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 process (Tranfield *et al.*, 2003) and adopts a four-step process format from previous literature reviews within the entrepreneurship context (Miller *et al.*, 2018). 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, which 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

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

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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 1) recognizes that the economic variables (individual, organizational and institutional-level) may have an impact on the psychological variables

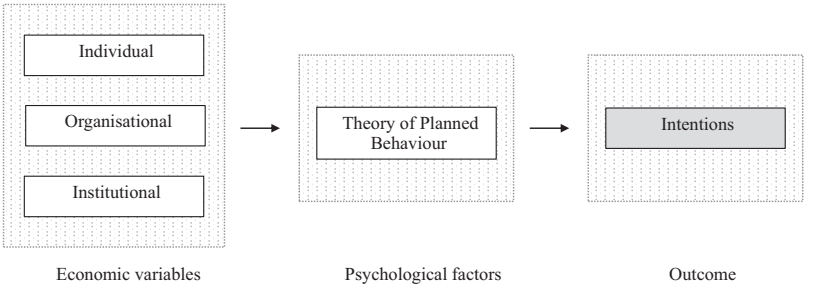

Figure 1.
Conceptual framework

(TPB), which then may influence the academics' intention to engage in knowledge valorisation activities.

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 *et al.*, 2017a). 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.

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).

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', 'startup', 'spinoff' 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 1).

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.

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 1,814 papers. The research team removed 395 papers due to duplication in the databases (1,419).

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 give 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.

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 2).

Findings

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 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.

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).

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

Year	No of papers	No 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

Table 1.
Number of papers and citations by year

with a total of nine papers. Due to the particularity of professor privilege (Damsgaard and Thursby, 2013), Sweden is also a well-exploited case (5 papers).

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), there is an acute interest in addressing the academic's intentions to create a company (30 papers). The intentions to engage in patenting is under research in seven papers. Moreover, ten 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,

Table 2.
Number of papers by journal

Journal title	No of papers
Journal of Technology Transfer	13
Research Policy	12
Technovation	5
Industrial and Corporate Change	2
Science and Public Policy	2
Others	32

Table 3.
Summary of papers by type of data and country analysed

Study characteristics	No. 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

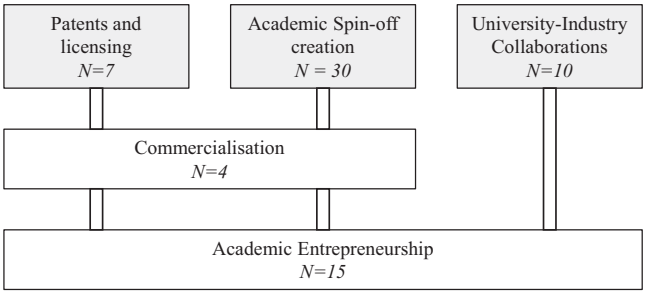

Figure 2.
Knowledge valorisation activities under study (frequency)

2017; Perkmann *et al.*, 2013) and is analysed in four 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).

Content analysis

In this section, the study uncovers the drivers identified in the literature (Figure 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 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).

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.

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 *et al.*, 2017a) 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

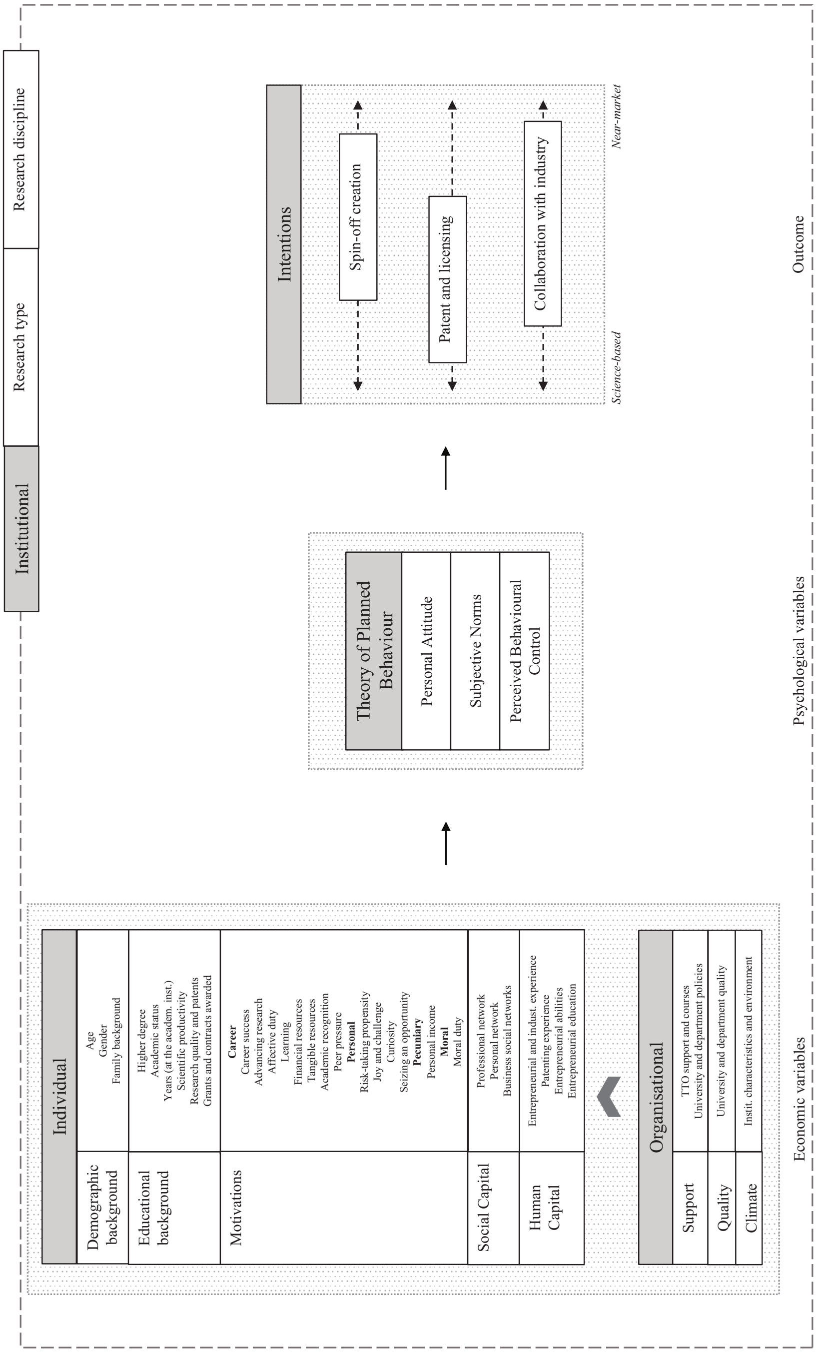

Figure 3.
Economic and psychological drivers of academics' intentions

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

Note(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

Table 4.
Tabular summary with the individual demographic background effect, by knowledge valorisation activity

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 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

Economic variable	Knowledge valorisation activities: 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) Link *et al.* (2007)	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.* (2017a)	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)	

Table 5.
Tabular summary with the individual educational background effect, by knowledge valorisation activity

Note(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

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.

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 *et al.* (2017b) 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 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).

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).

Table 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) Hesse and Brünjes (2018)	Positive Göktepe-Hulten and Mahagaonkar (2010) Baldini (2011) Lam (2011) Bodas Freitas and Nuvolari (2012)		Positive Bicknell *et al.* (2010) Foo *et al.* (2016)
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)

(*continued*)

Economic variable	Knowledge valorisation activities: Spin-off creation	Patent and licensing	Industry collaboration	Academic entrepreneurship
Seizing an opportunity	Positive Clarysse *et al.* (2011) Hayter (2015) Miranda *et al.* (2017b) 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(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

Table 6.

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 *et al.*, 2017a), 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 *et al.*, 2017a). 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 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.

With a focus exclusively on the intentions of creating spin-offs, studies by Obschonka *et al.* (2015), Bergmann (2017) and Miranda *et al.* (2017a) 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.

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(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

Table 7. Tabular summary with the individual social capital effects, by knowledge valorisation activity

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 *et al.*, 2017b; 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 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 (D'Este and Perkmann,

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 *et al.* (2017b) 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.* (2017a)			
Entrepreneurial education	Positive García-Rodríguez *et al.* (2017) Mixed Bergmann (2017) Passaro *et al.* (2018)			

Table 8.
Tabular summary with the individual human capital effects, by knowledge valorisation activity

Note(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

2011), or they simply want their invention protected (Bodas Freitas and Nuvolari, 2012; Tartari and Breschi, 2012).

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 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 4,400 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, which is whether the research is more science-based or more market-oriented. It is known that some basic disciplines

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) Negative Erikson *et al.* (2015) Mixed Muscio *et al.* (2016) Non-significant Zahari *et al.* (2018)	Positive Erikson *et al.* (2015) Huyghe and Knockaert (2015)	Positive Erikson *et al.* (2015) Escobar *et al.* (2017) Negative Huyghe and Knockaert (2015)	Positive Francis-Smythe (2008) Holley and Watson (2017)
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.* (2017a) 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)	

Table 9.
Tabular summary with the organisational and institutional effects, by knowledge valorisation activity

Note(s): *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 where included in this column. However, when the papers presented the data desegregated by activity, the different results were presented accordingly under the respective column

(mathematics, chemistry, and physics) are less requested by industry (Tartari and Salter, 2015) but more likely to disclose (Bercovitz and Feldman, 2008).

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.*

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)		

Table 10.
Tabular summary with the Theory of Planned Behaviour effects, by knowledge valorisation activity

(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 10).

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 attitude (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 *et al.*, 2005; Markman *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 organizational 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 organizational-level determinants reinforce each other (Huyghe and Knockaert, 2015).

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Appendix 1

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*	

Note(s): 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

Table A1.

Table A2. 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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 (2) The results found no evidence that personal characteristics or human capital play an essential role in the decision to become 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 the 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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 organizational justice (2) The policymakers focus should be on intra-individual dimension and should emphasize the human aspect, especially more attention should be given to the faculty member

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 with 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' perceptions of the entrepreneurial climate?	(1) Individual and contextual factors influence climate perceptions (2) Contextual characteristics have a different impact depending on students' background and gender. The 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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 work useful 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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 competences, 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 public financed research
Bodas Freitas and Verspagen (2017)	Netherlands	Industry collaboration	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

(*continued*)

Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 number of grants and show ambiguous results for network time allocation
Brettel *et al.* (2013)	Germany	Patents and licences University Spin-off	(1) What types of incentives, mediated by attitude, subjective norm and perceived behavioural control, influence star scientists to disclose an invention?	(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 significantly 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 organizational 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, 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 networks influence entrepreneurial intentions?	(1) Mentors, business networks and personal networks have a decisive role in promoting academics' interest in new business 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 are specific policies 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 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 the 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 norms, perceived behaviour control) predict academic entrepreneurial intentions?	(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 showed indirect effects on intentions via attitudes and perceived control

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 expectation 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
Halilem *et al.* (2017)	Canada	Patents and licences	(1) 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 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 organizational commitment are relevant mediators (3) Spin-off intentions can be reinforced by both passions, the entrepreneurial and scientific

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 (3) Male academics are more likely to engage with external partners (4) 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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 transfer activities?	(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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 *et al.* (2017b)	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 variable positively affecting the academics intention (2) The result shows no relationship for productivity (publications), regional environment; university environment, self-confidence, creativity; with entrepreneurial intentions

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
Miranda *et al.* (2017a)	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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 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' increases 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 of 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 their control beliefs (4) Among academics with high group identification, entrepreneurial intentions were essential a function of social norms

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 working relationships with the industry?	(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

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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 (3) Among the institutional factors, the results found support for one institutional factor – TTO cost-saving practices (4) There is no support industry funding and TTO service effectiveness

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Table A2.

Author(s)	Location	Knowledge valorisation	Research questions	Findings
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

Note(s): 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)