

Along the pathway of university's missions: looking at the evolution of performance indicators

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1. Introduction

Over the last decades, research on the relationship between universities and local development has steadily increased (Harrison and Turok, 2017). Several theoretical frameworks have been developed, including the “triple helix”, the “quadruple helix” and the “quintuple helix” models of innovation (Etzkowitz & Leydesdorff, 2000; Carayannis and Campbell, 2010; Carayannis and Rakhmatullin, 2014), the “learning region” (Shaw and Allison, 1999), the “regional innovation systems” (Benneworth et al., 2017), or the “smart specialization strategy” (Kempton et al., 2013). As a result of such conceptual and theoretical pathway, the pressure on the university to facilitate the direct application and exploitation of its knowledge and capabilities in order to contribute to the social, cultural and economic development is nowadays higher and higher (e.g., Etzkowitz, 2002, 2004, 2013; Napolitano and Riviezzo, 2008; Riviezzo and Napolitano, 2010, 2014; Urbano and Guerrero, 2013; Leih and Teece, 2016; Schmitz et al., 2017; Riviezzo et al., 2017; Riviezzo et al., 2019a).

In this regard, it is possible to maintain that universities are “overloaded” with new missions (Enders and Boer, 2009; Benneworth et al., 2017). For instance, to the third mission of contributing to the economic development, a fourth mission has been recognized to the university, that is a renewed civic engagement or civic responsibility within the community, the city and region of which it is part and on which it forms its identity (e.g., Goddard, 1999; Chatterton and Goddard, 2000; Thornton and Jaeger, 2008; Goddard and Vallance, 2013; Riviezzo et al., 2019b). Therefore, the university plays a key role as an “anchor” institution, which works with and in its community to create shared value (Goddard and Kempton, 2016). Part of the literature refers to this as the “third role” of the university (e.g., Goddard, 1999; Chatterton and Goddard, 2000) to indicate the need of an «increasing embeddedness of higher education institutions in their regions and their duty as responsible local, as well as national and international agents» (Chatterton and Goddard, 2000; p. 490). Thus, these theoretical developments have served «to strengthen regional ties and reinforce an awareness of a responsibility of universities to be partners in the economic health and wealth of their region» (Allison and Keane, 2001; p. 127), putting the “third role” not only «alongside, but fully integrated with mainstream teaching and research» (Chatterton and Goddard, 2000; p. 475).

As a consequence of this progressive “enlargement” of the role of the university in the dynamics of local development, a corresponding evolution of performance metrics and indicators used to assess the impact of university activities is required. However, the theme of measures and indicators of universities activities is, to a large extent, not yet sufficiently explored (e.g., Urbano and Guerrero, 2013; Mazdeh et al., 2013; Schmitz et al., 2017). Through a bibliometric and then a critical review of the extant literature, the present chapter aims precisely to provide: *i*) an overall picture of the state-of-art of literature on universities’ missions and roles in regional development; *ii*) a systematisation of the contributions on performance measures and indicators of universities activities. We finally draw useful insights for future research, highlighting that the empirical assessment of social and cultural impact of the university in a community has been, to date, largely overlooked.

2. Methodology

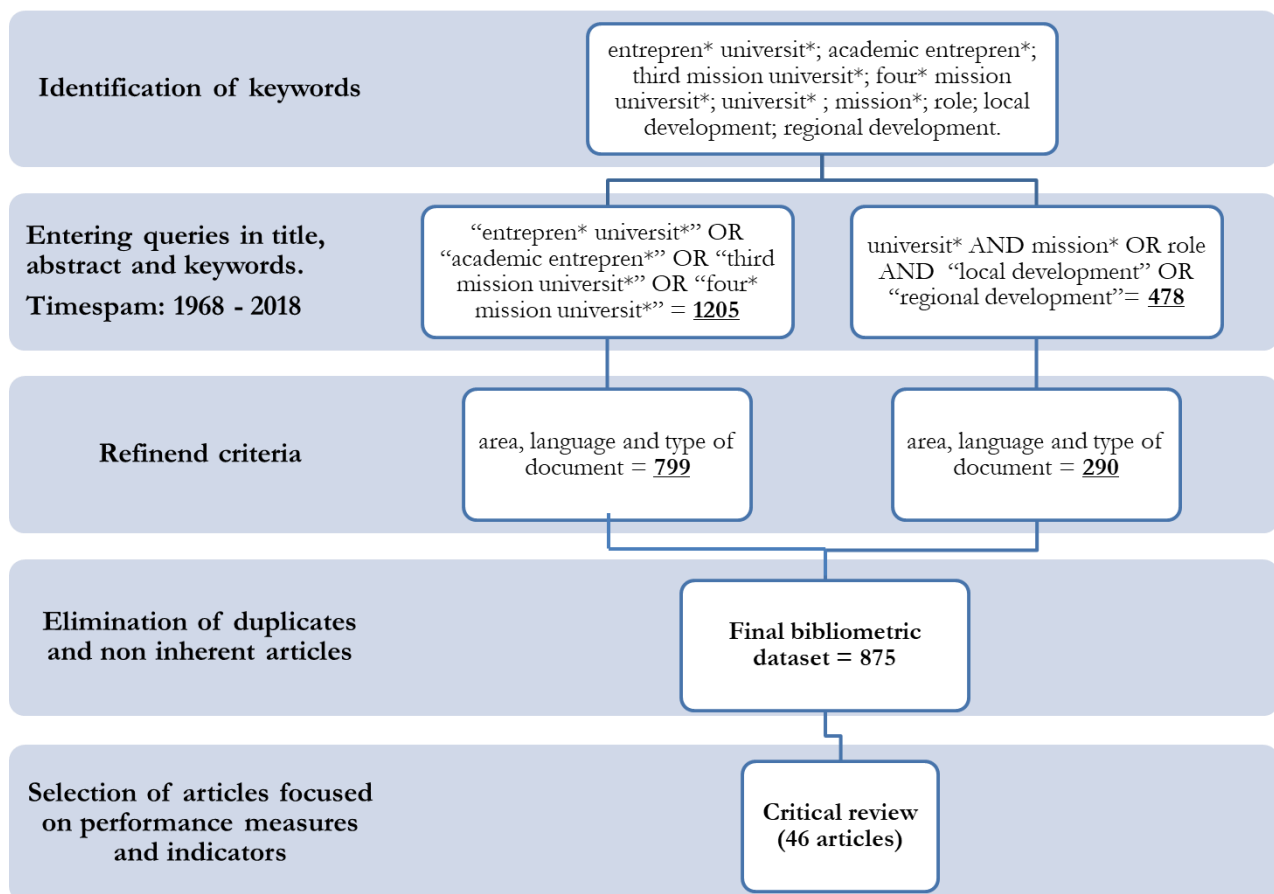
In order to reach the aims of this study, we used both quantitative and qualitative methods (Figure 1). Firstly, we employed a bibliometric analysis to draw a picture of the extant literature on the topic. Since it is based on the statistical measurement of science, scientists or scientific activity, bibliometric analysis is an objective and reproducible method to develop a review process (Verbeek et al., 2002; Diodato and Gellatly, 2013), and it is increasingly used in social sciences (e.g., Teixeira et al., 2012; Riviezzo et al., 2015; Schmitz et al., 2017; Mascarenhas et al., 2017; Fusco and Ricci, 2019). There are two main approaches in conducting a bibliometric analysis: performance analysis and science mapping (Noyons et al., 1999; van Raan, 2003; Cobo et al., 2011; Zupic and Čater, 2015). The performance analysis aims to quantify the research field, through the measurement of performances and impacts of the scientific actors (i.e., countries, universities, departments, authors), such as the number of published documents or the number of citations (Nederhof and van Raan, 1993; van Raan, 2003; Cobo et al., 2011). Indeed, the citation analysis also falls in this technique; it is based on the hypothesis that frequently cited studies have a greater influence on the development of the research field than those less frequently cited (Culnan, 1987; Tahai and Meyer, 1999). On the other hand, the science mapping, including co-citation (Small, 1973) and co-word analysis (Callon et al., 1983), aims to determine the cognitive structure of the field and its evolution. In the present study, we carried out a performance analysis by using Bibliometrix, a free software supported by R environment, that provides a set of tools for quantitative research in bibliometrics and scientometrics (Aria and Cuccurullo, 2017). We used Scopus as database for our review.

The first step was the definition of the best keywords set to be used in order to better map the evolution of the research field. Then, considering our specific aims and as a result of the previous step, we entered in Scopus the following queries: “entrepren* universit*” OR “academic entrepren*” OR “third mission

universit*” OR “four* mission universit*”; universit* AND mission* OR role AND “local development” OR “regional development”. The searching was refined by time (1968 – 2018), language (English) and type of document (article, review and article in press). Moreover, we restricted the area of interest to “business, management and accounting”; “social sciences”; “economics, econometrics and finance”. These queries, launched on 5 March 2019, resulted in the retrieval of 1089 documents. After the exclusion of duplicates and articles not really related to the topic, the collection has been cleaned up through a screening of titles and abstracts. The final dataset is made up by 875 articles, used for our bibliometric quantitative analysis.

The following step in our research process consisted of a critical review on 46 articles. The selection of the articles for the critical review was done by reading the title and the abstract of the articles included in our dataset. Thus, we chose for the critical analysis those articles that best fitted our aims (i.e., those explicitly focused on the topic of university missions’ performance measures). Furthermore, by using the snow-ball technique, we integrated the articles retrieved from our dataset with some others not originally included. Thus, this represents the qualitative part of our review.

Figure 1 – Research flow



3. Key findings of the bibliometric analysis

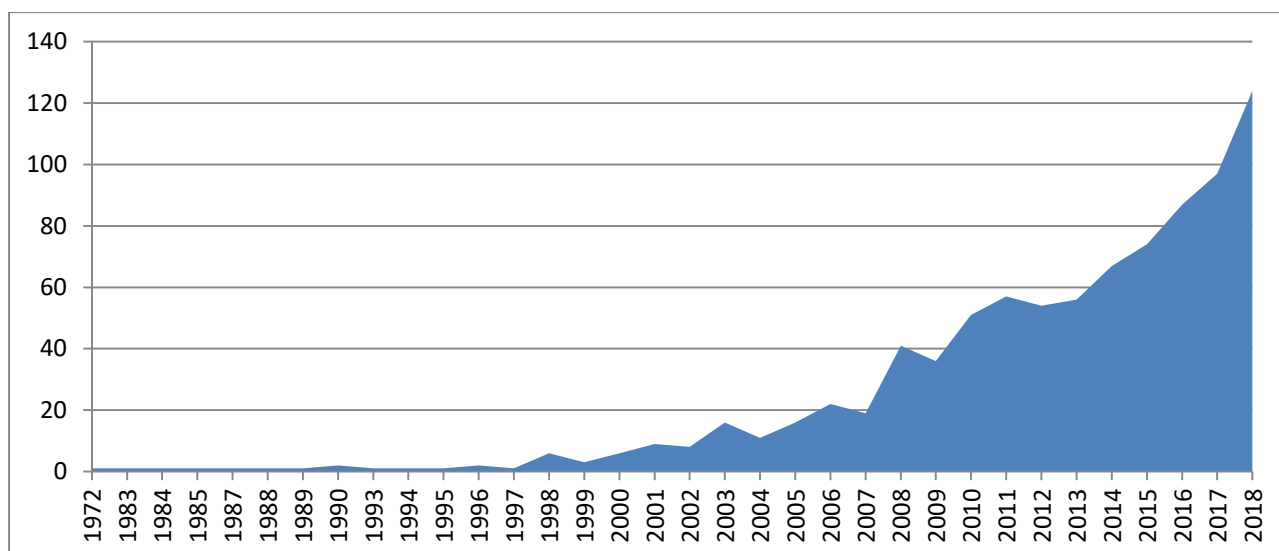
The sample used for our bibliometric analysis consists of 875 articles, sourced by 280 Journals, and published in a period of 46 years (1972 – 2018). Our data show a collaboration index of 2.1, with an average of 1.74 authors for each document (0.58 documents per author), while the single-authored articles are 246 (Table 1).

Table 1 – Sample characteristics

Main information	
Document	875
Sources (Journals, Books, etc.)	280
Keywords Plus (ID)	1226
Author's Keywords (DE)	1797
Period	1972 - 2018
Average citations per documents	24,51
Authors	1520
Single-authored documents	246
Documents per Author	0.58
Authors per Document	1.74
Collaboration Index	2.1

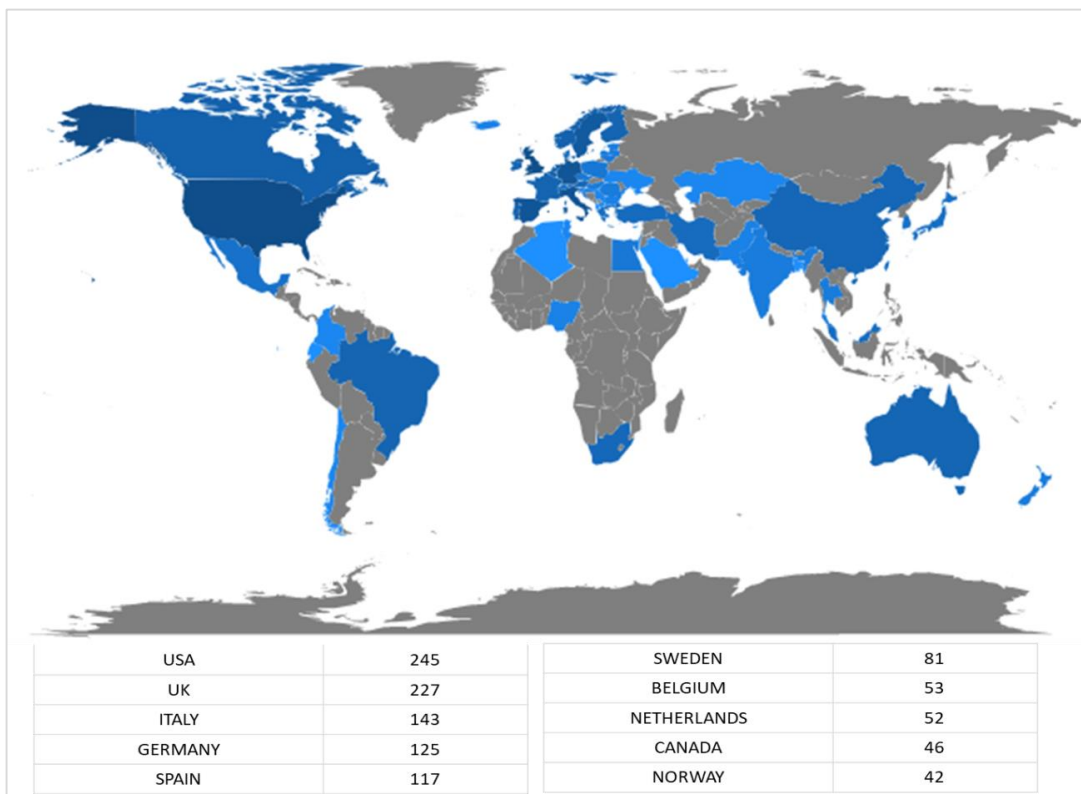
Scientific productivity is heavily concentrated in the last decade, with over 85% (n. 744) of the articles published since 2008 and over 14% (n. 124) only in 2018 (Figure 2).

Figure 2 – Distribution of the articles in the sample per year



The research field is strongly localised in Anglo-Saxon countries (USA, UK and Canada) and Europe (especially Italy, Germany and Spain), even if scholars from the emerging countries are increasingly contributing to the field (Figure 3).

Figure 3 – Distribution of the articles in the sample per country of the authors*



*Different shades of blue indicate different levels of productivity. The countries with more articles are in darker blue, while the areas with no articles are in grey.

The ten most productive authors are reported in Figure 4. They are all academics, with similar seniority (full or associate professor), correlated background (Management, Economics, Engineering), and research interests mainly focused on Innovation, Entrepreneurship, and Technology Management. The first author in this list, with 23 articles, is Henry Etzkowitz, who theorized seminal concepts such as the “entrepreneurial university” model and the “Triple Helix” model. Then, we find some other pioneers of the field, such as Mike Wright (18 articles) or Magnus Klofsten (8 articles), but also authors who have a more recent presence in this field of research, but a very high productivity, such as David Urbano (17 articles) or Maribel Guerrero (16 articles). Such high productivity is also confirmed by the temporal distribution of their publications (Figure 5).

Figure 4 – Top ten authors in the sample

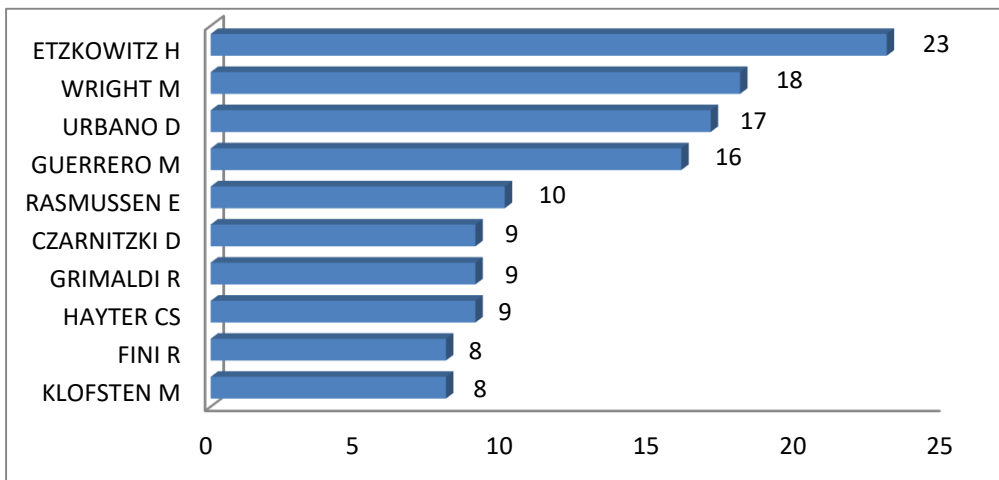
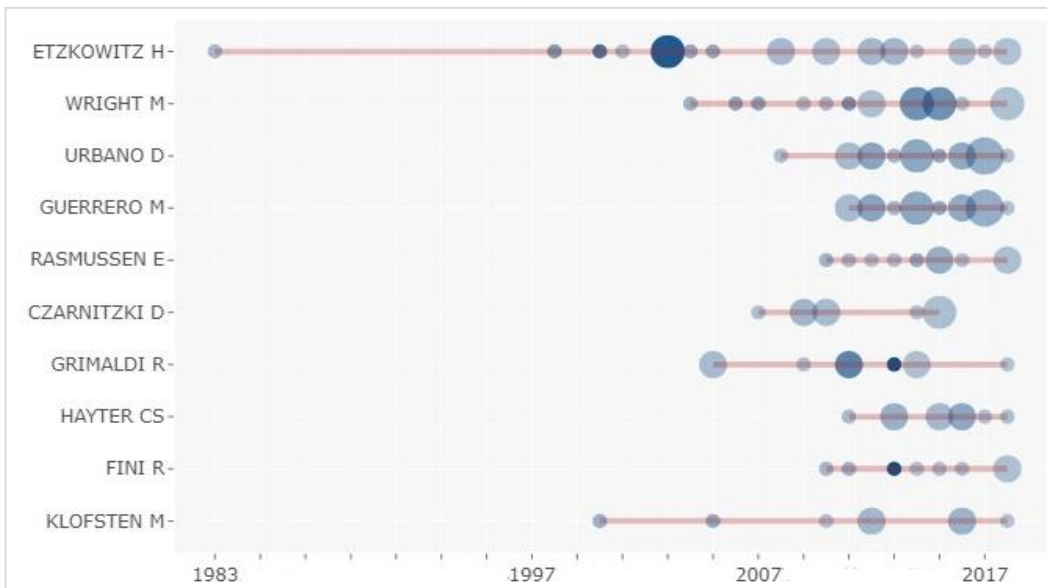


Figure 5 – Top authors' production over the time



Among the 280 sources, the top ten per publications (Table 2) are mainly journals dedicated to Technology, Innovation and Entrepreneurship or Higher Education, with the only exception of *European Planning Studies*, an outlet focused on development processes and policies in Europe.

Table 2 – Top ten sources in the sample

Journals	N. Papers
Journal Of Technology Transfer	82
Industry And Higher Education	62
Research Policy	45
Science And Public Policy	18
Technovation	18
European Planning Studies	17
Higher Education	15
Small Business Economics	15
Higher Education Policy	14
International Entrepreneurship And Management Journal	12
International Journal Of Technology Management	12

It's worth observing the citation pattern in the field, considering both the citation of the papers in the sample, and the citation of the references within them, thus identifying the most influential articles. We can use this as a first, even if basic, indicator of the intellectual structure of this literature.

Firstly, focusing the attention on the average citations per year of the articles in our sample (Figure 6), we can observe that the citational peaks correspond with the years of publication of prominent contributions, that is 1983, 1998, 2000, 2003, 2004. Table 3 shows the top ten documents in our sample per number of global citations, that is the number of citations received from the documents to the date of our extraction. The most cited article among those in our sample is “Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B. R. C. (2000), The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm, *Research policy*, 29(2), 313-330”. Then, we can find other contributions that conceptualized or empirically tested the Triple Helix model (n. 1), the industry-university relations (n. 2), the entrepreneurial university model (n. 2), and the academic engagement (n. 4).

Figure 6 – Average citations of the articles in the sample per year

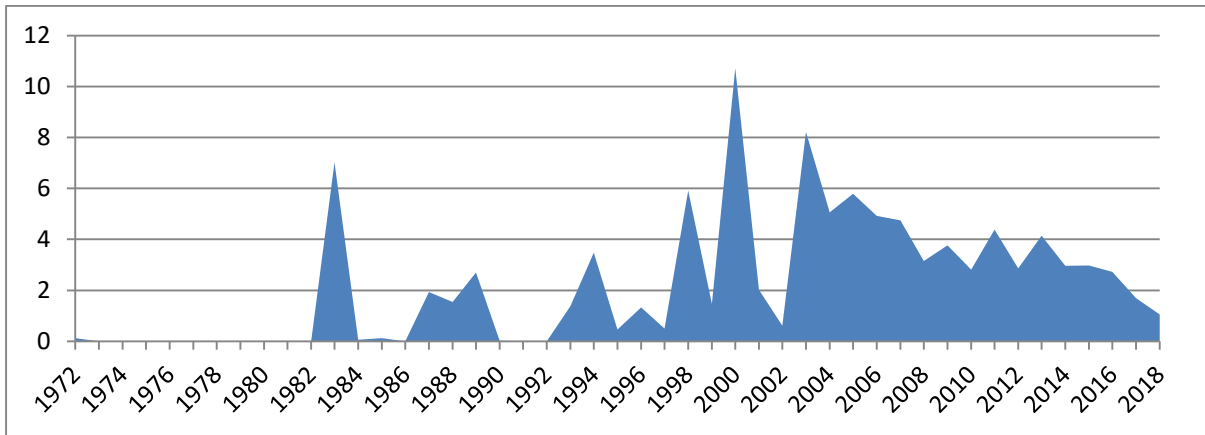


Table 3 – Top ten articles per number of citations

Documents	Citations
Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B. R. C. (2000). The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. <i>Research policy</i> , 29(2), 313-330.	943
Etzkowitz, H. (2003). Research groups as ‘quasi-firms’: the invention of the entrepreneurial university. <i>Research policy</i> , 32(1), 109-121.	612
Etzkowitz, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university–industry linkages. <i>Research policy</i> , 27(8), 823-833.	539
Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D’Este, P., ... & Krabel, S. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. <i>Research policy</i> , 42(2), 423-442.	485
Walter, A., Auer, M., & Ritter, T. (2006). The impact of network capabilities and entrepreneurial orientation on university spin-off performance. <i>Journal of business venturing</i> , 21(4), 541-567.	439
Etzkowitz, H. (2003). Innovation in innovation: The triple helix of university-industry-government relations. <i>Social science information</i> , 42(3), 293-337.	425
Bercovitz, J., & Feldman, M. (2008). Academic entrepreneurs: Organizational change at the individual level. <i>Organization science</i> , 19(1), 69-89.	332
Gulbrandsen, M., & Smeby, J. C. (2005). Industry funding and university professors’ research performance. <i>Research policy</i> , 34(6), 932-950.	314
Powers, J. B., & McDougall, P. P. (2005). University start-up formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship. <i>Journal of business venturing</i> , 20(3), 291-311.	306
Goldfarb, B., & Henrekson, M. (2003). Bottom-up versus top-down policies towards the commercialization of university intellectual property. <i>Research policy</i> , 32(4), 639-658.	270

The most cited references are shown in Table 4. They refer to the most cited references within the articles in our sample. They are all scientific papers, mainly empirical (n. 8), and adopting different theoretical frameworks, sometimes not explicitly explained. We can find in this list some of the most influential contributions in the field, such as, for instance, the ones theorizing the “entrepreneurial university” or the “Triple Helix” models (Etzkowitz et al., 2000; Etzkowitz, 1983, 1998, 2003). Among the most recurring theoretical frameworks used in these studies, it’s worth citing the institutional theory (e.g.,

Bercovitz and Feldman, 2008; Etzkowitz et al., 2000), the resource-based view (e.g., Lockett and Wright, 2005) and the entrepreneurial opportunities (e.g., Shane and Stuart, 2002).

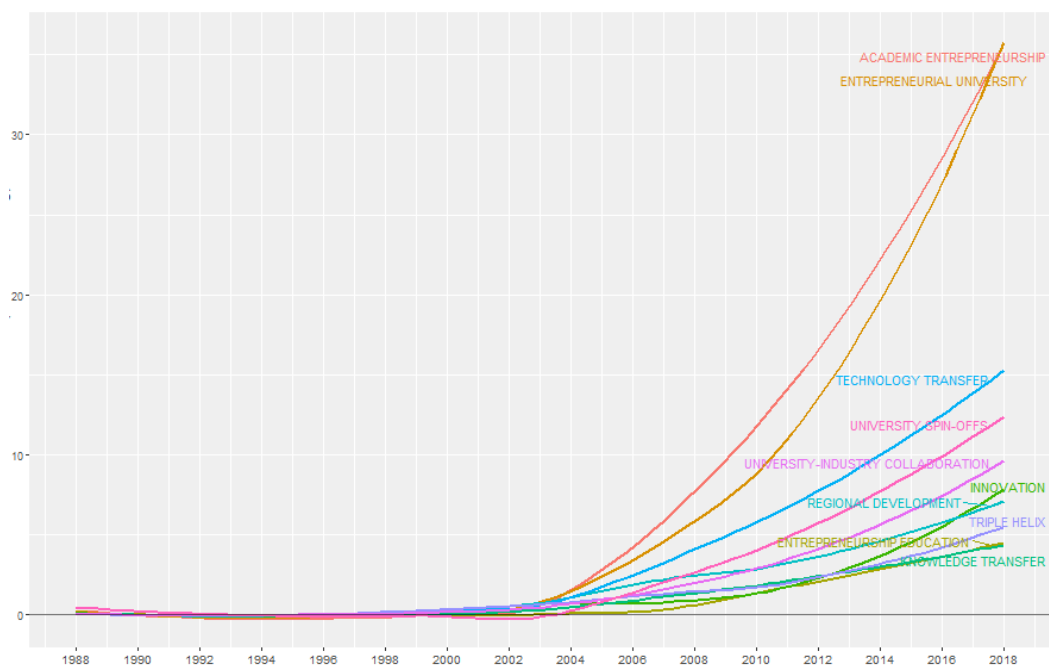
Table 4 – Top cited references

References	Citations	Theoretical Framework	Methodology	Findings
Di Gregorio, D., Shane, S., (2003). Why Do Some Universities Generate More Start-Ups Than Others?. <i>Research Policy</i> , 32, Pp. 209-227	99	Academic engagement	Empirical	The intellectual eminence of the university, and the policies of making equity investments in TLO start-ups and maintaining a low inventor share of royalties increase new firm formation activity.
Bercovitz, J., Feldman, M., (2008). Academic Entrepreneurs: Organizational Change At The Individual Level. <i>Organization Science</i> , 19 (1), Pp. 69-89	79	Academic entrepreneurship/ Technology transfer/ Institutional theory	Empirical	Individual attributes are conditioned by the local working environment. In terms of personal attributes, individuals are more likely to participate if they trained at institutions that had accepted the new initiative and been active in technology transfer. The longer the time that had elapsed since graduate training, the less likely the individual was to actively embrace the new commercialization norm. Considering the localized social environment, when the chair of the department is active in technology transfer, other members of the department are also likely to participate, if only for symbolic reasons.
Etzkowitz, H., (2003). Research Groups As 'Quasi-Firms': The Invention Of The Entrepreneurial University. <i>Research Policy</i> , 32 (1), Pp. 109-121	78	Entrepreneurial university/ Academic entrepreneurship/ Triple Helix	Conceptual with example	Academic entrepreneurship is both endogenous and exogenous. Endogeneity and exogeneity may be defined in terms of what is developed within an institutional sphere versus what is imported into it. It is endogenous in the sense that it is an internal development within academia that emanates from the way that the research university grew up. On the other hand, university-based innovation is in part the result of external influences including military research funding.
Lockett, A., Wright, M., (2005). Resources, Capabilities, Risk Capital And The Creation Of University Spin-Out Companies. <i>Research Policy</i> , 34 (7), Pp. 1043-1057	52	Technology transfer/ Resource-based view	Empirical	Both the number of spin-out companies created and the number of spin-out companies created with equity investment are significantly positively associated with expenditure on intellectual property protection, the business development capabilities of technology transfer offices and the royalty regime of the university. The results highlight the importance not just of resource stocks, but also of developing appropriate capabilities of technology transfer officers in spinning-out companies.
Etzkowitz, H., (1998). The Norms Of Entrepreneurial Science: Cognitive Effects Of The New University-Industry Linkages. <i>Research Policy</i> , 27 (8), Pp. 823-833	45	Academic entrepreneurship/ Technology transfer	Empirical	A 'second revolution' interested the universities, supposed to incorporate economic and social development as part of their mission. The heart of this new mission is the 'capitalisation of knowledge', that could have different approaches such as: 1) hands off, leave the matter entirely to the transfer office; 2) knowledgeable participant, aware of the potential commercial value of research and willing to play a significant role in arranging its transfer to industry; and 3) seamless web, integration of campus research group and research program of a firm.
Etzkowitz, H., (1983). Entrepreneurial Scientists And Entrepreneurial Universities In American Academic Science. <i>Minerva</i> , 21, Pp. 198-233	42	Entrepreneurial university/ Academic entrepreneurship	Theoretical	Entrepreneurial science has not arisen as a result of demand by existing industries. It came about as university scientists, at times through interaction with venture capitalists, decided to exploit the industrial applications of their research. The university is evolving from an institution dependent for its support on income from endowment, gifts, fees paid by students and grants from governments, into an enterprise capable of obtaining income from its research activities.
Etzkowitz, H., Webster, A., Gebhardt, C., Terra, B.R.C., (2000). The Future Of The University And The University Of The Future: Evolution Of Ivory Tower To Entrepreneurial Paradigm. <i>Research Policy</i> , 29 (2), Pp. 313-330	38	Triple helix/ Entrepreneurial university/ Institutional theory	Conceptual with example	A pattern of transformation toward an entrepreneurial university is emerging, from different bases, in the US, Latin America, Europe and Asia. At least two major trends can be identified that affect the future role of the entrepreneurial university: one is the shift to ever greater dependence of the economy on knowledge production and, the second, the attempt to identify and guide future trends in knowledge production and their implications for society.

Vohora, A., Wright, M., Lockett, A., (2004). Critical Junctures In The Development Of University High-Tech Spinout Companies. <i>Research Policy</i> , 33 (1), Pp. 147-175	28	Academic entrepreneurship	Empirical	University spinout companies go through various stages: (1) research phase; (2) opportunity framing phase; (3) pre-organization phase; (4) re-orientation stage; and finally (5) sustainable returns phase. At the interstices between the different phases there are some “critical junctures” that ventures face in terms of the resources and capabilities they need to acquire to progress to the next phase of development. These are: (1) opportunity recognition; (2) entrepreneurial commitment (3) venture credibility; and (4) venture sustainability.
Shane, S., Stuart, T., (2002). Organizational Endowments And The Performance Of University Start-Ups. <i>Management Science</i> , 48 (1), Pp. 154-170	28	Entrepreneurial opportunities / Resource-based view	Empirical	Two measures of founders' social capital - the presence of direct and indirect ties to venture investors prior to firm founding - sharply decrease the hazard of mortality and increase the likelihood that start-ups obtain external funding. The social capital endowments, through their impact on the fund-raising process, have long- term, positive influences on the performance of new ventures.
Shane, S., Venkataraman, S., (2000). The Promise Of Entrepreneurship As A Field Of Research. <i>Academy Of Management Review</i> , 25 (1), Pp. 217-226	26	Entrepreneurial opportunities	Theoretical	Entrepreneurship is the process through which new economic activities and organizations come into existence. Opportunities are central to this process. Micro-level explanations of entrepreneurial action and outcomes should look beyond the individuals involved. Equally important is the quality of the opportunities they pursue, and the fit between individual and opportunity. Within this framework, a central task for entrepreneurship research is to develop and test theory about how characteristics of opportunities, directly and in interaction with individuals' characteristics, give shape to entrepreneurial processes.
Jacob, M., Lundqvist, M., Hellsmark, H., (2003). Entrepreneurial Transformations In The Swedish University System: The Case Of Chalmers University Of Technology. <i>Research Policy</i> , 32 (9), Pp. 1555-1568	24	Entrepreneurial university	Empirical	Creating an entrepreneurial university takes several years, as both infrastructural and cultural changes are necessary to achieve success. Moreover, innovation policy at macro level and flexibility at micro level are required.
Clarysse, B., Wright, M., Lockett, A., Van De Velde, E., Vohora, A., (2005). Spinning Out New Ventures: A Typology Of Incubation Strategies From European Research Institutions. <i>Journal Of Business Venturing</i> , 20 (2), Pp. 183-216	23	Entrepreneurship	Empirical	It is possible to identify three distinct incubation models of managing the spin-out process: Low Selective, Supportive, and Incubator. The different incubation models have very different resource implications in managing the process. In particular, the resource and competence differences relate to finance, organization, human resources, technology, network, and infrastructure. The growing body of accounts of successful technology-transfer models in the academic literature may be misspecified for three main reasons: initial goals, organizational culture and regional environment, that should be considered.

Looking at the keywords (Figure 7), “academic entrepreneurship” has been the most used keyword in the field until a few years ago, when “entrepreneurial university” reached it. Although there is no agreement on what exactly the two theoretical constructs really mean and what are the differences between the two, it is possible to ascribe to the former a more individual connotation. In this view, “academic entrepreneurship” is the entrepreneurial activity fielded by an academic/researcher or students in order to exploit and commercialise knowledge and technology (e.g., Klofsten and Jones-Evans, 2000; Urbano and Guerrero, 2013). The construct is, therefore, strictly related to the “academic entrepreneurs”; for instance, Urbano and Guerrero (2013, p. 41) defined an “academic entrepreneur” as «both an academic, affiliated at a higher academic organization categorized as an entrepreneurial university, and an entrepreneur involved in a new venture start up founded to exploit intellectual property created in this organization». On the other hand, “entrepreneurial university” seems to refer to the organizational level of analysis, and it «includes developmental mechanisms and emergent structures» within universities (Etzkowitz et al., 2000, p. 316). In this perspective, Kirby et al. (2011, p. 304) defined the “entrepreneurial university” as «a university oriented towards innovation and the development of an entrepreneurial culture which has a new managerial ethos in governance, leadership, and planning, including greater faculty responsibility for accessing external sources of funding»; Guerrero et al. (2014, p. 415) defined it as «a university that tries to provide a supportive environment, in which the university community can explore, evaluate and exploit ideas that could be transformed into social and economic entrepreneurial initiatives». Therefore, the entrepreneurial university is the cradle in which the academic entrepreneurship is fed. However, it must be emphasized that this distinction is not widely accepted and the two theoretical constructs have been often used as synonymous. For instance, the eight specific types of academic entrepreneurship identified by Klofsten and Jones-Evans (2000) – that are *i)* large scale science projects; *ii)* contracted research; *iii)* consulting; *iv)* patenting/licensing; *v)* spin-off firms; *vi)* external teaching; *vii)* sales; *viii)* testing – represent also commonly used indicators of performance of the entrepreneurial university, as it will be highlighted in the following paragraph.

Figure 7 – The keywords temporal dynamics



Coming back to the most recurrent keywords, “technology transfer”, “knowledge transfer” and “university-industry collaboration” were frequently used in the early development stage of the field, being largely outdated in recent years by the two above mentioned “academic entrepreneurship” and “entrepreneurial university”. Looking at the fast growing keywords in the most recent years, it is possible to observe how research in this field has expanded to various interconnected topics, such as “entrepreneurship education” and “regional development”. The presence of the first keyword must be interpreted as a sign of scholars’ large interest towards the educational activities carried out by the universities that have the purpose of stimulating the entrepreneurial culture and skills among the students (e.g., Jesselyn Co and Mitchell, 2006; Blenker et al., 2008; Galvão et al., 2018). On the other hand, the occurrence of “regional development” among the frequently used keywords refers to the growing attention posed on the specific role that universities may play in regional development, that is precisely the focus of the critical analysis presented below.

4. A critical review: the evolution of universities’ features and performance indicators

As stated above, the specific aim of this chapter is to provide a picture of the performance metrics and indicators proposed in the literature in order to assess the impact of universities activities on local development. Thus, a further step in our research process was the selection and critical analysis of a set of articles best fitting our objectives among those included in the bibliometric analysis, following an approach largely used in systematic literature reviews (e.g., Schmitz et al., 2017). Furthermore, we also included in such critical review some relevant articles caught using the snowball technique and not originally entered in our bibliometric dataset. On the whole, we analysed 46 articles focused on the performance measures and indicators of universities’ role in regional development. The full list of these articles is available on request to the authors.

Our critical review confirmed the progressive emergence of new missions for universities, with new theoretical frameworks proposed to describe this transformation and heterogeneous indicators adopted to assess its effect on the dynamics of economic and social development. Since Etzkowitz (1983) theorised the so called “second academic revolution” and the born of the third mission of contributing to local development, besides the traditional missions of education and research of the Humboldtian model, additional missions and models have been identified for universities. For instance, Goldstein (2010) proposed three different university models: the Humboldtian model, the land-grant or engaged university model, and the triple helix or the entrepreneurial university model. Trippl et al. (2015) proposed four models: the entrepreneurial university model, the regional innovation system university model, the mode 2 university model, and the engaged university model.

Despite the heterogeneity of the models proposed, the theoretical frameworks developed, and the empirical methods adopted, moving from our critical review and focusing specifically on the differences in terms of performance metrics and indicators, three relevant groups of articles can be defined: *i)* the first group is based on the entrepreneurial university model (third mission); *ii)* the second group embraces those studies based on the regional engaged university model (third role); *iii)* the third group combines those contributions based on the civic engaged university or broader engaged university model (fourth mission). As already noted (Schmitz et al., 2017), these models very often share some components and variables and the boundaries between them are not always very clear. In this regard, the first and the second groups of articles seem to have many similarities, also in terms of performance metrics, but they clearly originated from different disciplines and research areas. And this is reflected also in the outlets

used for their publication. The first group, aggregated around the entrepreneurial university model, is more rooted in the strategic, innovation and technology management areas (and it is mainly published in journals like: *The Journal of Technology Transfer*, *Research Policy*, *Technological Forecasting and Social Change*, and so on). The second group, built around the regional engaged university model, is more linked with the territorial development and regional studies (and mostly published in journals like: *Local economy*, *European Planning Studies*, *Regional Study*, and so on). The third group turns out to be a convergent but non-linear evolution of the previous two, as a result of the progressive expansion of the role assigned to the university towards the territory and the community it belongs to. This is manifested also in the nature of measures and indicators used to assess the different missions recognized to the university, as we will discuss in depth below.

Table 6 presents a sample of empirical papers falling into the three groups.

4.1. *The entrepreneurial university: the third mission*

The entrepreneurial university is the result of the so-called “second academic revolution”, through which the university has been transformed into a «teaching, research and economic development enterprise» (Etzkowitz, 2003, p. 110). Thus, it is no more considered an “isolated island” (Klofsten and Jones-Evans, 2000) or an “ivory tower” and becomes an economic actor, with the ability to create «new sources of funds like patents, research under contracts and entry into a partnership with a private enterprise» (Etzkowitz, 1983, p. 198). Although a shared definition is still lacking and there is yet no agreement around a comprehensive model of what exactly it is, we can state that it is characterised, on the one hand, by a strong emphasis on closer relationships with industry and the dissemination and commercialisation of its knowledge; on the other hand, by a strategic and organizational change, that is needed to encourage individuals and groups towards entrepreneurship (e.g., Etzkowitz, 1983; Clark, 1998, 2004; Subotzky, 1999; Riviezzo and Napolitano, 2010, 2014; Urbano and Guerrero, 2013; Riviezzo et al., 2019a). However, while the focus of these studies was initially on the creation of economic development through the protection and commercialization of university’s knowledge, thus responding to an internal logic (University Entrepreneur Two), the emphasis has been gradually translated into a broader concept of contributing to regional development (University Entrepreneur Three), with a growing attention posed on the impact of universities activities on the territory (Etzkowitz, 2013).

Regarding the performance metrics and indicators, it’s possible to observe that the contributions included in this first group are characterised by an assessment of universities entrepreneurial activities that is mainly economic in nature. Even though many authors, from the conceptual point of view, maintain that the entrepreneurial university should create economic and social utility, then most of the empirical studies make use of just economic and quantitative parameters. A largely used indicator is the number of *spin-off*, both as the sole parameter (e.g., Vincett, 2010) and, more often, in combination with others (e.g., Perkmann et al., 2015; Guerrero et al, 2016; Riviezzo et al., 2019a). For instance, Fini et al. (2017) distinguish the quantity of spin-offs, that is the number of university spin-offs from a given university in a given year, and the quality of spin-offs, operationalised as the number of university spin-offs from a given university in a given year, which have received a first round of venture capital financing in that year. Other frequently used metrics are: *patents* (e.g., Urbano and Guerrero, 2013; Secundo and Elia, 2014; Guerrero et al., 2015; Perkmann et al. 2015; Riviezzo et al., 2019a); *consulting or professional contracts* (e.g., Perkmann et al, 2015; Guerrero et al., 2015; Trequattrini et al., 2018); *publications* (e.g., Urbano and Guerrero, 2013; Secundo and Elia, 2014); *entrepreneurial education* (e.g., Secundo and Elia, 2014; Trequattrini et al., 2018); *student or researcher exchange* (e.g., Urbano and Guerrero, 2013); *facilities* (Guerrero et al., 2015); *networking and collaboration with industry* (e.g., Secundo and Elia, 2014; Guerrero et al., 2015).

With regard to regional impact, the metrics most frequently used are: *GDP* (e.g., Vincett, 2010; Urbano and Guerrero, 2013; Guerrero et al., 2016); *Gross Value Added – GVA* (Guerrero et al., 2015; Trequattrini et al., 2018); *employment rate* (e.g., Guerrero et al., 2016; Trequattrini et al., 2018); *regional exports value* and *regional return on assets (ROA) values* (e.g., Trequattrini et al., 2018). Urbano and Guerrero (2013) also report indirect *social impacts*, such as *attracting business* or *producing social mobility*.

Despite the academic consensus received and the great empirical echo, the model of entrepreneurial university has been questioned for different reasons. Audretsch (2014) stresses the lack of effective integration between the traditional Humboldt core and the “third mission” areas that should be exceeded through the transition towards the university in the entrepreneurial society, whose mission «is not just to promote technology transfer and increase the number of startups but to ensure that people thrive in the emerging entrepreneurial society» (p. 320). Czarnitzki et al. (2014) underline that the push towards the commercial opportunities or commercialising knowledge could restrict public disclosure, so the decrease in the production of academic research should be considered as a potential social cost and taken into account to calculate net social benefit. Other scholars held the effectiveness of this model and its ability to produce expected results (Harrison and Leitch, 2010), as its limited attention on the non-economic and non-financial aspect of development (e.g., McAdams and Debackere, 2018; Riviezzo et al., 2019b).

4.2. *The regional engaged university: the third role*

Articles clustered in this group assign to the university a key role in regional development, first as a “spending multiplier”, then as a “stimulator” of economic development through specific activities (Goldstein, 2010). The advancement of knowledge society pushed policymakers to leave the idea of the industrialization as the only way of promoting local development, thus putting emphasis on a knowledge-based endogenous growth, where the learning and the innovation are the driving forces (Charles, 2003). At the same time, the region (that is an area larger than a city, but smaller than a country) has been increasingly seen as an important basis of economic coordination at the meso-level. The result is the development of theoretical frameworks such as “regional innovation systems” (RIS) and “learning regions”, where the focus is on the collaborative interaction between regional actors (firms and institutional entities) to assure continuous learning and innovative processes (e.g., Florida, 1995; Morgan, 1997; Cooke et al., 1998; Cooke, 2001; Asheim and Isaksen, 2002; Gunasekara, 2006). Cooke et al. (1998; p. 1581) define RIS as a system «in which firms and other organizations are systematically engaged in interactive learning through an institutional milieu characterized by embeddedness». In this context, the university, as the knowledge infrastructure par excellence (Tripl et al., 2015), becomes the core of this innovative growth process (e.g., Allison and Keane, 2001; Charles, 2003; Benneworth et al., 2009). The new and strengthened role of university in regional development has been defined “third role”, widely understood as the responsibility of higher education institutions to be partners in the economic health and wealth of their region (Goddard, 1999; Chatterton and Goddard, 2000; Allison and Keane, 2001). Such conceptualization of the third role, compared to the third mission and the triple helix model, put more emphasis on adaptive responses and stronger focus on regional needs in defining the university missions (Gunasekara, 2006). Moreover, it also paid much attention to the first and second missions and their links with context (Tripl et al., 2015). Thus, these theoretical developments have served to out the “third role” not only «alongside, but fully integrated with mainstream teaching and research» (Chatterton and Goddard, 2000; p. 475).

Concerning the metrics used to assess this new role, there are some similarities with “entrepreneurial university”, mainly in term of knowledge commercialisation (spin-offs) and knowledge exchange. However, in this group of studies much more emphasis is posed on networking, even informal, and collaboration, and also the engagement with local community is more underlined. It’s worth noting, that the empirical studies in this group are mainly qualitative (above all, case studies), thus the indicators are more descriptive. For instance, Allison and Keane (2001) analyse the role of the university in the region on the basis of six dimensions: *i) enterprise development*, understood as the support for industry and sponsorship of enterprise development (e.g., staff support to local industry, management education, etc.); *ii) skills transfer*, that is the design of an educational offer with a local focus; *iii) sourcing and supply chains*, that is supplies from local firms; *iv) technology and research development*, that arises from an exchange of technology and ideas between universities and local firms; *v) partnerships and networks*, with local firms and other institutions; *vi) civic engagement*, that leads providing facilities (i.e. library) and potential opportunities for the promotion of sports/health. Benneworth et al. (2009) focused on *spin-off companies, responding to firm-based knowledge demands; collective research; infrastructure sharing; networking and consultancy support*. The formation of human capital and knowledge that respond to local needs and strong business support is also found in Glasson (2003), that points out also the role in terms of employment and GDP. In sum, we can say that in this model *i)* the contribution of university is strongly dependent of context, because it should respond to local specific needs; *ii)* this contribution is largely translated into knowledge support to local firms; *iii)* although evident differences between entrepreneurial model and some references to community development, there is still a strong prevalence of economic concerns. Furthermore, the excessively local and restricted territorial vision has been criticized (e.g., Trippl et al., 2015).

4.3. *The broader university or civic engaged university: the fourth mission*

In the last years, the need to consider more broadly the role and the consequent impacts of the university gave birth to a flourishing but still fragmented literature. The labels assigned to universities are several, but they all share the emphasis on non-economic and therefore social, environmental and cultural impacts (Goddard et al., 2011). «The quest for an ‘ethical university’ is more important today than ever before, a quest in which ethical values, practices and responsibility will be the dominant factors in terms of the university’s vision, targeted objectives, strategic planning and management, while the commercial values, practices and profitability will only be of secondary importance. This points to an interdependence of citizenship and education» (Chan, 2011; p. 275). Thus, the engaged university appears to be entrepreneurial, but also closely linked to the territory and widely responsible for the overall community development and well-being. For example, a broader regional impact is recognised in “smart specialization strategy” (S3) literature, based on the key concept underlying the European innovation strategy in 2014-2020 programming period (Kempton et al., 2013; Kempton, 2015). In addition to stretch the role of university in regional innovation as active player in defining the territorial strategy, S3 is also variously linked with other concepts. Carayannis and Rakhmatullin (2014) investigate the growth based on regional innovation smart specialisation strategies via the ‘multi-focal lens’ of the Quadruple and Quintuple Innovation Helices perspective. They argue that «Quadruple Helix models place a stronger focus on cooperation in innovation and, in particular, the dynamically intertwined processes of co-opetition, co-evolution and co-specialisation within and across regional and sectorial innovation ecosystems that could serve as the foundation for diverse smart specialisation strategies» (Carayannis and Rakhmatullin, 2014; p. 218). Quadruple and Quintuple helices expanded the “triple helix model” adding the “civil society” and the “environment” with the specific aim of ensuring a more democratic, socially

and ecological approach to innovation, driving policies and practices towards a triple-bottom baseline (Carayannis and Rakhmatullin, 2014; Carayannis et al., 2018). In this more complete and complex dynamic, “Mode 3” university emerge to integrate and combine the “Mode 2” and “Mode 1”. It represents a type of open and non-linear knowledge production, emphasizing and engendering creative and innovative organizational contexts for research, education, and innovation (Carayannis and Campbell, 2010; Carayannis et al., 2018). The link with sustainability is also present in Trencher et al. (2013a, 2013b), that coin the “transformative university” and “the co-creation for sustainability” mission. They argue that the sustainability crisis has led organisations and civil society to collaborate in order to create concrete and effective solutions. Therefore, to the three missions of the university, another one is added, that is «collaborate with diverse social actors to create societal transformations with the goal of materialising sustainable development in a specific location, region or societal sub-sector» (Trencher et al., 2013a; p. 152).

The focus on local area (city or regions) and the host community is found in Goddard et al. (2011), who point out the potential ability of universities of providing not only economic innovation but also social inclusion, emphasizing also the barriers and the poor recognition of this aspect in public policy or governance. In others works (Goddard, 2009; Goddard and Kempton, 2016), the strong responsibility toward host communities and areas were declined in terms of a renewed civic engagement (or civic responsibility) of the university within the community, the city and the region of which it is part and on which it forms its identity. In this view, university is «a civic institution, mobilising its resources to meet quintessentially multi-disciplinary challenges, like urban sustainability, health and culture» (Goddard and Vallance, 2013, p. 151). Other authors (e.g., Mbah, 2016; Shiel et al., 2016) encourage the university-community cooperation with the aim of a sustainable development. The idea of the “interconnected university” emphasises the role of the university as an institution able to establish strong cords of relationships within itself, as well as with different segments of the community to determine shared ideas, and galvanise collective participation/action towards a common mission of addressing community but also university (sustainable) aspirations. In this “interconnected university” model, «the community provides the context of the learning environment and may play a central role in the learning process. [...] Furthermore, community sites provide ideal locations for class projects, applied and service learning, and internships, whereas academic institutions, as members of the community, are core to educating citizens, professionals, innovators, and problem-solvers» (Shiel et al., 2016, p.124). Thus, community development includes not only the community involvement and the faculty work in communities, but an «extended working together across organisational, institutional, political, cultural, economic, social and personal divides to realise the holistic transformation of a residential community, with each member experiencing an improvement in wellbeing» (Mbah, 2016, p. 1230).

Concerning the commonly used performance metrics, Trencher et al. (2013) propose the following parameters: *i) knowledge management* (e.g., collaborative research and publications, consulting, training for key stakeholders and decision-makers); *ii) technical demonstration projects and experiments* (e.g., innovation or pilot project); *iii) technology transfer and economic development* (e.g., patenting and licensing to industry, or the creation of spinoff firms, technology parks, and cluster zones); *iv) reform of built and natural environment* (e.g., university administration-led real-estate development, neighbourhood reform or infrastructure improvements); *v) socio-technical experiments* (e.g., building or reconfiguration of a food or consumption network, the re-organising of technological artefacts or the introduction of an experimental incentive or policy tool designed to change the behaviour of citizens or the private sector). Therefore, besides some entrepreneurial metrics, Trencher et al. (2013) introduce responsibility measures towards the environment and society. Rinaldi et al. (2018), analysing an Italian university by the lens of co-creation

for sustainability and S3 strategy, recur to Kempton et al. (2013) classification to capture the activities through which universities can be able to contribute to regional smart specialization strategy. In fact, they stress in their case-study the presence of: *i) initiatives to support the development of creative and cultural industries; ii) initiatives to support food and tourism culture; iii) initiatives to promote entrepreneurship*. Similarly, Shiel et al. (2016) and Mbah (2016) identify the *democratic value*, the adoption of relevant channels to ascertain *community ideas and needs*, and the participation and involvement of *community in research*, the focus on *local sustainability* and the creation of *customised learning courses* and the *voluntary community service*. Goddard and Vallance (2013) propose activities like *health improvement, physical regeneration and place making, student housing, and cultural production and consumption*.

As noted above, the specific mean of “fourth mission” is still not uniform, although the general, common reference is to the promotion of social, cultural and economic development of the host community, that, in a very broad sense, leads to argue that university should contribute also to the quality of life perceived by the community itself (Riviezzo et al., 2019b). This new focus and the concept of societal impact is now a recurring theme for academics as well as for policymakers and practitioners. Fini et al. (2018) defines it as «the effect on or change or benefit to the economy, society, culture, public policy or services, health, the environment, or quality of life from new or improved products or services based on scientific knowledge. These impacts can be both positive and negative» (Fini et al., 2018, p. 8). However, the impact measures are mostly qualitative, that is an enumeration of activities and behaviours. The development of less relative and appropriate indicator of these complex and long-term relations between university and community/territory is therefore a key challenge (Kempton, 2015).

Table 5 - Key performance measures

Group of articles	References	Methodology	University performance and impact measures	
			Soft	Hard
The entrepreneurial university: the third mission	Perkmann, M., Fini, R., Ross, J. M., Salter, A., Silvestri, C., & Tartari, V. (2015). Accounting for universities' impact: Using augmented data to measure academic engagement and commercialization by academic scientists. <i>Research Evaluation</i> , 24(4), 380-391.	Empirical/ Quantitative		<ul style="list-style-type: none"> • Consulting contracts • Patenting activities • Entrepreneurial activities (spin-outs)
	Guerrero, M., Urbano, D., & Fayolle, A. (2016). Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities. <i>The Journal of Technology Transfer</i> , 41(1), 105-131.	Empirical/ Quantitative		<ul style="list-style-type: none"> • number of start-ups • GDP per capita; • GDP change; • Employment rate by highest level of education;
	Trequattrini, R., Lombardi, R., Lardo, A., & Cuozzo, B. (2018). The impact of entrepreneurial universities on regional growth: a local intellectual capital perspective. <i>Journal of the Knowledge Economy</i> , 9(1), 199-211.	Empirical/ Quantitative		<ul style="list-style-type: none"> • Entrepreneurial curricula; • Academic spin-offs; • Supply of professional services • Percentage of regional added value on the total • Regional return on assets (ROA) values • Regional employment rate • Regional exports value
	Riviezzo, A., Santos, S. C., Liñán, F., Napolitano, M. R., & Fusco, F. (2019). European universities seeking entrepreneurial paths: the moderating effect of contextual variables on the entrepreneurial orientation-performance relationship. <i>Technological Forecasting and Social Change</i> , 141, 232-248.	Empirical/ Quantitative		<ul style="list-style-type: none"> • Patents • Spin-offs
The regional engaged university: the third role	Allison, J., & Keane, J. (2001). Evaluating the role of the Sunshine Coast University (USC) in the regional economy. <i>Local Economy</i> , 16(2), 123-141.	Empirical/ Qualitative	<ul style="list-style-type: none"> • support for industry and sponsorship of enterprise development • Skills transfer (courses offer with local focus) • Local sourcing; 	

			<ul style="list-style-type: none"> • Collaboration with local firms and knowledge exchange • Partnerships and networks with local organisations (high schools, businesses, regional public institutions) • Cultural and sports facilities; • Promotion of sport and health 	
	<p>Glasson, J. (2003). The widening local and regional development impacts of the modern universities-a tale of two cities (and north-south perspectives). <i>Local Economy</i>, 18(1), 21-37.</p>	Empirical/Qualitative	<ul style="list-style-type: none"> • Initiatives to encourage student and graduate placements • University-Industry collaborations • Activities to reduce physical environmental impacts • Lifelong learning activities • Public access to university facilities and events • Support to local voluntary and community organisations 	<ul style="list-style-type: none"> • Direct and indirect employment and expenditure impacts • Consultancy, training and business support activity • Spin-outs
	<p>Benneworth, P., Coenen, L., Moodysson, J., & Asheim, B. (2009). Exploring the multiple roles of Lund University in strengthening Scania's regional innovation system: Towards institutional learning?. <i>European Planning Studies</i>, 17(11), 1645-1664.</p>	Empirical/Qualitative	<ul style="list-style-type: none"> • Responding to firm-based knowledge demands • Collective research and learning activities • Infrastructure sharing • Networking 	<ul style="list-style-type: none"> • Spin-off companies • Patenting/Licensing • Consultancy support
<p>The broader university or civic engaged university: the fourth mission</p>	<p>Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N., & Kraines, S. B. (2013). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. <i>Science and Public Policy</i>, 41(2), 151-179.</p>	Empirical/Qualitative	<ul style="list-style-type: none"> • Knowledge management (e.g. collaborative research and publications, consulting, training for key stakeholders and decision makers) • Technical demonstration projects and experiments (e.g. innovation or pilot project) • Reform of built and natural environment (e.g. university administration-led real-estate development, neighbourhood reform or infrastructure improvements) • Socio-technical experiments (building or reconfiguration of a food or consumption network, the re-organising of technological artefacts) 	<ul style="list-style-type: none"> • Technology transfer and economic development (e.g. patenting and licensing to industry, or the creation of spinoff firms technology parks and cluster zones)

			or the introduction of an experimental incentive or policy tool designed to change the behaviour of citizens or the private sector)	
	Mbah, M. F. (2016). Towards the idea of the interconnected university for sustainable community development. <i>Higher Education Research & Development</i> , 35(6), 1228-1241.	Empirical/ Qualitative	<ul style="list-style-type: none"> • Embracing a collaborative form; • Broadening participation; • Adopting relevant channels to ascertain community ideas and needs; • Operating accessible community centres; • Researching local concerns • Customising educational programmes and service learning 	
	Rinaldi, C., Cavicchi, A., Spigarelli, F., Lacchè, L., & Rubens, A. (2018). Universities and smart specialisation strategy: From third mission to sustainable development co-creation. <i>International Journal of Sustainability in Higher Education</i> , 19(1), 67-84.	Empirical/ Qualitative	<ul style="list-style-type: none"> • Initiatives to support the development of creative and cultural industries (cultural incubators) • Initiatives to support local culture, products and firms • Initiatives to promote entrepreneurship (scholarship program and training) 	

5. Conclusions

The multiplicity of conceptual and theoretical advances on the relationship between universities and local development has been paralleled by the need of new performance metrics and indicators in order to assess the missions progressively recognized to the university. Indeed, the use of a few and very specific indicators may prevent a consistent assessment of the economic, social and cultural externalities created by universities and associated with their impact on «demography, economy, infrastructure, culture, mobility, education, and society» (Guerrero et al., 2015, p. 752). Thus, the investigation of universities activities' measures and indicators represents an emerging theme in this stream of literature (e.g., Urbano and Guerrero, 2013; Mazdeh et al., 2013; Schmitz et al., 2017). However, to date, it seems to be not yet sufficiently explored. Through a bibliometric and then a critical review of the extant literature, this study aimed precisely to provide a systematisation of the contributions on performance measures and indicators of universities activities.

Our bibliometric analysis confirmed the growing importance of the literature on the relationship between university and local development. The analysis of bibliographical production shows an accelerated growth in the number of publications on the topic, driven primarily by Anglo-Saxon countries (USA, UK and Canada) and Europe (especially Italy, Germany and Spain), even if scholars from the emerging countries are increasingly contributing to the field. Furthermore, the profile of the publications confirms the interdisciplinarity of the field, with journals of academic relevance in the areas of management, technology, innovation, entrepreneurship, higher education, and regional studies.

The conceptual approaches identified in the literature are really fragmented, such as the methods and the findings, thus generating multiple perspectives on the topic.

Our critical review of selected articles was focused on the measures and indicators developed to assess outputs, outcomes and impacts of universities activities. We identified three relevant groups of articles: i) the first group is based on the entrepreneurial university model (third mission); ii) the second group embraces those studies based on the regional engaged university model (third role); iii) the third group combines those contributions based on the civic engaged university or broader engaged university model (fourth mission). What clearly emerged from our critical review is that, while contributions on the entrepreneurial university and, to certain extent, those on the regional engaged university make large use of very focused (i.e., mainly economic) and mostly hard (i.e., identifiable, measurable, quantifiable) indicators, the contributions aggregated around the civic engaged university model propose multi-dimensional (i.e., economic, social, cultural) indicators that are, very often, soft (i.e., descriptive, qualitative) indicators. This is mainly due to the research methods adopted, that are qualitative in most of the selected articles falling in the third group (i.e., mostly single case-study researches).

Such approach, on the one hand, allowed a deeper analysis of the multifaceted nature of the relationship between the university and the region where it is located; but, on the other side, it prevented the

accumulation of knowledge around specific topics (e.g., the performance measures and indicators), thus favouring a fragmentation of the literature. Thus, the richness of the theoretical frameworks developed and university models proposed, including the “civic university” (e.g., Goddard, 2009; Goddard and Kempton, 2016), the “community-engaged university” (e.g., Shiel et al., 2016), the “transformative university” (e.g., Trencher et al., 2013a, 2013b; Rinaldi et al., 2018) or the “interconnected university” (e.g., Mbah, 2016), has not been adequately paralleled on the empirical level by the elaboration of corresponding measures, both “hard” (i.e., built around quantifiable indicators) and “soft” (i.e., which deal with less tangible community impacts and values).

Therefore, our study provides arguments to sustain that the empirical assessment of social and cultural impacts of the university in a community has been largely overlooked. Indeed, the impact measures are mostly qualitative, that is an enumeration of activities and behaviours. Given the new role of university in the knowledge based society, there is the need to assess holistically and systematically the impact of teaching, research and entrepreneurial activities that universities carry on in order to increase economic, social and cultural development and preserving autonomy and sustainability of the universities themselves (Schmitz et al. 2017). University is now intended as «a civic institution, mobilising its resources to meet quintessentially multi-disciplinary challenges, like urban sustainability, health and culture» (Goddard and Vallance, 2013; p. 151). Hence, even activities such as health improvement, physical regeneration and place making, student housing and cultural production and consumption (Goddard and Vallance, 2013) should be included in the evaluation of the impact of universities activities.

Thus, assessment indicators should present a balanced picture of university’s performance across all its missions (Kapetaniou and Lee, 2017), by adopting a more «holistic approach that examines the main channels that bind universities to the rest of society» (Molas-Gallart et al., 2002; p. IV). Such plurality of metrics and indicators did not emerge from our critical analysis of the extant literature. In this perspective, we can maintain that the development of less relative and more appropriate indicators of these complex and long-term relations between university and community/territory still represents a key challenge for future research (Kempton, 2015; Riviezzo et al., 2019b).

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