



Bibliometric analysis of alternative financing for entrepreneurship

Análisis bibliométrico de la financiación alternativa para el emprendimiento

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ABSTRACT

One of the main limitations of entrepreneurship is access to finance, especially in the early stages. Over the years, new sources of finance have evolved to respond to this need and provide new options for entrepreneurs. Using a bibliometric analysis, this paper examines the evolution of the academic literature and analyses the relationship between entrepreneurship and alternative financing over three periods of time (1975-1999, 2000-2010, and 2011-2020). This work aims to provide a clearer view of the evolution of this relationship and identifies current trends and future lines of research. The data were obtained from the Web of Science (WOS) database and systematized using SciMAT software. Results show that venture capital and business angels have become the main financing sources for entrepreneurs, being the most studied from different approaches, especially since 2000. Incubators in universities and research centers, corporate governance, and development of this type of financing in emerging countries are emerging as potential areas for further research in this field.

Keywords: Bibliometric Analysis, Alternative Financing, Venture Capital, Entrepreneurship.

RESUMEN

Una de las principales limitaciones del emprendimiento es el acceso a la financiación, especialmente en sus etapas iniciales. Con el paso de los años, nuevas fuentes de financiación han ido evolucionando para dar respuesta a esta necesidad y brindar nuevas opciones a los emprendedores. En este artículo, a través de un análisis bibliométrico, se analiza la evolución de la literatura académica en la relación entre emprendimiento y financiación alternativa a través de tres períodos de análisis (1975-1999, 2000-2010 y 2011-2020). Este trabajo pretende aportar una visión más clara sobre la evolución de esta relación, determinando corrientes actuales y futuras líneas de investigación. Los datos han sido obtenidos de la base de datos Web of Science (WOS) y sistemáticos en el software SciMAT. Los resultados muestran cómo el *venture capital* y el *business angels* se han configurado como principales herramientas para el emprendimiento, siendo las más estudiadas desde distintos enfoques, especialmente desde 2000. Las incubadoras de universidades y centros de investigación, el gobierno corporativo y el desarrollo de esta financiación en países emergentes se perfilan como potenciales vías de investigación en este campo.

Palabras clave: Análisis Bibliométrico, Financiación Alternativa, *Venture Capital*, Emprendimiento.

1. INTRODUCTION

Entrepreneurship and financing are notably related due to the difficulties entrepreneurs face in obtaining financial resources to launch their projects (Bucardo *et al.*, 2015). A solution for this problem presents itself with alternative financing methods (Cho and Lee, 2018). According to Gulati and Higgins (2003) and Baum and Silverman (2004), alternate financing methods can be understood to be financing obtained from sources other than traditional lines, i.e., any instrument outside the banking network or circuit. Similarly, Li and Zahra (2012) and Cho and Lee (2018) indicate that alternative financing is any source that is independent of traditional banking and equity markets. Although alternative financing sources utilize exist outside conventional financing channels, they must still respect certain aspects of formality, such as being offered by legally registered and supervised institutions. However, informal options, i.e., those that are not properly registered and monitored, are also attractive options for the early stages of entrepreneurial activity (Nguyen and Cahn, 2020).

Conceptually, entrepreneurship can be viewed in different ways. Some authors, such as De Vries (1997), define entrepreneurship as the conception and implementation of an idea through innovation, management, and risk-taking. The Global Entrepreneurship Monitor defines it as an activity with special characteristics where, in addition to exclusively considering a new venture, it includes a factor of innovation and added value in the activities carried out by the entrepreneur and that is maintained in the different stages of entrepreneurial activity (GEM, 2010). Bucardo *et al.* (2015) and Reverte and Badillo (2019) mention that one of the main problems in achieving success in entrepreneurship is the lack of access to traditional sources of financing.

Nguyen and Cahn (2020) conclude that those ventures that are financed by non-traditional sources are the ones that show the highest short-term growth, especially when they in their early stages of development. Berger and Udell (1998) analyze the sources of financing according to a company's stage in life: seed, start-up, growth, and maturity, highlighting that each business stage will be more effective if the appropriate financing method that corresponds to its needs that can be found at that stage. In general terms, financing alternatives for the seed and start-up stages of enterprises are non-conventional and even informal, such as financing through the so-called 3Fs (family, friends, and "fools"). However, there are also non-traditional formal alternatives such as crowdfunding, accelerators, or venture capital. Traditional sources such as bank loans generally appear in the more mature stages, when businesses have already been established as companies (Fathonih *et al.*, 2019).

For Rossi *et al.* (2021), the right choice of financing is vital to strengthen entrepreneurial competitive advantage. Analyzing 136 countries, Dutta and Meierrieks (2021) conclude there is a direct relationship between the financial development of a sector or a nation and entrepreneurship. They suggest that financial development beneficially contributes to entrepreneurial activity. Cumming and Johan (2017) stress that the literature linking finance and entrepreneurship has been relatively weak since its inception. However, since 2006, there has been a notable increase in incorporating these fundamental criteria and some new ones such as venture capital. Horisch and Tenner (2020) specifically mention that one of the sustainability factors in entrepreneurship refers to

the availability of non-traditional sources of financing, focussing their study on crowdfunding. Ivárr *et al.* (2021) also highlight cooperatives and rural associations as alternative financing methods for entrepreneurship. In general, both alternatives also can meet environmental, social, and sustainable objectives.

Gurau and Dana (2020) mention that the year 2000 represented not only the turn of the millennium but also a turning point in scientific analysis, especially in the field of business, where events such as digitalization and crises such as the "dot-com bubble" represented significant changes. However, Cumming and Johan (2017) find another turning point in the analysis of finance, specifically in the developed countries of Europe and North America, where the crises of 2008 and 2012 marked significant changes in the behaviour of investors and entrepreneurs resulting in a change in scientific analysis.

Thus, a bibliometric analysis is appropriate to study this relationship in greater depth. Cobo *et al.* (2011) indicate that bibliometric analysis, especially scientific mapping, makes it possible to analyze the thematic evolution of a given field of research, as well as to detect and visualize conceptual subdomains, which leads to the establishment of knowledge gaps that provide the opportunity for new researchers to continue with the development of knowledge. Similarly, Ljungkvist (2017) highlights the importance of using relevant databases that guarantee the reliability of the information, as well as the factors that should be considered when analyzing the literature, such as: studies published by year, authors, countries, journals, and indexes.

One of the specific contributions that relate financing and entrepreneurship is that of Cumming and Johan (2017). They analyze the literature and determine that in publications on entrepreneurship, terms related to business financing eventually appear, specifically venture capital, private equity, private debt, commercial credit, business angels, and crowdfunding, among others. On the other hand, Guzmán and Trujillo (2018), through a bibliometric analysis, highlight the relevance of concepts such as social finance in entrepreneurship in the Latin American region and propose it as an alternative solution to the economic growth problems of countries in the region.

Against this background, our research aims to develop a bibliometric analysis to identify the most important areas of knowledge and the knowledge gaps that can be evidenced in the relationship between entrepreneurship and alternative sources of finance. To this end, the conceptual evolution and relationship between the two are analyzed in a bibliometric analysis over three periods. Using SciMAT software, the driving and emerging themes will be determined through knowledge maps.

A weak relationship between the subjects analyzed has been evident in the first few years from the literature review. However, the significant growth in scientific production related to both subjects is worth noting, so it is appropriate to analyze how this relationship has evolved. To achieve this, the strategic diagrams for each period are presented, determining approximately ten clusters per period, which are developed in detail. In the end, five areas of knowledge are determined, in which the clusters found are grouped evolutionarily, defining these as future and potential lines of research and action. In each period, the evolution of the themes that make up the clusters can be seen, determining transversal themes, and identifying future lines of research and action.

This study shows that the leading and most consolidated line of research is the financing of entrepreneurship through venture capital and business angels. Three lines of study are emerging and have great potential: the one associated with the transfer of knowledge from academia to the real sector, the problem of corporate governance in entrepreneurship linked to alternative financing, and the development of alternate financing in emerging countries.

After this introduction, the second section presents the methodology. The third section details the results. Finally, the conclusions are presented.

2. METHODOLOGY

2.1. Keyword co-occurrence analysis

A bibliometric analysis will be carried out to determine how alternate financing has evolved and the knowledge gaps that link alternative sources of funding and entrepreneurship. The tool used is the open-source software SciMAT developed by Cobo *et al.* (2011). It was chosen for its flexibility in selecting measures to obtain and visualize bibliometric networks and scientific knowledge maps, in addition to being able to conduct longitudinal analysis. Bibliometric analysis is a part of scientific metrics that use mathematical methods to analyze scientific publications written about a specific field of study or topic (Ellegaard and Wallin, 2015). According to Cobo *et al.* (2011), the SciMAT software allows a bibliometric study to be carried out based on two essential procedures: evaluation and analysis of scientific production and the creation and interpretation of scientific maps. The latter is one of the techniques whose aim is to monitor a scientific field to understand its structure, development, and main participants (Ramezani *et al.*, 2014).

We have chosen to work with keywords as the unit of analysis (type of information to be processed) to establishing different relationships and to create bibliometric networks based on which the scientific maps will be designed. A co-occurrence relationship was used to study the relationships. Co-occurrence relationships occur when two elements appear together in a document. This analysis allows us to identify the main themes of a scientific field, showing their conceptual and cognitive aspects (Cobo *et al.*, 2011; Paule-Vianez *et al.*, 2020). To obtain meaningful information on the area under analysis, the bibliometric network must first be normalized. Normalizing the network makes it possible to relativize the relationships between two units of study. The normalization measure used in this work was the equivalence index.

The equivalence index: The equivalence index, e_{ij} is defined as: $e_{ij} = c2 i/ccj$, where cij is the number of documents in which two keywords i and j coexist, and ci and cj represent the number of documents in which each one appears. When the keywords always appear together, the equivalence index equals unity. However, it equals zero when they are never associated (Cobo *et al.*, 2011).

Once the network is normalized, topics are extracted using clustering techniques, whose nodes are strongly linked to each other and weakly linked to others. The clustering algorithm based on simple centers was used as it has the advantage of automatically returning clusters labeled with the most central node of the group (Paule-Vianez *et al.*, 2020).

As described by Cobo *et al.* (2014), performing the bibliometric analysis consists of four phases. The first step starts with

identifying a field of research that needs to be investigated. Next, a bibliometric network of normalized joint words is established using an equivalence index considering the co-occurrence of keywords and then grouping keywords into topics through the algorithm of simple centers have. Strategic Diagrams (described later) are then constructed based on centrality and density. The third phase consists of determining the themes through the evolution of research topics to detect the main research fields, their origins, and interrelationships. Finally, through performance analysis, the relative contribution of the research themes to the whole research field is measured (quantitatively and qualitatively).

The Strategic Diagram has allowed for the placement of themes according to their centrality (x-axis) and density (y-axis). Centrality indicates the degree of interaction of a given theme with other themes in the Strategic Diagram by measuring the strength of the external links of a theme with the others; moreover, centrality allows for the measurement of the importance of a theme in the overall development of a scientific field. Density on the other hand, is an indication of the degree of internal cohesion of a topic. It measures the internal strength of the different links of the nodes within a cluster. This value can be understood as a measure of the development of the topic (Cobo *et al.*, 2014). Considering the above, themes can be classified into four categories in the Strategy Diagram as follows:

- Driving themes are in the upper right quadrant and show a strong centrality and density. Themes are well developed and important in the research field.
- Highly developed and isolated themes are in the upper left quadrant and have low centrality but high density. Themes are of marginal importance to the field.
- Emerging or declining themes are in the lower left quadrant and show low centrality and density. They are underdeveloped and marginal.
- Basic and transversal themes are in the lower right quadrant; they show a strong centrality but a low density. They are themes that are interconnected with the other themes but are not well developed.

2.2. Data

The database used for the bibliometric analysis was obtained from the Thomson Reuters Web of Science (WOS) source in all categories of "Social sciences", "Science", "Arts & Humanities" and "Emerging Sources". This database was selected because it is one of the repositories with the most important scientific publication journals in the areas of science, social sciences and arts and humanities (Horisch & Tenner, 2020). In addition, WOS has a higher number of scientific publications compared to other databases. The data were collected in May 2021 and therefore only articles published from the earliest records until 2020 were considered.

Specifically, the search equation used was $TS=(((("financ^* source^*" OR "venture capital" OR "alternative ways of financ^*" OR "financ^* alternative resource^*" OR "business angel^*" OR "alternative source of financ^*" OR "mezzanine financ^*" OR "alternative form^* of financ^*" OR "crowdfunding" OR "financ^* strateg^*" OR "risk capitalist^*") AND "Entrepreneur^*") NOT "bank^* finance^*"))$, which included the concepts analysed. Firstly, alternative financing, expressed through different variants such as: venture capital,

business angels, crowdfunding, among others were used. Documents dealing with conventional or traditional financing through banks were excluded. The search equation exclusively considered the term entrepreneur and its variations, based on what was mentioned in one of the GEM reports (GEM, 2020), which indicates that entrepreneurship includes a factor of innovation and added value in the activities carried out by the entrepreneur and that it is maintained at different stages of entrepreneurial activity. Therefore, entrepreneurship should not be defined exclusively as economic activity at an early age (early entrepreneurial activity) and confused with terms such as start-up. On the other hand, based on the criterion of formality and as indicated at the beginning of the paper, only formal financing alternatives have been considered, which according to Dutta and Meierrieks (2021) represent

an important percentage of financing in successful ventures, and which are included in the search equation. Regarding the type of document, only articles were selected in the search; conference or conference proceedings and book chapters were not considered.

In total, 1,916 documents were obtained. The information obtained was classified into three analysis periods, resulting in a longitudinal study. The first corresponds to 1975 to 1999, the second period was from 2000 to 2010, and the third was from 2011 to 2020. Each of these periods was defined according to the literature reviewed. Cumming and Johan (2017) and Gurau and Dana (2020) note that the turn of the millennium, the year 2000 and the financial crisis of 2008 (that had its eventual effects in 2010) are the major turning points in the analysis of entrepreneurship and finance.

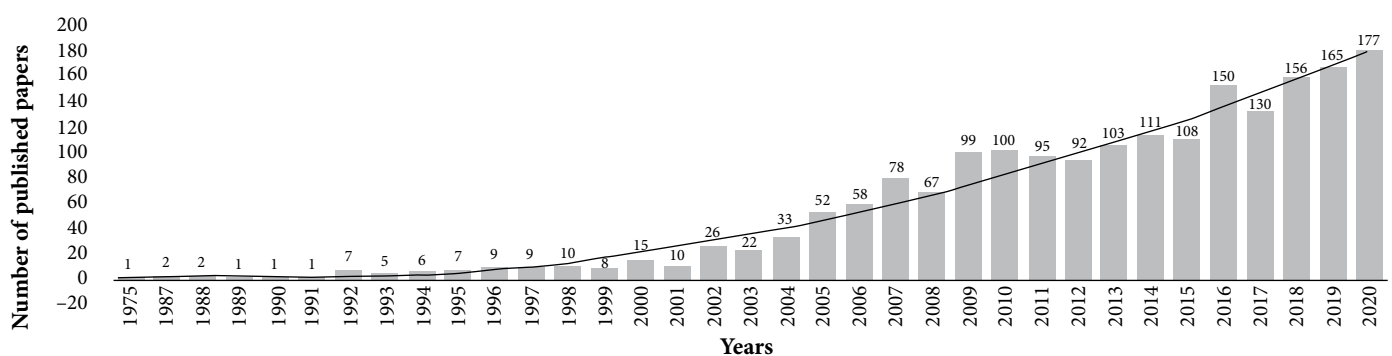


Figure 1
Evolution by year of articles on the subject

Source: Own elaboration.

3. RESULTS

3.1. Evaluation and analysis of the performance of scientific production

An analysis of the evolution of papers on alternative finance and entrepreneurship shows a significant growth over the periods analyzed (Figure 1). The trend line that the data follow indicates a polynomial growth (degree 2) of scientific production. From 1975, when the first publication on the subject under analysis appeared, until 1990, production was sporadic (3.6% of the total). From 2000 onwards, there was sustainable growth of scientific output, reaching 29.2% in 2010. The bulk of the scientific production was found in the third analysis period when 67.2% of the papers in the study were produced. Between the first and the second period, the increase in scientific production is 712%, while between the second and the third period, the increase is 130%. In this sense, the relationship proposed by Price (1956) and Price and Gürsey (1975) suggests that the study of science grows at an exponential rate. If we apply this relationship, it could be expected that by 2025 the scientific production related to the analyzed topic will reach 3,500 documents, and by 2030 it will be approximately 8,000 documents. To determine these values, an exponential equation was considered with the historical data obtained, as follows: $y = 1.1398e^{0.1616x}$.

Concerning the analysis of the authors' performance, Table 1 shows that Douglas Cumming (Florida Atlantic University) is the author with the highest scientific production and the

highest number of citations of his work in alternative finance and entrepreneurship. Toby Stuart (University of California, Berkeley) and Scott Shane (Case Western Reserve University) have a low production of articles but their high number of citations suggest a high quality of research and one that is respected in the field. Richard Harrison, Mike Wright, and Colin Mason have a considerable number of articles and also a high number of citations.

An analysis of the journals in which works on alternative finance and entrepreneurship have been published revealed 850 journals that publish related papers. The 10 journals with the highest scientific output are listed in Table 2 and account for 23% of the total number of articles used in this study. Of these, three are the most significant and accounting for approximately 15% of publications. These journals account for 6%, 5%, and 4%, respectively, of the papers included in the analysis.

Interestingly, the most cited articles do not include any from the most cited author with the highest number of published articles (see Table 3). The most cited paper, with 1,301 citations, is Stuart *et al.* (1999). These authors study the influence of inter-organizational networks of young ventures and firms on the ability to raise the resources necessary for survival and growth, in non-traditional ways, through different sources of finance. They specifically show that biotech companies with an initial composition of non-traditional funding, mainly through venture capital, access IPOs and raise funding faster and with a higher exit valuation than companies with traditional (bank) funding.

Table 1
Scientific production by the author (number of articles and number of citations)

Authors with more articles			Top Citing Authors		
Author	Number of articles	Citations	Author	Number of articles	Citations
Cumming, D	47	2,161	Cumming, D	47	2,161
Harrison, RT	28	1,109	Stuart, T	2	1,963
Wright, M	20	1,305	Shane, S	5	1,506
Schwiebacher, A	16	477	Wright, M	20	1,305
Manigart, S	14	606	Mason, CM	14	1,280
Mason, CM	14	1,280	Harrison, RT	28	1,109

Source: Own elaboration.

Table 2
Most productive journals in the field

Journal	Number of articles	Percentage of total items
<i>Venture Capital Journal</i>	106	6%
<i>Journal Of Business Venturing</i>	93	5%
<i>Small Business Economics</i>	71	4%
<i>Entrepreneurship Theory and Practice</i>	33	2%
<i>Research Policy</i>	30	2%
<i>Strategic Entrepreneurship Journal</i>	26	1%
<i>Journal Of Financial Economics</i>	22	1%
<i>Journal Of Corporate Finance</i>	19	1%
<i>International Entrepreneurship and Management Journal</i>	19	1%
<i>Entrepreneurship And Regional Development</i>	19	1%

Source: Own elaboration.

Table 3
Most cited articles in the area

Journal	Title	Authors	Year	Citations
<i>Administrative Science Quarterly</i>	<i>Interorganisational endorsements and the performance of entrepreneurial ventures</i>	Stuart, TE, Hoang, H, Hybels, RC	1999	1,301
<i>Strategic Management Journal</i>	<i>Internal capabilities, external networks, and performance: A study on technology-based ventures</i>	Lee, C, Lee, K, Pennings, JM	2001	939
<i>Management Science</i>	<i>Organisational endowments and the performance of university start-ups</i>	Shane, S, Stuart, T	2002	662
<i>The Review of Economic Studies</i>	<i>Financial contracting theory meets the real world: An empirical analysis of venture capital contracts</i>	Kaplan, SN, Stromberg, P	2003	652
<i>Research Policy</i>	<i>Why do some universities generate more start-ups than others?</i>	Di Gregorio, D, Shane, S	2003	633

Source: Own elaboration.

3.2. Analysis of scientific maps

Once the performance of the scientific production concerning alternative sources of finance and entrepreneurship was evaluated and analyzed, an analysis of the related thematic studies was carried out through the co-occurrence of keywords.

3.2.1. PERIOD 1975 -1999

We worked with terms with a minimum frequency of one and no minimum frequency of co-occurrence. In the first peri-

od, nine clusters were obtained, representing the following topics: initial public offerings, investment decision-making models, managerial abilities, small business, enterprise innovation, capital market, governance, information analysis and knowledge. According to Cobo *et al.* (2011), the centrality and density of each of the representative clusters should be analyzed to determine the level of development of each theme and its impact on the area respectively. This can be seen in the Strategic Diagram for the first period (see Figure 2).

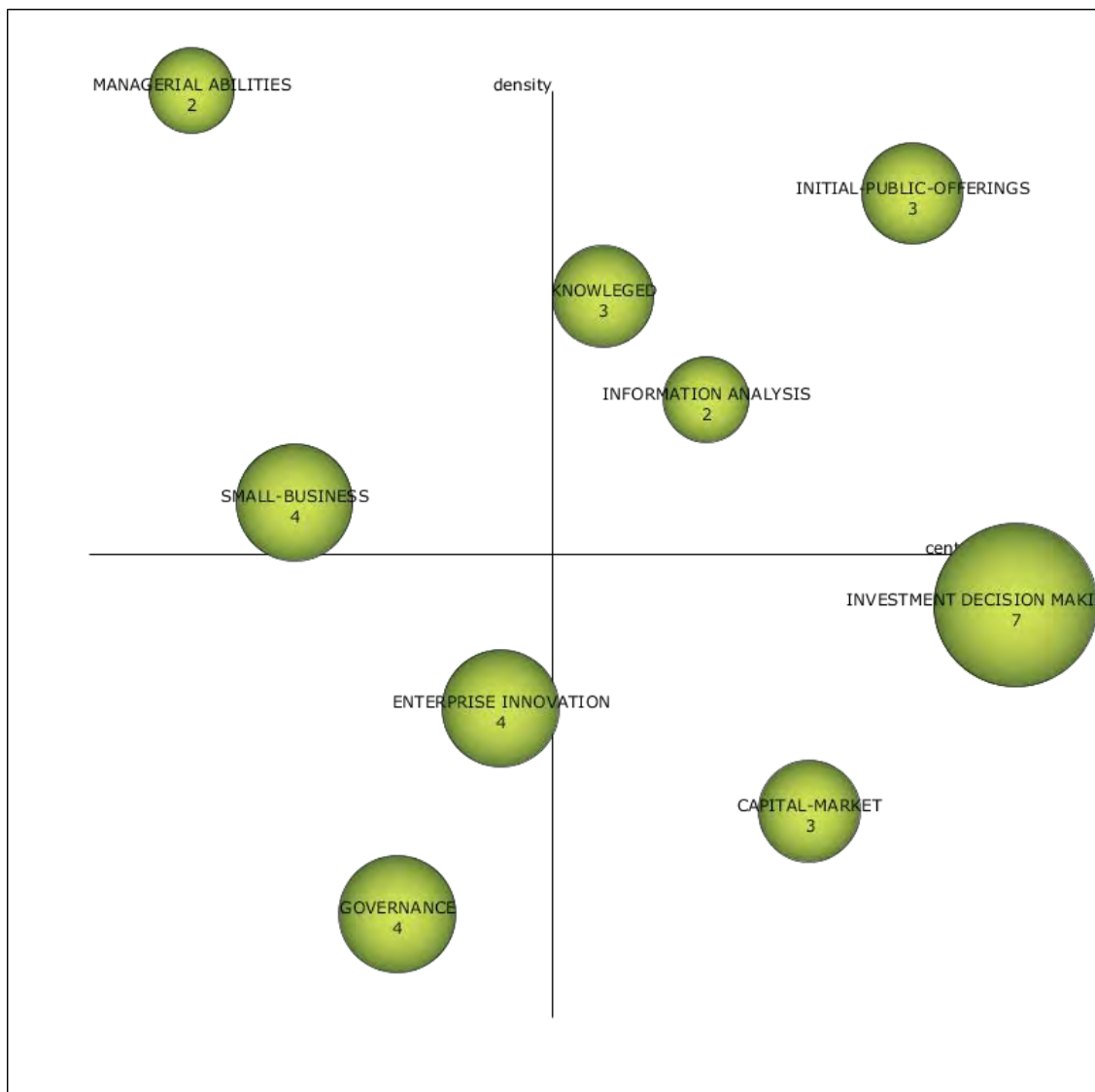


Figure 2
Strategic diagram period 1975 - 1999

Source: Own elaboration through SCIMAT software.

The driving themes, i.e., those with the highest density and centrality, are in the upper right quadrant and, in this case, are:

- Initial Public Offerings: this topic refers to one of the main alternative sources of financing, which large companies in their incorporations have generally used to access the equity markets; however, authors such as [Stuart et al. \(1999\)](#) and [Black and Gilson \(1998\)](#) place it as a source of financing for startups and entrepreneurship.
- Knowledge: This topic refers to knowledge of the environment in decision-making. [Norton and Tenenbaum \(1993\)](#) point out that, especially for investors with an appetite for high-risk (so-called venture investors), knowledge of the market is necessary to apply diversification strategies and avoid risk. Moreover, the more knowledge they have about others, the better they can take advantage of opportunities. [Cable and Shane \(1997\)](#), for their part, mention that success in

venture capital consists of transparency of information and knowledge of the companies of interest to investors that are willing to invest in companies that they understand, know, and are transparent.

- Information Analysis: This topic refers to the process of information analysis. Authors such as [Shepherd \(1999\)](#) highlight the importance of information analysis in the financial decision-making process, especially in venture capital investments. The author indicates that information must be analyzed and contrasted through various methods to obtain more accurate results that avoid erroneous decisions. He also mentions that the smaller the company, the more difficult it is to access and interpret the information, which is why he highlights the relevance of this issue in the analysis of investments in startups and newly created companies. [Storey and Wynarczyk \(1996\)](#) indicate that the survival or otherwise of organizations depends on the study of information.

The basic and transversal themes, those which, despite having a high centrality, have a low density, i.e. those that are not significantly developed in themselves, concerning the theme analyzed, are presented below:

- Investment Decision Making Models: this theme refers to models developed for decision-making, especially financial decisions. [Shepherd \(1999\)](#) highlights a process of careful analysis of information to build a model for effective decision making. [Cable and Shane \(1997\)](#) use the prisoner's dilemma to adapt a decision-making scenario for start-ups and ventures, and venture capitalists. [Hall and Hofer \(1993\)](#) point out the importance of investor decision models, especially for entrepreneurs and small businesses, who usually choose this option as the only financing alternative for their start-ups.
 - Capital Markets: this topic refers to capital markets, where [Yosha \(1995\)](#) stresses that these markets are only open to large companies. He outlines the conditions under which small and medium-sized companies are not able to enter these markets, including high barriers to entry and lack of knowledge. On the other hand, [Norton and Tenenbaum \(1993\)](#) suggest that alternative markets should be considered for small firms that do not meet the requirements for small firms to access traditional markets.
- When looking at the relatively less critical but high-density issues, we find:
- Small Business: this topic concerns the financing of small and medium-sized enterprises. The literature shows that one of the main complications for small business owners is access to finance on competitive and easy terms. [Mason and Harrison \(1995\)](#) point out that venture capital is one of the alternatives for such firms. This topic also includes the analysis of small firms and the success factors for their emergence, growth, and survival ([Walsh et al., 1995](#)).
 - Managerial Abilities: this topic refers to the management skills of entrepreneurs, which directly influence financing decisions. [Tiessen \(1997\)](#) indicates that organizational skills and culture influence financing decisions, determining that entrepreneurs with an individualistic approach tend to use

risk financing that is different from the traditional approach. [Ratnatunga and Romano \(1997\)](#) also mention the impact of entrepreneurship on financial strategies, especially in small and medium-sized enterprises.

Finally, the issues with less development and importance are:

- Enterprise innovation: this theme refers to the impact of enterprise innovation on the value and financing of firms. The authors focus on technological innovation. [Hurry et al. \(1992\)](#) stress that business innovation, with a particular focus on technological innovation, increases the value of firms and the interest of venture capitalists such as business angels and venture capitalists. [Guild and Bachher \(1996\)](#) highlight the importance of alternative financing for the initial operations and growth of firms, especially those with a high technological innovation component.
- Governance: this theme refers to corporate governance and the influence of risk investors in defining business strategies. [Black and Gilson \(1998\)](#) highlight the difference between corporate and central governments in American and Asian countries, determining that these differences influence the financial markets in which they operate and their forms of financing. On the other hand, [Hellman \(1998\)](#) and [Fried et al. \(1998\)](#) refer to governance as the internal control of firms and determine that entrepreneurs should consider that high-risk investors will want to take control of ventures with growth potential and should decide whether they are willing to give it up.

In this way, one of the emerging themes corresponds to business innovation, strongly linked to technological innovation and technological entrepreneurship. In contrast, one of the themes that may disappear due to its low centrality and density is governance.

After analyzing each of the topics in the Strategic Diagram, it is appropriate to assess the productivity and impact of each topic (Table 4). We have analyzed the number of documents, the H-index (h articles out of the total number of articles in the theme that have at least h citations) ([Paule-Vianez et al., 2020](#)), and the average number of citations for each theme according to the different main articles.

Table 4
Productivity and impact by theme period 1975 - 1999

Topics	Number of Documents	Index H	Average number of citations	Centrality Rank	Density range
Initial Public Offerings	3	3	746.00	0.89	0.89
Managerial Abilities	2	2	144.50	0.11	1.00
Small Business	4	3	39.75	0.22	0.56
Knowledge	3	3	109.67	0.56	0.78
Information Analysis	2	2	138.50	0.67	0.67
Investment Decision Making Model	7	7	179.86	1,00	0.44
Enterprise Innovation	4	4	85.25	0.44	0.33
Governance	4	4	257.25	0.33	0.11
Capital-Market	3	3	224.33	0.78	0.22

Source: Own elaboration.

In the first period, we worked with 25 documents, from which 9 keywords were determined. The cluster of Initial Public Offerings stood notably from the rest regarding the average number of citations. The only cluster that stood out in terms of the number of documents and H-index was the Investment Decision-Making Model cluster with 7 papers and an H-index of 7. Furthermore, this cluster was the only one with total centrality (1.00). It was the most important of the topics analyzed during this analysis period. The cluster of Initial Public Offerings was also among the most important. Concerning the level of theme development, the cluster of Managerial Abilities was identified as being the most devel-

oped as it presented a density of 1.0. The Initial Public Offerings cluster was also located within the highest density clusters.

3.2.2. PERIOD 2000 - 2010

We worked with terms with a minimum frequency of four and a minimum co-occurrence of three for the second period. Eleven clusters emerged in the analysis and are as follows: Initial Public Offerings, Convertible Securities, Start-Ups, Small Business, Industry Relations, Knowledge, Portfolio, Economic Growth, Research and Development, Partnership and Venture Capital (see Figure 3).

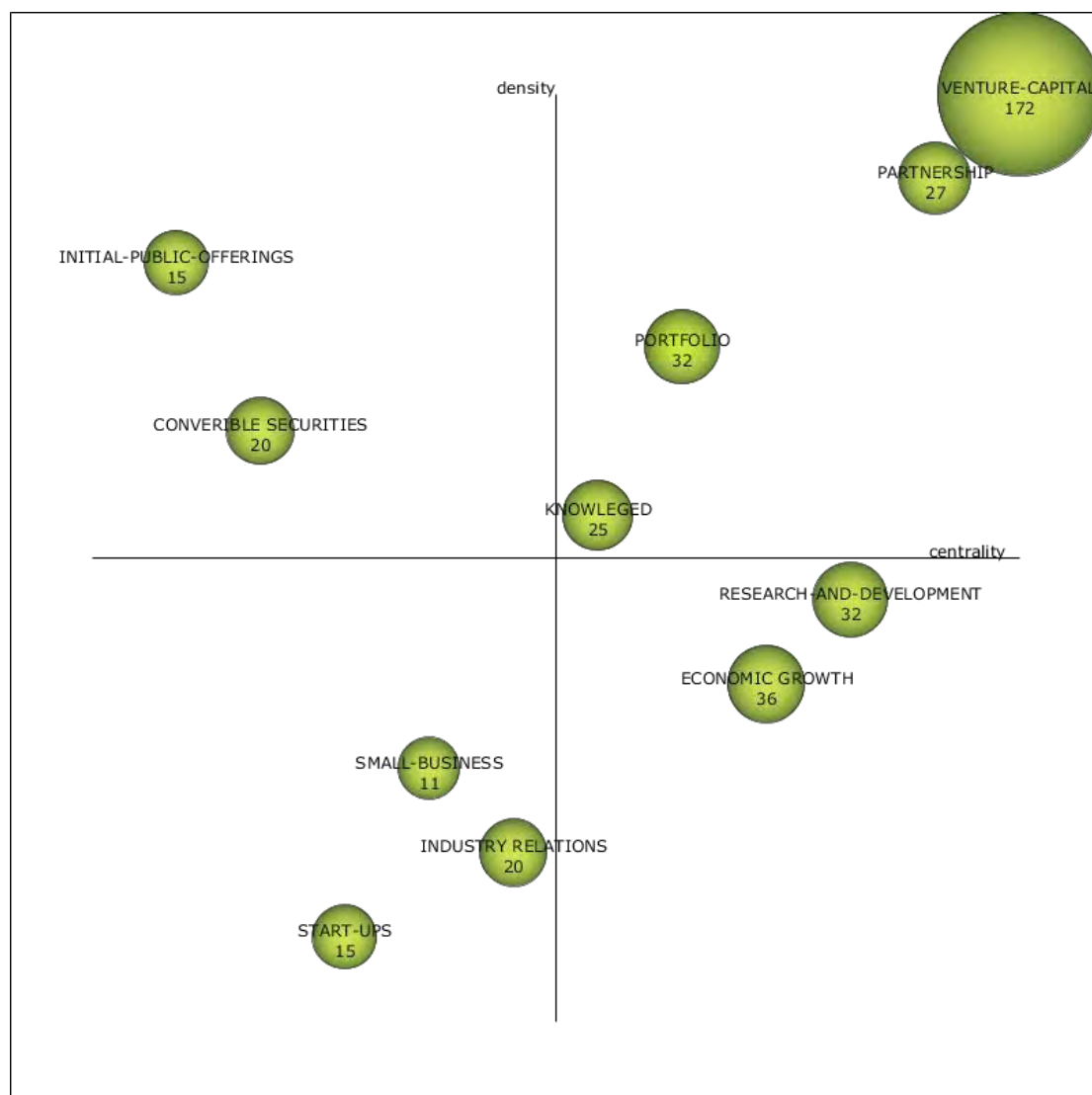


Figure 3
Strategic diagram period 2000 - 2010

Source: Own elaboration through SCIMAT software.

The driving themes are as follows:

— Venture capital: This topic had the most significant number of papers and refers to venture capital. [Gompers and Lerner \(2001\)](#) define venture capital as the perfect intermediaries in the finan-

cial markets that provide capital to companies with traditional financing problems. They have become an attractive source of alternative financing, which aims to strengthen start-ups and potential ventures that cannot access traditional sources. [Baum and Silverman \(2004\)](#) add that venture capital is the dominant

source of selection that shapes the environment in which new companies evolve, identifying future potential and helping to realize it. In other words, venture capital impacts the success of a venture (Kaplan & Stromberg, 2003). Gulati and Higgins (2003) point out that ventures and start-ups backed by venture capital have more value in the marketplace, so they argue that venture capital financing is beneficial for ventures.

- Partnership: this theme refers to business partnerships or associativity to form businesses. This cluster is related to other clusters in the network, such as collaborative platforms, cooperation, and business strategies. Baum and Silverman (2004) highlight the partnership between venture capitalists, owners of financial capital, and entrepreneurs, owners of business ideas to strengthen start-ups. Hsu (2007) mentions that experienced entrepreneurs can form partnerships to finance new entrepreneurs with potential thus avoiding the need to include venture capitalists and their influence on the decisions of the companies they fund.
- Portfolio: this topic refers to portfolios of investors' securities with a high-risk profile. In this case, it should be noted that portfolios that invest in formal financial markets are not considered. Cumming and Dai (2010) highlight that venture capital portfolios are mainly composed of technology ventures, which is why they point out that investors with a high risk appetite have a bias towards not diversifying and betting almost everything on the technology sector. Cumming (2006) analyses the make-up of portfolios that invest in Silicon Valley venture capital for enterprises and start-ups and analyses them in terms of the outstanding regulations.
- Knowledge: this theme was one of the themes analyzed in the first period and now reappears. It remains in the category of driving theme, although its density has decreased. The cluster network of this theme changed from the first period to second with corporate experiences and resources found in the latter. Ramos-Rodriguez *et al.* (2010) argue that knowledge and recognition of business opportunities is the first stage of the entrepreneurial process, so individuals and investors must access knowledge about the likelihood of accessing good business opportunities in their area of expertise.

The basic and transversal themes are presented below:

- Research and development: this theme refers to research and development and is a theme composed of business innovation, academic spin-offs, and technological innovation. This theme includes investment in research and development by companies as well as contributions from academia. Youtie and Saphira (2008) note that universities have become knowledge centers promoting innovation and supporting entrepreneurs by providing them with tools to improve their businesses. Several universities have even developed spin-off initiatives based on research generated at their institutions (Wright *et al.*, 2006).
- Economic growth: this theme refers to economic growth and its relationship to entrepreneurship. Hsu (2007) and Shane and Stuart (2002) emphasize that ventures contribute to the economic growth of nations. However, they indicate that the ventures that generate the most value by providing solutions to macroeconomic problems and by generating economic growth are those that are financed by venture capital.

When looking at the relatively less important, but high-density issues, we find:

- Initial Public Offering (IPO): this theme refers to initial public offerings that enable companies to be listed and publicly traded in the financial markets. In the previous period, this issue was also analyzed as a driving issue (high centrality and density). In this period the issue continues to have density, but centrality has decreased suggesting that it is a less important issue in the analysis. Gulati and Higgins (2003) noted that venture IPOs increased because of two factors: financing through venture capital and strategic alliances with international companies.
- Convertible securities: this topic refers to convertible securities. Bascha and Walz (2001) mention that convertible securities are one of the solutions that enable entrepreneurs to exit their businesses and allowing venture capitalists to take more control of the ventures. Hellman (2006) mentions that convertible securities operate under a dual moral hazard model under which both the entrepreneur and the venture capitalist must make value-added contributions.

Finally, the emerging or disappearing themes are:

- Small business (SMEs): refers to small businesses. This theme also appeared in the previous period in the quadrant of high density and low centrality. However, it has decreased to less developed with lower centrality, becoming an emerging or disappearing theme. This theme highlights the different criteria used by banks, venture capitalists, or business angels to finance small businesses (Mason & Stark, 2004). It also includes the determinants of capital structure and financing decisions of small and medium-sized enterprises (Abor & Biekpe, 2009).
- Industry relations: This theme refers to industrial relations in ventures. Markman *et al.* (2008) stress that ventures with industry relations with sustainable companies and international companies are more attractive when seeking additional funding. Lechner *et al.* (2006) also argue that industrial relations strengthen the value of ventures.
- Start-ups: This topic refers to technology-intensive start-ups with scalable business models. Lee *et al.* (2001) indicate that start-ups financed by venture capital are virtually guaranteed success and growth in the short term. Hsu (2007) adds that in addition to the success of the start-up, it is guaranteed to increase in value through IPOs or convertible securities.

After analyzing each of the themes of the Strategic Diagram for the second period, it is important to evaluate the productivity and impact of each theme (Table 5). During the second period, work was carried out on 405 documents resulting in 11 keywords. In academic research, the IPO is being used as a form of financing that can also address the needs of start-ups and SMEs. At the same time, venture capital is growing in strength as a financing alternative in this second period, demonstrated by its complete centrality and density. In fact, its relevance is evident in Table 2, as the Venture Capital Journal is the journal with the highest volume of papers on alternative financing. The concept of start-up begins to be used progressively after the steps taken in the first period.

Table 5
Productivity and impact by theme period 2000 -2010

Topics	Number of Documents	IndexH	Average number of citations	Centrality Rank	Density range
Partnership	27	17	85.48	0.91	0.91
Venture-Capital	172	55	59.58	1.00	1.00
Initial-Public-Offerings	15	13	101.60	0.09	0.82
Portfolio	32	25	68.47	0.64	0.73
Research-And-Development	32	25	93.34	0.82	0.45
Economic Growth	36	25	84.58	0.73	0.46
ConvertibleSecurities	20	16	42.30	0.18	0.64
Knowledge	25	17	84.92	0.55	0.55
Small-Business	11	9	67.00	0.36	0.27
Industry Relations	20	14	60.15	0.45	0.18
Start-Ups	15	9	125.60	0.27	0.09

Source: Own elaboration.

3.2.3. PERIOD OF 2011- 2020

Finally, we worked with a minimum frequency of seven and a minimum co-occurrence of six for the third period. Ten clusters

were obtained: venture capital, emerging economies, economic growth, technology strategies, governance, business angel investment, academic entrepreneurship, managerial abilities, business groups and entrepreneurial skills (see Figure 4).

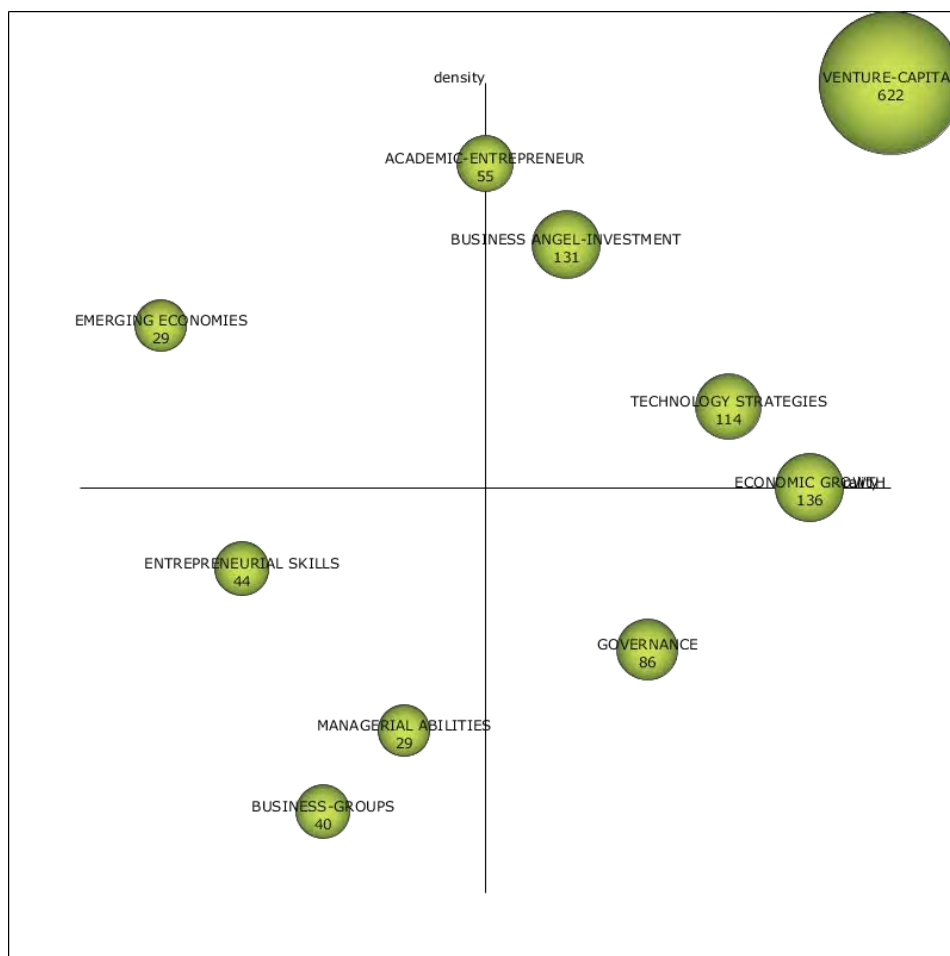


Figure 4
Strategic diagram 2011 – 2020
Source: Own elaboration through SCIMAT software.

The driving themes are as follows:

- Venture capital: this theme refers to risk investments and was one of the themes that emerged in period two. It remains in the quadrant of driving themes, showing the highest centrality and density in both periods. In period three, variations in venture capital in each country are analyzed, with institutional formality being one of the main determinants (Li & Zahra, 2012). Concepts such as independent venture capital (IVC) and the relationship with innovation and value-added creation in ventures are also included (Chemmanur *et al.*, 2014).
- Academic entrepreneur: this theme refers to entrepreneurship as a result of academic research. It highlights the dissemination and transfer of knowledge and technology from science and academia that results in the creation of ventures (Hayter, 2013). These ventures are built based on technical know-how and knowledge and have a greater guarantee of being successful ventures. They contribute to the generation of employment and economic development but are dependent on the environment in which they are located (González *et al.*, 2013).
- Business angel investment: this topic analyses the influence of business angels on ventures. Maxwell *et al.* (2011) define the criteria that business angels consider when financing ventures, identifying that profitability of the business is not the only criterion but is among a wide range of factors that are considered. They also analyze the conditions that entrepreneurs must have to attract business angel financing (Parhankangas & Ehrlich, 2014).
- Technology strategies: this theme refers to strategies that transform technology into innovation and that make ventures more attractive. Panhke *et al.* (2014) stress that technology transfer strategies should be applied to all types of businesses regardless of the sector in which they are developed and that the earlier they are applied, the greater the likelihood of success.
- Economic growth: this theme refers to the economic growth of nations driven by the generation of entrepreneurship. In the previous period, this theme was also considered with high centrality and low density; for this period, centrality remains high, and density has increased, making it a driving theme. Grilli and Murtinu (2012) point out that ventures mainly funded by venture capital tend to contribute to economic development.

The basic and transversal themes identified are:

- Governance: this topic refers to corporate governance. This topic was analyzed in the first period when it was considered an emerging issue, but by the third period, it has become a basic or cross-cutting issue, as its level of centrality has increased. The authors continue to indicate that the participation of venture capital has an impact on corporate governance and decision-making. Hearn and Piesse (2013) highlight that this situation can have a negative outcome if the venture capitalists are not state or local, as foreigners diminish business value; Cumming *et al.* (2019) and Gurau and Dana (2020) affirm that venture capitalists have a posi-

tive impact on corporate governance due to their management experience.

When looking at the relatively less important, but high-density issues, we find:

- Emerging economies: this theme refers to ventures and alternative financing in emerging economies. Hain *et al.* (2016) point out that venture capital investors are investing more heavily in ventures in emerging economies, as their development potential is accelerating. Scheela and Jitrapanun (2012) mention that business angels are also opting for ventures in emerging areas with a special focus on the Asian region.

Finally, the issues with less development and importance are:

- Entrepreneurial skills: this theme mainly refers to entrepreneurship, entrepreneurial intention, and entrepreneurial orientation, which are considered the main entrepreneurial skills. Cho and Lee (2018) highlight that these entrepreneurial skills impact the financial performance of ventures.
- Managerial skills: this topic refers to the managerial skills of entrepreneurs, which directly influence funding decisions. Maxwell and Levesque (2014) indicate that managerial skills can be a decisive factor for a venture capital or business angel investor. The primary outcome that needs to be achieved is that of building trust.
- Business groups: This theme refers to business groups as an alternative to help start-ups deal with institutional knowledge, management, and other gaps (Mingo, 2013). Ljungkvist (2017) highlights that business group support has better effects on family businesses, newly created start-ups, and new ventures. For well-established companies, joining these groups does not have a big impact.

After analyzing each of the themes of the Strategic Diagram for the third period, it is necessary to evaluate the productivity and impact of each theme (Table 6), where the analysis of 1,286 documents can be seen. As was found in period two, the theme that stands out with the greatest productivity as measured by the number of papers and H-index, is venture capital with 622 documents and an h-index of 43. In addition, this cluster is the only one that presents centrality and total density (1.00), i.e., it is the most important of the themes analyzed, and the most developed in this period. In this way, venture capital is consolidated as a central theme in alternative financing in the third period. The figure of the Business Angel appears as another more specific financing alternative. In the field of entrepreneurship, the transfer of knowledge from academia to the productive sector appears for the first time with the theme of Academic entrepreneur and the development of entrepreneurship in emerging countries with emerging economies. Finally, the concept of Governance is also incorporated in line with the progress made in this area in the business world under the umbrella of Corporate Social Responsibility.

Figure 5 shows the longitudinal analysis of the themes analyzed over the three periods. The analysis is based on the number of documents per theme, where venture capital and the themes of the third period, in general, stand out.

Table 6
Productivity and impact by theme period 2011 -2020

Topics	Number of Documents	Index H	Average number of appointments	Centrality Rank	Density range
Venture-Capital	622	43	12,23	1,00	1,00
Business Angel-Investment	131	20	12,92	0,60	0,80
Economic Growth	136	22	13,08	0,90	0,50
Academic- Entrepreneur	55	14	8,20	0,50	0,90
TechnologyStrategies	114	24	12,77	0,80	0,60
Governance	86	19	11,56	0,70	0,30
ManagerialAbilities	29	11	13,69	0,40	0,20
EntrepreneurialSkills	44	9	9,50	0,20	0,40
Business-Groups	40	9	6,58	0,30	0,10
Emerging Economies	29	10	15,03	0,10	0,70

Source: Own elaboration.

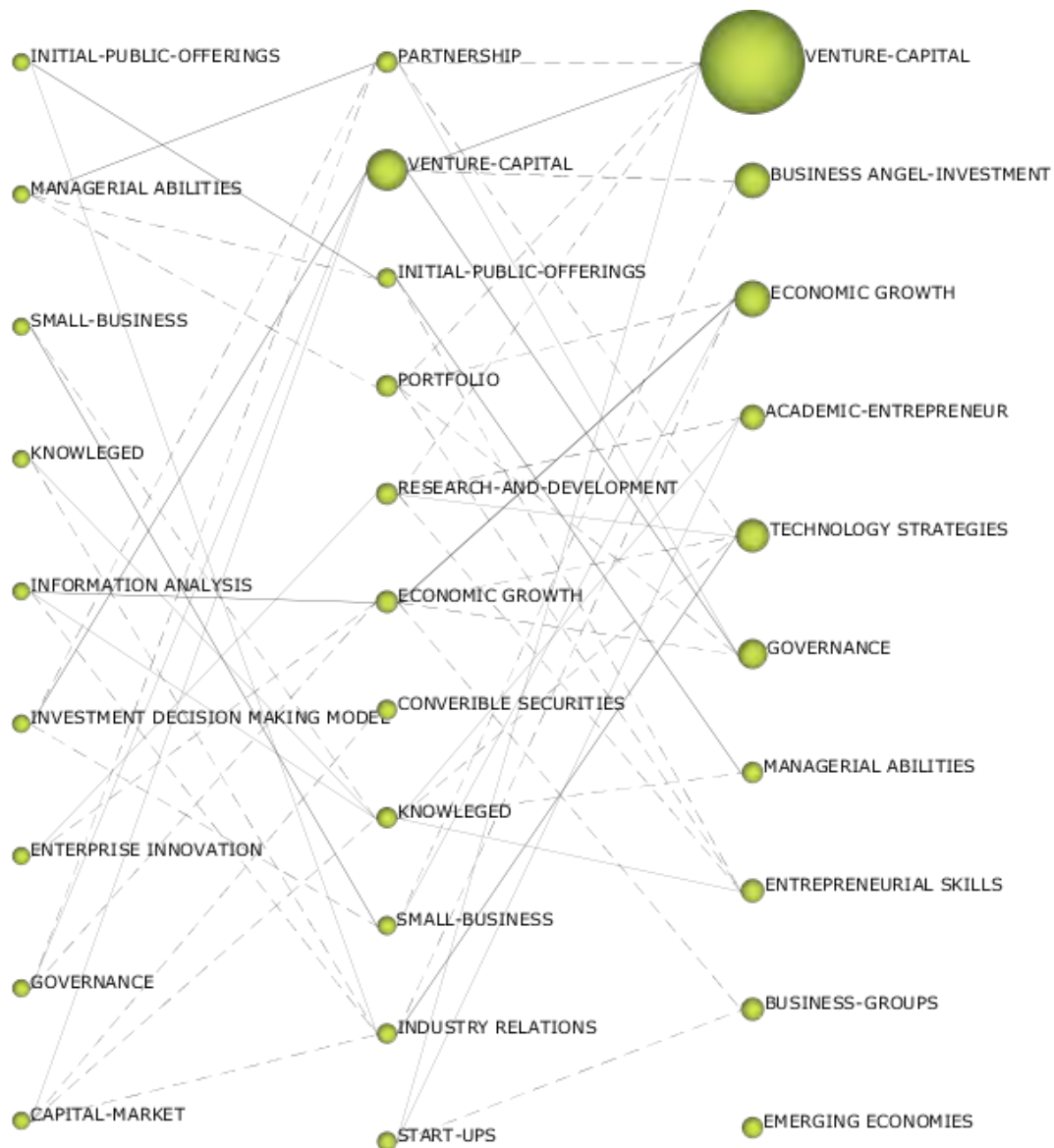


Figure 5
Longitudinal analysis of themes by period
Source: Own elaboration through SCIMAT software.

Five general areas have been identified in terms of the evolution of topics and areas of knowledge: venture finance, knowledge and information analysis, SME management, corporate governance, and economic growth (Figure 6).

The first area analyzed corresponds to venture finance through strategies that are alternatives to the traditional stock market but that are related to it. The topic of venture capital is strongly developed, especially from the second period on. It includes the options of IPOs, convertible securities, and business angel investors as strong links to venture capital.

The second area of knowledge is related to the knowledge and analysis of information, representing a straightforward evolutionary process, starting in the first period simply as knowledge and analysis

for decision-making. In the second period, it becomes research and development. In the third period, the results show the application of science and academia in the business sphere through the creation of ventures from laboratories or academic incubators.

The third area of knowledge deals explicitly with the management of small and medium-sized enterprises. In the first period, this dealt exclusively with the themes of management in general and innovation. During the second period, special emphasis is put on partnership as a response of start-ups at birth, and the literature pays special attention to start-up financing. In the third period, technology strategies, management skills related to entrepreneurship skills, and maintaining the associativity line of period two, business groups are also included.

1975 -1999	2000-2010	2011-2020
INITIAL-PUBLIC-OFFERINGS CAPITAL-MARKET	INITIAL-PUBLIC-OFFERINGS VENTURE-CAPITAL CONVERTIBLE SECURITIES PORTFOLIO	VENTURE-CAPITAL BUSINESS ANGEL- INVESTMENT
KNOWLEDGED INFORMATION ANALYSIS INVESTMENT DECISION MAKING MODEL	KNOWLEDGED RESEARCH-AND- DEVELOPMENT	ACADEMIC-ENTREPRENEUR
MANAGERIAL ABILITIES SMALL-BUSINESS ENTERPRISE INNOVATION	SMALL-BUSINESS INDUSTRY RELATIONS START-UPS PARTNERSHIP	TECHNOLOGY STRATEGIES MANAGERIAL ABILITIES ENTREPRENEURIAL SKILLS BUSINESS-GROUPS
GOVERNANCE		GOVERNANCE
	ECONOMIC GROWTH	EMERGING ECONOMIES ECONOMIC GROWTH

Figure 6

Evolution of areas of knowledge by period

Source: Own elaboration.

The remaining two areas are less developed, with very specialized topics. The topic of corporate governance is discussed in both the first and third periods. Finally, from the second period onwards, economic growth is considered because of ventures using alternative financing, and in the third period, emerging economies are also included in scenarios that favour alternative sources of financing.

4. CONCLUSIONS

Alternative sources of financing can be a solution for entrepreneurs in their initial stage of operation, so it is important to analyze and determine the evolution of these variables to define new research areas. Considering that entrepreneurship is an important part of an economy's dynamism, it is essential to assess the impact of the type of financing on their operation.

To meet the research objective, to identify the most important areas of knowledge, as well as the knowledge gaps that can

be evidenced in the relationship between entrepreneurship and alternative sources of financing, a bibliometric study has been carried out on the relationship between entrepreneurship and alternative financing. Through the analysis of co-occurrence of keywords with SciMAT software, we found themes that are repeated in some periods, venture capital (second and third periods), knowledge (first and second periods), governance (first and third periods), determining a specific evolution in the areas of knowledge analyzed. We also found a polynomial growth in the number of documents related to the subject, especially since the year 2000 and which was accentuated in the last 10 years of analysis. This situation is due to academic development in general, but also as a response to crises such as the dot-com bubble at the end of the 1990s and the global financial crisis of 2008.

The potential for growth in scientific production in the coming years is remarkable, as mentioned in the results section. This situation could be explained by the globalization of the economy, access to the internet, the use of social networks, among other factors that facilitate research, communication, and dissemination.

With respect to the most representative authors cited in the document, Douglas Cumming stands out, whose main line of study is the analysis of venture capital. This topic is also the most productive and with the highest performance, especially in periods two and three, in which it has complete centrality and density. Thus, it is the most important driving theme of the analysis. This author considers venture capital as one of the determinants of the success and sustainability of ventures and analyses it from various perspectives, such as corporate governance and the economic environment. These factors are determinants for portfolio formation, entrepreneurial intention, and orientation, among other aspects, which give strength to the relationship between venture capital financing and venture success.

The journal that has published the most articles is *Venture Capital Journal* despite having articles since 2005, as well as *Entrepreneurship Theory and Practice* and *Research Policy Journal*, which have many articles related to the analysis. It should be noted that articles are increasingly being published in journals with a more specific focus, in contrast to the first period of study, where articles are published in journals such as the *Journal of Business Venturing*, *Small Business* and the *Journal of Financial Economics*, which have a broader focus on finance, economics and small business in general. The latter, mainly in the last decade, has published several contributions related to finance and entrepreneurship, identifying broad advantages and benefits of this relationship.

The analysis carried out by areas of knowledge over the three periods analyzed shows how the literature is changing. In the first period, transparency and knowledge of information for decision-making and how this influences the valuation of a company is addressed. This is especially the case when companies gain size and consider financing in the capital market through an IPO. It should be noted that corporate governance emerges as an emerging issue, a factor that is strengthened later in the third period. For the second period, the analysis of information ceases to play a relevant role, and venture capital appears as a basis for expanding the study of other topics such as economic development due to its importance in the promotion of entrepreneurship, the formation of venture capital portfolios and the development of entrepreneurship itself. Likewise, in this period, small businesses lose weight as the literature focuses on entrepreneurship in general. Finally, in the third period, although the topic of venture capital continues to be the main driving force, technological development in business processes is incorporated, the importance of economic growth is maintained, and the transfer of knowledge from academia to entrepreneurship is highlighted. All issues related to entrepreneurial management skills disappear in this period, as they are aspects that have already been overcome in previous periods as part of business management. In this way, it can be concluded that the literature points to the fact that alternative financing has developed fundamentally through venture capital and business angel strategies, with studies being carried out on more specific factors of the environment in which the entrepreneur works, with implications for the financing of his project.

Based on these findings, three areas could be considered future research lines: academia itself as a support for entrepreneurship, the role of corporate governance in the relationship between entrepreneurship and finance, and finally, the development of alter-

native finance in emerging economies. Recent studies have highlighted the growing role of academia in transferring knowledge to the real sector. Laboratories, simulators, and business incubators in universities and think tanks have facilitated access to alternative finance and increased their chances of success. In addition, some of the literature notes complications with corporate governance, as partners providing an alternative source of finance wish to intervene in decisions. These difficulties open a field of study in which it is possible to analyze how an entrepreneur's management skills and abilities relate to the more political decision-making criteria of financing partners. Finally, alternative finance ventures have been shown to foster economic growth and are emerging more strongly in emerging economies. This movement opens an area of research needed to boost alternative finance in such countries. Research on this topic is so far scarce in emerging economies. It is worth noting that venture capital, business angels, and crowdfunding are being very well accepted in the early stages of startups. However, one of the lines of work within the new research trends may focus on the analysis and application of these sources of financing as a factor in the survival of ventures. On the other hand, the alternative financing tools found in the literature should be planned and implemented in any type of company, not only in technology or fast-growing companies but also in ventures in their first years of creation and growth.

Several implications can be drawn from this research, especially for entrepreneurs. It is suggested that they turn to academia as a source of knowledge and support, in addition to accessing different programs such as incubators found in entrepreneurship centers. Entrepreneurs should pay special attention to the behaviour of venture capitalists trying to provide other alternative sources of financing, especially at an early stage.

Finally, among the main limitations of this paper, is the possible omission of some key terms that could be related to alternative finance and entrepreneurship. In this analysis, we sought to focus exclusively on the variables related to the formality of financing. As a consequence, we did not include terms such as "start-up", "seed funding sources", "early-stage funding sources", "early growth funding sources" because the conceptual definitions on which our study was based did not suggest the incorporation of these terms. It is suggested that future research include these additional terms to contrast the results obtained in this study and corroborate that Academia, corporate governance, and emerging economies are the most relevant topics of analysis. Another limitation corresponds to the characterization of formality in the types of alternative financing. In this study, only formal financing alternatives were analyzed; however, informal funding alternatives may also constitute another interesting alternative for future studies that analyze financing and entrepreneurship.

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