Map of the existing research on business innovation, funding, and policy framework

Edmund Mallinguh[1], *Zeman Zoltan*[2]

Abstract

In the last decade, empirical studies focusing on business-related innovation, funding of innovation activities, and policy (implications) have continued to increase. However, not enough effort has been undertaken yet to investigate existing literature on the subject matter. To fill the gap, the present study seeks to synthesize and map out existing empirical studies on business innovation, financing, and policy framework published between 1990 and February 2019. Bibliographic analysis of relevant articles retrieved from the Web of Science Core Collection was performed using Vosviewer. The bibliometric results show the prominent publication outlets, authoritative scholars and items, dominant higher learning institutions, and countries. Still, selected articles were content analyzed, providing a summary of the publications, the methodology adopted, country and period covered. The papers were classified into different themes based on the study focus, thus pinpointing areas that have received more or less scholarly attention. The identified gaps from both bibliographic and content analysis offer future research opportunities in different aspects touching on business innovation, how its financed and related policy issues.

Keywords*: business innovation, funding, policy framework, bibliometrics, citation analysis, Scientometrics*

INTRODUCTION

Gault (2018), from a general point of view, defines innovation as the implementation of an original or significantly distinct process or product.

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A product could be a good or service, whereas a process may entail production or delivery, organizational, and marketing processes. Kahn (2018) expounds further by stating that innovation is a combination of three different conditions; innovation as an outcome, as a process, and innovation as a mindset. Kahn explains that as an outcome, it may include but not limited to; product, process, marketing, business model, supply chain, and organizational innovation. These outcomes of innovation have been researched. For example, product innovation (Hannigan, Seidel, & Yakis-Douglas, 2018; Wang, Wang, Chang, & Kang, 2019); process innovation (Aliasghar, Rose, & Chetty, 2019; Diéguez-Soto, Garrido-Moreno, & Manzaneque, 2018; Möldner, Garza-Reyes, & Kumar, 2018); marketing innovation (Aksoy, 2017; Fiore, Silvestri, Contò, & Pellegrini, 2017; Gupta, Malhotra, Czinkota, & Foroudi, 2016); business model innovation (Ciulli & Kolk, 2019; Hamelink & Opdenakker, 2019); supply chain innovation (Chen, Dimitrov, & Pun, 2018; Sabri, Micheli, & Nuur, 2018); and organizational innovation (Anzola-Román, Bayona-Sáez, & García-Marco, 2018; Azar & Ciabuschi, 2017). Competitiveness and sustainable development in the current highly competitive business environment is achievable through innovation (Pelikánová, 2020). Also, small and medium enterprises must take stock of factors that influence their competitiveness in international markets (Stawasz, 2019)

The framework governing innovation remains critical for any economy, whether emerging or mature, as it can either stifle or stir outcomes, and should never static. Borrás and Laatsit (2019) examined the system-oriented innovation policy focusing on the European Union 28 member states and finds that despite the many positives, there are obstacles with the system that need attention. Policies on innovation are crossing cutting, for instance, Arundel, Bloch, and Ferguson (2019) focused on the public sector; Hermans, Geerling-Eiff, Potters, and Klerkx (2018) on public-private partnerships; private sector (Lopez-Berzosa & Gawer, 2014); emerging economies (Fernández-Sastre & Montalvo-Quizhpi, 2019); business survival (Ortiz-Villajos & Sotoca, 2018). The significance of funding innovation is crucial due to associated benefits and risks. Funding remains a hurdle for most firms keen on engaging intensively in innovative activities. That notwithstanding, the link between innovation and its funding has been scrutinized for varying reasons. Yanbo Wang, Li, and Furman (2017) probed the relationship between the performance of a firm and its innovation activities funded by the government; main funders of food and health innovations in the European Union (Strähle et al., 2016); crowdfunding (Wonglimpiyarat, 2018); hedge funding (Brav, Jiang, Ma, & Tian, 2018) among other studies.

Equally, a considerable number of review studies on the subject exist such as indicators of innovation (Dziallas & Blind, 2018); in the supply chain (Wong & Ngai, 2019); innovation nature and variety (Edwards-Schachter, 2018); business model (Geissdoerfer, Vladimirova, & Evans, 2018; Pieroni, McAloone, & Pigosso, 2019); and innovation in organizations (Hauser, Linos, & Rogers, 2017). Bibliographic coupling, a technique that uses citation analysis to create a similarity link of articles, is an idea by Kessler (1963). Hass (1974) reviewed the theoretical grounding of bibliographic coupling and its practical usage by following the works of Kessler. One advantage of bibliographic review is the ability to eliminate humanly related biases. Small and Koenig (1977) used the technique in earlier times to perform journal clustering. Over the years, the researcher has continued to use the method to map scientific work in various fields. The technique continues to be improved to make the findings more comprehensive and comprehensible (Garfield, 2001).

Hence based on the above, it is crucial to map out existing literature on innovation, funding, and governance. Therefore, this article aims to; perform a bibliographic review to determine the most critical papers on business innovation, finance, and policy; group these articles based on their main themes; present a summary of each of selected publications; highlight areas of possible future research based on the analysis. The authors anticipate that this review will provide a good starting point for future studies on innovation, funding, and policy since no study has attempted to evaluate current literature. Also, it may be relevant to policymakers charged with formulating the right plans on novelty as well as its funding. The study addresses the issues identified by providing answers to the following questions:

RQ1: What is the co-authorship level per country?

RQ2: What is the extent of collaborative authorship on innovation between or among institutions of higher learning?

RQ3: What are the main themes of the literature reviewed? What are the influential publications on innovation, funding, and policy from a business perspective, their summary?

To the best knowledge of the authors, the current study is the first to analyze scholarly literature on funding critically, policy framework (as well as their effect) on and business innovation. The study is structured as follows: the next part, part two, is about the methodology and articles reviewed in this study. In section three, the study presents co-authorship from a country-

specific point of view, scientific publications authored through collaboration between institutions of higher learning, and central themes of the papers examined. Part four is a summary of selected articles. Finally, section five is in the conclusion and possible opportunities for future studies.

MATERIAL AND METHOD

This study employs bibliographic coupling to map out the current literature on business-related innovation, funding, and policy. Furthermore, authors have applied bibliographic review approaches to present a comprehensive picture of research status in various fields, for example, (Chen, 2011; Chen et al., 2014; Jarneving, 2007; Ferreira, 2018). For this analysis, documents were searched in the Web of Science core collection database. "Innovation," "Policy," (and) "Funding" were the key terms used in the search. The search is limited to the period between 1990 and mid-February, 2019. The key words resulted in 2,845 articles, and so to further scale down the figure, another keyword, "Business," was introduced. The final search query was ['innovation' AND/OR 'policy' AND/OR 'funding' AND 'business']. The publications considered are those with query words in the title only. Additionally, the introduction of the 'business' as part of the query, limited the search specifically to business-focused publications. The search resulted in 437 papers, as illustrated in Table 1, and articles per year in Figure 1. The authors used Vosviewer software to perform a bibliographic analysis of the document retrieved. Moreover, the 437 articles assessment for association and linkage aimed at singling out related studies, and this resulted in 310 publications.

Also, the 310 documents were analyzed on co-authorship by country and collaborative articles between institutions of higher learning (Finardi, 2014; Talab, Scholten, & van Beers, 2018). The 310 articles must have been cited at least once for inclusion in the analysis. The citing criterion resulted in 242 publications, out of which only 183 had an association with each other. These 183 articles were grouped differently depending on their themes, as shown by both Table 2 and Figure 6. Finally, to identify essential publications, a document must have had a minimum of 20 citations to be considered. Thus, from the remaining 183 papers, 44 papers met the cut, but only 32 articles were related, and these are the ones summarised as illustrated by Table 4. By use of VosViewer, the authors were able to visually present the network of scientific articles on innovation, its funding, and policies from a business point of view. The clustering of reviewed publications shown in Figure 6. The clustering also allowed for the grouping of reviewed articles under particular themes. Figure 1 is a summary of the methodology applied.

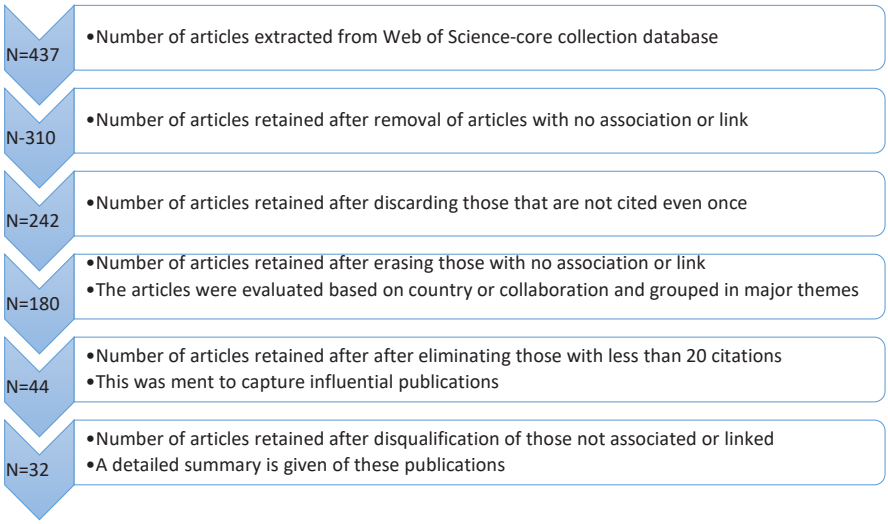

Figure 1. Study sampling process

The reviewed articles were visualized in 13 different clusters depending on their strength of association. From a practical point of view, certain documents would have been placed in more than one group or instead appeared to be not so closely related to the chosen cluster; nevertheless, the authors wish not to manipulate the clustering manually. Likewise, these clusters had different numbers of articles, some having more and other less, but the authors, to the best of their abilities, attempted to find the right theme for each group. Under the analysis of the theme, the authors omitted documents that were in a language other than English, articles with limited access, textbooks, which are non-research work and sections of publications on conference proceedings. Using Vosviewer: Bibliographic coupling and Co-authorship were the basis of analysis with the unit of analysis being documents and countries, while the full counting method was adopted. In summary, the outcome comprised of 242 publications analyzed, 64 clusters, 1413 links, and a total strength standing at 2207.

RESULTS AND DISCUSSION

Scientometrics

This section examines reviewed articles under three main headings: 1) co-authoring to determine the level of academic cooperation between countries on the subject matter at an international level; 2) collaboration in conducting

and publishing scientific work by institutions of higher learning, whether locally, in the region or global angle. Collaboration helps in the sharing or spreading of knowledge, based on the strength of the institution and avoid duplication of research efforts; 3) provide a summary of reviewed publications deemed necessary on innovation, funding, and policy business-wise. The retrieved literature was published in various journals and conference proceedings, as typified in Table 1. Most papers were in the journals relating to innovation, business, and entrepreneurship.

Number of publications per journal

Table 1 epitomizes the different journals and conference proceedings for reviewed articles. The journals are many, but generally, most of them are in the field of innovation, business/entrepreneurship, economics, management, and technology

Table 1. Publication in different journals

Journal	No. of Articles	Journal	No. of Articles
Research Policy	11	Technology in Society	2
Technovation	7	International Journal of Innovation & Technology Management	2
European Planning Studies	7	Transformations in Business & Economics	2
Science & Public Policy	6	International Journal of Technology Management	2
Journal of Technology Transfer	6	Journal of Entrepreneurship & Public Policy	2
Baltic Journal of Economic Studies	6	European Journal of Innovation Management	2
Sustainability	5	Competitiveness Review	2
Small Business Economics	5	Health Research Policy & Systems	2
Tomsk State University Journal	5	Energy Policy	2
Technological Forecasting & Social Change	5	Journal of New Economics Association	2
Marketing & Management of Innovations	4	Research Evaluation	2

Journal	No. of Articles	Journal	No. of Articles
Journal of Rural Studies	4	Entrepreneurship and Regional Development	2
Venture Capital	3	Industry and Innovation	2
Scientific Bulletin of Polissa	3	International Journal of Cultural Policy	2
Journal of Small Business & Enterprise Development	3	Climate Policy	2
Industry and Higher Education	3	Journal of Economic & Policy	2
Journal of Knowledge-Economy	3	Terra Economicus	2
Food Policy	3	Entrepreneurial Knowledge, Technology & the Transformation of Regions	2
Health Affairs	3	Policy Studies	2
Foresight & STI Governance	3	Economics of Innovation and New Technology	2
BMC International Health and Human Rights	3	Economics of Innovation and Technology	2
Asia Pacific Journal of Innovation and Entrepreneurship	3	Regional Studies	2
Journal of Macroeconomics	3	Asia Pacific Journal of Innovation and Entrepreneurship	2
Journal of Cleaner Production	3	Others- Journals with (1) Publication	184
Tourism Management	3	Others- Conference Proceedings	97

Table 1 highlights the 437 articles published in 320 different journals and conference proceedings. Research Policy is the only journal with a high ten publication mark, few within 5-10 range, and a number falling in the 2-4 scope. Nevertheless, most of the journals had just one publication, whereas conference proceedings had a significant amount of documents.

Number of publications per year

Figure 2 presents the number of articles that have published over the years. There was moderate growth in a number of these publications between 1992 and 2008. From a general perspective, however, there is a steady rise in published articles from 2009 to 2018. Innovation is critical for the survival of any firm given the dynamism of the business environment, changes in technology, and ever-growing consumer demands. The importance of innovation in enhancing the competitiveness of an entity cannot be over-emphasized (Ciocanel & Pavelescu, 2015; Distanont & Khongmalai, 2018). Besides, business is now forced to find strategic fits between adopted innovation strategies and the business environment in which they operate to improve on their performance and delivery (Prajogo, 2016). The 2007/8 Global Financial Crisis (GFC) was a turning point for most businesses, and this has captured in many studies (Driver & Muñoz-Bugarin, 2019; Tsuruta, 2019).

Similarly, technological changes dictate reviewing of business models, for example, Lin (2017) explains the importance of collaborations aimed at transferring (innovation) knowledge between universities and the industry (Baglieri, Baldi, & Tucci, 2018). Additionally, some firms are now forming strategic partnerships to harness their respective competitive advantages. Therefore, the reasons mentioned above may partly explain the increase in studies focusing on innovation.

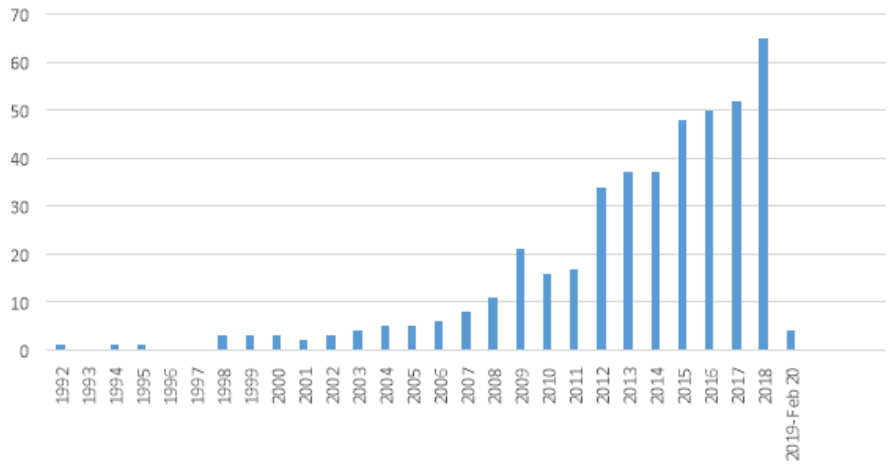

Figure 2. Number of articles published per year

Studies focusing on innovation continue to increase over the years, and this may be the trend in the foreseeable future for some reason. According to [1], 84 percent of the executives concur that innovation is key to a firm's

growth strategies; however, only 6 percent are satisfied with the performance of innovation or rather understand what the problem is precisely and how to enhance innovation and R&D activities in their enterprises. For a firm to survive today's competitive business environment, innovation has to be part of the strategy. [2] report shows that only 12 percent of the Fortune 500 enterprises from 1955 are still operational. Moreover, [3] shows that 50 percent of the S&P 500 firms may be replaced in the next decade, signifying the importance of rapid response to external challenges. There is a clear distinction in both revenues (11 percent) and Earnings before Inflation Tax Depreciation and Amortization (22 percent) growth favoring more innovative enterprises [4].

Publications per country

Figure 3 shows affiliated publications in a given state. To be considered under this category, a country must have had a minimum of 5 publications. International collaborations in research are crucial for any country; uneven global collaboration impacts negatively the practicality of countries' scientific results and expected technological and social effect (Zanotto, Haeffner, & Guimarães, 2016). From the findings, the United States has the most significant number of co-authored articles, followed by England and then the rest.

Furthermore, apart from the United States, most articles are from European countries, few from Latin America and Asia. However, no country from Africa or the Middle East met the cut implying a low level of co-authorship from these two regions. However, innovative, collaborative studies between countries are crucial in the production and dissemination of knowledge. Zhao, Wu, Xi, Na, and Liu (2018) analyzed how a collaborative innovation approach can evolve into a competitive knowledge-intensive alliance by focusing on China, Korea, and Germany. The study also provides new insights and methods for performing collaborative studies between researchers in different countries. Gorraiz, Reimann, and Gumpenberger (2012) explain the principal elements and what should be in the evaluation of international research collaboration by examining Austria and six other countries (Choi, 2012; Kim, 2006).

The under this category publications examined the extent to which countries (authors) engage in collaborative scholarly work across borders. Based on the findings, it is possible to deduce that economies with the higher implementation of innovative activities also have a higher output of collaborative studies.

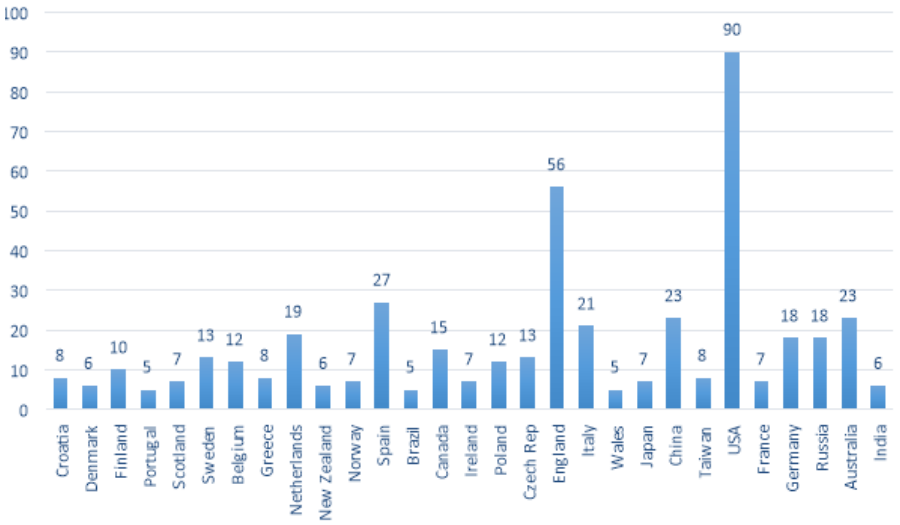

Figure 3. Publications affiliations by country

Number of published articles through collaborations of higher education institutions

Figure 4 illustrates articles published by way of institutional partnerships. Enough empirical literature exists to support continued collaborative studies among academic institutions. Bozeman, Fay, and Slade (2013) probed individual-level collaborations among academic researchers, focusing on university researchers' partnerships with researchers in other areas and industry. The study offers recommendations for improving on such collaborative studies such as increased consideration to multi-levels of analysis and the interplay amongst them; realistic evaluation of impacts rather than outputs; highlighting 'malpractice' and exploitations in these collaborations if any; giving some attention to collaborators' inspiration or the motivation of collaborative teams. Figure 2 shows that based on related research, collaborative studies among institutions of higher learning range between 2 and 5, the cut-off had been set at a minimum of two. England has more academic institutions' engaging in collaborative research.

Additionally, based on the findings, institutions of higher learning in Africa, Asia, and Middle East engagement in collaborative research is almost non-existent. Moreover, collaboration breadth has a direct effect, whereas collaboration depth has a curvilinear impact on academic research performance (Yuandi Wang, Hu, Li, Li, & Li, 2015). Collaborative research is an

alternative way of measuring research performance in institutions of higher learning (Kim, Lim, & Lee, 2014).

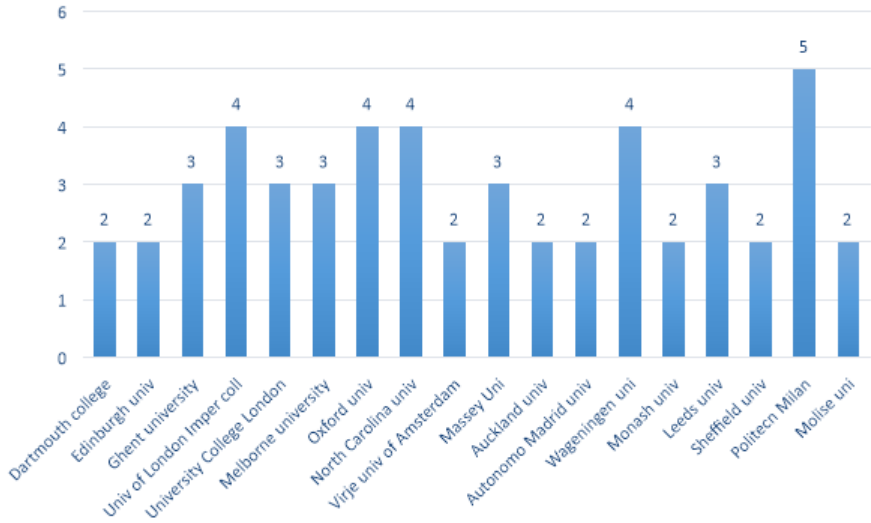

Figure 4. Number of articles authored through institutional collaboration

The findings under this section tend to support those found in the affiliation publications in a given country. Most of the institutions of higher learning partnering in academic work on innovation are from those countries highlighted in the previous section. These findings concur with the work of Crudu (2020), who explains that innovation is more pronounced in states with higher incomes and higher development levels.

Figure 5 is the scientific network of reviewed documents that comprised of 13 clusters, as illustrated by the different color shades. A particular group consists of articles associated with each other based on the strength of the links. Related articles are clustered together under one shade, whereas those in between or among different clusters take the mixture of the associated groups, as shown by the linking lines. Still, the stronger the tone of a circle (article) and track (network), the stronger the link between the publications.

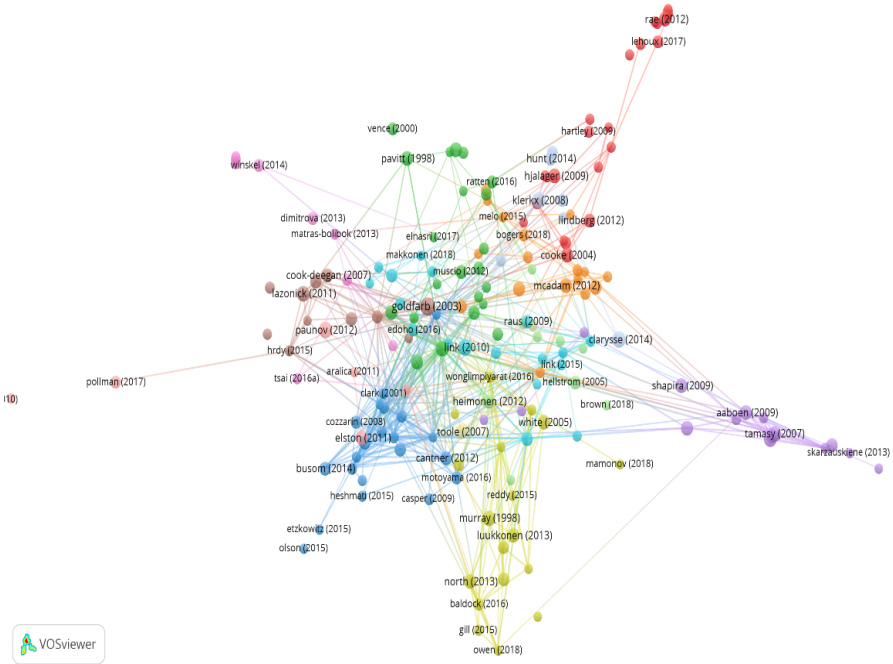

Figure 5. A bibliographic system of connected articles

Themes of reviewed publications

Figure 6 shows the items used to group the 13 clusters presented in Figure 5. These themes or the 13 clusters can be broken down further into three main categories based on the number of articles. These categories are very high, high, moderate, and intermediate impact publications groupings. Type one, on very high impact, consists of themes or clusters with a high number of publications, the items are; policy, economic growth, and research and development/incentives. Category two, top impact publications consist of themes with the second-highest number of documents, which include; funding, business incubation, entrepreneurship, and institutionalization of innovation. Category three consists of life science innovation, and the last category have themes focusing on; sustainability, financial decisions, network/ecosystem, agriculture, and biotechnology.

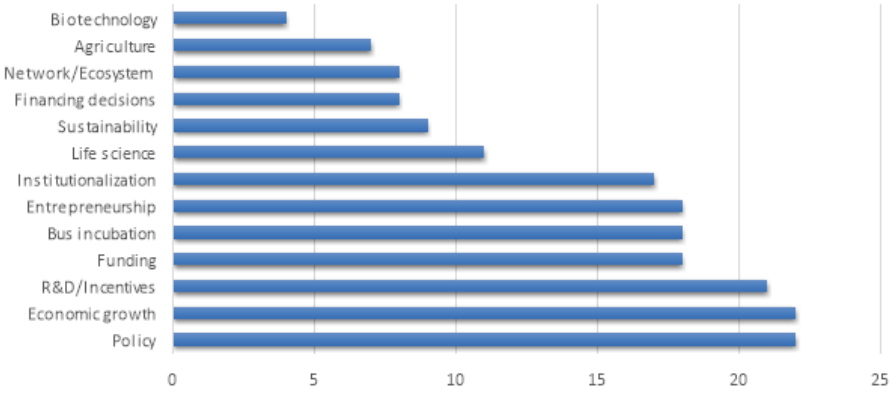

Figure 6. Themes of reviewed articles

Themes and summaries of selected reviewed publications

This section has into three parts; part one contains the various materials examined, part two outlines the 32 selected articles, and their corresponding citations, while part three, is a summary of these chosen articles.

Themes and associated publications

Table 2 represents the articles that constitute a given theme. That notwithstanding, some documents were not included in this section for reasons expounded on under methodology. The higher the standing/level of the group or theme, the higher is the number of the document.

Citation analysis

The citation evaluation of the reviewed literature was done using the document as a unit of study. Only 242 out of the 437 articles had been cited at least once or more, which was the cut-off criteria, as presented by Figure 7. Table 3 shows selected documents from the 242 and their associated level of citation as per the Web of Science. Based on association rule and a requirement of 20 citations, 32 articles were finally selected, as shown. The most cited article is by Goldfarb and Henrekson (2003) at 231citations, whereas a study by comes a distant second, Clarysse et al. (2014), at 96 citations. The remaining publications had citations ranges of between 22 and 81.

Table 2. Themes of reviewed studies

Group	Theme	Article/Author
1	Policy/Regulation	Sá, Kretz, and Sigurdson (2013); Calo (2018); Cooke (2004); de Laurentis (2012); De Lucia, Balena, Stufano Melone, and Borri (2016); Dodescu and Chirilă (2013); Gilmore and Comunian (2016); Kasa Underthun (2010); Jordan, Lemken, and Liedtke (2014); Greenhalgh et al. (2017); Hartley and Montgomery (2009); Reficco and Gutiérrez (2016); Moreton (2016); Rae et al. (2012); Gurzawska, Mäkinen, and Brey (2017); Parvizi and Parvizi (2017); Seppo, Rõigas, and Varblane (2014); Tan (2018); Witten et al. (2018); Lindberg, Danilda, and Torstensson (2012).
2	Economic Growth/Collaboration	Antonioli, Marzucchi, and Montresor (2014); Cumming, Johan, and Zhang (2014); Klerkx and Leeuwis (2008); Lynskey (2004); Domingo and Soriano (2014); Mendes, Serrasqueiro, and Nunes, (2014); Nelson (1995); Pavitt (1998); Muscio and Nardone (2012); Lynch, Lenihan, and Hart (2009); Hemphill (2013); Vickers and North (2000); Rubach (2013); Fogg (2012); Yan, Chien, Hong, and Yang (2018); Vence and Gunti (2000); Ratten, Ferreira, and Fernandes (2016); Elnasri and Fox (2017); Fundeanu and Badele (2014).
3	R&D/Incentives	Afcha and León López (2014); Kenney and Patton (2018); Cozzarin (2008); Lanahan (2016); Wu, Popp, Bretschneider, Maxwell, and Policy (2007); Engel, Rothgang, and Eckl (2016); Heshmati (2015); Cantner and Kösters (2012); Olson and Young (2016); Etzkowitz and Etzkowitz (2015); Busom, Corchuelo, and Martínez-Ros (2014); Czarnitzki (2014); Archibugi and Filippetti (2018); Wang, Li, and Furman (2017); Jr. and Paolucci (2004); Michalsen (2006).
4	Funding	Owen, Brennan, and Lyon (2018); Campos, Coville, Fernandes, Goldstein, and McKenzie (2014); Gill (2015); Baldock (2015); North, Baldock, and Ullah (2013); Collewaert, Manigart, and Aernoudt (2010); Henrekson and Sanandaji (2018); Luukkonen, Deschryvere, and Bertoni (2013a); Murray (1998); Mamonov and Malaga (2018); Kolesnyk (2017); White, Gao, and Zhang (2005); Das, Hui, and Sha (2018); Wonglimpiyarat (2016).
5	Business Incubation	Aaboen (2009); Frenkel, Shefer, and Miller (2005); Mubarak et al. (2015); Löfsten and Lindelöf (2003); Tamásy (2007); Tang, Baskaran, Pancholi, and Lu (2013); Dvouletý, Longo, Blažková, Lukeš, and Andera (2018); Cumming and Fischer (2012); Shapira and Wang (2009); Appelbaum, Gebbie, Han, Stocking, and Kay (2016); Breznitz and Ornston (2018); Walwyn and Cloete (2016); Perampaladas et al. (2010); Chakma, Masum, and Singer (2010).

Group	Theme	Article/Author
6	Entrepreneurship	Bearse and Link (2010); Costa, Laureano, and Laureano (2014); Pergelova and Angulo-Ruiz (2014); Welsh, Kaciak, Trimi, and Mainardes (2018); Link and Scott (2010); Divisekera and Nguyen (2018); Makkonen, Williams, Weidenfeld, and Kaisto (2018); Kalisz and Aluchna (2012); Rószkiewicz (2014); (Petrescu, 2009); Edoho (2016); Sjøvaag and Krumsvik (2017);(Link and Wright (2015).
7	Institutionalization/Academia	Venturini and Verbano (2017); Bengtsson (2017); Rizos et al. (2016); Rosli and Rossi (2016); Wolley (2016); McAdam, Miller, McAdam, and Teague (2012); Minshall, Schmithausen, Kouris, Mortara, and Weiss (2013); Jaekel, Wallin, and Isomursu (2015); Holm (2015); Bogers, Chesbrough, and Moedas (2018); Meissner (2018); Zhang et al. (2018); Catulli and Frye, (2012); Antony, Johnson and, Sin field (2008).
8	Life science	Bar-Shalom and Cook-Deegan (2002); Lazonick and Tulum (2011); Bar-Shalom and Cook-Deegan (2002); Goldfarb and Henrekson (2003); Evens and Kaitin (2015); Džupka, Klasová, and Kováč, (2016); Ghauri and Rao (2009); Kolympiris, Kalaitzandonakes, and Miller (2014);Rdy et al. (2014).
9	Sustainability	Malen and Marcus (2017); Chirambo (2018); Dimitrova (2013); Winskel, Radcliffe, Skea, and Wang (2014); Kolk (2015); Bumpus (2015); Bointner, Pezzutto, Grilli, and Sparber (2016).
10	Financing decisions	Concilio, Molinari, and Morelli (2017); Elston and Audretsch (2011); Pike (2010); Paunov, (2012); Padilla-Ospina, Medina-Vásquez, and Rivera-Godoy (2018); Pollman and Barry (2016).
11	Network/Ecosystems	Heimonen (2012); Heimonen (2012); Begonja, Čićek, Balboni, and Gerbin (2016); Hellström and Jacob (2005); Rubach (2013); Brown et al. (2018); Samford, Warrian, and Goracinova (2017).
12	Agriculture	Klerkx and Leeuwis (2008); Clarysse, Wright, Bruneel, and Mahajan (2014); Sisko Patana, Pihlajamaa, Polvinen, Kanto, and Carleton (2013); Hoppe and Sanders (2014); Hunt, Birch, Vanclay, and Coutts (2014); Ton, Klerkx, de Grip, and Rau (2015); Gava, Favilli, Bartolini, and Brunori (2017).
13	Biotechnology	Toole and Czarnitzki (2007); Bagchi-Sen and Scully (2004); Chang and Tsai (2016).

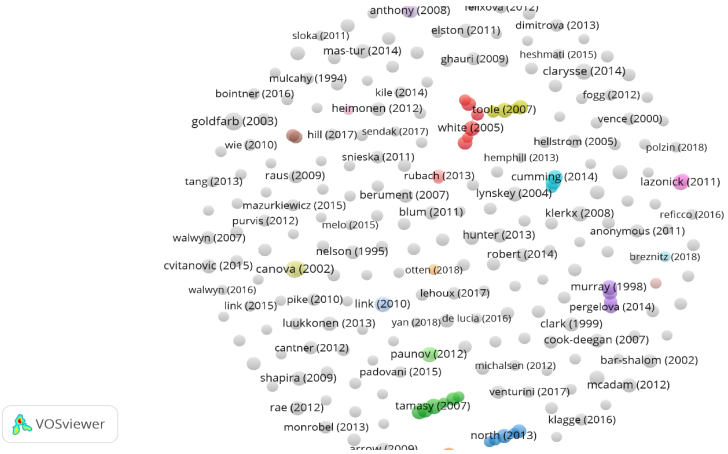

Figure 7. Citation network of 242 out of 437 publications reviewed

Table 3. Ranking publications by the number of citations received

Author	Title	Citations
Aaboen (2009)	Explaining incubators using a firm analogy	35
Clarysse, Wright Bruneel and, Mahajan (2014)	Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems	96
Cumming and Fischer (2012)	Publicly funded business advisory services and entrepreneurial outcomes	28
Löfsten and Lindelöf (2003)	Determinants of entrepreneurial milieu: Science parks and business policy in growing firms	44
Shapira and Wang (2009)	From lab to market: Issues and strategies in the commercialization of nanotechnology in China	37
Sofouli and Vonortas (2007)	S&T parks and business incubators in middle-sized countries: The case of Greece	34
Tamásy (2007)	Rethinking technology business-oriented incubators: Developing a robust policy instrument for entrepreneurship, innovation and, development	60
Czarnitzki (2014)	Innovation subsidies: Does the funding source matter for innovation intensity and Intensity? Empirical evidence from Germany	23
Link and Scott (2010)	Government as an entrepreneur: Evaluating the commercialization success of SBIR projects	71
Lynskey (2004)	Determinants of innovative activity in Japanese Technology-based start-up firms	44
Domingo and Soriano (2014)	The level of innovation among young innovative companies: The impacts of knowledge-intensive services use, firm characteristics and the entrepreneur attributes	33

Author	Title	Citations
Paunov (2012)	The global crisis and firms' investments in innovation	71
Toole and Czarnitzki (2007)	Biomedical academic entrepreneurship through the SBIR program	41
Bar-Shalom and Cook-Deegan (2002)	Patents and innovation in cancer therapeutics: Lessons from CellPro	21
Cooke (2004)	Life science clusters and regional science policy	27
Hjalager (2009)	Cultural Tourism Innovation Systems – The Roskilde Festival	26
Klerkx and Leeuwis (2008)	Balancing multiple interests: Embedding innovation intermediation in the agricultural knowledge infrastructure	81
Lazonick and Tulum (2011)	US biopharmaceutical finance and the sustainability of the biotech business model	63
Antony, Johnson and, Sin field (2008)	Institutionalizing innovation	27
Cumming, Johan and, Zhang (2014)	The economic impact of entrepreneurship: Comparing international datasets	30
Goldfarb and Henrekson (2003)	Bottom-up versus top-down policies towards the commercialization of university intellectual property	231
Heimonen (2012)	What are the factors that affect innovation in growing SMEs?	22
Collewaert, Manigart and, Aernoudt (2010)	Assessment of government funding of business angel networks in Flanders	22
Elston and Audretsch (2011)	Financing the entrepreneurial decision: An empirical approach using experimental data on risk attitudes	27
Elston and Audretsch (2011)	Funding the growth of UK technology-based small firms since the financial crash: are there breakages in the finance escalator?	32
Luukkonen, Deschryvere and, Bertoni (2013)	The value added by government venture capital funds compared with independent venture capital funds	30
Murray (1998)	A policy response to regional disparities in the supply of risk capital to new technology-based firms in the European Union: The European seed capital fund scheme	48
White, Gao and, Zhang (2005)	Financing new ventures in China: System antecedents and institutionalization	41
McAdam, Miller, McAdam and, Teague (2012)	The development of university technology transfer-stakeholder relationships at a regional level: Lessons for the future	35
Rizos et al. (2016)	Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers	26
Nelson (1995)	Why should managers be thinking about technology policy?	26
Pavitt (1998)	The inevitable limits of EU R&D funding	33

A summary of selected publications

Table 4 provides an overview of the 32 chosen documents considered significant based on the citation levels. The summary is necessary for providing information on these studies in a short and precise way. Most of the publications focused on mature economies in Europe, the United States, and a few on emerging such as China. Once again, there are no studies on emerging economies. Nevertheless, the publications are even for quantitative and qualitative studies.

Table 4. Summaries of selected articles

Theme	Study	Summary of the Study
Funding	Aaboen (2009)	The case study uses the analogy of a professional service firm to describe an incubator by stressing on attributes related to resources. The important attributes being an enlistment of new technology-based firms (NTBFs), service delivery, knowledgeable staff, and resource base. Moreover, an improvement in these attributes relates to the incubator's progress with the increased complicatedness of the resource base minimizing chances of imitation. The authors submit that an incubator may have numerous clients with diverse value creation processes or none at all, depending on the context. *Region: Sweden; Study: qualitative; Period:2003-2005.*
Business Incubation	Cumming and Fischer (2012)	The authors empirically interrogate the effectiveness of publicly financed business advisory services and entrepreneurial results. The study finds a positive relationship between advisory services and growth in firms, patents, financing, and strategic alliances. *Region: Canada; Study: quantitative; Duration: over five years Period: 2008-2009.*
	Löfsten and Lindelöf (2003)	The survey study differentiates between new technology-based entities (NTBFs) within and without Science Parks to single out any factor of the added value provided by the parks to these new technology-based firms. NTBFs inside the Park is found to have a greater market distribution within and without Sweden as compared to typical small entities. *Region: Sweden; Study: quantitative; Period:1996-1998.*
	Shapira and Wang (2009)	The conceptual study analyses the gap between nanotechnology researches and assesses future commercialization trajectories of such researches. The study offers two avenues for commercializing enhanced R&D developments in nanotechnology. The commercialization can be through spill-over from the academic sector and spill-over from foreign firms. *Region: China; Study: qualitative; Period:1990-2006.*
	Tamásy (2007)	The survey queries political rationales, explores appraisal literature, and outlines proposals for the future of the business incubation industry. The study argues against public funding of technology-oriented business incubators, instead suggests that they are running as private organizations.

Theme	Study	Summary of the Study
	Sofouli and Vonortas (2007)	The conceptual study connects the policy on science and technology to the goals and features of the well-established parks and incubators. The authors argue that science, technology parks, and incubators in-country ownership and management have moved from academic or research institutes to private players.
		Similarly, financing, the supply of seed capital and venture capital has shifted from government to the private sector. *Region: Greece; Study: qualitative..*
R&D/Incentive	Czarnitzki (2014)	The survey study explores the impact of European policies and public financing on both innovation input and output for the firm. On innovation input, the policies complement each other. On output, subsidy beneficiaries are active in terms of patents. Thus, public funding stimulates socially beneficial research endeavors, while the presence of both national and European policies has no crowding-out effect. *Region: Germany; Study: quantitative; Period:1992-1994*
	Paunov (2012)	The survey analyses the long term effect of the global financial crisis on business innovation activities to formulate necessary post-recovery policy framework. The authors focus on firms in eight Latin American countries. The study finds that such a crisis results in many firms halting ongoing innovation program; however, entities accessing public funding are unlikely to stop these projects. *Region: Latin America; Study: quantitative; Period: 2008-2009.*
Collaboration/ Economic Growth	Lynskey (2004)	The study examines the determinants of innovation, based on patent registrations and new products for technology-based start-up firms in Japan. The authors conclude that technological capacity, the availability of internal financial resources, venture capital funding, and academia-industry collaborations are crucial determinants of innovation at the firm level. Additionally, educational qualifications and the ability of the chief executive officer to network with researchers are fundamental managerial characteristics. *Region: Japan; Study: qualitative.*
	Domingo and Soriano (2014)	The survey probes on the characteristics that improve innovation and adoption of knowledge-intensive business services support for driving innovation in young innovative firms. Further, the study links the level of innovation among these innovative firms to the entities' attributes and the entrepreneurs' characteristics. The authors conclude that the use of knowledge-intensive business services stirs innovation in young innovative companies. *Region: Spain; Study: quantitative; Period: 2009- 2010.*
	Pavitt (1998)	The study aimed at provoking a discussion at a time when there was a general feeling that policies and systems for funding of research and development in the European Union had challenges relating to budgetary constraints, political hurdles, and varying ideas on what the right policy ought to have been *Region: EU; Study: qualitative.*

Theme	Study	Summary of the Study
	Nelson (1995)	The author details three significant aspects of contemporary technology policy, which are significantly crucial to the business. These are; applied for research support by the government, managing declines in basic research funded by corporations, and complex matters on intellectual property rights (IRS) *Region: general; Study: qualitative.*
Funding	Collewaert, Manigart and, Aernoudt (2010)	The survey appraises whether government intervention, such as the subsidization of business angel networks (BANs), promotes regional economic development. The study concludes that BANs minimize the challenges associated with information and financing faced by entrepreneurial firms. Additionally, these firms add to economic growth or expansion. Finally, such a program has several desirable indirect effects, implying that BAN support by the public is necessary. *Region: Belgium; Study: qualitative.*
Entrepreneurship	Link and Scott (2010)	The survey focuses on the Small Business Innovation Research (SBIR) program. The authors show that the innovative utilization of public resources through the SBIR programs aimed at targeting and supporting research activities in small firms tends to minimize innovation impediments that make small entities to underinvest in research and development. *Region: United States; Study: quantitative.*
	Hjalager (2009)	The case study examines cultural tourism from an innovation point of view. Focusing on Denmark's Roskilde Festival as a case study, the authors describe how different organizational frameworks have been developed with political backing to stimulate spin-offs. Additionally, there is a more substantial representation of both the academic and research players. *Region: Denmark; Study: qualitative.*
	Cumming, Johan and, Zhang (2014)	The comparative study is focusing on the effect of entrepreneurship on gross domestic product/capita, levels of unemployment, exports/gross domestic product, and patents registration per population across countries. The study finds entrepreneurship has a significant positive impact on total domestic product/capita, exports/ gross domestic product, and patents registration per population; nonetheless, it hurts levels of unemployment. *Region: 12 countries in western and eastern Europe; Study: quantitative; Period: 2004-2009.*
Policy/Regulation	Cooke (2004)	The comparative analysis probes the likely impact on the science-policy of shifts in R&D-based clusters attributed to the boost of knowledge-economies. The study focuses on life sciences and ways by which Research and Development led groupings to provide crucial resources such as innovative businesses, research funding, and infrastructure in fewer clusters. The authors recommend the provision of new region-based science-policy tools for redistributing this knowledge economy, which is an advantage more significant than just supporting innovation. *Region: the United States and the United Kingdom; Study: qualitative.*

Theme	Study	Summary of the Study
Institutionalization/ Academic	Antony, Johnson and, Sin field (2008)	The case study illustrates that successful innovation depends on three main elements. These include growth blueprints, where managers must know where the entity intends to be and provide the necessary resources; innovation systems and engines; their creation requires developing mechanisms to screen and reduce uncertainty in the projects; right mind-sets, through the creation of a supportive innovation environment by senior managers. The authors finalize by detailing a blueprint and checklist for converting an entity into an innovation hub. *Region: United States; Study: qualitative.*
	McAdam, Miller, McAdam and, Teague (2012)	The case study reviews the link between Government funding entities and technology transfer procedures by the university. The findings indicate that higher targeted funding and policy attributable to the stakeholder relationship mechanism results in the expansion of joint systems with close positioning of performance measures between the technology transfer office and the regional development agencies. *Region: UK; Study: qualitative.*
	Rizos et al. (2016)	
Network/Ecosystem	Heimonen (2012)	The authors explain factors that affect the innovativeness of thriving small and medium-sized entities using intellectual property rights (trademarks, patents, registered designs, and utility modes) as a measure of innovation. The findings suggest that flourishing intellectual property rights intensive entities face more financial pressures as compared to those producing nothing at all. Funding research and development through public finances enhances the chances of desirable innovation *Region: Finland; Study: qualitative; Period: 2002-2005.*
Financing Decisions	Elston and Audretsch (2011)	The study combines both survey and experimental research designs to explore the importance of personal funds in the entry decisions for high-tech entrepreneurs. The findings reveal that; small business innovation research grants (SBIR), use of credit cards, and salary for employed people top sources of funding for entrepreneurs wishing to set-up a firm. Furthermore, firm set-up depends on accessing capital in both initial and early phases of development, also funded by the government covering SBIR grants, is a vital source of financing high technology entrepreneurs. *Region: US; Study: qualitative; Period: 2004.*
	Luukkonen, Deschryvere and, Bertoni (2013)	The comparative study examines the significance of an entity's growth of post-investment, value-added actions by government venture capital firms (GVC) and independent venture capital entities (IVC), based on a survey of growing high tech venture capital-backed firms in seven European countries. The study finds no significant disparity between the two sets of investors. However, the value-added varies depending on the type of investor, with the contributions of IVC funding being significantly higher than those of GVC funding. Besides, this is so in instances such as in the advancement of the business idea, exit strategy, and professionalization. *Region: Belgium, Finland, Germany, France, Italy, Spain & UK; Study: qualitative; Period: 2010*

Theme	Study	Summary of the Study
	White, Gao and, Zhang (2005)	Through a survey study, the authors recommended a general structure for the financing of new ventures as a result of government policy on technology. The situation was at a time when innovation was still a new phenomenon in China in the 80s to early 2000s. The study had a policy and managerial ramifications touching across varying venture funding systems. *Region: China; Study: qualitative.*
	Murray (1998)	The study examines the European Seed Capital Fund Schemes meant to address regional disparities in the availability of risk-free capital for start-ups or new technology-based firms within the European Union in the early 1990s. The scheme was as a result of private venture capital providers lessening their support for start-ups and early-stage technology-based firms in the European Union; and, the presence of spatial concentrations in the availability of venture capital disadvantaged the creation of new, innovative entities in under-developed parts of the Union. The scheme was found to have achieved its objective of stimulating private funding into young innovative technology-based businesses *Region: European Union; Study: qualitative.*
Agricultural	Clarysse, Wright Bruneel and, Mahajan (2014)	The authors empirically examine the knowledge and business ecosystem of the financial support network. The study finds that the knowledge ecosystem has a good framework coalescing around some central actors, whereas the business ecosystem is practically non-existent at the local stage. Additionally, the financial support network is entirely publicly supported and does not link to the knowledge and business ecosystem. *Region: Belgium; Study: quantitative; Period:2005-2011.*
	Klerkx and Leeuwis (2008)	The case study focuses on the link between the for-profit intermediary entity and numerous players for which it carries out diverse bridging roles. The study findings indicate that whereas innovation intermediation remains beneficial, misunderstandings may emerge concerning the innovation intermediary's management framework, modes of revenue generation, and various activities it performs. To minimize such challenges, the authors recommend the demarcation of the intermediary role to avoid competition with other financiers of R&D or knowledge-intensive business services. Equally, funding of innovation intermediaries should be between the public and private sectors. *Region: Netherlands; Study: quantitative; Period: 2005.*
Biotechnology	Toole and Czarnitzki (2007)	The survey interrogates the Small Business Innovation Research (SBIR) program as a policy facilitating entrepreneurship in institutions of higher learning. The findings demonstrate that the program is commercialization avenue by biomedical academic researchers. Equally, the SBIR firms having scientists are significantly better in terms of performance as compared to other SBIR firms; more so on follow-up venture capital financing, SBIR project completion, and patenting. *Region: US; Study: quantitative; Period: 1972-1996.*

Theme	Study	Summary of the Study
Life Science	Bar-Shalom and Cook-Deegan (2002)	The case study highlights the existing link between the utilization of publicly funded research and academia-positioned intellectual property. The study explains how to patent legislation might or might not have a different outcome in the medical sector when compared to other highly technological areas. For example, medical innovations tend to be subjected to more scrutiny from both moral and political perspectives, unlike other non-medical sectors. *Region: United States; Study: qualitative.*
	Lazonick and Tulum (2011)	The case study offers an answer to the "Pisano puzzle," providing a base for investigating the industrial and institutional environments under which the development of the biopharmaceutical (BP) industry can be sustainable. One component of the solution relates to the readiness of the investors at the stock markets to soak in the initial public offerings of a BP project yet to generate a commercial product with the probability of never do so. The other component of the solution is on the knowledge base tapped by BP firms to develop products, to a large extent, this tends to come from government financing and expenditure than from business financing. *Region: United States; Study: qualitative; Period; 1983-2009.*
	Goldfarb and Henrekson (2003)	The comparative study examines the question of what national policies are suitable for enhancing the commercialization of academia-created knowledge. The findings point to laggard levels of commercialization of university-generated research output. The authors attribute this partly to the top-down style of Swedish policies targeting commercialization of innovations and academic surrounding that demotivates academicians from actively engaging in the marketing of their results. On the contrary, in the United States, institutional context is defined by competition between universities and researchers for research funding. The competition, in turn, leads to higher academic flexibility, increased interaction with the industry, especially with new firms. *Region: Sweden and the United States; Study: qualitative.*

CONCLUSION

The authors performed a bibliographic review of published literature on innovation, funding, and policy from a business point of view. The survey examined documents published between 1990 and February 2019 extracted from the Web of Science core collection. A total of 437 articles were retrieved and went through various staged before settling on 32 publications. The analysis of retrieved documents focused on the journal of publication, articles per year, affiliations (publications) per country, co-authorship collaborations of the university, and the main themes of the reviewed studies. Still, the study outlines the citations received by each of the 32 selected publications and their summaries. The summaries grouped in themes have shown areas

that have received more or less attention from researchers. The number of papers in the field has been growing over the years owing to reasons outlined earlier. Generally, countries engaged in higher levels of innovation had higher authoring. Interestingly, few studies on the subject matter were authored in emerging economies such as Africa and Asia, other than China and Taiwan, but to mention a few. The situation is the same for countries in the Middle East. Likewise, most of the collaborative studies are from institutions in the United States and European countries, while other regions lag. Equally, most of the reviewed studies focused on short periods of 5 years and below, probably due to rapid changes innovations. Finally, a case study was the preferred research approach for most authors, followed by comparative studies and the least being experimental; this is not to say there are no other study designs. Therefore, these could be opportunities for future studies.

Limitation, the authors appreciate that reviewing articles by the use of bibliographic techniques is not a substitute for the traditional comprehensive reading approach but rather a compliment. Thus, the method could be a limitation in itself. Moreover, the study used data retrieved from one database, whereas there are other well-established ones. The authors may have been subjective in their omission of articles in languages other than English. Still, it may not have been possible to present all the articles extensively, thus a summary of selected publications. Nonetheless, the findings show a picture of the present state of authoring on innovation, funding, and policy.

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Abstrakt

W ostatniej dekadzie, badania empiryczne, koncentrujące się na innowacjach związanych z biznesem, finansowaniu działań innowacyjnych oraz polityce (implikacje), stale rosły. Nie podjęto jednak jeszcze wystarczających starań, aby zbadać istniejącą literaturę na ten temat. Aby wypełnić tę lukę, niniejsze badanie ma na celu zsyntetyzowanie i zmapowanie istniejących badań empirycznych na temat innowacji biznesowych, finansowania i ram polityki opublikowanych między 1990 a lutym 2019 r. Analizę bibliograficzną odpowiednich artykułów uzyskanych z Web of Science Core Collection przeprowadzono za pomocą Vosviewer. Wyniki bibliometryczne pokazują wybitne publikacje, autorytetów i badaczy, dominujące instytucje szkolnictwa wyższego i kraje. Wybrane artykuły poddano analizie treści, zapewniając streszczenie publikacji, przyjętą metodologię, kraj i okres badań. Artykuły zostały podzielone na różne tematy w oparciu o ukierunkowanie badania, wskazując w ten sposób obszary, które zyskały mniej lub bardziej uwagę naukową. Zidentyfikowane luki zarówno w analizie bibliograficznej, jak i treściowej oferują przyszłe możliwości badawcze w różnych aspektach dotyczących innowacji biznesowych, sposobu finansowania i powiązanych kwestii politycznych.
Słowa kluczowe: *innowacje biznesowe, finansowanie, ramy polityki, bibliometria, analiza cytowań, Scientometrics*

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Conflicts of interest

The authors declare no conflict of interest.

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