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Entrepreneurial universities: A bibliometric analysis within the business and management domains

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ABSTRACT

This study presents a bibliometric analysis of scientific publications investigating entrepreneurial universities in the business and management fields. The authors collected 511 documents from the Web of Science and analysed them using Bibliometrix, an RStudio package for performance analysis and science mapping. The study aims to provide an overview of the evolution of research about this topic and describe the structures (i.e., conceptual, social, and intellectual) characterising it. It discusses the results to identify the main areas addressed so far and highlight gaps in the literature, offering avenues for possible future research. The results show that publications on entrepreneurial universities started over 30 years ago and show an increasing trend, more than tripling in the last 10 years. Considering authors and documents as a unit of analysis, the US and Europe perform well in terms of productivity and relevance, but the phenomenon is globally relevant. The contribution to socio-economic development, especially in developing countries, is a hot topic for future studies. Despite increasing production rates, research on this topic remains fragmented, justifying the need for more systematisation. Furthermore, the paper offers policy makers and practitioners a useful baseline for developing entrepreneurial universities and considering their technological, managerial, and organisational implications.

1. Introduction

In current knowledge-driven societies, universities are increasingly involved in outreach activities that extend beyond teaching and research (Ardito et al., 2019; Rinaldi et al., 2018; Trencher et al., 2014). In this regard, universities have started to become more open towards societies, performing different kinds of activities (e.g., knowledge dissemination, technological innovation, social innovation, advisory services, or entrepreneurship), with government support or not, at a local, regional, or global level (Guerrero et al., 2016a). This shift started when Etzkowitz (1983) first introduced the "entrepreneurial university" concept. As a consequence, research on entrepreneurial universities has steadily increased over the years, especially in the business and management fields. It has expanded to a variety of interrelated topics, such as technology transfer (Etzkowitz, 2003a; Guerrero and Urbano, 2012; Martinelli et al., 2008), performance management (Audretsch, 2014; Cosenz, 2014; Wong et al., 2007), entrepreneurial education (Fayolle and Redford, 2014; Guerrero et al., 2015; Rasmussen and Sørheim, 2006), regional development (Bramwell and Wolfe, 2008; Cooke, 2005; Kirby, 2006), stakeholder engagement (Klofsten and Jones-Evans, 2000; Trencher et al., 2014), and knowledge management (Martinelli et al., 2008; Scuotto et al., 2019; Secundo et al., 2019).

Although several scholars have addressed the issues related to entrepreneurial universities over the years, a shared view regarding this topic is still lacking (Secundo et al., 2020). However, regardless of its public or private nature, scholars seem to agree that, if a university aspires to develop towards an entrepreneurial model, the following five characteristics need to be taken into consideration (Etzkowitz, 1983, 2003b; Guerrero et al., 2016b; OECD, 2012): first, the presence of interconnections with governments, industries, and societies; second, the existence of different revenue streams, which make the university partially or totally independent from public funding; third, students' and faculties' involvement in some entrepreneurial activities, such as entrepreneurial education or technology transfer activities; fourth, the creation of academic start-ups or spin-offs, supported by the implementation of ad hoc strategies and the development of specific structures; and fifth, the adaptation of the university's organisational structure to implement such changes.

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Following these common patterns, examples of entrepreneurial universities that can be considered as best practices are present worldwide, with each institution excelling in one or more specific areas. This can also refer to the variety of resources and capabilities that characterise each local context (Guerrero and Urbano, 2012; Siegel and Wright, 2015) or to the different political scenarios and markets that characterise each environmental setting in which entrepreneurial universities operate (Etzkowitz, 2017; Guerrero et al., 2016b), from the strict embeddedness of Stanford University with Silicon Valley's ecosystem to the links built by the Autonomous University of Madrid to support its regional needs and from the profitable technology transfer activities conducted by the Massachusetts Institute of Technology (MIT) to the creation of spin-offs and science parks performed by the Katholieke Universiteit of Leuven.

Adopting this broad perspective and answering different calls for more research on the topic (e.g., Mascarenhas et al., 2017; Siegel and Wright, 2015), this paper aims to systematise the scientific production published to date in the business and management fields. In this way, it offers scholars a holistic overview of the fragmented literature published to date and proposes possible future research streams. Moreover, policy makers and practitioners could find a useful baseline for fostering the development of an entrepreneurial university and considering its technological, managerial, and organisational implications. In this vein, a bibliometric analysis is conducted to answer the following research questions:

RQ1. How has the business and management literature addressing entrepreneurial universities evolved so far?
RQ2. What structures characterise the business and management literature about entrepreneurial universities?
RQ3. What are the possible future trends for research on entrepreneurial universities within the business and management research fields?

Bibliometry represents an appropriate solution to achieve these objectives since it empowers scholars to identify a discipline's most influential studies and relevant scientific activities (Broadus, 1987; Cuccurullo et al., 2016; Merigó et al., 2015). Leveraging performance analysis and science mapping, several indicators were considered to identify the most influential documents, authors, journals, and countries.

The performance analysis shows that publications related to entrepreneurial universities started more than 30 years ago and reveal an increasing trend. Moreover, while the topic is globally relevant, advanced countries (e.g., the US and other European economies) perform better in terms of productivity and relevance, considering authors and documents as a unit of analysis. In this sense, the first implication of this study is that more analyses from developing countries should be encouraged and international collaborations amongst scholars incentivised. Moreover, most of the journals are connected to technological aspects, suggesting a different focus of journals on this research topic.

Differently, science mapping enables the identification of the structures (i.e., conceptual, intellectual, and social) that characterise the topic under study. Notably, the conceptual structure was analysed through keywords' co-occurrences, which enabled the identification of three thematic clusters: (i) knowledge management and innovation, (ii) performance management and economic growth, and (iii) technology transfer and knowledge commercialisation. The social structure was analysed through co-authorships and the results highlight that most relevant authors act in restricted circles and broader networks are still lacking. The intellectual structure was investigated through references' co-occurrences to determine which documents have most influenced the research field over the years. Finally, following the content analysis, the evolution of the themes that have been addressed by the most relevant authors over the years is presented and implications for future research are investigated in depth.

The remainder of this work is organised as follows. Section 2 presents the theoretical background. Section 3 systematically describes the adopted methodology. Section 4 presents the results of the bibliometric analysis. More precisely, Section 4.1 reports the results of the performance analysis while Section 4.2 is dedicated to science mapping. Section 5 discusses the results of the content analysis. Section 6 presents the main implications of the work. Finally, Section 7 contains the conclusions, limitations, and further developments.

2. Theoretical background

Since the introduction of the Bayh–Dole Act in the US in the early 1980s, universities have experienced a shift in the missions that they have traditionally been asked to pursue (Etzkowitz, 1998; Grimaldi et al., 2011). Indeed, the political reform incentivised forms of private funding (Etzkowitz et al., 2000; Philpott et al., 2011) and, consequently, universities increased their entrepreneurial activities, especially along the dimension of technological transfer (Etzkowitz, 2003b, 2003c; O'Shea et al., 2005; Rothaermel et al., 2007). Following this trend, some authors have examined the theoretical underpinnings of an entrepreneurial university, criticising the progressive commercialisation of knowledge (D'Este and Perkmann, 2010; Van Looy et al., 2011) in what they defined as academic capitalism (Slaughter and Leslie, 1997) or the "McDonaldisation" of universities (Hayes, 2017). Other scholars have recognised that the contribution of universities to social and economic progress should not be limited to the capitalisation of knowledge (Etzkowitz, 2004) since universities could act as local agents to stimulate entrepreneurship capital (Audretsch, 2014; Guerrero and Urbano, 2012) by promoting entrepreneurial thinking, actions, and institutions (Guerrero et al., 2016a). Hence, entrepreneurial universities should be considered as transformational agents able to boost entrepreneurial abilities, drive ecosystem change, and catalyse natural or financial resources in a given environment (Klofsten and Jones-Evans, 2000; Siegel and Wright, 2015).

Over the years, efforts from all over the world have been made to foster a shift towards the entrepreneurial university model. As a consequence, according to Etzkowitz (2017), two main approaches can be identified. In more laissez-faire economies (e.g., in Anglo-Saxon or Northern European countries), entrepreneurial universities arose following more bottom-up approaches as well as being pushed by reductions in public funding and the consequent necessity to look for new financial sources. In this regard, some archetypal universities, such as MIT, Stanford, Cambridge, and Leuven, progressively built relationships with governments and industries and undertook entrepreneurial activities that were more tangible and related to economic returns (e.g., patenting, licensing, and spin-off creation). Conversely, in "higher-state" societies (e.g., in continental Europe), this transition was mainly induced by political or institutional efforts to close the innovation gap with Anglo-Saxon universities, adopting a more top-down approach.

A famous project aimed at systematising academic entrepreneurial activities was conducted in 2010 in Europe. Third mission activities were grouped into three main categories (E3M, 2010), namely (i) technology transfer and innovation, (ii) continuing education, and (iii) public engagement. Briefly, it could be said that entrepreneurial universities are adaptive institutions that effectively pursue their third mission by adjusting their goals and strategies, seizing new opportunities, and taking risks to adapt themselves to modern dynamic and competitive knowledge-based societies (Clark, 1998; Etzkowitz, 2003b; Kirby, 2002; Rasmussen and Wright, 2015; Secundo et al., 2017). Thus, although some misalignment remains regarding performance measurement systems and tensions can arise between the pursuit of the three academic missions (O'Kane et al., 2015), especially in the allocation of scarce resources, such as scholars' time, the third mission and entrepreneurial activities have the power to build synergies amongst these missions and push universities' capability to achieve their full potential.

3. Methodology

In this work, a bibliometric analysis was conducted. Bibliometrics can be defined as a sub-branch of informetrics that aims to measure scientific publications' impact and their related level of knowledge dissemination through statistical techniques (Broadus, 1987; Cuccurullo et al., 2016; Merigó et al., 2015). In this sense, it enables researchers to investigate a larger amount of data than systematic literature reviews, keeping a high level of rigour, scientific soundness, transparency, and replicability (Dada, 2018; Rey-Martí et al., 2016).

This study used bibliometrics to unveil what is known and what is not in the topic of entrepreneurial universities, with a particular focus on the business and management literature. Thus, a quantitative analysis was conducted, applying performance analysis and science mapping using the RStudio software (RStudio Team, 2016), which is one of the most used tools by researchers, data analysts, and analytical practitioners to conduct statistical analysis. R integrates several packages and is updated almost daily, making it very helpful for conducting meta-analyses such as bibliometric ones. To perform this study, the Bibliometrix package developed by Aria and Cuccurullo (2017) was adopted. Bibliometrix has been gaining increasing attention from scholars in a wide range of disciplines (e.g., Addor and Melsen, 2019; Linnenluecke et al., 2019; Secinaro and Calandra, 2020) as it enables them to perform descriptive analysis starting with bibliographic databases.

Moreover, as in other bibliometric studies (e.g., Baima et al., 2020; Martínez-Climent et al., 2018), a content analysis of the most influential articles was performed to investigate the thematic evolution of the discipline and the specialisation of authors. Consequently, the "hidden patterns" characterising the discipline were identified and avenues for future research are proposed (Cappellesso and Thomé, 2019; Daim et al., 2006).

3.1. Data collection

The first step in a bibliometric analysis is to collect raw data from which the necessary metadata (e.g., authors, countries, references, or number of citations) can be obtained (Carvalho et al., 2013). Several bibliometric databases exist. However, the two largest are the Web of Science (WoS) from Clarivate Analytics and Scopus from Elsevier. The WoS covers more than 15,000 journals and over 90 million documents. Scopus indexes more than 20,000 active titles (i.e., peer-reviewed journals, books, and conference proceedings) and contains around 69 million records. In this study, the WoS Core Collection was consulted for conducting the bibliometric analysis. Scholars have recognised it as having higher quality standards than Scopus (Merigó et al., 2015), leading to fewer false positive results regarding authors and keyword disambiguation thanks to keywords plus. Keywords plus are keywords that are automatically generated from the WoS according to the terms that appear more than once in a document's reference list and do not produce comparison problems (e.g., related to single or plural forms or acronyms). For these reasons, it is the most suitable database for data mining and has become one of the primary databases used by scholars for conducting bibliometric analysis (Thelwall, 2008; Waltman and van Eck, 2012).

3.2. Data extraction

To collect data from the WoS database, the following search string was used within the document topic field:

"entrepren* universit*" OR "universit* entrepren*" OR "academic entrepren*" OR "entrepren* academic"

Searching within the document topic field provides results that contain the selected keyword in documents' title, abstract, author keywords, and keywords plus. Following the WoS's syntax, the Boolean operator (OR) and wildcards were adopted to capture documents containing different combinations of the selected keywords and both plural and singular forms. The search was conducted in November 2019 and included all documents released before 2018.

The initial search returned 1520 records. Then, restrictions on the year (documents published before 2018), document type (articles, reviews, and letters), and language (English only) were applied (Merigó et al., 2016), resulting in 808 records. Restrictions on the year were posed to improve the comparability during the bibliometric analysis since more recent publications had not had the time to receive an adequate number of citations (Massaro et al., 2016). Restrictions on the document type were imposed to include only documents that have been subject to a double-blind review process (Gaviria-Marin et al., 2019). Finally, to answer the research questions of the present study and provide a more accurate comparison amongst the metrics of scholars, journals, and publications, only the results included in the "management" and "business" fields were considered. The final result was 511 records, representing around 75% of the dataset found in the previous phase and demonstrating the relevance of the topic in the selected sub-domains. Fig. 1 provides graphical evidence of the different phases of the data extraction activity.

3.3. Bibliometric analysis

The final sample was examined through bibliometric analysis. In this regard, two techniques were primarily used: performance analysis and science mapping (Noyons et al., 1999).

3.3.1. Performance analysis

Performance analysis can adopt several indicators, mainly related to analysing the overall trend of the topic and the number of publications or citations of the documents within the dataset and sorting them by authors, journals, countries, and affiliations (Massaro et al., 2016; Thelwall, 2008). However, evaluating the scientific impact of researchers or journals through other indicators along with those mentioned above is generally accepted. amongst them, thanks to its easy interpretability, one of the most popular is the h-index, proposed by Hirsch (2005). The h-index indicates the number of publications that have received at least h citations, and it is considered to be an appropriate and robust indicator to evaluate productivity and the relevance of scientific production at the same time (Vanclay, 2007). However, despite its objectivity, the h-index is not a suitable index when authors from different research fields or authors characterised by different seniority levels are to be compared (Kelly and Jennions, 2006). In this study, only scholars pertaining to the business and management fields were compared. To overcome the problems related to comparing researchers at diverse stages of their career, the m-index was adopted as

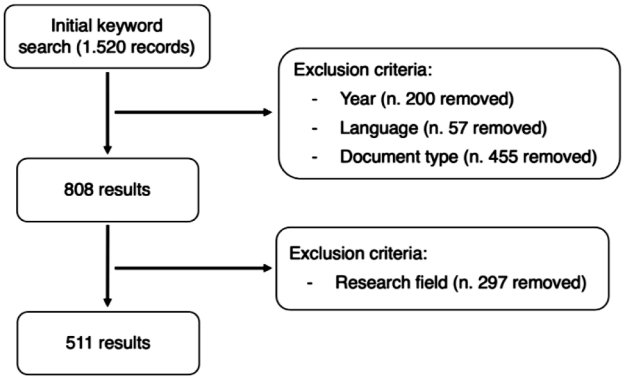

Fig. 1. The different phases of the data extraction activity.
Source: Authors' own elaboration.

another unit of analysis. The m-index is the h-index divided by the number of years that have passed between a scholar's first and his or her latest publication (Hirsch, 2007). It thus enables researchers to weight a scholar's productivity with his or her career length.

3.3.2. Science mapping

Another widely adopted technique in bibliometric analysis is science mapping, which empowers the researcher to capture hidden patterns in the conceptual, social, and intellectual structure of a given body of knowledge and their dynamic evolution over time (Börner et al., 2003; Cobo et al., 2012). The conceptual structure refers to the links that can emerge between different concepts or words. The social structure highlights the connections that occur between different units of analysis, such as authors, institutions, and countries. The intellectual structure concerns relationships between different nodes (e.g., documents, authors, and journals) that can highlight evolutions in a given discipline or body of knowledge. To conduct these kinds of analyses, scholars can adopt several techniques (van Eck and Waltman, 2014), but the most used are co-occurrence analysis and co-citation analysis (Callon et al., 1983; Small, 1973; van Eck and Waltman, 2010).

To capture the conceptual structures related to entrepreneurial universities, in this study, a co-occurrence analysis was conducted using keywords plus as a unit of analysis. Accordingly, 50 nodes were obtained, adopting the association strength normalisation (van Eck and Waltman, 2009) and the Louvain cluster algorithm (Blondel et al., 2008). Moreover, plotting clusters in a bi-dimensional matrix in which the axes are functions of density and centrality, a thematic evolution map is presented. Notably, 250 keywords plus were considered with a minimum cluster frequency of 5 and 2 cut-off points to provide a comprehensive evolution of themes related to entrepreneurial universities over time.

To capture the social structure, a co-authorship analysis was performed on the basis of co-authored documents (Peters and van Raan, 1991), in which 50 authors represented the unit of analysis. In this case as well, the association strength normalisation (van Eck and Waltman, 2009) and the Louvain cluster algorithm (Blondel et al., 2008) were adopted. Isolated nodes were not discarded to provide a more comprehensive view of the level of collaboration existing amongst scholars in this domain.

Finally, to analyse the intellectual structure of the topic, a historiograph (Garfield, 2004) was drawn, plotting the evolution of the citations of the 20 most influential documents over the years. It was possible to identify 4 thematic groups, thus supporting the results of the analysis of the conceptual structure.

4. Results of the bibliometric analysis

4.1. Performance analysis

In this section, a bibliometric analysis is presented on the basis of different performance indicators. In this way, it is possible to answer the first research question of this study:

RQ1. How has the business and management literature addressing entrepreneurial universities evolved so far?

4.1.1. Articles' evolution over time

Studies on entrepreneurial universities started in 1983, when Etzkowitz published his seminal study in which he recognised the emerging need of universities to search for alternative income streams. In this study, he first coined the term "entrepreneurial university" to describe universities that are able to obtain funds from their research activity. Research on this topic has been published for more than 30 years since then, although it received scant attention from the scientific community until 2003 (see Fig. 2).

By this year, Etzkowitz had published several other seminal studies. Etzkowitz (1998) theorised about the introduction of the capitalisation of knowledge and economic development as a third mission besides teaching and research. The author conceptualised the "triple-helix" model in which universities, governments, and industries are recognised as intertwined actors that contribute to fostering technological innovation in modern knowledge-based societies (Etzkowitz, 2001, 2003a, 2003b; Etzkowitz et al., 2000; Leydesdorff and Etzkowitz, 2001). Then,

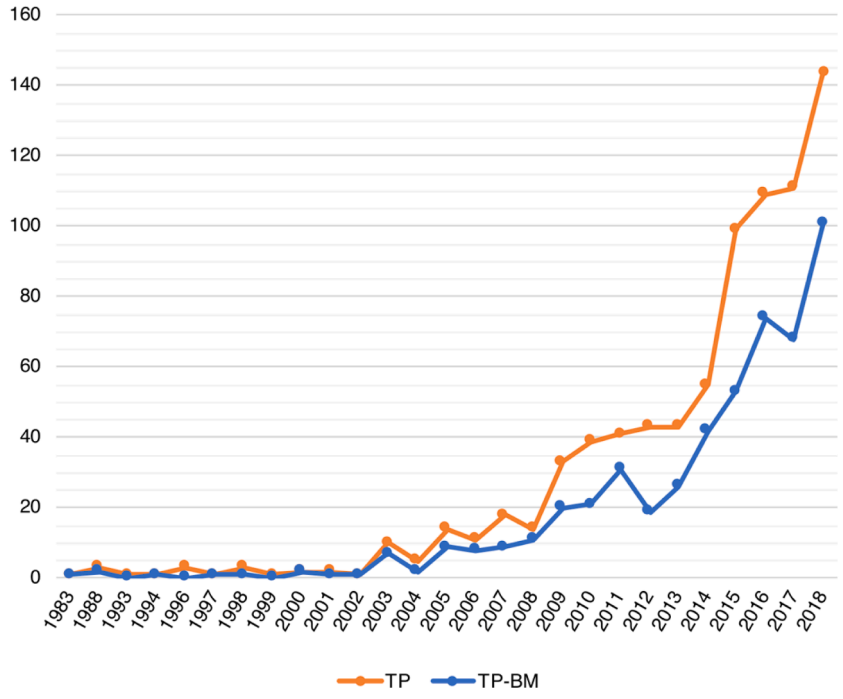

Fig. 2. Distribution of publications over time in all research fields (TP) and in the business and management domain (TP-BM).
Source: Authors' own elaboration.

the academic life of scientists involved in academic entrepreneurship activities was recognised as similar to that of entrepreneurs engaged in start-ups (Etzkowitz, 2003b). Hence, the total production rate acquired increasing relevance between 2003 and 2008, reaching its first peak in 2009, when the number of documents roughly doubled compared with the number in previous years. While, in Anglo-Saxon contexts, this increase can be explained by increasing restrictions on public funding and the impelling necessity for universities to become autonomous and seek alternative funding streams, in Europe, the shift towards an entrepreneurial model of universities was pushed more from the top down. The European Commission and the OECD made admirable efforts to promote an entrepreneurial culture in Europe to close the gap with American universities. Indeed, they recognised that most innovative ideas were coming from the academic world (European Commission, 2008). Some of these initiatives were the European Third Mission Project, launched in 2010 (E3M, 2010), and the creation of the European Institute of Innovation and Technology (EIT) and different knowledge and innovation communities (KICs) in 2008 (Didier, 2010). Finally, in 2012, the European Commission and the OECD published a guiding framework for helping European universities to manage this entrepreneurial transition (OECD, 2012). Therefore, different third-mission activities were disciplined to drive universities to manage their novel mission in the economy and society, pushed by those institutional and cultural changes. The production rate developed steadily over the years, with another peak in 2015 and a sound increase in the subsequent years, reaching 144 records in 2018. In the business and management fields, this increase was more gradual but followed a similar trend.

To identify the articles that have most influenced researchers related to entrepreneurial universities in the business and management fields, analysing the number of citations received is considered to be a suitable measure (Merigó et al., 2015). Indeed, citations can synthesise the relevance and influence of a publication amongst scholars in a single number. The ten most influential documents in the analysed dataset are presented in Table 1. More precisely, the total citations received as retrievable in the WoS (TC) and the average number of citations received each year (TC/Y) are shown. Interestingly, Etzkowitz appears three times on this list and can be considered soundly as one of the seminal authors of the third mission and entrepreneurial university concepts. After Etzkowitz et al. (2000), the most cited documents are those by Rothaermel et al. (2007), containing a comprehensive literature review on entrepreneurial universities, followed by Perkmann et al. (2013), who proposed a taxonomy of the literature to investigate the relationship between universities and industry.

4.1.2. Articles' geography

A total of 966 authors from 48 countries and 589 different institutions contributed to publishing the 511 articles in the analysed dataset. This means that collaboration is a critical aspect for authors studying entrepreneurial universities as there are only 92 single-authored documents. However, considering the multi-authored publications, it can be observed that the most prolific countries are not necessarily also the most open to international collaborations. This can be observed in Table 2, in which three different metrics are considered: (i) single-country publications (SCPs), (ii) multi-country publications (MCPs), and (iii) the ratio between the MCPs and the total number of publications in the dataset (TP-BM). "SCP" represents the number of publications written by authors from the same country (intra-country collaboration). "MCP" represents the number of publications written by authors from different countries (inter-country collaboration). "MCP_Ratio" provides a relative value that shows the level of openness of each country to international collaborations.

Of the 48 countries involved, only 11 have published only 1 paper, demonstrating a global interest in the topic of entrepreneurial universities. However, in terms of overall productivity, it can easily be noted that all of the most prolific countries are from advanced economies in North America or Europe. Interestingly, the US accounts for around twice as many publications as the UK, which ranks second. However, they do not appear amongst the top 10 in terms of international collaborations when considering their MCP ratio.

Differently, Table 3 reports the top 10 countries in the total number of citations received. As in Table 2, the US proves to be a leader for both productivity and relevance concerning entrepreneurial universities, followed by the UK, Italy, and Germany. Other countries, such as Belgium and Ireland, rise in relation to the total citations received, while still others, like the Netherlands and Russia, no longer rank amongst the top ten.

4.1.3. Authors

Two relevant aspects should be considered when evaluating an author's relevance within a specific field: the productivity and the impact. In Fig. 3, both these measures are considered to provide an overview of the top 20 most productive authors in the last 20 years. The productivity was evaluated through the number of articles published by an author in the given period of time. Conversely, the impact was evaluated by considering the number of citations received each year. It can be noted that Wright, Guerrero, and Urbano are the most productive authors, while Grimaldi and Fini received the highest number of citations per year. Moreover, it can easily be observed that Etzkowitz is a seminal author on the topic, with an unbroken series of publications from 1998 to 2018.

However, productivity per se is not representative of the overall quality of researchers' production, and scholars have generally used

Table 1
Citation analysis of the 10 most relevant documents in the dataset ordered by the total number of citations received (TC).

#	Author(s)	Title	Year	Journal	TC	TC/Y
1	Etzkowitz et al.	The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm	2000	Res. Policy	924	44.00
2	Rothaermel et al.	University entrepreneurship: a taxonomy of the literature	2007	Ind. Corp. Change	632	45.14
3	Perkmann et al.	Academic engagement and commercialisation: a review of the literature on university–industry relations	2013	Res. Policy	608	76.00
4	Etzkowitz	Research groups as "quasi-firms": the invention of the entrepreneurial university	2003	Res. Policy	606	33.67
5	Etzkowitz	The norms of entrepreneurial science: cognitive effects of the new university–industry linkages	1998	Res. Policy	532	23.13
6	Walter et al.	The impact of network capabilities and entrepreneurial orientation on university spin-off performance	2006	J. Bus. Ventur.	438	29.20
7	O'Shea et al.	Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities	2005	Res. Policy	416	26.00
8	Bercovitz and Feldman	Academic entrepreneurs: organizational change at the individual level	2008	Organ. Sci.	337	25.92
9	Gulbrandsen and Smeby	Industry funding and university professors' research performance	2005	Res. Policy	325	20.31
10	D'Este and Perkmann	Why do academics engage with industry? The entrepreneurial university and individual motivations	2011	J. Technol. Transf.	298	29.80

Source: Authors' own elaboration.

Table 2
On the left, the top 10 countries ordered by the total number of publications in the dataset (TP-BM); on the right, the top 10 countries ordered by the ratio of inter-country collaborations (MCP/TP-BM).

#	Country	TP-BM	SCPs	MCPs	#	Country	MCP_Ratio
1	US	108	71	37	**1**	Belgium	0.778
2	UK	59	27	32	**2**	Russia	0.636
3	Italy	44	28	16	**3**	Netherlands	0.600
4	Germany	38	20	18	**4**	Ireland	0.600
5	Spain	35	24	11	**5**	Denmark	0.571
6	Sweden	25	17	8	**6**	UK	0.542
7	Netherlands	15	6	9	**7**	Canada	0.500
8	Canada	12	6	6	**8**	Brazil	0.500
9	Norway	12	8	4	**9**	Switzerland	0.500
10	Russia	11	4	7	**10**	Germany	0.474

Source: Authors' own elaboration.

Table 3
The top 10 countries ordered by the total number of citations received (TC).

#	Country	TC
1	US	6977
2	UK	3592
3	Italy	1206
4	Germany	1017
5	Norway	834
6	Sweden	828
7	Spain	772
8	Belgium	604
9	Ireland	530
10	Canada	437

Source: Authors' own elaboration.

other indicators apart from the total citations for assessing their relevance to the scientific community. Therefore, in Table 4, three measures are provided concerning the local dataset and the top 20 most productive authors: the total citation number (TC-BM), the h-index (h-BM), and the m-index (m-BM). The most cited authors in the dataset are Etzkowitz (2332 citations) and Wright (1695 citations), followed by Grimaldi (1136 citations) and Perkmann (1063 citations). Interestingly, these 4 authors are the only ones to exceed the threshold of 1000 citations in the results. However, Wright has the best combination of productivity and impact (Hirsch, 2005), with 19 local publications (TP-BM) and an h-BM of 15, which means that he has published 15 articles that have received at least 15 citations. Guerrero and Urbano have performed admirably as well, with 14 publications each and a local h-index of 10. Interestingly, the 3 best-performing authors have addressed the entrepreneurial university topic under the primary lens of regional development and societal impact, analysing technology transfer, universities' spin-offs, and academic start-ups.

To avoid penalising younger scholars, the m-index was also calculated. The m-index is defined as the h-index weighted for the activity period of an author (Hirsch, 2007). Hence, apart from established scholars, such as Wright, Guerrero, and Urbano, amongst the others, Shirokova, Cunningham, and Knockaert, who started to publish in 2015–2016 and can be counted amongst the most influential authors on the topic, are worthy of mention.

To offer a more comprehensive overview of the authors, in Table 4, their country based on their current affiliation, total citations received (TC), and h-index (h) as retrievable from the WoS at the time of the

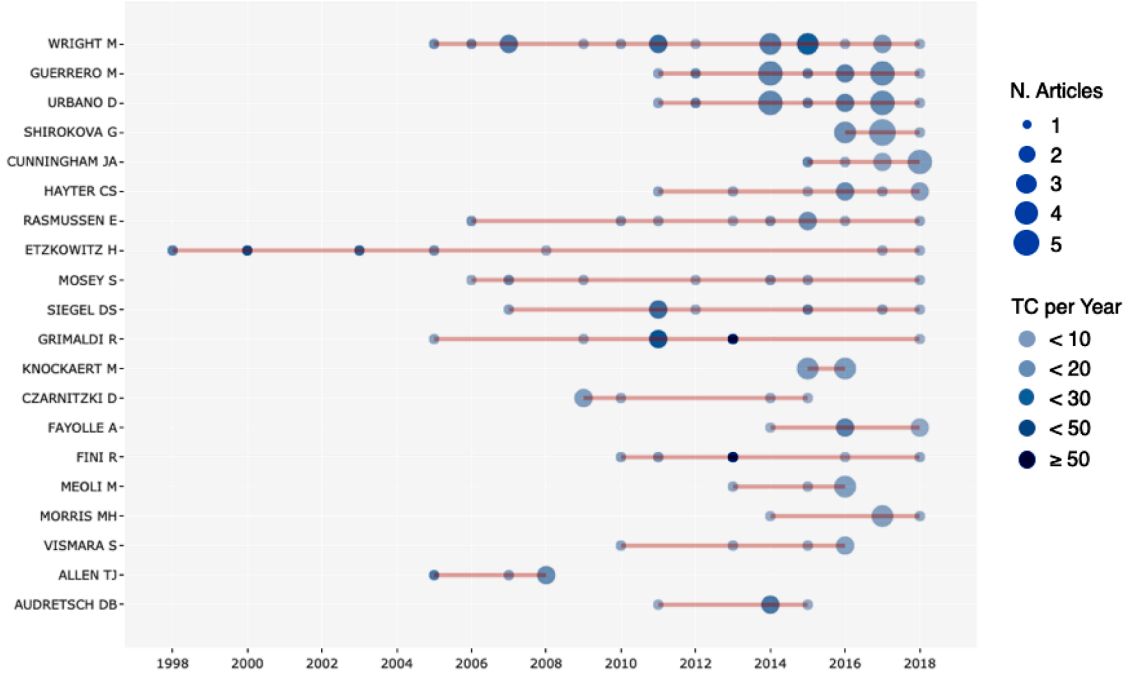

Fig. 3. Top authors' production over time. Note that the bigger the circle is, the more articles have been published by the author in that year. The darker the circle is, the more citations have been received per year.
Source: Biblioshiny, based on the WoS dataset.

Table 4
The 20 most relevant authors ordered by the local number of publications (TP-BM).

#	Author	Country	TC	h	TP-BM	TC-BM	h-BM	PY_start	m-BM
1	Wright, M.	UK	10,783	61	19	1695	15	2005	0.938
2	Guerrero, M.	UK	9700	45	14	675	10	2011	1
3	Urbano, D.	SPA	2598	28	14	675	10	2011	1
4	Shirokova, G.	RUS	238	9	9	119	5	2016	1
5	Cunningham, J.A.	IRL	8851	45	8	190	6	2015	1
6	Hayter, C.S.	US	366	10	8	228	7	2011	0.700
7	Rasmussen, E.	NOR	846	15	8	386	8	2010	0.727
8	Etzkowitz, H.	US	6460	23	7	2332	7	1998	0.304
9	Mosey, S.	UK	786	11	7	472	7	2006	0.467
10	Siegel, D.S.	US	13,456	53	7	567	6	2007	0.429
11	Grimaldi, R.	ITA	4978	36	6	1136	5	2005	0.313
12	Knockaert, M.	BEL	3422	24	6	103	5	2015	0.833
13	Czarnitzki, D.	BEL	2238	27	5	181	5	2009	0.417
14	Fayolle, A.	FRA	2581	26	5	121	4	2014	0.571
15	Fini, R.	ITA	1108	10	5	836	5	2010	0.455
16	Meoli, M.	ITA	505	14	5	89	5	2013	0.625
17	Morris, M.H.	US	2713	26	5	53	5	2014	0.714
18	Vismara, S.	ITA	1244	19	5	147	5	2010	0.455
19	Allen, T.J.	US	9952	56	4	759	4	2005	0.250
20	Audretsch, D.B.	US	16,203	63	4	224	4	2011	0.400

Source: Authors' own elaboration.

analysis are also shown.

4.1.4. Journals

Articles on entrepreneurial universities in the business and management fields have been published in a great variety of journals. Over the years, this topic has made steady advancements. To describe journals' impact, in Table 5, the 20 most relevant journals are presented.

In terms of productivity, the Journal of Technology Transfer and Research Policy resulted as the best ranked. Interestingly, the former also performed well in relative terms since around 15% of the total publications released by the same journal addressed the topic of entrepreneurial universities. Conversely, this does not happen for Research Policy. Hence, the topic appears to be more representative of journal publications in the International Entrepreneurship and Management Journal and the Journal of Enterprising Communities, in which it was addressed by around 7% of their total publications. However, including some seminal works published by Etzkowitz, the h-index of Research Policy's publications is almost double that of the second journal on the list, the Journal of Technology Transfer. These results are confirmed by the m-index, which also considers how many years have passed since each journal published its first publication present in the dataset.

Concerning the citations received by each journal from other authors in the collection (TC-BM), apart from Research Policy, which collects four times the citations of the second-best one (i.e., the Journal of Technology Transfer), the Journal of Business Venturing should be mentioned. This can probably be explained by the presence of some seminal articles regarding the topic amongst the journal's publications (e.g., Powers and McDougall, 2005; Shane, 2004; Vesper and Gartner, 1997; Walter et al., 2006). This can be confirmed further by Table 6, in which a synthesis of the number of citations that the articles in the dataset have received, per journal, is provided according to different thresholds. It is interesting to notice that Research Policy is the only journal in which some articles have received more than 500 citations. Furthermore, more than 250 citations have been received by articles published in the Journal of Technology Transfer, the Journal of Business Venturing, and Small Business Economics.

4.2. Science mapping

To complete the analysis of entrepreneurial university issues, in this section, the results of science mapping are provided, identifying the conceptual, intellectual, and social structures of the topic under

Table 5
The 20 most relevant journals ordered by the local number of publications (TP-BM).

#	Journal	TP[1]	TP-BM	% TP-BM	TC-BM	h-BM	PY_start	m-BM
1	J. Technol. Transf.	604	89	14.74%	2743	24	2007	1.714
2	Res. Policy	3146	59	1.88%	7903	42	1998	1.826
3	Small Bus. Econ.	1725	20	1.16%	856	15	2000	0.714
4	Technovation	1974	18	0.91%	1065	12	1994	0.444
5	Int. J. Technol. Manag.	2091	17	0.81%	68	4	2003	0.222
6	Sci. Publ. Policy	782	15	1.92%	76	5	2013	0.625
7	J. Bus. Venturing	1127	11	0.98%	1481	11	1987	0.324
8	R&D Manag.	1733	10	0.58%	617	10	1988	0.303
9	Technol. Forecast. Soc. Change	3969	10	0.25%	162	6	2006	0.400
10	Entrep. Reg. Dev.	570	9	1.58%	210	6	2006	0.400
11	Technol. Anal. Strateg. Manag.	1314	9	0.68%	165	7	2006	0.467
12	J. Manag. Dev.	312	8	2.56%	17	3	2014	0.429
13	Int. Entrep. Manag. J.	394	7	1.78%	31	3	2016	0.600
14	J. Int. Entrep.	95	7	7.37%	117	4	2010	0.364
15	Acad. Manag. Perspect.	527	6	1.14%	28	3	2016	0.600
16	Entrep. Theory Pract.	791	6	0.76%	81	6	2010	0.545
17	Int. J. Innov. Technol. Manag.	187	6	3.21%	426	5	2007	0.357
18	J. Enterp. Communities	90	6	6.67%	7	2	2015	0.333
19	Entrep. Res. J.	150	5	3.33%	19	3	2017	0.750
20	Ind. Corp. Change	865	5	0.58%	33	3	2014	0.429

[1] Total number of publications published by each journal at the time of the analysis that are retrievable in the WoS.Source: Authors' own elaboration.

Table 6
The 20 most relevant journals ordered by different citation thresholds.

#	Journal	TP-BM	≤ 50	≤ 100	≤ 250	≤ 500	> 500
1	Res. Policy	59	19	10	19	7	4
2	J. Technol. Transf.	89	74	9	5	1	–
3	J. Bus. Venturing	11	5	2	3	1	–
4	Small Bus. Econ.	20	17	1	1	1	–
5	Technovation	18	9	6	3	–	–
6	R&D Manag.	10	7	–	3	–	–
7	Entrep. Theory Pract.	6	4	1	1	–	–
8	Entrep. Reg. Dev.	9	7	2	–	–	–
9	Technol. Forecast. Soc. Change	10	9	1	–	–	–
10	Int. J. Technol. Manag.	17	17	–	–	–	–
11	Sci. Publ. Policy	15	15	–	–	–	–
12	Technol. Anal. Strateg. Manag.	9	9	–	–	–	–
13	J. Manag. Dev.	8	8	–	–	–	–
14	Int. Entrep. Manag. J.	7	7	–	–	–	–
15	J. Int. Entrep.	7	7	–	–	–	–
16	Acad. Manag. Perspect.	6	6	–	–	–	–
17	Int. J. Innov. Technol. Manag.	17	4	–	–	–	–
18	J. Enterp. Communities	6	6	–	–	–	–
19	Entrep. Res. J.	5	5	–	–	–	–
20	Ind. Corp. Change	5	5	–	–	–	–

Source: Authors' own elaboration.

investigation. Hence, it will be possible to answer the second research question of this study:

RQ2: What structures characterise the business and management literature about entrepreneurial universities?

4.2.1. *Conceptual structure*

This analysis allows researchers to emphasise the connections that occur amongst the same terms that appear in a specific collection, that is, co-occurrences (Boyack and Klavans, 2010). In this study, the co-occurrences were identified between the keywords plus that have been assigned by the WoS to each publication in the dataset. Thus, the 50 most developed keywords were connected to each other following the Louvain cluster algorithm (Blondel et al., 2008). The results are presented in Fig. 4.

The more co-occurrences were identified, the nearer to the centre the words appear on the network map. The more keywords were used at the same time by authors, the greater is their proximity, resulting in closer and more robust links. The more a keyword was used by scholars, the bigger is its bubble. Different colours define each cluster. In this case, three clusters can be distinguished:

i) knowledge management and innovation (red bubbles);
ii) performance management and economic growth (green bubbles);

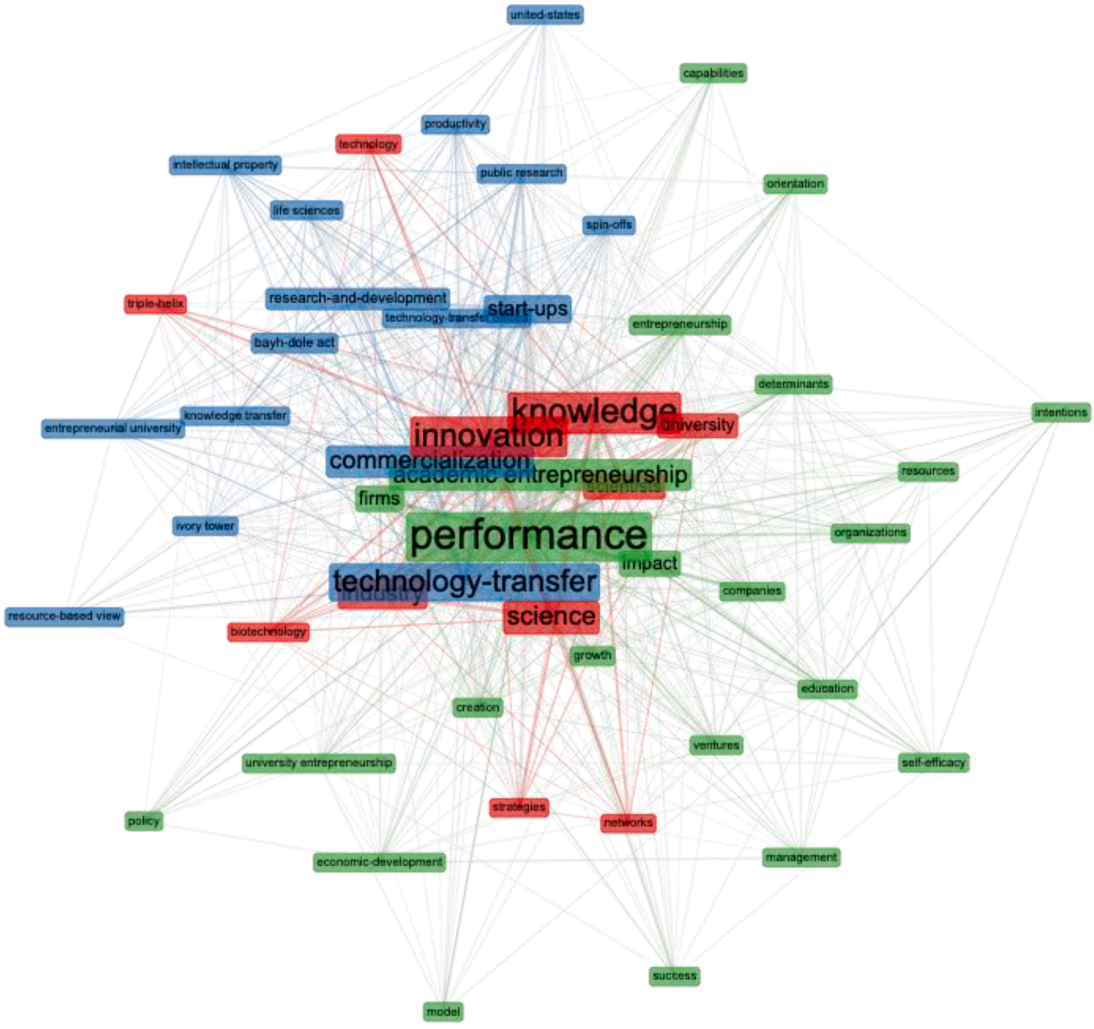

Fig. 4. The conceptual structure of the dataset.
Source: Biblioshiny, based on the WoS dataset.

iii) technology transfer and knowledge commercialisation (blue bubbles).

To provide more comprehensive information about the different sub-topics addressed by the authors over the years, a thematic evolution of the topic is also provided (Figs. 5–7). Notably, the co-occurrence of 250 keywords plus was considered and 2 cut-off points were identified in 2009 and 2015, according to significant variations in production trends, as explained in Paragraph 4.1.1 (also see Fig. 2).

Thematic maps are very intuitive and enable researchers to analyse the evolution of topics in the four different quadrants (Cobo et al., 2011), identified on the basis of their centrality (plotted on the X-axis) and density (plotted on the Y-axis). More precisely, the centrality measures the level of inter-cluster interactions, namely the extent to which a topic is connected to other topics and, in turn, significative in a specific domain. On the other hand, the density measures the level of intra-cluster cohesion, specifically the extent to which the keywords in a given cluster are connected and thus a theme is developed. In this sense, the upper-right quadrant contains themes with high centrality and density: themes that are both able to influence the research field and well developed. The lower-right quadrant shows themes that are transversal for a discipline, being able to influence other topics (i.e., they have high centrality) but being weakly internally established (i.e., they have low density). The lower-left quadrant highlights topics that are emerging or disappearing since they have low centrality and density. Finally, the upper-left quadrant includes niche themes amongst scholars, which are internally well developed (high density) but not able to influence other themes (low centrality). It can therefore be observed that the keywords from the first two clusters (i.e., knowledge management and innovation and performance) have remained seminal and transversal during the three periods identified. Indeed, they are characterised by high centrality but low density, meaning that they are able to influence other themes but are not fully developed and present gaps for future research. Conversely, technology transfer has attracted increasing attention, becoming a core theme in the second time slice of publications analysed but leaving technology transfer offices to very focused ones.

4.2.2. Social and intellectual structure

Through the co-occurrence technique, it is possible to determine not only the conceptual structure of a specific field but also its social and intellectual structure. Thus, by analysing groups of co-authors (Peters and van Raan, 1991), the connection degree amongst business and management scholars studying entrepreneurial universities was determined. Similar to Fig. 4, the more documents were authored by a scholar, the bigger is the node. The more documents were co-authored by scholars, the closer the bubbles appear and the thicker are the links connecting them. Interestingly, adopting the Louvain cluster algorithm again (Blondel et al., 2008), Fig. 8 shows that 10 clusters (each defined by a different colour) exist amongst the 50 most influential authors, while many them still act as isolated nodes. However, this does not mean that those authors did not collaborate at all. Indeed, as observed in Paragraph 3.1.2, only 77 out of 511 publications were single authored.

Moreover, considering authors' affiliations, it can be noted that there is a high level of engagement between authors from advanced economies, such as European countries (e.g., Italy, Spain, Germany, and Sweden), the UK, and the USA. This collaboration rate is represented by more robust lines in Fig. 9, while the darker the country is, the more productive it was. However, there is still a paucity of engagement from authors from developing or emerging countries. This suggests that investigating entrepreneurial universities in such contexts represents a topic that authors should consider for further research.

Finally, to reconstruct the intellectual structure of publications related to entrepreneurial universities, a historiograph was developed and is presented in Fig. 10 (Garfield, 2004). To achieve this, the number of times that articles have been cited together by other documents present in the dataset (i.e., co-citation analysis) was considered as a unit of analysis and the historical network map of the most relevant publications could be reconstructed. On this map, documents that are close to each other addressed similar topics. Thus, four thematic clusters could be identified as follows: (i) conceptualisations of the entrepreneurial university model (purple group), (ii) technology transfer and university–industry collaborations (blue group), (iii) academic entrepreneurship and research commercialisation (green group), and (iv) organisational changes and knowledge dynamics (yellow group). However, it must be noted that these clusters are not perfectly distinguishable and partially overlap with each other but support the thematic analysis conducted through keywords' co-occurrences. Moreover, no recent articles appear in the group of the most influential in the definition of the intellectual structure of this research field since the most recent one was published in 2013. However, a more comprehensive picture of the evolution of this research field will be provided in the next paragraph.

5. Content analysis

This section provides the results of a content analysis of the 10 most influential articles in each of the time slices identified in Paragraph 4.1.1 and Paragraph 4.2.1. The most influential articles were selected based

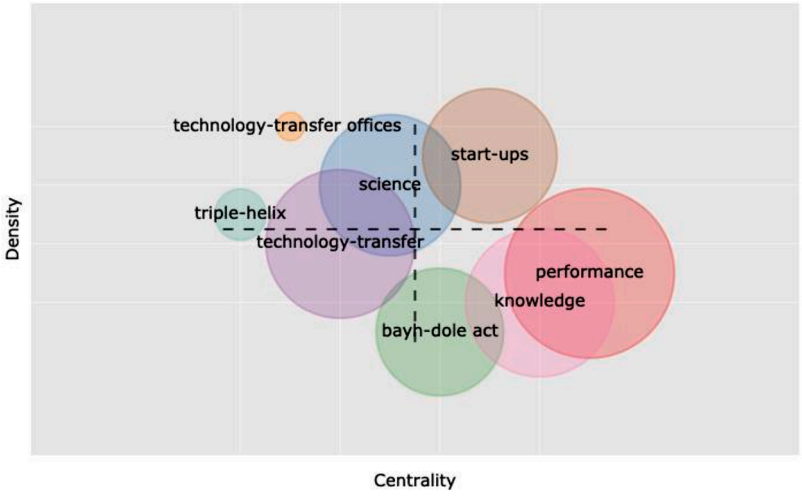

Fig. 5. Thematic evolution of the topic: first time slice (1983–2009).
Source: Biblioshiny, based on the WoS dataset.

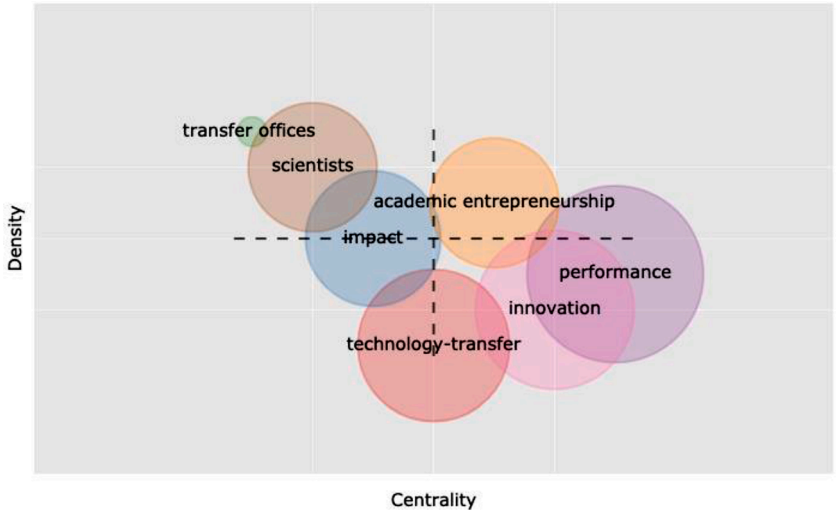

Fig. 6. Thematic evolution of the topic, second time slice (2010–2014).
Source: Biblioshiny, based on the WoS dataset.

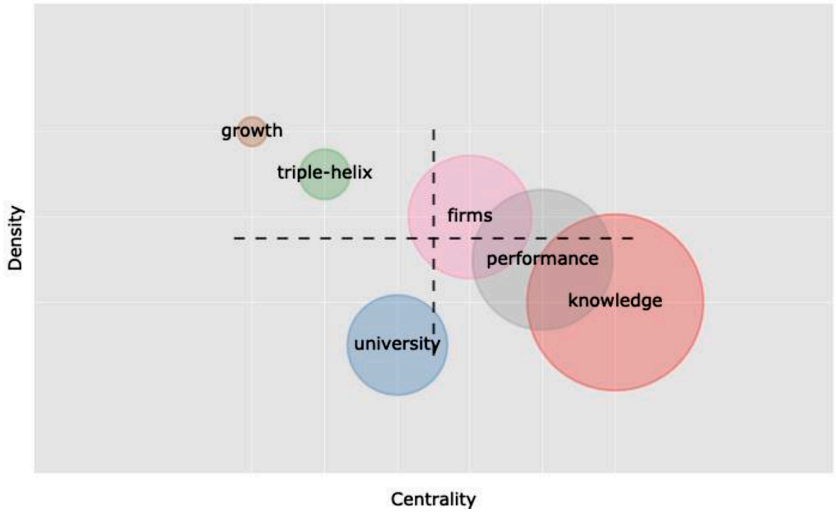

Fig. 7. Thematic evolution of the topic: third time slice (2015–2018).
Source: Biblioshiny, based on the WoS dataset.

on the total citations received at the moment of the study. Consistently with other bibliometric studies (e.g., Martínez-Climent et al., 2018), this analysis was performed to provide a more comprehensive picture of the different themes addressed by scholars over the years and to identify avenues for future studies. The results were divided into three sections that represent the different turning points of studies addressing entrepreneurial universities.

5.1. Time slice 1: 1983–2009

The articles in this first time slice were mainly devoted to conceptualising an entrepreneurial university as the logical step of universities reaching beyond their traditional mandate of teaching and researching (Rothaermel et al., 2007). Etzkowitz (1998) introduced the concept of the "second academic revolution" to capture the emerging phenomenon of universities involved in economic and societal development. Indeed, recognising the crucial role played by knowledge in modern societies, companies no longer see universities as providers of human capital more than knowledge. Thus, the interconnections between academics and practitioners become stricter, leading to the conceptualisation of the triple-helix model in which universities, industries, and government collaborate (Etzkowitz et al., 2000). Hence, with an isomorphic development path all over the world, universities incorporate industrial research goals and work practices into their business models, capitalising the outputs of this form of applied research and fostering technological innovation through reciprocal knowledge flows (Etzkowitz, 1998; Etzkowitz et al., 2000). In this scenario, innovation is interactive rather than linear and knowledge sharing increases according to companies' technological requirements (Etzkowitz, 2003c). Governments partially leave their regulatory role to act increasingly as public entrepreneurs and venture capitalists. These changes lead to improved results in terms of research performance (e.g., productivity or collaboration amongst scholars) (Gulbrandsen and Smeby, 2005) and higher network capabilities, and thus competitiveness, of academic spin-offs (Walter et al., 2006).

Hence, the propensity to invest in technology transfer activities has antecedents not only in the action of policy makers but also in the internal resources of each institution. Following this idea, the resource-based view (RBV) or the knowledge-based view (KBV) has been adopted by different authors to explain the success of diverse universities' initiatives (O'Shea et al., 2005; Powers and McDougall, 2005). Moreover, Bercovitz and Feldman (2008) found that the intention of scholars

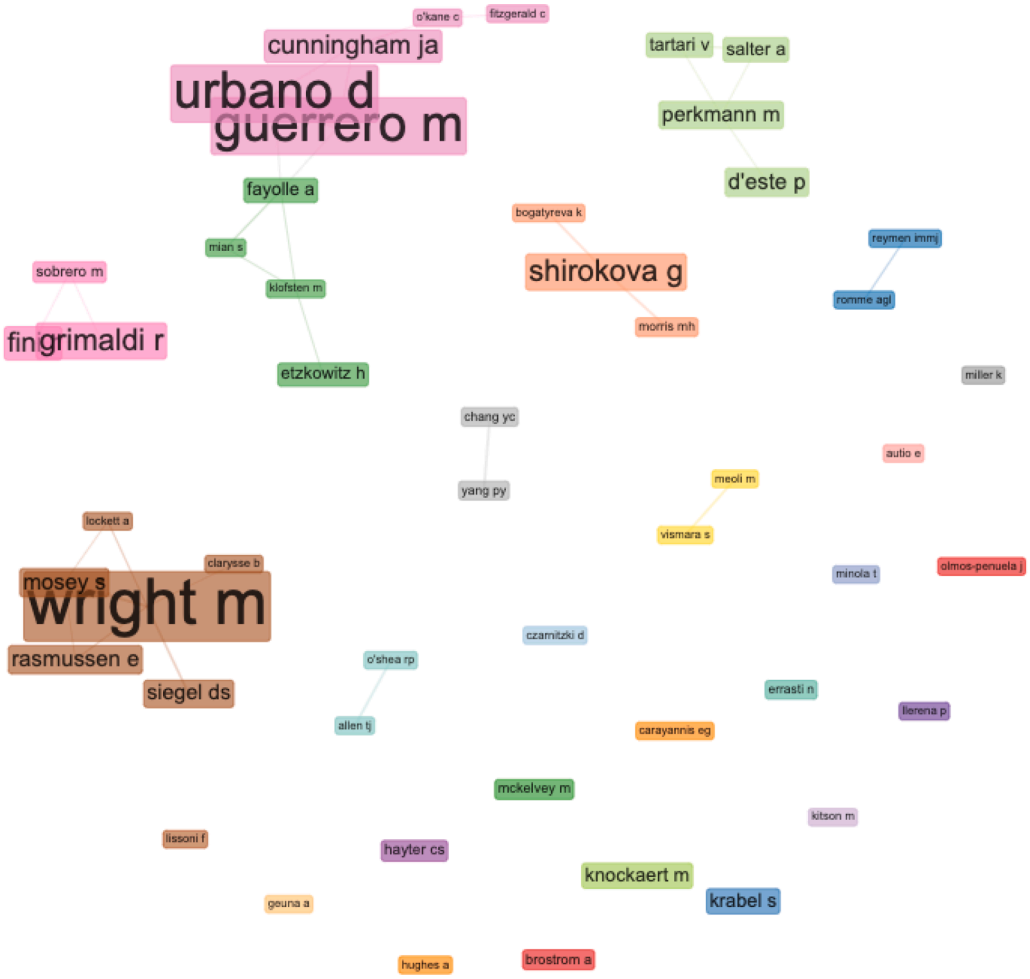

Fig. 8. The social structure of the dataset.
Source: Biblioshiny, based on the WoS dataset.

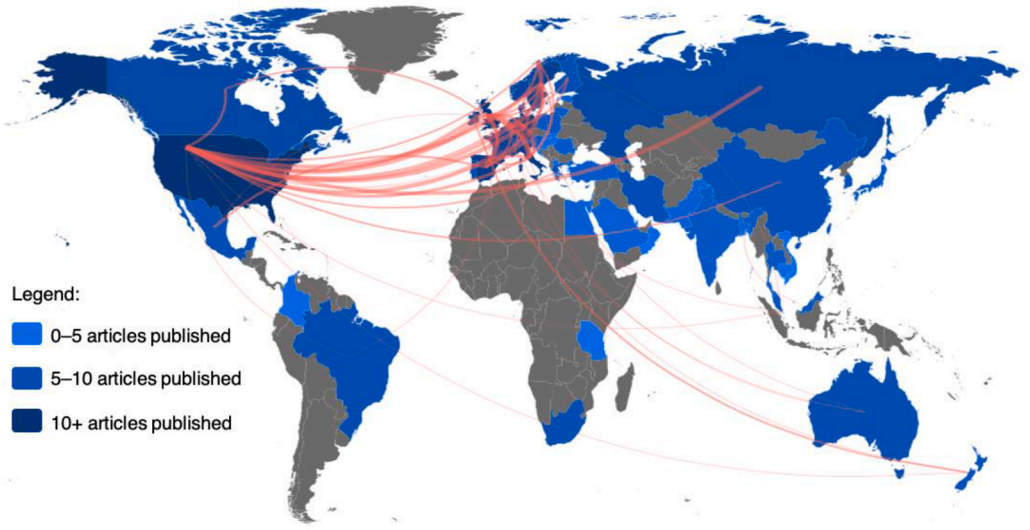

Fig. 9. The rate of collaboration between countries based on authors' affiliations.
Source: Biblioshiny, based on the WoS dataset.

to engage in technology transfer activities is linked with their localised social learning environment and with previous entrepreneurship training at the institution, even if only for symbolic reasons.

However, in recent years, most of the authors concentrated more on investigating technology transfer activities. In fact, they are easier to observe and quantify, especially regarding their economic returns. A

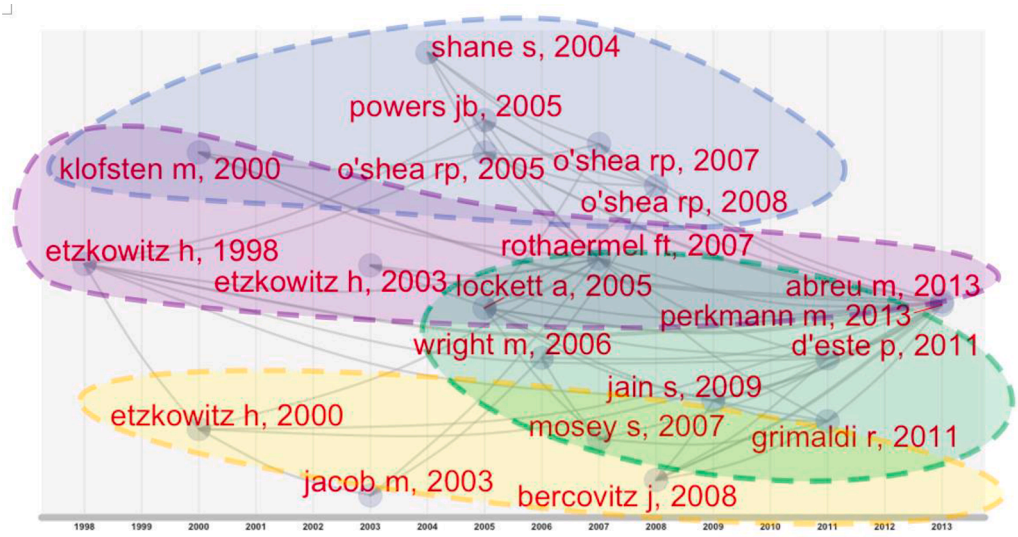

Fig. 10. The historic evolution of co-citations amongst the 20 most relevant articles.
Source: Biblioshiny, based on the WoS dataset.

rare example of the application of a broader perspective, besides the taxonomy of the literature performed by Rothaermel et al. (2007), is the study by Klofsten and Jones-Evans (2000). The authors distinguished between formal and informal academic entrepreneurial activities. The former study was connected to technological aspects (e.g., patenting, licensing, and spin-off venture creation), while the latter study was related to public engagement initiatives or sponsored activities (e.g., public lectures, sponsored research, and consulting). Starting from this point, they concluded that universities play an active role in converting scientific knowledge into technological innovation and generating economic returns. Hence, they helped European economies, which have traditionally struggled in this, to convert research into industrial and commercial successes.

5.2. Time slice 2: 2010–2014

With the increasing institutionalisation of the third mission in the business model of universities, several articles speculated on the different heterogeneous activities that an entrepreneurial university can conduct. According to Audretsch (2014), economies are no longer driven by physical capital or knowledge but by entrepreneurship. Hence, universities have a crucial role in providing entrepreneurial capital that can contribute to advancing the society. Therefore, the approach became more comprehensive than the one adopted in the articles in the previous group and mainly focused on technology transfer. However, several articles, using a critical lens, investigated the effects of the transition towards the entrepreneurial university and its relationship with basic research (D'Este and Perkmann, 2010; Van Looy et al., 2011).

Given the above, the most influential article in this group was published by Perkmann et al. (2013), who investigated the engagement of academics in entrepreneurial and knowledge commercialisation activities through a literature review. The authors concluded that investing in formal technology transfer activities (e.g., patenting and licensing) is less effective in academic engagement, which is not always beneficial as well. Indeed, it can result in detrimental results for the other traditional academic missions. As a consequence, academic engagement should be incentivised when it can lead to improvements in the research activity. D'Este and Perkmann (2010) reached a similar conclusion, stating that the primary intent of patenting and spin-off creation is commercial, while research motivations are linked to joint research, sponsored research, and consulting. Conversely, Van Looy et al. (2011) found a positive relationship between entrepreneurial effectiveness and scientific productivity.

Following 30 years of the Bayh–Dole Act in the US, authors also started paying attention to the European context, in which similar shifts were occurring (Grimaldi et al., 2011). They asserted that European policy makers should adopt a more harmonic push towards entrepreneurship, involving regional stakeholders and not adopting a one-size-fits-all model (Grimaldi et al., 2011). Indeed, not considering institutional and geographic factors could hinder advancements in this transition (Philpott et al., 2011).

Shifting to an individual perspective, on which there has been a call for more research (Bozeman et al., 2013), according to Guerrero and Urbano (2012), the uniqueness of each community can explain the above-mentioned difference. Consequently, the critical factor for successfully implementing an entrepreneurial shift is the attitude towards entrepreneurship of academics and students. Thus, factors such as entrepreneurship education, teaching methodologies, role models, and reward systems become critical. An analysis on the individual level was also conducted by Clarysse et al. (2011), who found a positive relationship between spin-offs' performance and academics' capacity to identify and exploit opportunities. Lam (2011) proposed a structured framework that links academics' value orientations with commercial engagement. In her study, the author leveraged the self-determination theory to speculate that scholars who are more interested in reputational or career rewards will use commercial activities to obtain resources to support their scientific interests, being extrinsically motivated. Differently, applied research will be used to achieve autonomy and economic returns by scholars who are intrinsically motivated towards commercial engagement. Thus, policy makers should leverage reputational returns and intrinsic motivations rather than economic ones.

5.3. Time slice 3: 2015–2019

In the last time slice, several articles recognised that academic entrepreneurship has changed dramatically. Entrepreneurial activities need to become an integral part of universities' strategy (Guerrero et al., 2016b; Rasmussen and Wright, 2015). For example, using technology transfer offices from the US, New Zealand, and Ireland as a unit of analysis, O'Kane et al. (2015) showed that the dichotomic existence of a commercial and a scientific sphere results in diminished legitimacy and competitiveness. Thus, strategies aimed at clearly defining an identity need to be incorporated as much in a technology transfer office as in a

university. Building a strong identity is critical for the acquisition of resources and the success of the organisation. This identity must be shaped according to different audiences and expectations (Fisher et al., 2016). Moreover, a strong entrepreneurial orientation of a university's department leads to a stronger orientation towards entrepreneurial activities of academics, with technology and knowledge transfer perceived as being less harmful (Kalar et al., 2015).

Furthermore, several stakeholders different from students and scholars are affected by entrepreneurial universities, which are critical drivers of the development of a given territory (Siegel and Wright, 2015). In this sense, entrepreneurial universities can be viewed as spillovers of knowledge and entrepreneurial capital that contribute to economic and social development (Guerrero et al., 2015). In this novel scenario, such universities should contribute to generating both knowledge and leadership for the development of entrepreneurial thinking, actions, and institutions (Guerrero et al., 2016a). According to Shirokova et al. (2016), entrepreneurship education is one of the critical factors that can nurture the entrepreneurial intentions of individuals, together with other personal and institutional factors. In the Taiwanese context, the presence of human capital was demonstrated to be a critical factor for the success of technology transfer activities (e.g., the creation of start-ups and patenting) and other "informal" entrepreneurial activities (e.g., collaborative or sponsored research, consulting, and entrepreneurship education) (Hsu et al., 2015). Moreover, a fundamental role is played by financial resources that can be used to enhance direct technology transfer activities (e.g., the university's intellectual property) or the network capabilities of the university and its members.

For these reasons, implementing policies that enhance innovative or entrepreneurship initiatives would result in benefits that can be spread widely over the region (Guerrero et al., 2016a). Moreover, homogeneous performance management systems should be implemented and legitimised, like some initiatives implemented in the US and the UK (Guerrero et al., 2016b). Indeed, such implementation would lead scholars to invest more time and effort in performing entrepreneurial activities.

6. Implications for research: avenues for future studies

Based on the results of the bibliometric and content analysis, in this paragraph, the implications for research will be provided. It was possible to answer the third research question of this study:

RQ3. What are the possible future trends for the research on entrepreneurial universities within the business and management research fields?

6.1. The need for systematisation works

It has been observed that 966 authors addressed the entrepreneurial university topic in the business and management fields within a time span of more than 30 years (with the first publication being released in 1983). Although the topic has boomed in recent years, spurred by different special issues and calls for papers, publications are still fragmented. This justifies the need for systematisation works such as the one proposed in this paper, and more of them should be encouraged in the future (Secundo et al., 2019; Siegel and Wright, 2015).

6.2. Scholars' engagement

According to the results of the social network analysis, only 10 clusters of co-authors could be identified amongst the most influential scholars, meaning that they mostly represent elective circles. However, single-authored publications (92 records) account for around 18% of the total records in the dataset. This implies that the topic presents low barriers to entry and a few specialised authors have addressed it (Massaro et al., 2016). Thus, these results should encourage more scholars to consider contributing to the present debate.

6.3. Journals and thematic specialisation

Regarding journals, great attention was paid to the topic of entrepreneurial universities by journals focused on technology-related issues. This explains why considerable attention has been devoted to the technology and knowledge transfer aspects, such as those linked to knowledge exploitation and its related activities (e.g., spin-off creation, patenting, research commercialisation, and new technology development). This means that authors have no significant communities to refer to and the debate has remained slightly focused on several themes related to the topic. Hence, journals can be encouraged to consider thematic specialisation on the topic, which can represent a proper source for acquiring high relevance since many of them ranked amongst the most influential ones with a relatively low number of publications.

Considering the clusters that emerged from the analysis of the conceptual structure and content analysis of the most influential papers in each time slice, the following examples can be considered:

- Cluster 1: performance management and economic growth. What relationships exist between governance models and performance dimensions? How can stakeholders be involved in model performance management systems and improve their performance? How can universities' outcomes be monitored to foster the generation of public value?
- Cluster 2: knowledge management and innovation. How is digital transformation shaping knowledge flows between universities and other relevant stakeholders? How can entrepreneurship education be leveraged through knowledge management practices? What are the theoretical foundations and empirical evidence that demonstrate the role of entrepreneurial universities as promoters of innovation?
- Cluster 3: technology transfer and knowledge commercialisation. This is the most investigated cluster, but different questions should be addressed further. For example, what are the motivations that foster academics to act like entrepreneurs? What are the organisational implications of universities dealing with entrepreneurial activities? How is digital transformation affecting knowledge transfer and technology transfer activities?

6.4. Geography

Not only most of the articles addressing entrepreneurial universities were published in technology-related or different non-focused journals, but they also received no such relevant average citations (AC_Y = 37.51). In line with Nomaler et al. (2013), this can be attributed to relatively low levels of international collaborations between scholars. In Table 2, it was demonstrated that the most productive countries are not always the most open in terms of inter-country collaboration between scholars. Moreover, according to the world collaboration map, it could be noted that there is still low engagement of scholars from developing and emerging countries. Therefore, collecting more empirical evidence from such countries would be highly relevant to advancing the knowledge about the development of entrepreneurial universities and their impact on local growth.

Moreover, entrepreneurial universities play a potentially important role in modern economies, acting as focal actors of entrepreneurial ecosystems (De Bernardi et al., 2020; Scuotto et al., 2019). An important issue that needs further study concerns whether and how this momentum is sustained as well as stakeholders' engagement in promoting economic advancements (Klofsten and Jones-Evans, 2000; Trencher et al., 2014). Furthermore, universities' impact on societies and local growth should be taken into consideration since it has been shown to be an emerging topic with great potentialities (Rinaldi et al., 2018; Trencher et al., 2017).

7. Conclusion, limitations, and further developments

In conclusion, this study has offered an overview of the business and management literature addressing entrepreneurial universities. Several bibliometric analysis techniques were adopted to evaluate the scientific production's performances and map its related conceptual, social, and intellectual structures. Performance analysis was conducted using different bibliometric indicators to capture the productivity ratio (e.g., total publication) and relevance (e.g., total citations, citations per year, h-index, and m-index) of authors, journals, and countries. Answering RQ1, it was shown that the topic has attracted increasing attention from scholars but remains fragmented. Moreover, some scholars are very influential in the topic, even with a low number of published papers. In this sense, future studies and systematisation works should be encouraged. Moreover, except for technology-related journals, journals do not excel in terms of productivity, so thematic specialisation could be a strategic choice. Science mapping complemented the results of the performance analysis through the co-occurrence of keywords, co-authorship analysis, thematic mapping, and historical co-citation analysis of relevant documents within the field under investigation. These analyses were conducted using Bibliometrix, an RStudio package (Aria and Cuccurullo, 2017), and enabled the conceptual, social, and intellectual structures of the research field to be presented, answering RQ2. With particular regard to the conceptual structure, through the analysis of keywords' co-occurrences, three different thematic clusters were identified as follows: (i) knowledge management and innovation; (ii) performance management and economic growth; and (iii) technology transfer and knowledge commercialisation. Finally, the bibliometric analysis was complemented with a content analysis of the most influential articles and avenues for future research were traced in response to RQ3.

The present study can help both scholars and practitioners who are approaching this topic and want to have a comprehensive overview of the scientific literature produced so far. Moreover, scholars can leverage the results of this study to address future studies better, considering the proposed avenues for future research. At the same time, policy makers and practitioners could find a useful baseline to foster the development of an entrepreneurial university and consider its technological, managerial, and organisational implications.

However, this study is not free from limitations. First, the dataset was collected through the WoS to obtain higher-quality results. However, this limited the number of analysable publications. In addition, some exclusion criteria were imposed to improve the performance analysis (i.e., publication year, document type, language, and research fields). Second, as stated in the Methodology section, some indicators can lead to inconsistencies when used to compare different publications or authors. Hence, each indicator should be read together with the other ones, for example in the case of the h-index. Finally, to provide better comparability and align with the research questions of this study, only the business and management fields were chosen as a unit of analysis. Each of those limitations thereby provides opportunities for future work for academics and practitioners who are interested in the advancement of such encouraging future research streams.

Authors statement

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