



ORIGINAL ARTICLE

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Development of research on the university entrepreneurship ecosystem: trends and areas of interest of researchers based on a systematic review of literature

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Keywords: *academic entrepreneurship; university (academic) entrepreneurship ecosystem; systematic literature review*

Abstract

Research background: The concept of the university entrepreneurship ecosystem is nowadays a part of the current trends in researching the determinants of support for commercialization of research results. The subject is relatively new, because the first papers in this topic are dated to 2009, and in fact it has only been in the last 3 years that the interest of researchers in this subject has increased.

Purpose of the article: The purpose of this study is to analyze the state of research on the issue of the university ecosystem of academic entrepreneurship and to identify the main research trends related to this topic.

Methods: The article was based on a systematic review of the literature (SLR), which included the selection of basic literature and selection of publications, mayor researchers, bibliometric analysis and content analysis.

Findings & Value added: The results of the conducted research indicate that the study of the university ecosystem of academic entrepreneurship is still a new issue, poorly recognized in literature, without a solid methodological foundation and which may constitute a current and

interesting research area. Our paper adds to existing research in four important ways. We provide a holistic review of university entrepreneurial ecosystem. We also identify the challenges identified in this area and suggest how they may be developed. Third, our results are also policy-relevant. For policy-makers, it is important to know whether academic engagement is driven by mechanisms existing in academic ecosystem or affected by factors that may not be activated by it.

Introduction

Universities and their immediate surroundings are places that play a key role for contemporary societies in the field of education and generating the latest knowledge (Perkmann *et al.*, 2013, p. 423). Over the past decade, researchers have started to see the university and its surroundings as a special ecosystem supporting entrepreneurs in developing their business ideas (Isenberg, 2011; Hechavaria & Ingram, 2014; Sherwood, 2018). It is about creating a specific ecosystem of the university, which creates favourable conditions for cooperation between many entities, i.e. University, business incubators, technology transfer centres, financial support institutions, etc. involved in supporting academic entrepreneurship. An ecosystem-based on high-quality relationships between entities can affect the loyalty of partners involved in cooperation, their behaviour, willingness to get involved and help, thus being an important factor conducive to achieving a better result of cooperation from the point of view of academic entrepreneurship (Kobylińska, 2019, pp. 17–33). Academic entrepreneurial ecosystems affect the nature and quality of entrepreneurial activity, shape the direction and potential benefits associated with the identification, creation and implementation of opportunities. Entrepreneurial ecosystems contain multi-level processes and stakeholders, as well as many contexts (Isenberg, 2010).

Considering the above, the paper intended to systematize the literature, aiming to clarify which streams of the literature are more important for the most recent approach to university entrepreneurial ecosystem. With this in mind, the aim is to identify the main studies dealing with the complex topics, but related to academic entrepreneurial ecosystem. For the purposes of this study, the following research questions were formulated:

Q1: How widely is the concept of academic entrepreneurial ecosystem understood nowadays?

Q2: Which streams of the literature are most important in presenting an overall definition of university entrepreneurship ecosystem?

Q3: *What research methods are used to study the academic entrepreneurship ecosystem?*

When analyzing the literature on the subject, it was noticed that there was no systematic review of the literature on academic ecosystems that identifies clear concepts in this topic. Most of the available publications does not integrate a number of factors affecting university entrepreneurship ecosystem in an integrated way, given the emerging conceptualization of ecosystems (especially for selected universities), which provides an incomplete picture of this phenomenon. We fill these gaps by providing a systematic review of the literature on the academic entrepreneurial ecosystem (in particular from the perspective of mainstream research in this field and the methods used to study this concept).

The article was prepared as follows. Part 1 is an introduction. Part 2 reviews the literature on the academic entrepreneurship ecosystem. Part 3 discusses the methodological approach used in this study and part 4 presents the results of the study. The final parts of the article discuss the results, contain conclusions and implications for future research.

Literature review

The entrepreneurial ecosystem is an ambiguous term to define, but the fact is that this concept has been becoming more and more explored by scientists for several years (Stam & Spigel, 2016; Oh *et al.*, 2016, pp. 1–6) and involves many interactions between organizations (Jacobides *et al.*, 2018; Leitão *et al.*, 2018). Such ecosystems are attractive because they can bring about co-evolution and value creation (Dodgson *et al.*, 2014). In practice, we can see various unique entrepreneurial ecosystems such as Silicon Valley or MIT. The ecosystem consisting of many entities related to education, research and social networks contributes to growing entrepreneurial activity (Roberts & Eesley, 2009, p. 7).

Mason and Brown (2014, p. 5) define the entrepreneurship ecosystem as a “set of interconnected entrepreneurial actors, entrepreneurial organizations, institutions and processes which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment”. An ecosystem is a result of various mechanisms and actors, in different contexts and evolves over time. Most recently, Jones *et al.*, (2018) outlined the role played by entrepreneurial ecosystems, especially in emerging contexts that influence entrepreneurial behavior, based on the contextual factors made apparent by knowledge spillovers. Spigel (2017) distinguishes three categories of attributes of entrepreneurial ecosystem that

provide resources and benefits to entrepreneurs: cultural, social and material. Cultural attributes include specific regional entrepreneurial attitude or culture (Bosma *et al.*, 2009) and histories of entrepreneurship. Social attributes encompass networks, capital investment, mentors and dealmakers, and worker talent. Material attributes include universities, support services and physical facilities, policy and governance and the availability of local markets.

In recent years, researchers have recognized that the university plays an important role in building and maintaining the entrepreneurial ecosystem (Hechevarria & Ingram, 2014). Fetter *et al.* (2010) introduced the term University-Based Entrepreneurship Ecosystem, or UBEE (Sherwood, 2018, p. 245).

In the literature of reference, the approach to university entrepreneurship ecosystem is still recent, but has gained popularity in recent years above all due to *Academic entrepreneurship: creating an entrepreneurial ecosystem* by (Siegel *et al.*, 2014) and *How to Start an Entrepreneurial Revolution* by Isenberg (2010) published in the Harvard Business Review. Hayter (2016), in the context of academic entrepreneurship, believes that the effectiveness of academic entrepreneurship ecosystems depends on a series of interactions and interrelationships occurring within this environment, as well as their ability to provide information and resources essential for the success of a company (Powell *et al.*, 2009; Whittington *et al.*, 2009). A well-shaped ecosystem can help change the way of thinking about commercialization of technology and strengthen academic culture, as well as contribute to the increase in the competitiveness of academic spin-off companies on global markets (Hallam *et al.*, 2017, p. 78).

Research methodology

The research method used to assess publications in the area of university entrepreneurship ecosystem was a systematic literature review (SLR) using bibliometric analysis techniques.

A systematic review needs to define clear questions, criteria and conclusions that provide new information based on the content examined. The scope of literature research was as follows: (1) formulation of the research objectives, (2) the subject, area and keywords of the study were selected; (3) an analysis of changes in the number of publications in subsequent years and an analysis of citation from the analyzed subject in the *Scopus* and *ISI Web of Science* databases; (4) key publications in the databases were identified and the journal IF was assessed; (5) major researchers and

their countries of origin have been identified; (6) the content of the publication was analyzed in terms of detailed research areas/research methods.

Step 1

At the first stage, a research plan was drawn up including the research goals and a set of criteria for including and excluding publications. As the aim of this study is to identify main streams of literature found to be most important for presenting a new concept of university (academic) entrepreneurial ecosystems, the protocol considers the three research questions formulated and presented in the introduction.

In choosing the databases to use for gathering documents, the main two indexed base with greatest acceptance in the area of Management, Business and Economics was considered. The choice of *ISI Web of Science and Scopus* were justified on two counts, firstly, because they are a multidisciplinary database, and secondly, because they include all the journals indexed, with the greatest number of citations in the respective fields of scientific specialization. Moreover, those database provide an index of citations, giving information about each publication in terms of documents cited and documents citing it.

Step 2

This step included searching for definitions of research conditions as well as selected keywords, and then implementing strategies for identifying and locating related scientific articles that are part of the predefined forms in selected databases.

Data for the study were collected from the *ISI Web of Science* and *Scopus* databases in the fourth quarter of 2019. In the initial phase of research, searches were carried out for scientific publications which contained in their title, abstract or keywords the phrase "entrepreneurship ecosystem" and then "university entrepreneurship ecosystem". The review included publications from 2009–2019 and was limited to the field of economic sciences. The total number of documents found for the entry "entrepreneurship ecosystem" in the ISI Web of Science database was 927 and for Scopus 997. After narrowing the search to "university entrepreneurship ecosystem", the number of publications for business, management and economics decreased to 168 in the WoS database and 224 in Scopus.

It was decided to use the following key terms organised by: subject [(“university entrepreneurship ecosystem”) OR (“entrepreneurial ecosystem in University”) OR (“academic entrepreneurship ecosystem”) refined

by: languages: (English); areas of research: Business OR Management OR Economics); types of document: (Articles), and period: 2009–2019.

Step 3

In principle, since 2009 initially there is little interest of researchers in the problems of the university entrepreneurship ecosystem. Chart 1 presents information on the number of publications for economic sciences (area: business, economics, management) in the Scopus and ISI WoS databases. As can be seen in the chart after a period of stagnation in the years 2009–2015, the number of publications has been steadily increasing, and in the last two years (2019–2020) there have been relatively the largest number of them.

In fact, before 2009, there were no publications from the analyzed topic identified in the ISI WoS database. There is increased interest of researchers in university entrepreneurship ecosystem, after 2016. Information on the number of publications from the analyzed topic is presented in Figure 1. As can be seen in the graph, after a period of stagnation in the years 2009–2015, the number of publications was systematically growing, and in the last years (2016–2019) their number was relatively the highest (over the past 4 years 70% of all publications on the studied issues have been created).

Step 4 and 5

In a further stage of the research, a bibliometric analysis was limited to the analysis of quotability, taking into account publications issued in the years 2009–2019 and limiting them only to scientific articles. The largest number of articles on the subject studied in the Scopus database was published in the journals: *Journal of Technology Transfer* (IF–4.037) (20), *Small Business Economics* (IF–3.555) (10), *Proceedings of the European Conference on Entrepreneurship and Innovation* (6), *Entrepreneurship and Regional Development* (IF–2.928) (5), *Journal of Enterprising Communities: People and Places in Global Economy* (5), *Science, Technology and Society* (IF–0.927) (5). The most frequently quoted authors are: Miller K. (87), Guerrero M. (77), Urbano D. (77). Nine publications of these authors from 2016 were cited 164 times in total. The most cited articles come from researchers from countries such as the United States (58), the United Kingdom (19 publications), Spain (14), Italy (13), Germany (11). US scholars published over 50% of articles in the subject.

Step 6

In a further stage of the research, a bibliometric analysis was made to analyze the content of the most cited articles, dealing with the issue of UEE. After reviewing the abstracts or the full version of the articles, those that did not directly address issues related to the university entrepreneurial ecosystem were eliminated. Attention was paid to such aspects as: the area of research/analysis, the type of the subject of the analysis, applied research methods. Table 1 gathers the most cited publications on the subject (at least 25 citations in one of the databases).

The most cited publication in the database is an article by Spigel entitled *The Relational Organization of Entrepreneurial Ecosystems*, published in *Journal Entrepreneurship: Theory and Practice* (Vol. 41, Issue 1, January 2017, pp. 49–72). The article examines the attributes constituting entrepreneurial ecosystems, the relationships between them, and how they influence the competitiveness of new ventures and became an inspiration to start research on UEE for many authors. The remaining articles collected definitely fewer citations. As mentioned earlier, the majority of articles from the studied issues were created in 2016–2019, therefore the number of citations of publications, especially from the last period, may still be small.

The review of the content most cited articles shows that they focus on:

- the attributes that shape the university's business ecosystem,
- the characteristics of this ecosystem, its relationships,
- key ecosystem factors affecting the entrepreneurial intentions of the academic environment,
- the characteristics of the entrepreneurial university and its supporting networks,
- the impact of the university ecosystem for spinoff development or technology transfer.

The first theoretical models pointing to components of the university-based entrepreneurship ecosystem are being created. The variety of issues in the subject of the ecosystem is very wide and ambiguous.

Research methods used to explore the subject indicate the early stage of research development in this area. The research methods are dominated by case study and systematic literature review. The case studies were often carried out using interviews and document analysis. University ecosystem analysis was usually studied in single or comparative case studies. Quantitative methods have been used much less frequently. In this connection, we can see that the qualitative approach prevails when examining university ecosystem practices. This means, among others that the context of ecosys-

tem is examined and factors in this context have been the subject of special attention.

In the last stage of the systematic literature review, the contents of all articles identified in the ISI WoS and Scopus databases were analyzed, which in the abstract, title, keywords have the subject of the university ecosystem of academic entrepreneurship. After analyzing the content of the articles or their abstracts, it was noted that only some of the articles directly concern university entrepreneurship ecosystems subject. A total of 157 articles were analyzed.

After their in-depth analysis, it can be concluded that the existing UEE research creates certain research currents regarding:

- a synthesis of the literature on UEE,
- expanding knowledge on the dynamics of academic entrepreneurship from the perspective of the ecosystem and the relationship between its elements,
- the role of the entrepreneurial ecosystem in creating start-ups and their internationalization,
- conceptualizing the model of the academic ecosystem,
- management in the university ecosystem.

Discussion

As the analysis in this article has shown, research on the academic entrepreneurship ecosystem is clearly expanding, but is still a fragmentary field. At the moment, there is no literature review that would focus comprehensively on the academic entrepreneurship ecosystem and provide a general framework for its conceptualization.

The discussion that takes place in the literature in relation to academic ecosystems focuses mainly on the basic components, while largely ignoring the processes for their connection in a sustainable environment with entrepreneurial vitality (which is highlighted by Malecki, 2017) or eschewing strategic and systemic conceptualizations of entrepreneurship ecosystems (Hayter *et al.*, 2018).

The review of the literature contained in this article is intended to signal the need to deepen empirical research on the main actors and elements shaping the ecosystem of academic entrepreneurship and the relationships between them, aimed at long-term cooperation and, as a result, greater effectiveness in commercializing knowledge. Our review of the most cited articles found that most of the existing research focuses on the results of individual ecosystems or universities, which may not always translate into

a broader context, e.g. inference at the macro level, let alone these combinations in terms of complex interactions.

As noted in review of the literature of Hayter *et al.* (2018), researchers have already thoroughly examined the resources of academic entrepreneurship within individual universities and the regions in which they are located, compared the programs of entrepreneurship support among scientists, however these studies are mainly descriptive and do not study interaction between ecosystem features. The desired research in this topic can combine two approaches — mapping and interaction within the ecosystem — to examine how an academic entrepreneur thinks and uses services supporting knowledge commercialization and additionally, how different ecosystem features (e.g. relationships in occurring) are evolving towards a particular result.

The variety of perspectives shown in the literature review in the study of the academic enterprise ecosystem can also help researchers to contribute to the emerging research trend. Their research conclusions can provide useful tips for decision makers and contribute to better ecosystem effects.

Our research concentrated only on studies indexed in the ISI WoS or Scopus, which could be understood as a limitation of the study. Future studies can benefit from exploring other techniques for retrieving and sampling articles such as complete scanning of academic publications in a selected set of journals. The article also does not assess the perspective of effectiveness and efficiency of university models of entrepreneurial ecosystems for the development of entrepreneurial initiatives at universities. Further research could broaden the current research perspective and fill these gaps.

Conclusions

The review of the content of most cited articles shows that they focus on the attributes that shape the university's entrepreneurship ecosystem, the characteristics of this ecosystem, its relationships, key ecosystem factors affecting the entrepreneurial intentions of the academic environment, the characteristics of the entrepreneurial university and its supporting networks, the impact of the university ecosystem for spinoff development or technology transfer. As can be seen in the literature, one research trend cannot be found in the analyzed topic. The first theoretical models pointing to components of the university-based entrepreneurship ecosystem are being created. The variety of issues in the subject of the ecosystem is very wide and ambiguous. Research methods used to explore the subject indicate the early

stage of research development in this area. The research methods are dominated by: case study and systematic literature review.

With a view to clarifying the concept of UEE, this study identified the streams of the literature revealed to be most important for the approach to UEE through gathering the main studies on the subject. To answer the research questions raised and examine the current state of this field of research, an SLR was carried out based on a random, convenience and non-probabilistic sample of 157 academic articles, obtained through a rigorous data-collection process. The literature was systematized according to the protocol established, formed of five stages.

The purpose of the systematic review of the literature was to identify trends and the growing role of researching the academic entrepreneurship ecosystem in world literature. So far, no latest articles have been found in the database that would review the achievements of other researchers in the field of researching the university entrepreneurship ecosystem.

Concerning the first research question, from this SLR it is argued that the conceptualization of UEE can be carried out in the following terms: UEE are a set of independent networks and factors, associated with a University and coordinated in such a way to allow extend spin-offs and startups in the region.

Regarding the second research question, the SLR gives grounding to the thesis that the main streams of the literature identified are: networks in university ecosystem, configurations of UEE, spin-offs and startups in ecosystem, University–industry cooperation; relationship in UEE.

Regarding third question, from SLR perspective it is argued that empirical research of the issues is at the initial stage of development, as evidenced by the research methods used: case studies or a review of the literature. A small number of quantitative studies are noted. In addition, research often has a local context, concerns selected universities and a small research sample.

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Annex

Table 1. Areas of research/research methods used in the most cited articles from the Scopus / ISI WoS database with the title, keyword, summary “university entrepreneurial ecosystem”

Author/Authors	The title of the publication/ journal	The number of citations in the Scopus database	The number of citations in the WoS database	Main areas of research
Spigel, B.	The Relational Organization of Entrepreneurial Ecosystems, <i>Entrepreneurship: Theory and Practice</i> , 2017, Vol. 41, Issue 1, pp. 49-72.	234	194	Aim: The article examines the attributes constituting entrepreneurial ecosystems, the relationships between them, and how they influence the competitiveness of new ventures. Method: case studies of entrepreneurial ecosystems in Waterloo, Ontario and Calgary, Alberta. Findings: The article argues that successful ecosystems are not defined by high rates of entrepreneurship but rather how the interaction between these attributes creates a supportive regional environment that increases the competitiveness of new ventures.
Samila S., Sorenson O.	Venture capital as a catalyst to commercialization, <i>Research Policy</i> , 2010, Vol. 39, Issue 10, pp. 1348-1360.	81	66	Aim: analysis of the relationship between the public funding of academic research and venture capital in fostering innovation and the creation of new firms. Method: panel data on metropolitan areas in the United States, from 1993 to 2002. Findings: Consistent with perspectives that emphasize the importance of an innovation ecosystem, authors findings point to a strong interaction between private financial intermediation and public research funding in promoting entrepreneurship and innovation.

Table 1. Continued

Author/Authors	The title of the publication/ journal	The number of citations in the Scopus database	The number of citations in the WoS database	Main areas of research
Guerrero M., Urbano D., Fayolle A.	Entrepreneurial universities: emerging models in the new social and economic landscape, <i>Small Business Economics</i> , 2016, Vol. 47, Issue: 3, pp. 551-563.	56	49	<p>Aim: to analyze the role of entrepreneurial universities as major drivers of entrepreneurial innovation and activities</p> <p>Method: an overview by outlining an overarching framework. This allows the authors to highlight the contributions made in special issue within the framework.</p> <p>Findings: authors concluded by outlining an agenda for future research and discuss implications for university managers, policymakers, and other academic agents involved in the development of entrepreneurial/innovation ecosystems.</p>
Boh, W.F., De-Haan, U., Strom, R.	University technology transfer through entrepreneurship: faculty and students in spinoffs, <i>Journal of Technology Transfer</i> , 2016, Vol. 41, Issue 4, pp. 661-669.	52	43	<p>Aim: understanding of the technology commercialization process in university spinoffs, focusing in particular on student involvement in the early phases of the spinoff development process and on the impact of the larger university ecosystem.</p> <p>Method: detailed case studies</p> <p>Findings: larger university ecosystem, beyond the university technology transfer office and the university's commercialization policies, are also considered, including an examination of programs and practices that may influence this process. the authors discuss of guidelines for technology transfer and spinoff development at universities, based on the findings of research.</p>
Hayter C.	A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem, <i>Small Business Economics</i> , Vol. 47, Issue: 3, pp. 633-656.	51	38	<p>Aim: examining the composition, contributions, and evolution of social networks among faculty and graduate student entrepreneurs and the role of knowledge intermediaries therein.</p> <p>Method: detailed case studies</p> <p>Findings: the results show that the contributions of universities depend on the existence and interrelationship of loosely coordinated, heterogeneous knowledge intermediaries guided by a strong collective ethos to encourage and support academic entrepreneurship.</p>

Table 1. Continued

Author/Authors	The title of the publication/ journal	The number of citations in the Scopus database	The number of citations in the WoS database	Main areas of research
Miller K., McAdams R., McAdams M.	A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. <i>R & D Management</i> , 2018, Vol. 48, Issue: 1, pp. 7-24.	35	21	Aim: the paper reviews Mode 2 University Technology Transfer (UTT) from a quadruple helix perspective to identify key themes to develop a research agenda which reflects progression from a triple into a quadruple helix ecosystem. Method: SLR review Finding: research exploring the challenges of quadruple helix models is still in its infancy with existing research predominantly at the macro level reflecting a need for more longitudinal and case-based research at micro levels to fully understand its complexity.
Wright, M., Siegel, D. S., Mustar, P.	An emerging ecosystem for student start-ups, <i>Journal of Technology Transfer</i> , Vol. 42, Issue: 4, pp. 909-922.	45	28	Aim: to develop a framework to understand the ecosystem required to enable our students to launch successful startups. Method: theoretical analysis Finding: authors developed the ecosystem framework. The elements of this framework include university mechanisms to facilitate student entrepreneurship, along with a continuum of involvement from pre-accelerators through to accelerators; the involvement of a variety of entrepreneurs, support actors and investors; the particular nature of the university environment and the external context; and their evolution over time.
Hayter C.S., Nelson A.J., Zayed S., O'Connor A.C.	Conceptualizing academic entrepreneurship ecosystems: a review, analysis and extension of the literature, <i>Journal of Technology Transfer</i> , Vol. 43, Issue 4, 2018, pp. 1039-1082	25	12	Aim: review the extant literature to understand how academic entrepreneurship is conceptualized and the extent to which it adopts an ecosystem approach. Method: inductively reviewing the extant literature since the year 2000 to understand to what extent it illuminates academic entrepreneurship ecosystem elements and their interconnectivity. Findings: the authors find that scholars have largely focused on individual ecosystem elements and characteristics, eschewing strategic and systemic conceptualizations of entrepreneurship ecosystems. As a result, the authors

Table 1. Continued

Author/Authors	The title of the publication/ journal	The number of citations in the Scopus database	The number of citations in the WoS database	Main areas of research
Berger E., S.C., Kuckertz A.,	Female entrepreneurship in startup ecosystems worldwide, <i>Journal of Business Research</i> , Vol. 69, Issue: 11, pp. 5163-5168	29	18	<p>argue that the ecosystem perspective has not been fully leveraged to influence policy decisions.</p> <p>Aim: paper seeks to link the two research streams of female entrepreneurship and the characteristics of start-up ecosystems theoretically supporting each stream.</p> <p>Method: study uses qualitative comparative analysis to explore the combinations of ecosystem characteristics explaining a high proportion of female founders in the 20 most successful start-up ecosystems worldwide.</p> <p>Findings: The results suggest two different configurations explaining a high proportion of female founders and reveal which issues require attention on a metropolitan level and which issues might require national policymakers to become involved.</p>
Maja C., Claro J.	The role of a Proof of Concept Center in a university ecosystem: An exploratory study, <i>Journal of Technology Transfer</i> , 2013, Vol. 38, Issue: 5, pp. 641-650	25	22	<p>Aim: the paper seeks to contribute to the understanding of if and how PoCCs can positively impact different university ecosystems, through an exploratory case study of the role for a PoCC in the ecosystem of University of Coimbra</p> <p>Method: a focused literature review</p> <p>Findings: study suggests that there is, in fact, a possible role for a Proof of Concept Center in the regional ecosystem of the University of Coimbra, with a potentially very relevant impact in the technology commercialization process, through networking outside academia and research environments, funding of Proof of Concept activities, and technology entrepreneurship education for the development of entrepreneurial skills for researchers.</p>

Source: own study based on ISI WoS and Scopus databases. Date of search (02-01-2020).

Figure 1. Total number of publications for "university entrepreneurship ecosystem" in the SCOPUS and WoS database

