Impact of industry sponsorship on climate for academic freedom and other graduate student outcome", *Research Policy*, Vol. 30 No. 2, pp. 179–199.

Bekkers, R. and Freitas, I.M.B. (2008), "Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter?", *Research Policy*, Vol. 37 No. 10, pp. 1837–1853.

Belitski, M. and Heron, K. (2017), "Expanding entrepreneurship education ecosystems", *Journal of Management Development*, Vol. 36 No. 2, pp. 163–177.

Benneworth, P. and Charles, D. (2005), "University spin-off policies and economic development in less successful regions: Learning from two decades of policy practice", *European Planning Studies*, Vol. 13 No. 4, pp. 537–557.

Berbegal-Mirabent, J., Lafuente, E. and Solé, F. (2013), "The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities", *Journal of Business Research*, Vol. 66 No. 10, pp. 2051–2059.

Berbegal-Mirabent, J., Sabaté, F. and Cañabate, A. (2012), "Brokering knowledge from universities to the marketplace: The role of knowledge transfer offices", *Management Decision*, Vol. 50 No. 7, pp. 1285–1307.

Bercovitz, J. and Feldman, M. (2003), "Academic entrepreneurs and technology transfer: Who participates and why?", Copenhagen: DRUID, available at: https://doi.org/10.1017/CBO9780511618390.021.

Bercovitz, J. and Feldman, M.P. (2008), "Academic Entrepreneurs: Organizational Change at the Individual Level", *Organization Science*, Vol. 19 No. 1, pp. 69–89.

Bercovitz, J., Feldman, M., Feller, I. and Burton, R. (2001), "Organizational Structure as a Determinant of Academic Patent and Licensing Behavior: An Exploratory Study of Duke, Johns Hopkins, and Pennsylvania State Universities", *Journal of Technology Transfer*, Vol. 26 No. 1/2, pp. 21–35.

Berggren, E. (2017), "Researchers as enablers of commercialization at an entrepreneurial university", *Journal of Management Development*, Vol. 36 No. 2, pp. 217–232.

Bergmann, H. (2017), "The formation of opportunity beliefs among university entrepreneurs: an empirical study of research- and non-research-driven venture ideas", *Journal of Technology Transfer*, Vol. 42 No. 1, pp. 116–140.

Bergmann, H., Geissler, M., Hundt, C. and Grave, B. (2018), "The climate for entrepreneurship at higher education institutions", *Research Policy*, Vol. 47 No. 4, pp. 700–716.

Berry, M.W. (2004), *Survey of Text Mining: Clustering, Classification, and Retrieval*, edited by Berry, M.W., Springer-Verlag New York Copyright.

Betts, S.C. (2011), "Contingency Theory: Science Or Technology?", *Journal of Business & Economics Research*, Vol. 1 No. 8.

Bicknell, A., Francis-Smythe, J. and Arthur, J. (2010), "Knowledge transfer: de-constructing the entrepreneurial academic", *International Journal of Entrepreneurial Behavior & Research*, Vol. 16 No. 6, pp. 485–501.

Bienkowska, D., Klofsten, M. and Rasmussen, E. (2016), "PhD Students in the Entrepreneurial University - Perceived Support for Academic Entrepreneurship", *European Journal of Education*, Vol. 51 No. 1, pp. 56–72.

Bird, B. (1988), "Implementing Entrepreneurial Ideas: The Case for Intention", *Academy of Management Review*, Vol. 13 No. 3, pp. 442–453.

Blankesteijn, M., Bossink, B. and van der Sijde, P. (2021), "Science-based entrepreneurship education as a means for university-industry technology transfer", *International Entrepreneurship and Management Journal*, Vol. 17, pp. 779–808.

Blankesteijn, M., Sam, C. and van der Sijde, P. (2019), "Understanding the Governance of the Engaged and Entrepreneurial University in the Twenty-First Century: Towards a New Research and Policy Agenda", in Kliewe, T., Kesting, T., Plewa, C. and

Baaken, T. (Eds.), *Developing Engaged and Entrepreneurial Universities. Theories, Concepts and Empirical Findings*, Springer Singapore, pp. 43–53.

Boardman, P.C. (2009), "Government centrality to university-industry interactions: University research centers and the industry involvement of academic researchers", *Research Policy*, Vol. 38 No. 10, pp. 1505–1516.

Boardman, P.C. and Ponomariov, B.L. (2009), "University researchers working with private companies", *Technovation*, Vol. 29 No. 2, pp. 142–153.

Bodas Freitas, I.M. and Nuvolari, A. (2012), "Traditional Versus Heterodox Motives for Academic Patenting: Evidence from the Netherlands", *Industry and Innovation*, Vol. 19 No. 8, pp. 671–695.

Bodas Freitas, I.M. and Verspagen, B. (2017), "The motivations, institutions and organization of university-industry collaborations in the Netherlands", Journal of Evolutionary Economics, *Journal of Evolutionary Economics*, Vol. 27 No. 3, pp. 379–412.

Borges, C. and Filion, L.J. (2013), "Spin-off Process and the Development of Academic Entrepreneur's Social Capital", *Journal of Technology Management and Innovation*, Vol. 8 No. 1, pp. 21–34.

Bourelos, E., Magnusson, M. and Mckelvey, M. (2012), "Investigating the complexity facing academic entrepreneurs in science and engineering: The complementarities of research performance, networks and support structures in commercialisation", *Cambridge Journal of Economics*, Vol. 36 No. 3, pp. 751–780.

Boyd, N.G. and Vozikis, G.S. (1994), "The Influence of Self-Efficacy on the Development of Entrepreneurial Intentions and Actions", *Entrepreneurship Theory and Practice*, Vol. 18 No. 4, pp. 63–77.

Bozeman, B. and Boardman, C. (2013), "Academic Faculty in University Research Centers: Neither Capitalism's Slaves nor Teaching Fugitives", *Journal of Higher Education*, Vol. 84 No. 1, pp. 88–120.

Bozeman, B., Fay, D. and Slade, C.P. (2013), "Research collaboration in universities and academic entrepreneurship: the-state-of-the-art", *Journal of Technology Transfer*, Vol. 38 No. 1, pp. 1–67.

Bradley, S.R., Hayter, C.S. and Link, A.N. (2013), "Models and Methods of University Technology Transfer", *Foundations and Trends® in Entrepreneurship*, Vol. 9 No. 6, pp. 571–650.

Braunerhjelm, P. (2007), "Academic entrepreneurship: Social norms, university culture and policies", *Science and Public Policy*, Vol. 34 No. 9, pp. 619–631.

Brescia, F., Colombo, G. and Landoni, P. (2016), "Organizational structures of Knowledge Transfer Offices: an analysis of the world's top-ranked universities", *Journal of Technology Transfer*, Vol. 41 No. 1, pp. 132–151.

Brettel, M., Mauer, R. and Walter, T. (2013), "High-profile employees at universities and their intentions of commercializing research results", *Journal of Business Economics*, Vol. 83 No. 4, pp. 357–382.

Breznitz, S.M. and Feldman, M.P. (2012), "The engaged university", *Journal of Technology Transfer*, Vol. 37 No. 2, pp. 139–157.

Bronstein, J. and Reihlen, M. (2014), "Entrepreneurial University Archetypes: A Meta-Synthesis of Case Study Literature", *Industry and Higher Education*, Vol. 28 No. 4, pp. 245–262.

Browne, M.W. and Cudeck, R. (1992), "Alternative ways of assessing model fit", *Sociological Methods & Research*, Vol. 21 No. 2, pp. 230–258.

Budyldina, N. (2018), "Entrepreneurial universities and regional contribution", *International Entrepreneurship and Management Journal*, International Entrepreneurship and Management Journal, Vol. 14 No. 2, pp. 265–277.

Byrne, B.M. (2016), *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. Routledge.

Callaert, J., Landoni, P., Van Looy, B. and Verganti, R. (2015), "Scientific yield from collaboration with industry: The relevance of researchers' strategic approaches", *Research Policy*, Vol. 44 No. 4, pp. 990–998.

Cantner, U., Goethner, M. and Silbereisen, R.K. (2017), "Schumpeter's entrepreneur - A rare case", Journal of Evolutionary Economics, *Journal of Evolutionary Economics*, Vol. 27 No. 1, pp. 187–214.

Carayannis, E.G., Ferreira, J.J.M., Jalali, M.S. and Ferreira, F.A.F. (2018), "MCDA in knowledge-based economies: Methodological developments and real world applications", *Technological Forecasting and Social Change*, Vol. 131, pp. 1–3.

Carland, J., Hoy, F. and Carland, J.A. (1988), "'Who is an Entrepreneur?' Is a Question Worth Asking", *American Journal of Small Business*, Vol. 12 No. 4, pp. 33–40.

Centobelli, P., Cerchione, R., Esposito, E. and Shashi. (2019), "Exploration and exploitation in the development of more entrepreneurial universities: A twisting learning path model of ambidexterity", *Technological Forecasting and Social Change*, Vol. 141, pp. 172–194.

Chang, Y.C., Yang, P.Y., Martin, B.R., Chi, H.R. and Tsai-Lin, T.F. (2016), "Entrepreneurial universities and research ambidexterity: A multilevel analysis", *Technovation*, Vol. 54, pp. 7–21.

Chatterjee, D. and Sankaran, B. (2015), "Commercializing academic research in emerging economies: Do organizational identities matter?", *Science and Public Policy*, Vol. 42 No. 5, pp. 599–613.

Chen, F., Curran, P.J., Bollen, K.A., Kirby, J. and Paxton, P. (2008), "An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models", *Sociological Methods and Research*, Vol. 36 No. 4, pp. 462–494.

Chin, W.W. (1998), *The Partial Least Squares Approach for Structural Equation Modeling*, edited by Marcoulides, G.Modern Methods for Business Research, Lawrence Erlbaum Associates, Publisher.

Chin, W.W. (2010), "How to write up and report PLS analyses", in Vinzi, V.E., Chin, W.W., Henseler, J. and Wang, H. (Eds.), *Handbook of Partial Least Squares*, Springer: Berlin, Heidelberg, pp. 655–690.

Civera, A., Meoli, M. and Vismara, S. (2020), "Engagement of academics in university technology transfer: Opportunity and necessity academic entrepreneurship", *European Economic Review*, Vol. 123, p. 103376.

Clark, B.R. (1998), "The entrepreneurial university: Demand and response", *Tertiary Education and Management*, Vol. 4 No. 1, pp. 5–16.

Clark, B.R. (1998), *Creating Entrepreneurial Universities: Organisational Pathways of Transformation*, Pergamon Press, New York.

Clarysse, B., Tartari, V. and Salter, A. (2011), "The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1084–1093.

Clarysse, B., Wright, M. and Van de Velde, E. (2011), "Entrepreneurial Origin, Technological Knowledge, and the Growth of Spin-Off Companies", *Journal of Management Studies*, Vol. 48 No. 6, pp. 1420–1442.

Clauss, T., Kesting, T., Miller, K. and Meerman, A. (2018), "Editorial: Quo vadis entrepreneurial university? The need for multi-levels of analysis", *International Journal of Technology Management*, Vol. 77 No. 1/2, pp. 1–9.

Clauss, T., Moussa, A. and Kesting, T. (2018), "Entrepreneurial University: A stakeholder-based conceptualisation of the current state and an agenda for future research future research", *International Journal of Technology Management*, Vol. 77 No. 1–3, pp. 109–144.

Cohen, J. (1992), "A power primer", Psychological Bulletin, Vol. 112 No. 1, pp. 155–159.

Compagnucci, L. and Spigarelli, F. (2020), "The Third Mission of the university: A systematic literature review on potentials and constraints", *Technological Forecasting and Social Change*, Vol. 161, p. 120284.

Coupet, J. and Ba, Y. (2021), "Benchmarking university technology transfer performance with external research funding: a stochastic frontier analysis", Jo*urnal of Technology Transfer*.

Coviello, N.E. and Jones, M. V. (2004), "Methodological issues in international entrepreneurship research", *Journal of Business Venturing*, Vol. 19 No. 4, pp. 485–508.

Crescenzi, R., Filippetti, A. and Iammarino, S. (2017), "Academic inventors: collaboration and proximity with industry", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 730–762.

Crespo, N. (2019), "Entrepreneurial universities: collaboration, education and policies", *Journal of Small Business & Entrepreneurship*, Vol. 31 No. 3, pp. 265–267.

Cruz, M. de F.P. da, Ferreira, J.J. and Kraus, S. (2021), "Entrepreneurial orientation at higher education institutions: State-of-the-art and future directions", *International Journal of Management Education*, Vol. 19 No. 2.

Cunningham, J.A. and Link, A.N. (2015), "Fostering university-industry R&D collaborations in European Union countries", *International Entrepreneurship and Management Journal*, Vol. 11 No. 4, pp. 849–860.

Cunningham, J.A. and Menter, M. (2021), "Transformative change in higher education: entrepreneurial universities and high-technology entrepreneurship", *Industry and Innovation*, Vol. 28 No. 3, pp. 343–364.

Cunningham, J.A. and O'Reilly, P. (2018), "Macro, meso and micro perspectives of technology transfer", *Journal of Technology Transfer*, Vol. 43 No. 3, pp. 545–557.

Cunningham, J.A., Dolan, B., Menter, M., O'Kane, C. and O'Reilly, P. (2020), "How Principal Investigators' Commercial Experience Influences Technology Transfer and Market Impacts", *Research Technology Management*, Vol. 63 No. 5, pp. 49–58.

Cunningham, J.A., Harney, B. and Fitzgerald, C. (2020), "University Research Commercialisation: Contextual Factors", *Effective Technology Transfer Offices, Springer*, Cham, pp. 15–31.

Cunningham, J.A., Menter, M. and O'Kane, C. (2018), "Value creation in the quadruple helix: a micro level conceptual model of principal investigators as value creators", *R & D Management*, Vol. 48 No. 1, pp. 136–147.

Czarnitzki, D., Grimpe, C. and Pellens, M. (2015), "Access to research inputs: open science versus the entrepreneurial university", *Journal of Technology Transfer*, Vol. 40 No. 6, pp. 1050–1063.

Dabic, M., González-Loureiro, M. and Daim, T.U. (2015), "Unraveling the attitudes on entrepreneurial universities: The case of Croatian and Spanish universities", *Technology in Society*, Vol. 42, pp. 167–178.

Damsgaard, E.F. and Thursby, M.C. (2013), "University entrepreneurship and professor privilege", *Industrial and Corporate Change*, Vol. 22 No. 1, pp. 183–218.

Daraio, C., Bonaccorsi, A., Geuna, A., Lepori, B., Bach, L., Bogetoft, P., Cardoso, M.F., et al. (2011), "The European university landscape: A micro characterization based on evidence from the Aquameth project", *Research Policy*, Vol. 40 No. 1, pp. 148–164.

Davey, T. (2017), "Converting university knowledge into value. How conceptual frameworks contribute to the understanding of the third mission role of European universities", *International Journal of Technology Transfer and Commercialisation*, Vol. 15 No. 1, pp. 65–96.

Davey, T., Rossano, S. and van der Sijde, P. (2016), "Does context matter in academic entrepreneurship? The role of barriers and drivers in the regional and national context", *Journal of Technology Transfer*, Vol. 41 No. 6, pp. 1457–1482.

De Fuentes, C. and Dutrénit, G. (2016), "Geographic proximity and university-industry interaction: the case of Mexico", *Journal of Technology Transfer*, Vol. 41 No. 2, pp. 329–348.

de Wit-de Vries, E., Dolfsma, W.A., van der Windt, H.J. and Gerkema, M.P. (2019), "Knowledge transfer in university-industry research partnerships: a review", *Journal of Technology Transfer*, Vol. 44, pp. 1236–1255.

D'Este, P. and Patel, P. (2007), "University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?", *Research Policy*, Vol. 36 No. 9, pp. 1295–1313.

D'Este, P. and Perkmann, M. (2011), "Why do academics engage with industry? The entrepreneurial university and individual motivations", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 316–339.

D'Este, P., Llopis, O., Rentocchini, F. and Yegros, A. (2019), "The relationship between interdisciplinarity and distinct modes of university-industry interaction", *Research Policy*, Vol. 48 No. 9, p. 103799.

Di Gregorio, D. and Shane, S. (2003), "Why do some universities generate more start-ups than others?", *Research Policy*, Vol. 32 No. 2, pp. 209–227.

Dietz, J.S. and Bozeman, B. (2005), "Academic careers, patents, and productivity: Industry experience as scientific and technical human capital", *Research Policy*, Vol. 34 No. 3, pp. 349–367.

Diez-Vial, I. and Montoro-Sanchez, A. (2017), "Research evolution in science parks and incubators: foundations and new trends", *Scientometrics*, Vol. 110 No. 3, pp. 1243–1272.

Dillman, D.A., Smyth, J.D. and Christian, L.M. (2011), Int*ernet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*, John Wiley & Sons.

Djokovic, D. and Souitaris, V. (2008), "Spinouts from academic institutions: A literature review with suggestions for further research", *Journal of Technology Transfer*, Vol. 33 No. 3, pp. 225–247.

do Paço, A., Ferreira, J.M., Raposo, M., Rodrigues, R.G. and Dinis, A. (2015), "Entrepreneurial intentions: is education enough?", *International Entrepreneurship and Management Journal*, Vol. 11 No. 1, pp. 57–75.

Dolan, B., Cunningham, J.A., Menter, M. and Mcgregor, C. (2019), "The role and function of cooperative research centers in entrepreneurial universities A micro level perspective", *Management Decision*, Vol. 57 No. 12, pp. 3406–3425.

Dornbusch, F. and Neuhäusler, P. (2015), "Composition of inventor teams and technological progress - The role of collaboration between academia and industry", *Research Policy*, Vol. 44 No. 7, pp. 1360–1375.

Erikson, T., Knockaert, M. and Foo, M. Der. (2015), "Enterprising scientists: The shaping role of norms, experience and scientific productivity", *Technological Forecasting and Social Change*, Vol. 99, pp. 211–221.

Escobar, E.S.O., Berbegal-Mirabent, J., Alegre, I. and Velasco, O.G.D. (2017), "Researchers' willingness to engage in knowledge and technology transfer activities: an exploration of the underlying motivations", *R and D Management*, Vol. 47 No. 5, pp. 715–726.

Etzkowitz, H. (1983), "Entrepreneurial scientists and entrepreneurial universities in American academic science", *Minerva*, Vol. 21 No. 2–3, pp. 198–233.

Etzkowitz, H. (1998), "The norms of entrepreneurial science: Cognitive effects of the new university-industry linkages", *Research Policy*, Vol. 27 No. 8, pp. 823–833.

Etzkowitz, H. (2003), "Research groups as 'quasi-firms': The invention of the entrepreneurial university", *Research Policy*, Vol. 32 No. 1, pp. 109–121.

Etzkowitz, H. (2016), "The Entrepreneurial University: Vision and Metrics", *Industry and Higher Education*, Vol. 30 No. 2, pp. 83–97.

Etzkowitz, H. (2017), "Innovation Lodestar: The entrepreneurial university in a stellar knowledge firmament", *Technological Forecasting and Social Change*, Vol. 123 No. 4, pp. 122–129.

Etzkowitz, H. and Klofsten, M. (2005), "The innovating region: Toward a theory of knowledge-based regional development", *R and D Management*, Vol. 35 No. 3, pp. 243–255.

Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K.N. and Albats, E. (2019), "Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system", *Technological Forecasting and Social Change*, Vol. 141, pp. 159–171.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000), "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, Vol. 29 No. 2, pp. 313–330.

European Commision (2018), *The State of University-Business Cooperation in Europe*, Luxembourg: Publications Office of the European Union, 2018

European Commission (2003). *Communication from the commission: The role of the universities in the Europe of knowledge*. Brussels: European Commission.

European Commission (2006). *Communication from the commission: Delivering the modernization agenda for universities* - Education, research and innovation. Brussels: European Commission

European Parliament. 2000. Lisbon European Council 23 and 24 March 2000: Presidency conclusions. http://www.europarl.europa.eu/summits/lis1_en.htm Accessed 6 February 2021.

Fernandez-Alles, M., Diánez-González, J.P., Rodríguez-González, T. and Villanueva-Flores, M. (2019), "TTO characteristics and university entrepreneurship: a cluster analysis", *Journal of Science and Technology Policy Management*, Vol. 10 No. 4, pp. 861–889

Fernández-Pérez, V., Alonso-Galicia, P.E., Fuentes-Fuentes, M.D.M. and Rodriguez-Ariza, L. (2014), "Business social networks and academics' entrepreneurial intentions", *Industrial Management and Data Systems*, Vol. 114 No. 2, pp. 292–320.

Fernández-Pérez, V., Alonso-Galicia, P.E., Rodríquez-Ariza, L. and Fuentes-Fuentes, M. del M. (2015), "Professional and personal social networks: A bridge to entrepreneurship for academics?", *European Management Journal*, Vol. 33 No. 1, pp. 37–47.

Filippetti, A. and Savona, M. (2017), "University-industry linkages and academic engagements: individual behaviours and firms' barriers. Introduction to the special section", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 719–729.

Fini, R. and Toschi, L. (2016), "Academic logic and corporate entrepreneurial intentions: A study of the interaction between cognitive and institutional factors in new firms", *International Small Business Journal: Researching Entrepreneurship*, Vol. 34 No. 5, pp. 637–659.

Fini, R., Fu, K., Mathisen, M.T., Rasmussen, E. and Wright, M. (2017), "Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study", *Small Business Economics*, Vol. 48 No. 2, pp. 361–391.

Fini, R., Grimaldi, R. and Meoli, A. (2020), "The Effectiveness of University Regulations to Foster Science-Based Entrepreneurship", *Research Policy*, Vol. 49 No. 10.

Fini, R., Grimaldi, R. and Sobrero, M. (2009), "Factors fostering academics to start up new ventures: An assessment of Italian founders' incentives", *Journal of Technology Transfer*, Vol. 34 No. 4, pp. 380–402.

Fini, R., Grimaldi, R., Santoni, S. and Sobrero, M. (2011), "Complements or substitutes? the role of universities and local context in supporting the creation of academic spin-offs", *Research Policy*, Vol. 40 No. 8, pp. 1113–1127.

Fontes, M. (2005), "The process of transformation of scientific and technological knowledge into economic value conducted by biotechnology spin-offs", *Technovation*, Vol. 25 No. 4, pp. 339–347.

Foo, M. Der, Knockaert, M., Chan, E.T. and Erikson, T. (2016), "The Individual Environment Nexus: Impact of Promotion Focus and the Environment on Academic Scientists' Entrepreneurial Intentions", *IEEE Transactions on Engineering Management*, Vol. 63 No. 2, pp. 213–222.

Forliano, C., De Bernardi, P. and Yahiaoui, D. (2021), "Entrepreneurial universities: A bibliometric analysis within the business and management domains", *Technological Forecasting and Social Change*, Vol. 165.

Fornell, C. and Larcker, D.F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", Journal of Marketing Research, Vol. 18 No. 1, p. 39.

Francis-Smythe, J. (2008), "Enhancing academic engagement in knowledge transfer activity in the UK", *Perspectives: Policy and Practice in Higher Education*, Vol. 12 No. 3, pp. 68–72.

Friedman, J. and Silberman, J. (2003), "University Technology Transfer: Do Incentives, Management, and Location Matter?", *Journal of Technology Transfer*, Vol. 28 No. 1, pp. 17–30.

Fuller, D. and Pickernell, D. (2018), "Identifying groups of entrepreneurial activities at universities", *International Journal of Entrepreneurial Behavior & Research*, Vol. 24 No. 1, pp. 171–190.

Galan-Muros, V. and Davey, T. (2019), "The UBC ecosystem: putting together a comprehensive framework for university-business cooperation", *Journal of Technology Transfer*, Vol. 44, pp. 1131–1346.

Galán-Muros, V., van der Sijde, P., Groenewegen, P. and Baaken, T. (2017), "Nurture over nature: How do European universities support their collaboration with business?", *Journal of Technology Transfer*, Vol. 42 No. 1, pp. 184–205.

Galvão, A., Ferreira, J.J. and Marques, C.S. (2018), "Entrepreneurship education and training as facilitators of regional development: A systematic literature review", *Journal of Small Business and Enterprise Development*, Vol. 25 No. 1, pp. 17–40.

García-Rodríguez, F.J., Gil-Soto, E., Ruiz-Rosa, I. and Gutiérrez-Taño, D. (2017), "Entrepreneurial process in peripheral regions: the role of motivation and culture", *European Planning Studies*, Vol. 25 No. 11, pp. 2037–2056.

Gaus, O. and Raith, M.G. (2016), "Commercial transfer – A business model innovation for the entrepreneurial university", *Industry and Higher Education*, Vol. 30 No. 3, pp. 183–201.

Gerbin, A. and Drnovsek, M. (2016), "Determinants and public policy implications of academic-industry knowledge transfer in life sciences: a review and a conceptual framework", *Journal of Technology Transfer*, Vol. 41 No. 5, pp. 979–1076.

Gibb, A. (2012), "Exploring the synergistic potential in entrepreneurial university development: towards the building of a strategic framework", *Annals of Innovation & Entrepreneurship*, Vol. 3 No. 1, p. 16742

Gibson, E., Daim, T.U. and Dabic, M. (2019), "Evaluating university industry collaborative research centers", *Technological Forecasting and Social Change*, Elsevier, Vol. 146, pp. 181–202

Giuliani, E., Morrison, A., Pietrobelli, C. and Rabellotti, R. (2010), "Who are the researchers that are collaborating with industry? An analysis of the wine sectors in Chile, South Africa and Italy", *Research Policy*, Vol. 39 No. 6, pp. 748–761.

Giunta, A., Pericoli, F.M. and Pierucci, E. (2016), "University-Industry collaboration in the biopharmaceuticals: the Italian case", *Journal of Technology Transfer*, Vol. 41 No. 4, pp. 818–840.

Giuri, P., Munari, F., Scandura, A. and Toschi, L. (2019), "The strategic orientation of universities in knowledge transfer activities", *Technological Forecasting and Social Change*, Vol. 138, pp. 261–278.

Goel, R.K., Göktepe-Hultén, D. and Grimpe, C. (2017), "Who instigates university-industry collaborations? University scientists versus firm employees", *Small Business Economics*, Vol. 48 No. 3, pp. 503–524.

Goethner, M., Obschonka, M., Silbereisen, R.K. and Cantner, U. (2012), "Scientists' transition to academic entrepreneurship: Economic and psychological determinants", *Journal of Economic Psychology*, Vol. 33 No. 3, pp. 628–641.

Göktepe-Hulten, D. and Mahagaonkar, P. (2010), "Inventing and patenting activities of scientists: In the expectation of money or reputation?", *Journal of Technology Transfer*, Vol. 35 No. 4, pp. 401–423.

Goldstein, H.A. (2010), *Multilevel Statistical Models*, 4th Edition., Kendall's Library of Statistics, London, UK.

Good, M., Knockaert, M. and Soppe, B. (2019), "A typology of technology transfer ecosystems: how structure affects interactions at the science–market divide", *Journal of Technology Transfer*, Vol. 45, pp. 1405–1431.

Gretsch, O., Salzmann, E.C. and Kock, A. (2019), "University-industry collaboration and front-end success: the moderating effects of innovativeness and parallel cross-firm collaboration", *R and D Management*, Vol. 49 No. 5, pp. 835–849.

Grimaldi, R., Kenney, M., Siegel, D.S. and Wright, M. (2011), "30 years after Bayh-Dole: Reassessing academic entrepreneurship", *Research Policy*, Vol. 40 No. 8, pp. 1045–1057.

Guerrero, M. and Urbano, D. (2012), "The development of an entrepreneurial university", *Journal of Technology Transfer*, Vol. 37 No. 1, pp. 43–74.

Guerrero, M. and Urbano, D. (2014), "Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship", *Small Business Economics*, Vol. 43 No. 1, pp. 57–74.

Guerrero, M., Cunningham, J.A. and Urbano, D. (2015), "Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom", *Research Policy*, Vol. 44 No. 3, pp. 748–764.

Guerrero, M., Kirby, D. and Urbano, D. (2006), A Literature Review on Entrepreneurial Universities: An Institutional Approach. Working Paper Series 06/8, Business Economics Department, University of Barcelona.

Guerrero, M., Urbano, D. and Fayolle, A. (2016), "Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities", *Journal of Technology Transfer*, Vol. 41 No. 1, pp. 105–131.

Guerrero, M., Urbano, D. and Gajon, E. (2017), "Higher Education Entrepreneurial Ecosystems: Exploring the Role of Business Incubators in an Emerging Economy", *International Review of Entrepreneurship*, Vol. 15 No. 2, pp. 175–202.

Guerrero, M., Urbano, D., Cunningham, J. and Organ, D. (2014), "Entrepreneurial universities in two European regions: A case study comparison", *Journal of Technology Transfer*, Vol. 39 No. 3, pp. 415–434.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M. and Mian, S. (2016), "Entrepreneurial universities: emerging models in the new social and economic landscape", *Small Business Economics*, Vol. 47 No. 3, pp. 551–563.

Gulbrandsen, M. and Smeby, J.C. (2005), "Industry funding and university professors' research performance", *Research Policy*, Vol. 34 No. 6, pp. 932–950.

Gulbrandsen, M. and Thune, T. (2017), "The effects of non-academic work experience on external interaction and research performance", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 795–813.

Gümüsay, A.A. and Bohné, T.M. (2018), "Individual and organizational inhibitors to the development of entrepreneurial competencies in universities", *Research Policy*, Vol. 47 No. 2, pp. 363–378.

Haeussler, C. and Colyvas, J.A. (2011), "Breaking the Ivory Tower: Academic entrepreneurship in the life sciences in UK and Germany", *Research Policy*, Vol. 40 No. 1, pp. 41–54.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2016), A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), Sage.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M. and Thiele, K.O. (2017), “Mirror, mirror on the wall: a comparative evaluation of composite-based structural equation modeling methods”, *Journal of the Academy of Marketing Science*, Vol. 45 No. 5, pp. 616–632.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review*, Vol. 31 No. 1, pp. 2–24.

Hair, J.F., Sarstedt, M., Hopkins, L. and Kuppelwieser, V.G. (2014), "Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research", *European Business Review*, Vol. 26 No. 2, pp. 106–121.

Halilem, N., Amara, N., Olmos-Peñuela, J. and Mohiuddin, M. (2017), "'To Own, or not to Own?' A multilevel analysis of intellectual property right policies' on academic entrepreneurship", *Research Policy*, Vol. 46 No. 8, pp. 1479–1489.

Hand, D. and Adams, N. (2014), Data Mining, Wiley StatsRef: Statistics Reference Online.

Hauke, J. and Kossowski, T. (2011), "Comparison of values of pearson's and spearman's correlation coefficients on the same sets of data", *Quaestiones Geographicae*, Vol. 30 No. 2, pp. 87–93.

Hayter, C.S. (2011), "In search of the profit-maximizing actor: Motivations and definitions of success from nascent academic entrepreneurs", *Journal of Technology Transfer*, Vol. 36 No. 3, pp. 340–352.

Hayter, C.S. (2015), "Public or private entrepreneurship? Revisiting motivations and definitions of success among academic entrepreneurs", *Journal of Technology Transfer*, Vol. 40 No. 6, pp. 1003–1015.

Hayter, C.S. (2016), "A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem", *Small Business Economics*, Vol. 47 No. 3, pp. 633–656.

Hayter, C.S., Lubynsky, R. and Maroulis, S. (2017), "Who is the academic entrepreneur? The role of graduate students in the development of university spinoffs", *Journal of Technology Transfer*, Vol. 42 No. 6, pp. 1237–1254.

Hayter, C.S., Nelson, A.J., Zayed, S. and O'Connor, A.C. (2018), "Conceptualizing academic entrepreneurship ecosystems: a review, analysis and extension of the literature", *Journal of Technology Transfer*, Vol. 43 No. 4, pp. 1039–1082.

Hayter, C.S., Rasmussen, E. and Rooksby, J.H. (2020), "Beyond formal university technology transfer: innovative pathways for knowledge exchange", *Journal of Technology Transfer*, Vol. 45 No. 1, pp. 1–8.

Heaton, S., Lewin, D. and Teece, D.J. (2020), "Managing campus entrepreneurship: Dynamic capabilities and university leadership", *Managerial and Decision Economics*, Vol. 41 No. 6, pp. 1126–1140.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen, D.J., et al. (2014), "Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013)", *Organizational Research Methods*, Vol. 17 No. 2, pp. 182–209.

Henseler, J., Hubona, G. and Ray, P.A. (2016), "Using PLS path modeling in new technology research: Updated guidelines", *Industrial Management and Data Systems*, Vol. 116 No. 1, pp. 2–20.

Hesse, N. and Brünjes, J. (2018), "How entrepreneurial are students who intend to become academics? – A study of career motives", *Review of Regional Research*, Vol. 38 No. 1, pp. 27–52.

Hitt, M.A., Ireland, R.D., Sirmon, D.G. and Trahms, C.A. (2011), "Strategic Entrepreneurship: Creating Value for Individuals, Organizations, and Society", *Academy of Management Perspectives*, Vol. 25 No. 2, pp. 57–75

Hobbs, K.G., Link, A.N. and Scott, J.T. (2017), "Science and technology parks: an annotated and analytical literature review", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 957–976.

Holley, A.C. and Watson, J. (2017), "Academic Entrepreneurial Behavior: Birds of more than one feather", *Technovation*, Vol. 64, pp. 50–57.

Holstein, J., Starkey, K. and Wright, M. (2018), "Strategy and narrative in higher education", *Strategic Organization*, Vol. 16 No. 1, pp. 61–91.

Horner, S., Jayawarna, D., Giordano, B. and Jones, O. (2019), "Strategic choice in universities: Managerial agency and effective technology transfer", *Research Policy*, Vol. 48 No. 5, pp. 1297–1309.

Hossinger, S.M., Chen, X. and Werner, A. (2020), "Drivers, barriers and success factors of academic spin-offs: a systematic literature review", *Management Review Quarterly*, Vol. 70, pp. 97–134.

Hox, J.J. (2010), *Multilevel Analysis: Techniques and Applications*, Routledge, New York, NY.

Hu, L.T. and Bentler, P.M. (1999), "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives", *Structural Equation Modeling*, Vol. 6 No. 1, pp. 1–55.

Huyghe, A. and Knockaert, M. (2015), "The influence of organizational culture and climate on entrepreneurial intentions among research scientists", *Journal of Technology Transfer*, Vol. 40 No. 1, pp. 138–160.

Huyghe, A. and Knockaert, M. (2016), "The Relationship Between University Culture and Climate and Research Scientists' Spin-off Intentions", in Audretsch, D., Lehmann, E.E., Meoli, M. and Vismara, S. (Eds.), *University Evolution, Entrepreneurial Activity and Regional Competitiveness*, 32nd ed., Springer, Cham.

Huyghe, A., Knockaert, M. and Obschonka, M. (2016), "Unraveling the 'passion orchestra' in academia", *Journal of Business Venturing*, Vol. 31 No. 3, pp. 344–364.

Iorio, R., Labory, S. and Rentocchini, F. (2017), "The importance of pro-social behaviour for the breadth and depth of knowledge transfer activities: An analysis of Italian academic scientists", *Research Policy*, Vol. 46 No. 2, pp. 497–509.

Ivanova, I.A. and Leydesdorff, L. (2014), "Rotational symmetry and the transformation of innovation systems in a Triple Helix of university-industry-government relations", *Technological Forecasting and Social Change*, Vol. 86, pp. 143–156.

Jacob, M., Lundqvist, M. and Hellsmark, H. (2003), "Entrepreneurial transformations in the Swedish University system: The case of Chalmers University of Technology", *Research Policy*, Vol. 32 No. 9, pp. 1555–1568.

Jain, S., George, G. and Maltarich, M. (2009), "Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity", *Research Policy*, Vol. 38 No. 6, pp. 922–935.

Johnson, M., Monsen, E.W. and MacKenzie, N.G. (2017), "Follow the Leader or the Pack? Regulatory Focus and Academic Entrepreneurial Intentions", *Journal of Product Innovation Management*, Vol. 34 No. 2, pp. 181–200.

Kalar, B. and Antoncic, B. (2015), "The entrepreneurial university, academic activities and technology and knowledge transfer in four European countries", *Technovation*, Vol. 36, pp. 1–11.

Karlsson, T. and Wigren, C. (2012), "Start-ups among university employees: The influence of legitimacy, human capital and social capital", *Journal of Technology Transfer*, Vol. 37 No. 3, pp. 297–312.

Kassab, O. (2019), "Does public outreach impede research performance? Exploring the 'researcher's dilemma' in a sustainability research center", *Science and Public Policy*, Vol. 46 No. 5, pp. 710–720.

Kenney, M. and Patton, D. (2009), "Reconsidering the Bayh-Dole Act and the Current University Invention Ownership Model", *Research Policy*, Vol. 38 No. 9, pp. 1407–1422.

Kim, P.H. and Aldrich, H.E. (2005), "Social capital and entrepreneurship", *Foundations and Trends in Entrepreneurship*, Vol. 1 No. 2, pp. 55–104.

Kirby, D.A., Guerrero, M. and Urbano, D. (2011), "Making universities more entrepreneurial: Development of a model", *Canadian Journal of Administrative Sciences*, Vol. 28 No. 3, pp. 302–316.

Kirchberger, M.A. and Pohl, L. (2016), "Technology commercialization: a literature review of success factors and antecedents across different contexts", *Journal of Technology Transfer*, Vol. 41 No. 5, pp. 1077–1112.

Kline, R.B. (2015), *Principles and Practice of Structural Equation Modeling*, Guilford Publications.

Klofsten, M. and Jones-Evans, D. (2000), "Comparing Academic Entrepreneurship in Europe - The Case of Sweden and Ireland", *Small Business Economics*, Vol. 14 No. 4, pp. 299–309.

Klofsten, M., Fayolle, A., Guerrero, M., Mian, S., Urbano, D. and Wright, M. (2019), "The entrepreneurial university as driver for economic growth and social change - Key strategic challenges", *Technological Forecasting and Social Change*, Vol. 141, pp. 149–158.

Kochenkova, A., Grimaldi, R. and Munari, F. (2016), "Public policy measures in support of knowledge transfer activities: a review of academic literature", *Journal of Technology Transfer*, Vol. 41 No. 3, pp. 407–429.

Krabel, S. and Mueller, P. (2009), "What drives scientists to start their own company? An empirical investigation of Max Planck Society scientists", *Research Policy*, Vol. 38 No. 6, pp. 947–956.

Krueger, N.F. (1993), "The impact of prior entrepreneurial exposure on perceptions of new venture feasibility and desirability", *Entrepreneurship Theory and Practice*, Vol. 18 No. 1, pp. 5–21.

Krueger, N.F., Reilly, M.D. and Carsrud, A.L. (2000), "Competing models of entrepreneurial intentions", *Journal of Business Venturing*, Vol. 15 No. 5–6, pp. 411–432.

Lafuente, E. and Berbegal-Mirabent, J. (2019), "Assessing the productivity of technology transfer offices: an analysis of the relevance of aspiration performance and portfolio complexity", *Journal of Technology Transfer*, Vol. 44 No. 3, pp. 778–801.

Lam, A. (2011), "What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'?", *Research Policy*, Vol. 40 No. 10, pp. 1354–1368.

Lamine, W., Mian, S. and Fayolle, A. (2014), "How do social skills enable nascent entrepreneurs to enact perseverance strategies in the face of challenges? A comparative case study of success and failure", *International Journal of Entrepreneurial Behaviour and Research*, Vol. 20 No. 6, pp. 517–541.

Landry, R., Saïhi, M., Amara, N. and Ouimet, M. (2010), "Evidence on how academics manage their portfolio of knowledge transfer activities", *Research Policy*, Vol. 39 No. 10, pp. 1387–1403.

Laursen, K., Reichstein, T. and Salter, A. (2011), "Exploring the Effect of Geographical Proximity and University Quality on University–Industry Collaboration in the United Kingdom", *Regional Studies*, Vol. 45 No. 4, pp. 507–523.

Lee, L., Wong, P.K., Foo, M. Der and Leung, A. (2011), "Entrepreneurial intentions: The influence of organizational and individual factors", *Journal of Business Venturing*, Vol. 26 No. 1, pp. 124–136.

Lee, Y., Raimondi, S.C., Downing, J.R., Baker, S.D., Ribeiro, R.C. and Rubnitz, J.E. (2000), "The Sustainability of University-Industry Research Collaboration: An Empirical Assessment", *Journal of Technology Transfer*, Vol. 25, pp. 111–133.

Lehmann, E.E., Meoli, M. and Paleari, S. (2021), "Innovation, entrepreneurship and the academic context", *Industry and Innovation*.

Liao, J. and Welsch, H. (2005), "Roles of Social Capital in Venture Creation: Key Dimensions and Research Implications", *Journal of Small Business Management*, Vol. 43 No. 4, pp. 345–362.

Liñán, F. and Fayolle, A. (2015), "A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda", *International Entrepreneurship and Management Journa*l, Vol. 11 No. 4, pp. 907–933.

Liñán, F. and Santos, F.J. (2007), "Does social capital affect entrepreneurial intentions?", *International Advances in Economic Research*, Vol. 13 No. 4, pp. 443–453.

Link, A.N. and Sarala, R.M. (2019), "Advancing conceptualisation of university entrepreneurial ecosystems: The role of knowledge-intensive entrepreneurial firms", *International Small Business Journal: Researching Entrepreneurship*, Vol. 37 No. 3, pp. 289–310.

Link, A.N. and Scott, J.T. (2010), "Government as entrepreneur: Evaluating the commercialization success of SBIR projects", *Research Policy*, Vol. 39 No. 5, pp. 589–601.

Link, A.N. and Scott, J.T. (2013), "Public R&D subsidies, outside private support, and employment growth", *Economics of Innovation and New Technology*, Vol. 22 No. 6, pp. 537–550.

Link, A.N., Siegel, D.S. and Bozeman, B. (2007), "An empirical analysis of the propensity of academics to engage in informal university technology transfer", *Universities and the Entrepreneurial Ecosystem*, Vol. 16 No. 4, pp. 97–111.

Llopis, O., Sánchez-Barrioluengo, M., Olmos-Peñuela, J. and Castro-Martínez, E. (2018), "Scientists' engagement in knowledge transfer and exchange: individual factors, variety of mechanisms and users", *Science and Public Policy*, Vol. 45, pp. 790–803.

Lockett, A., Wright, M. and Franklin, S. (2003), "Technology Transfer and Universities' Spin-Out Strategies", *Small Business Economics*, Vol. 20 No. 2, pp. 185–200.

Lockett, N., Kerr, R. and Robinson, S. (2008), "Multiple Perspectives on the Challenges for Knowledge Transfer between Higher Education Institutions and Industry", *International Small Business Journal*, Vol. 26 No. 6, pp. 661–681.

Löfsten, H. and Lindelöf, P. (2002), "Science Parks and the growth of new technology-based firms - academic-industry links, innovation and markets", *Research Policy*, Vol. 31 No. 6, pp. 859–876.

López, S.F., Astray, B.P., Pazos, D.R. and Calvo, N. (2015), "Are firms interested in collaborating with universities? An open-innovation perspective in countries of the South West European Space", *Service Business*, Vol. 9 No. 4, pp. 637–662.

Lortie, J. and Castogiovanni, G. (2015), "The theory of planned behavior in entrepreneurship research: what we know and future directions", *International Entrepreneurship and Management Journal*, Vol. 11 No. 4, pp. 935–957.

MacCallum, R.C., Browne, M.W. and Sugawara, H.M. (1996), "Power analysis and determination of sample size for covariance structure modeling", *Psychological Methods*, Vol. 1 No. 2, pp. 130–149.

Maia, C. and Claro, J. (2013), "The role of a Proof of Concept Center in a university ecosystem: An exploratory study", *Journal of Technology Transfer*, Vol. 38 No. 5, pp. 641–650.

Maietta, O.W. (2015), "Determinants of university-firm R&D collaboration and its impact on innovation: A perspective from a low-tech industry", *Research Policy*, Vol. 44 No. 7, pp. 1341–1359.

Manley, S.C., Hair, J.F., Williams, R.I. and McDowell, W.C. (2020), "Essential new PLS-SEM analysis methods for your entrepreneurship analytical toolbox", *International Entrepreneurship and Management Journal*, Vol. 17 No. 4, pp. 1805–1825.

Markman, G.D., Gianiodis, P.T., Phan, P.H. and Balkin, D.B. (2004), "Entrepreneurship from the Ivory Tower: Do Incentive Systems Matter?", *Journal of Technology Transfer*, Vol. 29 No. 3/4, pp. 353–364.

Markman, G.D., Gianiodis, P.T., Phan, P.H. and Balkin, D.B. (2005), "Innovation speed: Transferring university technology to market", *Research Policy*, Vol. 34 No. 7, pp. 1058–1075.

Markman, G.D., Phan, P.H., Balkin, D.B. and Gianiodis, P.T. (2005), "Entrepreneurship and university-based technology transfer", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 241–263.

Markuerkiaga, L., Caiazza, R., Igartua, J.I. and Errasti, N. (2016), "Factors fostering students' spin-off firm formation. An empirical comparative study of universities

from North and South Europe", *Journal of Management Development*, Vol. 35 No. 6, pp. 814–846.

Markuerkiaga, L., Errasti, N. and Igartua, J.I. (2014), "Success Factors for Managing an Entrepreneurial University: Developing an Integrative Framework", *Industry and Higher Education*, Vol. 28 No. 4, pp. 233–244.

Markuerkiaga, L., Errasti, N. and Igartua, J.I. (2019), "An Entrepreneurial University Taxonomy Proposal", in Kliewe, T., Kesting, T., Plewa, C. and Baaken, T. (Eds.), *Developing Engaged and Entrepreneurial Universities. Theories, Concepts and Empirical Findings*, Springer Singapore, pp. 191–210.

Mascarenhas, C., Marques, C.S., Galvão, A. and Santos, G. (2017), "Entrepreneurial university: towards a better understanding of past trends and future directions", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 11 No. 3, pp. 316–338.

Mascarenhas, C., Marques, C.S.E., Galvão, A.R., Carlucci, D., Falcão, P.F. and Ferreira, F.A.F. (2019), "Analyzing technology transfer offices' influence for entrepreneurial universities in Portugal", *Management Decision*, Vol. 57 No. 12, pp. 3473–3491.

Mathisen, M.T. and Rasmussen, E. (2019), "The Development, Growth, and Performance of University Spin-Offs: A Critical Review", *Journal of Technology Transfer*, Vol. 44, pp. 1891–1938.

Mazzei, M.J., Ketchen, D.J. and Shook, C.L. (2017), "Understanding strategic entrepreneurship: a 'theoretical toolbox' approach", International Entrepreneurship and Management Journal, *International Entrepreneurship and Management Journal*, Vol. 13 No. 2, pp. 631–663.

Merton, R.K. (1973), *The Sociology of Science: Theoretical and Empirical Investigation*s, University of Chicago press.

Meyer, M. (2003), "Academic entrepreneurs or entrepreneurial academics? research-based ventures and public support mechanisms", *R and D Management*, Vol. 33 No. 2, pp. 107–115.

Mian, S., Lamine, W. and Fayolle, A. (2016), "Technology Business Incubation: An overview of the state of knowledge", *Technovation*, Vol. 50–51, pp. 1–12.

Mian, S.A. (1996), "The university business incubator: A strategy for developing new research/technology-based firms", *Journal of High Technology Management Research*, Vol. 7 No. 2, pp. 191–208.

Miles, M.B., Huberman, A.M. and Saldaña, J. (2014), *Qualitative Data Analysis: A Methods Sourcebook*, Sage publications.

Miller, K., Alexander, A., Cunningham, J. and Albats, E. (2018), "Entrepreneurial academics and academic entrepreneurs: a systematic literature review", *International Journal of Technology Management*, Vol. 77 No. 1/2/3, pp. 9–36.

Miller, K., Cunningham, J. and Lehmann, E. (2021), "Extending the university mission and business model: influences and implications", *Studies in Higher Education*.

Miller, K., McAdam, M. and McAdam, R. (2014), "The changing university business model: a stakeholder perspective", *R&D Management*, Vol. 44 No. 3, pp. 265–287.

Miller, K., McAdam, R. and McAdam, M. (2018), "A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda", *R and D Management*, Vol. 48 No. 1, pp. 7–24.

Miller, K., McAdam, R., Moffett, S., Alexander, A. and Puthusserry, P. (2016), "Knowledge transfer in university quadruple helix ecosystems: An absorptive capacity perspective", *R&D Management*, Vol. 46 No. 2, pp. 383–399.

Miner, G.D., Elder, J., Fast, A., Hill, T., Nisbet, R.A. and Delen, D. (2012), *Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications*, Academic Press, Academic Press.

Miranda, F.J., Chamorro, A. and Rubio, S. (2017), "Determinants of the intention to create a spin-off in Spanish universities", *International Journal of Entrepreneurship and Innovation Management*, Vol. 21 No. 4/5, pp. 299–317.

Miranda, F.J., Chamorro, A. and Rubio, S. (2018), "Re-thinking university spin-off: a critical literature review and a research agenda", *Journal of Technology Transfer*, Vol. 43, pp. 1007–1038.

Miranda, F.J., Chamorro-Mera, A. and Rubio, S. (2017), "Academic entrepreneurship in Spanish universities: An analysis of the determinants of entrepreneurial intention", *European Research on Management and Business Economics*, Vol. 23 No. 2, pp. 113–122.

Mitton, C., Adair, C., McKenzie, E., Patten, S. and Perry, B. (2007), "Knowledge Transfer and Exchange: Review and Synthesis of the Literature", *Milbank Quarterly*, Vol. 85 No. 4, pp. 729–768.

Moog, P., Werner, A., Houweling, S. and Backes-Gellner, U. (2015), "The impact of skills, working time allocation and peer effects on the entrepreneurial intentions of scientists", *Journal of Technology Transfer*, Vol. 40 No. 3, pp. 493–511.

Morales-Gualdrón, S.T., Gutiérrez-Gracia, A. and Dobón, S.R. (2009), "The entrepreneurial motivation in academia: A multidimensional construct", *International Entrepreneurship and Management Journal*, Vol. 5 No. 3, pp. 301–317.

Moray, N. and Clarysse, B. (2005), "Institutional change and resource endowments to science-based entrepreneurial firms", *Research Policy*, Vol. 34 No. 7, pp. 1010–1027.

Mosey, S., Guerrero, M. and Greenman, A. (2017), "Technology entrepreneurship research opportunities: insights from across Europe", *Journal of Technology Transfer*, Springer US, Vol. 42 No. 1, pp. 1–9.

Mosey, S., Noke, H. and Binks, M. (2012), "The influence of human and social capital upon the entrepreneurial intentions and destinations of academics", *Technology Analysis and Strategic Management*, Vol. 24 No. 9, pp. 893–910.

Moutinho, R., Au-Yong-Oliveira, M., Coelho, A. and Manso, J.P. (2016), "Determinants of knowledge-based entrepreneurship: an exploratory approach", *International Entrepreneurship and Management Journal*, Vol. 12 No. 1, pp. 171–197.

Mowery, D.C. and Sampat, B.N. (2004), "The Bayh-Dole Act of 1980 and University–Industry Technology Transfer: A Model for Other OECD Governments?", *Journal of Technology Transfer*, Vol. 30, pp. 115–127.

Mowery, D.C., Nelson, R.R., Sampat, B.N. and Ziedonis, A.A. (2001), "The growth of patenting by American universities: An assessment of the Bayh-Dole Act of 1980", *Research Policy*, No. 30, pp. 99–119.

Müller, R. and Kaltenbrunner, W. (2019), "Re-disciplining Academic Careers? Interdisciplinary Practice and Career Development in a Swedish Environmental Sciences Research Center", *Minerva*, Vol. 57 No. 4, pp. 479–499.

Munari, F., Rasmussen, E., Toschi, L. and Villani, E. (2016), "Determinants of the university technology transfer policy-mix: a cross-national analysis of gap-funding instruments", *Journal of Technology Transfer*, Vol. 41 No. 6, pp. 1377–1405.

Munari, F., Sobrero, M. and Toschi, L. (2018), "The university as a venture capitalist? Gap funding instruments for technology transfer", *Technological Forecasting and Social Change*, Vol. 127, pp. 70–84.

Muscio, A. and Ramaciotti, L. (2019), "How does academia influence Ph.D. entrepreneurship? New insights on the entrepreneurial university", *Technovation*, Vol. 82–83 No. October 2017, pp. 16–24.

Muscio, A., Quaglione, D. and Ramaciotti, L. (2016), "The effects of university rules on spinoff creation: The case of academia in Italy", *Research Policy*, Vol. 45 No. 7, pp. 1386–1396.

Muscio, A., Shibayama, S. and Ramaciotti, L. (2021), "Universities and start-up creation by Ph.D. graduates: the role of scientific and social capital of academic laboratories", *Journal of Technology Transfer*.

Mustar, P. and Wright, M. (2010), "Convergence or path dependency in policies to foster the creation of university spin-off firms? a comparison of France and the United Kingdom", *Journal of Technology Transfer*, Vol. 35 No. 1, pp. 42–65.

Nelson, A.J. (2014), "From the ivory tower to the startup garage: Organizational context and commercialization processes", *Research Policy*, Vol. 43 No. 7, pp. 1144–1156.

Neves, S. and Brito, C. (2020), "Academic entrepreneurship intentions: a systematic literature review", *Journal of Management Development*, Vol. 39 No. 5, pp. 645–704.

North, D.C. (1990), *Institutions, Institutional Change and Economic Performance*, Cambridge: Cambridge University Press.

Nosella, A. and Grimaldi, R. (2009), "University-level mechanisms supporting the creation of new companies: An analysis of italian academic spin-offs", *Technology Analysis and Strategic Management*, Vol. 21 No. 6, pp. 679–698.

Obschonka, M., Goethner, M., Silbereisen, R.K. and Cantner, U. (2012), "Social identity and the transition to entrepreneurship: The role of group identification with workplace peers", *Journal of Vocational Behavior*, Vol. 80 No. 1, pp. 137–147.

Obschonka, M., Silbereisen, R.K., Cantner, U. and Goethner, M. (2015), "Entrepreneurial Self-Identity: Predictors and Effects Within the Theory of Planned Behavior Framework", *Journal of Business and Psychology*, Vol. 30 No. 4, pp. 773–794.

OECD (2013*), Commercialising Public Research: New Trends and Strategies*, OECD Publishing.

OECD (2019), *University-Industry Collaboration: New Evidence and Policy Options*, OECD Publishing, Paris

O'Kane, C., Cunningham, J.A., Menter, M. and Walton, S. (2020), The Brokering Role of Technology Transfer Offices within Entrepreneurial Ecosystems: An Investigation of Macro–Meso–Micro Factors, *Journal of Technology Transfer*.

O'Kane, C., Zhang, J.A., Cunningham, J.A. and O'Reilly, P. (2017), "What factors inhibit publicly funded principal investigators' commercialization activities?", *Small Enterprise Research*, Vol. 24 No. 3, pp. 215–232.

O'Reilly, P. and Cunningham, J.A. (2017), "Enablers and barriers to university technology transfer engagements with small- and medium-sized enterprises: perspectives of Principal Investigators", *Small Enterprise Research*, Vol. 24 No. 3, pp. 274–289.

O'Shea, R.P., Allen, T., Morse, K., O'Gorman, C. and Roche, F. (2007), "Delineating the anatomy of an entrepreneurial university: the Massachusetts Institute of Technology experience", *R&D Management*, Vol. 37 No. 1, p. 16.

O'Shea, R.P., Allen, T.J., Chevalier, A. and Roche, F. (2005), "Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities", *Research Policy*, Vol. 34 No. 7, pp. 994–1009.

O'Shea, R.P., Allen, T.J., O'Gormna, C. and Roche, F. (2004), "Universities and Technology Transfer: A Review of Academic Entrepreneurship Literature", *Irish Journal of Management*, Vol. 25 No. 2, pp. 11–29.

Owen-Smith, J. (2003), "From separate systems to a hybrid order: Accumulative advantage across public and private science at Research One universities", *Research Policy*, Vol. 32 No. 6, pp. 1081–1104.

Ozgul, U. and Kunday, O. (2015), "Conceptual Development of Academic Entrepreneurial Intentions Scale", *Procedia - Social and Behavioral Sciences*, Vol. 195, pp. 881–887.

Passaro, R., Quinto, I. and Thomas, A. (2018), "The impact of higher education on entrepreneurial intention and human capital", *Journal of Intellectual Capital*, Vol. 19 No. 1, pp. 135–156.

Pauwels, C., Clarysse, B., Wright, M. and Van Hove, J. (2016), "Understanding a new generation incubation model: The accelerator", *Technovation*, Vol. 50–51, pp. 13–24.

Perkmann, M. and Walsh, K. (2008), "Engaging the scholar: Three types of academic consulting and their impact on universities and industry", *Research Policy*, Vol. 37 No. 10, pp. 1884–1891.

Perkmann, M., Fini, R., Ross, J.M., Salter, A., Silvestri, C. and Tartari, V. (2015), "Accounting for universities' impact: Using augmented data to measure academic engagement and commercialization by academic scientists", *Research Evaluation*, Vol. 24 No. 4, pp. 380–391.

Perkmann, M., Salandra, R., Tartari, V., Mckelvey, M. and Hughes, A. (2021), "Academic engagement: A review of the literature 2011-2019", *Research Policy*, Vol. 50 No. 1, p. 104114.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., et al. (2013), "Academic engagement and commercialisation: A review of the literature on university-industry relations", *Research Policy*, Vol. 42 No. 2, pp. 423–442.

Phan, P. and Siegel, D. (2006), "The Effectiveness of University Technology Transfer", *Foundations and Trends® in Entrepreneurship*, Vol. 2 No. 2, pp. 77–144.

Phan, P.H., Siegel, D.S. and Wright, M. (2005), "Science parks and incubators: Observations, synthesis and future research", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 165–182.

Philpott, K., Dooley, L., Oreilly, C. and Lupton, G. (2011), "The entrepreneurial university: Examining the underlying academic tensions", *Technovation*, Vol. 31 No. 4, pp. 161–170.

Pittaway, L. and Cope, J. (2007), "Entrepreneurship education: A systematic review of the evidence", *International Small Business Journal*, Vol. 25 No. 5, pp. 479–510.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. and Neely, A. (2004), "Networking and innovation: a systematic review of the evidence", *International Journal of Management Reviews*, Vol. 5–6 No. 3–4, pp. 137–168.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003), "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879–903.

Pollach, I. (2011), "Software Review: WordStat 5.0", *Organizational Research Methods*, Vol. 14 No. 4, pp. 741–744.

Prodan, I. and Drnovsek, M. (2010), "Conceptualizing academic-entrepreneurial intentions: An empirical test", *Technovation*, Vol. 30 No. 5–6, pp. 332–347.

Qian, H. and Acs, Z.J. (2013), "An absorptive capacity theory of knowledge spillover entrepreneurship", *Small Business Economics*, Vol. 40 No. 2, pp. 185–197.

Ramos-Vielba, I., Sánchez-Barrioluengo, M. and Woolley, R. (2016), "Scientific research groups' cooperation with firms and government agencies: motivations and barriers", *Journal of Technology Transfer*, Vol. 41 No. 3, pp. 558–585.

Rasmussen, E. (2011), "Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories", *International Small Business Journal*, Vol. 29 No. 5, pp. 448–471.

Rasmussen, E. and Rice, M.P. (2012), "A framework for government support mechanisms aimed at enhancing university technology transfer: the Norwegian case", *International Journal of Technology Transfer and Commercialisation*, Vol. 11 No. 1/2, pp. 1–25.

Rasmussen, E. and Wright, M. (2015), "How can universities facilitate academic spin-offs? An entrepreneurial competency perspective", *Journal of Technology Transfer*, Vol. 40 No. 5, pp. 782–799.

Rasmussen, E., Moen, Ø. and Gulbrandsen, M. (2006), "Initiatives to promote commercialization of university knowledge", *Technovation*, Vol. 26 No. 4, pp. 518–533.

Rasmussen, E., Mosey, S. and Wright, M. (2014), "The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures", *Research Policy*, Vol. 43 No. 1, pp. 92–106.

Renault, C.S. (2006), "Academic capitalism and university incentives for faculty entrepreneurship", *Journal of Technology Transfer*, Vol. 31 No. 2, pp. 227–239.

Richter, N.F., Cepeda, G., Roldán, J.L. and Ringle, C.M. (2016), "European management research using partial least squares structural equation modeling (PLS-SEM)", European Management Journal, Vol. 34 No. 6, pp. 589–597.

Ringle, C.M., Sarstedt, M. and Straub, D.W. (2012), "Editor's comments: a critical look at the use of PLS-SEM in MIS Quarterly", MIS Quarterly, Vol. 36 No. 1, pp. iii–xiv.

Rippa, P. and Secundo, G. (2019), "Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship", *Technological Forecasting and Social Change*, Vol. 146, pp. 900–911.

Rivero, C.A.P. and Ubierna, F. (2021), "The development of the entrepreneurial motivation from the university", *International Entrepreneurship and Management Journal.*

Rizzo, U. (2015), "Why do scientists create academic spin-offs? The influence of the context", *Journal of Technology Transfer*, Vol. 40 No. 2, pp. 198–226.

Romer, P. (1990), "Endogenous technological change", *Journal of Political Economy*, Vol. 98, pp. 71–102.

Romero, E.C., Ferreira, J.J.M. and Fernandes, C.I. (2021), "The multiple faces of the entrepreneurial university: a review of the prevailing theoretical approaches", *Journal of Technology Transfer*, Vol. 46 No. 4, pp. 1173–1195.

Rossi, F. and Rosli, A. (2014), "Indicators of university-industry knowledge transfer performance and their implications for universities: Evidence from the United Kingdom", *Studies in Higher Education*, Vol. 40 No. 10, pp. 1970–1991.

Rothaermel, F.T. and Thursby, M. (2005), "University-incubator firm knowledge flows: Assessing their impact on incubator firm performance", *Research Policy*, Vol. 34 No. 3, pp. 305–320.

Rothaermel, F.T., Agung, S.D. and Jiang, L. (2007), "University entrepreneurship: A taxonomy of the literature", *Industrial and Corporate Change*, Vol. 16 No. 4, pp. 691–791.

Ryan, R.M. and Deci, E.L. (2000), "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions", *Contemporary Educational Psychology*, Vol. 25 No. 1, pp. 54–67.

Sam, C. and van der Sijde, P. (2014), "Understanding the concept of the entrepreneurial university from the perspective of higher education models", *Higher Education*, Vol. 68 No. 6, pp. 891–908.

Sandström, C., Wennberg, K., Wallin, M.W. and Zherlygina, Y. (2018), "Public policy for academic entrepreneurship initiatives: a review and critical discussion", *Journal of Technology Transfer*, Vol. 43 No. 5, pp. 1232–1256.

Sarstedt, M., Hair, J.F., Cheah, J.H., Becker, J.M. and Ringle, C.M. (2019), "How to specify, estimate, and validate higher-order constructs in PLS-SEM", Australasian Marketing Journal, Vol. 27 No. 3, pp. 197–211.

Schartinger, D., Rammer, C., Fischer, M.M. and Fröhlich, J. (2002), "Knowledge interactions between universities and industry in Austria: sectorial patterns and determinants", *Research Policy*, Vol. 31 No. 3, pp. 303–328.

Schmitz, A., Urbano, D., Dandolini, G.A., de Souza, J.A. and Guerrero, M. (2017), "Innovation and entrepreneurship in the academic setting: a systematic literature review", *International Entrepreneurship and Management Journal, International Entrepreneurship and Management Journal*, Vol. 13 No. 2, pp. 369–395.

Scott, R. and Davis, G.F. (2015), *Organizations and Organizing: Rational, Natural and Open Systems Perspectives*, Routledge.

Secundo, G., Mele, G., Sansone, G. and Paolucci, E. (2020), "Entrepreneurship Education Centres in universities: evidence and insights from Italian 'Contamination Lab' cases", *International Journal of Entrepreneurial Behaviour and Research*, Vol. 26 No. 6, pp. 1311–1333.

Secundo, G., Ndou, V., Del Vecchio, P. and De Pascale, G. (2019), "Knowledge management in entrepreneurial universities: A structured literature review and avenue for future research agenda", *Management Decision*, Vol. 57 No. 12, pp. 3226–3257.

Secundo, G., Schiuma, G. and Jones, P. (2019), "Strategic knowledge management models and tools for entrepreneurial universities", *Management Decision*, Vol. 57 No. 12, pp. 3217–3225.

Shane, S. (2004), "Encouraging university entrepreneurship? The effect of the Bayh-Dole Act on university patenting in the United States", *Journal of Business Venturing*, Vol. 19 No. 1, pp. 127–151.

Shapero, A. (1984), "The entrepreneurial event", in C. A. Kent (Ed.), *The Environment for Entrepreneurship*, Lexington: Lexington Books.

Siegel, D.S. and Leih, S. (2018), "Strategic management theory and universities: An overview of the Special Issue", *Strategic Organization*, Vol. 16 No. 1, pp. 6–11.

Siegel, D.S. and Wright, M. (2015), "Academic Entrepreneurship: Time for a Rethink?", *British Journal of Management*, Vol. 26 No. 4, pp. 582–595.

Siegel, D.S., Veugelers, R. and Wright, M. (2007), "Technology transfer offices and commercialization of university intellectual property: performance and policy implications", *Oxford Review of Economic Policy*, Vol. 23 No. 4, pp. 640–660.

Siegel, D.S., Waldman, D. and Link, A.N. (2003), "Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy*, Vol. 32 No. 1, pp. 27–48.

Siegel, D.S., Waldman, D.A., Atwater, L.E. and Link, A.N. (2003), "Commercial knowledge transfers from universities to firms: Improving the effectiveness of university-industry collaboration", *Journal of High Technology Management Research*, Vol. 14 No. 1, pp. 111–133.

Sieger, P. and Monsen, E. (2015), "Founder, Academic, or Employee? A Nuanced Study of Career Choice Intentions", *Journal of Small Business Management*, Vol. 53, pp. 30–57.

Sjöö, K. and Hellström, T. (2019), "University–industry collaboration: A literature review and synthesis", *Industry and Higher Education*, Vol. 33 No. 4, pp. 275–285.

Skute, I. (2019), "Opening the black box of academic entrepreneurship: a bibliometric analysis", *Scientometrics*, Vol. 120, pp. 237–265.

Skute, I., Zalewska-Kurek, K., Hatak, I. and de Weerd-Nederhof, P. (2019), "Mapping the field: a bibliometric analysis of the literature on university-industry collaborations", *Journal of Technology Transfer*, Vol. 44 No. 3, pp. 916–947.

Snijders, T.A. and Bosker, R.J. (2011), *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*, Sage Publications, London.

Soetanto, D. and Jack, S. (2016), "The impact of university-based incubation support on the innovation strategy of academic spin-offs", *Technovation*, Vol. 50–51, pp. 25–40.

Sormani, E., Baaken, T. and van der Sijde, P. (2021), "What sparks academic engagement with society? A comparison of incentives appealing to motives", *Industry and Higher Education*.

Spigel, B. and Harrison, R. (2018), "Toward a process theory of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12 No. 1, pp. 151–168.

Stam, E. (2015), "Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique", *European Planning Studies*, Vol. 23 No. 9, pp. 1759–1769.

Sternberg, R. (2014), "Success factors of university-spin-offs: Regional government support programs versus regional environment", *Technovation*, Vol. 34 No. 3, pp. 137–148.

Stokes, D. (1997), *Pasteur's Quadrant: Basic Science and Technological Innovation*, Brookings Institution Press.

Streukens, S. and Leroi-Werelds, S. (2016), "Bootstrapping and PLS-SEM: A step-by-step guide to get more out of your bootstrap results", European Management Journal, Elsevier Ltd, Vol. 34 No. 6, pp. 618–632.

Stuart, T.E. and Ding, W.W. (2006), "When Do Scientists Become Entrepreneurs? The Social Structural Antecedents of Commercial Activity in the Academic Life Sciences", *American Journal of Sociology*, Vol. 112 No. 1, pp. 97–144.

Tabachnick, B.G. and Fidell, L.S. (1996), *Using Multivariate Statistics*, New York: Harper Collins.

Tartari, V. and Breschi, S. (2012), "Set them free: scientists' evaluations of the benefits and costs of university-industry research collaboration", *Industrial and Corporate Change*, Vol. 21 No. 5, pp. 1117–1147.

Tartari, V. and Salter, A. (2015), "The engagement gap: Exploring gender differences in University-Industry collaboration activities", *Research Policy*, Vol. 44 No. 6, pp. 1176–1191.

Tartari, V., Perkmann, M. and Salter, A. (2014), "In good company: The influence of peers on industry engagement by academic scientists", *Research Policy*, Vol. 43 No. 7, pp. 1189–1203.

Tartari, V., Salter, A. and D'Este, P. (2012), "Crossing the rubicon: Exploring the factors that shape academics' perceptions of the barriers to working with industry", *Cambridge Journal of Economics*, Vol. 36 No. 3, pp. 655–677.

Teixeira, S.J., Maria, C., Casteleiro, L., Rodrigues, R.G. and Guerra, M.D. (2018), "Entrepreneurial intentions and entrepreneurship in European countries", *International Journal of Innovation Science*, Vol. 10 No. 1, pp. 22–42.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M. and Lauro, C. (2005), "PLS path modelling", Computational Statistics and Data Analysis, Vol. 48 No. 1, pp. 159–205.

Thune, T. and Gulbrandsen, M. (2014), "Dynamics of collaboration in university-industry partnerships: do initial conditions explain development patterns?", *Journal of Technology Transfer*, Vol. 39 No. 6, pp. 977–993.

Thursby, J., Jensen, R. and Thursby, M.C. (2001), "Objectives, Characteristics and Outcomes of University Licensing", *Journal of Technology Transfer*, Vol. 26, pp. 59–72.

Tijssen, R.J.W. (2006), "Universities and industrially relevant science: Towards measurement models and indicators of entrepreneurial orientation", *Research Polic*y, Vol. 35 No. 10, pp. 1569–1585.

Tijssen, R.J.W. (2018), "Anatomy of use-inspired researchers: From Pasteur's Quadrant to Pasteur's Cube model", *Research Policy*, Vol. 47 No. 9, pp. 1626–1638.

Todorovic, Z.W., McNaughton, R.B. and Guild, P. (2011), "ENTRE-U: An entrepreneurial orientation scale for universities", *Technovation*, Vol. 31 No. 2–3, pp. 128–137.

Toole, A.A. and Czarnitzki, D. (2010), "Commercializing Science: Is There a University 'Brain Drain' from Academic Entrepreneurship?", *Management Science*, Vol. 56 No. 9, pp. 1599–1614.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review", *British Journal of Management*, Vol. 14 No. 3, pp. 207–222.

Trivedi, R. (2016), "Does university play significant role in shaping entrepreneurial intention? A cross-country comparative analysis", *Journal of Small Business and Enterprise Development*, Vol. 23 No. 3, pp. 790–811.

Unger, J.M., Rauch, A., Frese, M. and Rosenbusch, N. (2011), "Human capital and entrepreneurial success: A meta-analytical review", *Journal of Business Venturing*, Vol. 26 No. 3, pp. 341–358.

Urban, B. and Chantson, J. (2019), "Academic entrepreneurship in South Africa: testing for entrepreneurial intentions", *Journal of Technology Transfer*, Vol. 44 No. 3, pp. 948–980.

Urbano, D. and Alvarez, C. (2014), "Institutional dimensions and entrepreneurial activity: An international study", *Small Business Economics*, Vol. 42 No. 4, pp. 703–716.

Urbano, D. and Guerrero, M. (2013), "Entrepreneurial Universities: Socioeconomic Impacts of Academic Entrepreneurship in a European Region", *Economic Development Quarterly*, Vol. 27 No. 1, pp. 40–55.

Vallas, S.P. and Kleinman, D.L. (2008), "Contradiction, convergence and the knowledge economy: The confluence of academic and commercial biotechnology", *Socio-Economic Review*, Vol. 6 No. 2, pp. 283–311.

van de Burgwal, L.H.M., Dias, A. and Claassen, E. (2019), "Incentives for knowledge valorisation: a European benchmark", *Journal of Technology Transfer*, Vol. 44 No. 1, pp. 1–20.

van Rijnsoever, F.J. and Hessels, L.K. (2020), "How academic researchers select collaborative research projects: a choice experiment", *Journal of Technology Transfer*.

Vick, T.E. and Robertson, M. (2018), "A systematic literature review of UK university-industry collaboration for knowledge transfer: A future research agenda", *Science and Public Policy*, Vol. 45 No. 4, pp. 579–590.

Villasana, M. (2011), "Fostering university-industry interactions under a triple helix model: The case of Nuevo Leon, Mexico", *Science and Public Policy*, Vol. 38 No. 1, pp. 43–53.

Wagner, M., Schaltegger, S., Hansen, E.G. and Fichter, K. (2021), "University-linked programmes for sustainable entrepreneurship and regional development: how and with what impact?", *Small Business Economics*, Vol. 56 No. 3, pp. 1141–1158.

Walter, T., Ihl, C., Mauer, R. and Brettel, M. (2018), "Grace, gold, or glory? Exploring incentives for invention disclosure in the university context", *Journal of Technology Transfer*, Vol. 43 No. 6, pp. 1725–1759.

Wang, M., Soetanto, D., Cai, J. and Munir, H. (2021), "Scientist or Entrepreneur? Identity centrality, university entrepreneurial mission, and academic entrepreneurial intention", *Journal of Technology Transfer*.

Wetzels, M., Odekerken-Schröder, G. and Van Oppen, C. (2009), "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration Service Design for Innovation View project", MIS Quarterly, Vol. 33 No. 1, March 2009, pp. 177–195.

Wood, M.S. (2009), "Does one Size fit all? The multiple organizational forms leading to successful academic entrepreneurship", *Entrepreneurship: Theory and Practice*, Vol. 33 No. 4, pp. 929–947.

Wood, M.S. (2011), "A process model of academic entrepreneurship", *Business Horizons*, Vol. 54 No. 2, pp. 153–161

Wright, M. and Phan, P. (2018), "The Commercialization of Science: From Determinants to Impact", *Academy of Management Perspectives*, Vol. 32 No. 1, pp. 1–3.

Wright, M., Birley, S. and Mosey, S. (2004), "Entrepreneurship and university technology transfer", *Journal of Technology Transfer*, Vol. 29 No. 3–4, pp. 235–246.

Wright, M., Clarysse, B. and Mosey, S. (2012), "Strategic entrepreneurship, resource orchestration and growing spin-offs from universities", *Technology Analysis and Strategic Management*, Vol. 24 No. 9, pp. 911–927.

Wright, M., Clarysse, B., Lockett, A. and Knockaert, M. (2008), "Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries", *Research Policy*, Vol. 37 No. 8, pp. 1205–1223.

Wright, M., Siegel, D.S. and Mustar, P. (2017), "An emerging ecosystem for student start-ups", *Journal of Technology Transfer*, Vol. 42 No. 4, pp. 909–922.

Wu, Y., Welch, E.W. and Huang, W.L. (2015), "Commercialization of university inventions: Individual and institutional factors affecting licensing of university patents", *Technovation*, Vol. 36, pp. 12–25.

Würmseher, M. (2017), "To each his own: Matching different entrepreneurial models to the academic scientist's individual needs", *Technovation*, Vol. 59, pp. 1–17.

Yusof, M. and Jain, K.K. (2010), "Categories of university-level entrepreneurship: A literature survey", *International Entrepreneurship and Management Journal*, Vol. 6 No. 1, pp. 81–96.

Zahari, A.R., Tamyez, P.F.M., Azizan, N.A. and Hashim, F. (2018), "Student spin-off intentions in malaysian higher educational institutions: Founders' characteristics and university roles", *Journal of Entrepreneurship Education*, Vol. 21 No. 3, pp. 1–15.

Zavale, N.C. and Langa, P.V. (2018), "University-industry linkages' literature on Sub-Saharan Africa: systematic literature review and bibliometric account", *Scientometrics*, Vol. 116 No. 1, pp. 1–49.

Zollo, L., Laudano, M.C., Ciappei, C. and Zampi, V. (2017), "Factors affecting universities' ability to foster students' entrepreneurial behaviour: An empirical investigation", *Journal of Management Development*, Vol. 36 No. 2, pp. 268–285.