
Determinants of Startup's Value According to Venture Capitalists

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Abstract:

Purpose: The objective of this study is to analyze the existing literature and identify knowledge gaps about the main value determinants of startups – according to venture capitalists' perspective

Design/Methodology/Approach: This objective is verified through a bibliometric analysis and systematic review, which execution considers the use of RStudio, Biblioshiny and Rank Words softwares. The final sample consists of 184 articles, obtained from the Web of Science and Scopus databases. Furthermore, this study also verifies the main bibliometric laws - Lotka (authors), Bradford (journals) and Zipf (keywords).

Findings: There is a future research avenue related to the analysis of: i) financial determinants of startups' value that are in more advanced stages – scale-up and mature – e.g. expenditure on research and development, sales growth, profitability, ii) types of venture capitalists as startups' value determinants – e.g., crowdfunding, angel investor, mutual funds and iii) alternative methods of startups' valuation – e.g., First Chicago, Scorecard, Venture capital, Berkus.

Practical Implications: The results of the study allow an approximation between the research topics of the academic community and the startup management, enabling a consistent evolution of this market segment.

Originality/Value: The bibliometric analysis considers the verification of three main laws – Zipf, Bradford and Lotka. Furthermore, the systematic review is carried out through the codification of a (sub)categorization matrix. Moreover, the study also provides the analysis of the following aspects - not verified by other researches on the same topic: (i) stages of the startups as determinants of value for venture capitalists; (ii) geographical coverage between countries and (iii) mapping of the various types of venture capitalists.

Keywords: Startup valuation, Venture capitalists, Bibliometric analysis, Systematic review, Biblioshiny

JEL Classification: M13, G11, G15.

Paper type: Research article.

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1. Introduction

Startups (SUs) face difficulties in raising capital - own and third-party - at different stages of their life cycle. Because they do not have significant accounting history – due to the low or non-existent level of assets and revenues – their equity value is irrelevant, which makes it difficult to raise resources from third parties. When they finance themselves through equity, they do so through family, friends and venture capitalists (VCs).

In both scenarios, the insufficiency of these resources can cause their mortality even in the first years of existence (Laitinen, 2019). Thus, venture capital is an important source of financing for operational viability and organizational development of the SUs – especially when considering the high levels of information asymmetry, cash needs and risks involved in this process (Köhn, 2018).

In identifying SUs – investable – VCs prioritize those that: (i) are scalable and innovative, (ii) present unreplicable business models and (iii) have high potential for long-term growth. However, this strategy does not eliminate the risks of their investments, as there is no way to guarantee the survival of the SUs to market fluctuations (Lam and Seidel, 2020; Que and Zhang, 2021).

Thus, in order to mitigate risks and obtain high returns – at least from part of the invested investments – VCs: (i) promote the professionalization of the management team, (ii) define corporate governance policies, (iii) guide strategic planning, (iv) monitor the execution of actions at the operational level and (v) enable connections with other investors, suppliers and strategic customers (Gompers *et al.*, 2020; Liu, 2021).

As for the process of valuation of SUs, VCs consider various sources of information - (non) financial - as well as the use of unconventional valuation methodologies. Among the non-financial information, the characteristics of the management team, the degree of differentiation of the products, the stage of development of the company etc. are highlighted (Falik *et al.*, 2016; Gompers *et al.*, 2020; Lavanchy *et al.*, 2022).

Eventually, there are differences in the identification of value determinants between VCs and SUs (Heughebaert and Manigart, 2012). In the case of VCs, they prioritize those that measure the value-raising potential of the SU, since their aim is to obtain profits by alienating their share in the ownership structure of the company

In view of the above, the research problem of this study is to answer the following questions: (1) What are the keywords, authors and journals that have the greatest impact on the subject of this research? (2) What are the main value proxies and their determinants?; (3) What are the main theories that support the hypotheses of these studies; (4) What are major econometric methods adopted in these studies? (5) What

are the main characteristics of the samples considered in these studies? and (6) What are the avenues for future studies on the subject analysed? Such answers are obtained through a bibliometric analysis and systematic review of the topic.

VCs are those investors who participate in the funding rounds of SUs in their various stages – early stage, venture, growth and mature – including: angel investor and seed, crowdfunding, corporate accelerators, risk capital funds and private equity. As for the final sample, it presents 184 articles, obtained between 1 January 1985 and 19 February 2022, from the Web of Science (WoS) and Scopus databases. Adoption of both methodologies requires the use of specialized software - RStudio, Biblioshiny and Rank Words. In addition, it adopts the verification of the main bibliometric laws - Lotka (1926), Bradford (1934) and Zipf (1949).

Among the differences of this study is the analysis of the following aspects – not verified by other research on the same topic: a) stages of SUs as determinants of value for VCs (Cumming and Groh, 2018; Sharma *et al.*, 2023), b) geographic coverage between countries (Hemmert *et al.*, 2021), c) mapping of the different types of VCs (Sharma *et al.*, 2023). Furthermore, another difference consists in the verification of bibliometric laws - Lotka (1926), Bradford (1934) and Zipf (1949).

Furthermore, its results contribute to: i) academia with the confirmation of the main bibliometric laws and presentation of an innovative systematic review methodology, ii) companies with the identification of factors considered relevant by VCs in their investment decision, iii) the market and society with the determination of the main aspects that promote this segment of companies, which can be a guide for the development of public policies to encourage local economies.

2. Literature Review

According to Bis *et al.* (2021), SUs are firms that have to be constantly aligned with the changing market conditions, watching out for the absence of a ready product or service that might be delivered right away. As they are disruptive companies, the SUs valuation process takes into account subjective analyzes about the capacity of the founders, management team and business growth.

Therefore, the value attributed to future expectations is greater than the SU's ability to generate concrete results in the present. In fact, the study by Köhn (2018) suggests that the valuation of SUs is more art than science, and can generate values disconnected from reality. Thus, the value initially attributed to them must undergo significant changes during negotiations - with investors.

From the VCs' point of view, the assessment of SUs itself is not the definitive factor in their decision to contribute resources in financing rounds. However, its relevance tends to increase if the SU is at a more advanced stage of maturity (scale-up). For them, the success of the venture is more related to the management team, as well as

the characteristics of the business. These factors are even more significant for early stage SUs that operate in the technological sector (Gompers *et al.*, 2020; Barg *et al.*, 2021; Grima and Thalassinou, 2020).

Once the resource contribution has been made, experienced VCs add management expertise to the SUs that facilitates business scalability. When entrepreneurs have little or no knowledge, they are challenged by VCs to deliver goals. If they are not able to achieve them, this has a negative impact on the assessment of the SUs. Conversely, when VCs are less respected in the market, entrepreneurs are more concerned about the valuation of their SUs - characterizing the existence of agency conflicts between the parties (Falik *et al.*, 2016).

An alternative to mitigate information asymmetry – between entrepreneurs and VCs – and attract potential resource providers, is the use of signals to convey the quality of the enterprise. For the financing round to be successful, entrepreneurs disseminate messages about the viability of their business (Colombo, 2021). These messages are considered by VCs in their SU valuation process. Furthermore, the value of this new information sign depends on the level of pre-existing asymmetry (Koenig and Tennert, 2022).

The success of the round itself also announces important signals to the market. By the way, the intensity of these signals tends to increase with the amount of financing acquired before the current financing round. For Shi and Xu (2018), successful financing rounds are essential for SU survival and sustainable growth. In turn, Shafi *et al.* (2020) point out that adverse perceptions of signals associated with SU discontinuity reduce the amounts to be raised in the next financing rounds. This fact partially discourages potential investors - particularly the higher quality ones.

Network theory clarifies how a company's external relationships flow and shape its strategies, impacting its performance. According to the theory, there is a set of actors who are linked to each other, through human or non-human relationships and interactions (Barnes, 1954; Montanaro *et al.*, 2021). The size of the network is measured by the number of partners - of different natures - that the SU has before the contributions made by the VCs. Such connections allow them to develop specific assets, enabling innovative solutions.

Thus, the size of the network and its capacity for innovation end up having a positive impact on its valuation, before the VCs. This fact ends up attracting new strategic partners (Miloud *et al.*, 2012).

As for game theory, it establishes that cooperation between parties generates positive returns for all participants. The theory analyzes optimal behavioral choices, when the cost and benefit of each option is not fixed, but depends – above all – on the choices of other individuals. Equilibrium is obtained when no player can gain an advantage

through a unilateral change in strategy, assuming that the other participants do not also change what they are doing (Nash, 1953).

Disruptive businesses face even greater uncertainties than conventional ones. Therefore, in order to mitigate risks and make their operations viable, SUs seek cooperation from VCs, rather than starting the venture independently. When successful, the divestment of VCs – via the sale of their equity interest in the SUs – occurs profitably.

Finally, regarding valuation methods, due to the non-existence or low level of revenue, multiples related to total assets are most used. Furthermore, issuing financial reports – with greater frequency and credibility – signals greater transparency to VCs, positively impacting the value of the business. It turns out that the values initially established are subject to subsequent negotiations - between entrepreneurs and VCs - depending on the bargaining power between both.

Entrepreneurs are motivated to obtain a greater share of the value created due to their imminent concern of moral hazard (Hidayat *et al.*, 2022). VCs seek to establish flexible contracts that benefit entrepreneurs – when there is value creation – but punish them – when the return is negative.

3. Research Methodology

The objective of this study is to analyze the existing academic literature on the main determinants of the value of SUs - from the perspective of VCs - through a bibliometric analysis and systematic review. To this end, 7 steps are implemented. Steps 1 to 5 are related to bibliometric analysis, while in steps 6 and 7 the systematic review is developed. Bibliometric analysis allows the quantitative study of scientific articles, in order to identify common characteristics between them (Machado Junior *et al.*, 2016). The systematic review aims to provide a proposal for a future agenda on the research question (Hammersley, 2013).

Step 1 – Choosing the database. The articles are obtained from the following databases: (i) Web of Science (WoS) - Contains a record of scientific articles published in journals with a high impact factor, classified using the Journal Citation Reports (JCR) index; and (ii) Scopus – Measures the relevance of academic journals through the CiteScore index.

Step 2 – Defining the initial research parameters. To limit the scope of the study, a search is carried out using keywords. Filters from the WoS and Scopus databases related to language, type of document, area, category and period are then applied.

Step 3 – Unification of databases and exclusion of duplicate articles. After downloading the files – from the WoS and Scopus databases – they are unified. Duplicate articles are then excluded. Thus, only a single document is maintained,

avoiding its repetition in the intermediate sample. Both actions are performed via R Studio software.

Step 4 – Exclusion of articles not related to the defined topic. Once the intermediate sample has been defined, the summary, introduction and conclusion of these articles are read. The final sample, then, is obtained by excluding those who are not aligned with the main theme of the study. The evolution of the final sample is shown in Table 1.

Table 1. Evolution of the final sample

Sign	Description	Number of articles	
		WoS	Scopus
(+)	Initial sample , obtained using the keywords “valuat*” and “venture capit*”	218	264
(-)	Languages other than “English”	3	7
(-)	Types of documents other than “article”, “review” and “conference”	5	60
(-)	Research areas other than: i. WoS: “business economics”, “engineering”, “operations research management science” ii. Scopus: “business management and accounting”, “economics, econometrics and finance”, “engineering”, “social science”	20	7
(-)	Categories different from: i. WoS: “business”, “business finance”, “management”, “economics”, “operations research management science” ii. Scopus: this database does not have the category filter option	9	n/a
(=)	Subtotal	181	190
(-)	Exclusion of duplicate articles in the WoS and Scopus databases	112	
(=)	Total intermediate sample	259	
(-)	Articles not related to valuation, but to other corporate processes of SUs – e.g.: initial public offering (IPO), post-IPO, merger and acquisition (MandA), joint-ventures, franchises, etc.	21	
(-)	Articles not related to valuation, but to various topics about SUs – financial difficulties, lack of access to sources of fundraising, corporate governance, taxation regime, sustainability, environmental discussions, family management, organizational interactions, etc.	12	
(-)	Articles that mention other forms of financing for SUs, which do not see the participation of VCs in their own capital – e.g.: venture debt, initial coin offering (ICO), etc.	3	
(-)	Articles for which it was not possible to obtain the full text file or convert its data for analysis of Zipf's Law (1949) using the Rank Words software	33	

(-)	Articles that were published in conferences	6
(=)	Total final sample	184

Source: Own calculation based on Web of Science and Scopus.

Step 5 – Bibliometric analysis. The final sample file is imported into the Biblioshiny software, from which the objective data of the articles is analyzed – countries, authors, keywords, institutions, etc. - for preparing and analyzing relationship/co-citation tables and maps.

Additionally, the analyzes carried out are complemented by the verification of the main bibliometric laws, being: i) Zipf's Law (1949) - categorization and estimation of the frequency of keywords with the help of Rank Words software; ii) Bradford Law (1934) – verification of journals; and iii) Lotka's Law (1926) – identification of researchers who have the highest frequency of production on the defined topic.

Step 6 – Reading and coding the articles. Identification of objectives, samples, methods, contributions and other characteristics of the articles. These are classified and coded into non-exclusive categories and subcategories. This means that the same article can be classified into more than one subcategory, which allows the sum of the frequency of classifications to be greater than 100%.

Step 7 – Systematic review. Carrying out a frequency count of subcategories - and analysis of their less frequent combinations - in order to enable the identification of knowledge gaps.

Table 2. (Sub) Categorization matrix

Categories	Subcategories	Categories	Subcategories
1.Main topic	A – Qualitative determinants of the value of SUs	4. Dependent variables (continuation)	L - Others
	B – Financial determinants of SU's value	5. Independent variables	A – SU's financial data
	C – Types of VCs		B – SU's non-financial data
	D – SU's valuation methods		C – Founder's and manager's data
	E - Others		D – VC's data
2. Hypotheses theories	A - Signaling theory		E – Sector/industry data
	B - Agency theory		F – Market data
	C - Game theory		G - Others
	D - Network theory	6. Data source	A – Global
	E - Real options theory		B – North America
	F - Human capital theory		C – Europe

	G - Institutional theory		D - Asia/Oceania
	H - Entrepreneurship theory		E - Latin America
	I - Life cycle theory		F - Africa
	J - Prospect theory		G - Not applicable
	K - Social judgment theory	7. Analysis period	A - Up to 5 years
	L - Others		B - From 6 to 10 years
3. Research methodology	A- Theoretical/conceptual		C - More than 10 years
	B - Case study		D - Not applicable / not informed
	C – Regression analysis with cross-sectional data	8. Results	A - New perspectives
	D – Regression analysis with panel data		B – New conclusions
	E – Qualitative analysis		C - Conclusions similar to previously presented works
	F – Others		D - Others
4. Dependent variables	A - Pre-money valuation	9. Hypotheses conclusion	A - Confirmation of the main hypothesis
	B - Funding value		B - Non-confirmation of the main hypothesis
	C - Post-money valuation		C - Inconclusive result in relation to the main hypothesis
	D - Initial public offering		D - Not applicable
	E - Remuneration of founders/managers	10. Avenues for future studies	A – Conventional determinants of the SU's value
	F - Value multiples		B – Unconventional determinants of the SU's value
	G - Shareholding		C – Unconventional sources of SU's financing
	H – SU's information		D – VC's level of professionalization
	I – Divestment		E - Compensation policy
	J - Discounted cash flow		F - Others
	K – VC's information		

Source: Own elaboration.

4. Research Results and Discussion

Item 4.1 presents the results of the analysis and the main bibliometric laws, mentioned in Step 5. In item 4.2 are the results of the systematic review, described in Step 7 of this study.

4.1 Bibliometric Analysis

The final sample is made up of 184 articles, distributed between January 1, 1985 and February 19, 2022. During this period, there is a growing interest in the determinants of the value of SUs - according to the perception of the VCs. The year 2016 stands out with the publication of 18 articles. However, in 2017 there was a drop to 6 articles, with subsequent growth to a level close to 2016.

As for keywords, Zipf's Law (1949) analyzes and quantifies their distribution in a given text. To achieve this, the principle is considered that there is a tendency for minimal use of words that have a high frequency of occurrence. Zipf's first law indicates that (r) is the order of the series, (f) the frequency of occurrence and (C) the constant for any text – see Equation 1:

$$r \times f = C \tag{1}$$

In turn, for words with low frequency, Zipf proposed a second law, modified and revised by Booth (1967). For the author, in a given text, several words with a low frequency of occurrence have the same frequency – see Equation 2:

$$I_n = 2I_1 / n (n+1) \tag{2}$$

Where: I_1 = number of words that have frequency 1; I_n = number of words that have frequency n ; n = Goffman point or place of transition from low to high frequency words

Zipf's laws define the ends of the distribution list of words in a given text. Therefore, between these extreme points, there is a transition region from high-frequency to low-frequency words. For Goffman (1971), the existence of a transition point between the highest and lowest frequency words more adequately represents the semantic content of a given text. Pao (1978) presents the Goffman transition point formula – see Equation 3.

$$T = (-1 + \sqrt{1 + 8I_1}) / 2 \tag{3}$$

Where: T = Goffman transition point; I_1 = number of words that have frequency 1

The identification of Goffman's T point occurs through the descending ordering of words in the Rank Words software. Next, those that are repeated only once are

identified to calculate the Goffman T point. Then, the words that are above the classification indicated by that point are located. For the final sample of 184 articles, the maximum and minimum frequencies of word repetition vary between 59.57 and 8.89, respectively.

Table 3 presents the first 15 articles in descending order of Goffman's T point. In it, the transition point of words varies between 59.57 and 48.76, with an average of 52.53. In the case of the article by Hrdy (2015), for example, there are 1804 words whose repetition frequency is equal to 1 - e.g.: valuations, smart, signals, etc.

The calculation of Equation 3 results in the value of $59.57 \left(\frac{-1 + \sqrt{1 + 8 \cdot 1804}}{2} \right)$ Goffman's T points. The word that comes closest to this frequency is property.

The studies of Hrdy (2015), Berger and Kohn (2020) and Bock and Hackober (2020) mention that innovative patents from SUs are commercialized more quickly - effectively contributing to the creation of value - whether in the ideation phase or in the revenue generation stage.

However, there are external factors that can prevent the commercialization of innovations, such as: the tax system, legislation in each sector and information asymmetry in the capital market.

Next, an analysis of the region containing the most frequent words related to the main theme is carried out - for one of the 184 articles in the final sample. Rank Words sorts words in descending order of repetition. Those not relevant to the study are excluded - e.g. (in)definite articles, prepositions, adverbs and pronouns. Of the remaining words, those with the highest frequency are identified.

Table 4 presents the first 15 articles in descending order of the word with the most repetition - in each study. For example, Cumming *et al.* (2016) cite the abbreviation of the word venture capital (VC) 640 times. For these 15 articles, the most frequently used words total 6914. VC represents 49.58% (3428/6914) of this total, being the word that is most repeated in this subsample.

Cumming *et al.* (2016) examine the impact of investment from international VCs on the success of ventures. They find that there is greater business interaction between SUs and domestic investors. However, SUs that have an international investor base are more likely to increase their value in a potential IPO process (Cornell and Damodaran, 2020; Chahine *et al.*, 2021).

Table 3. Goffman's T

Table 4. Zipf's law

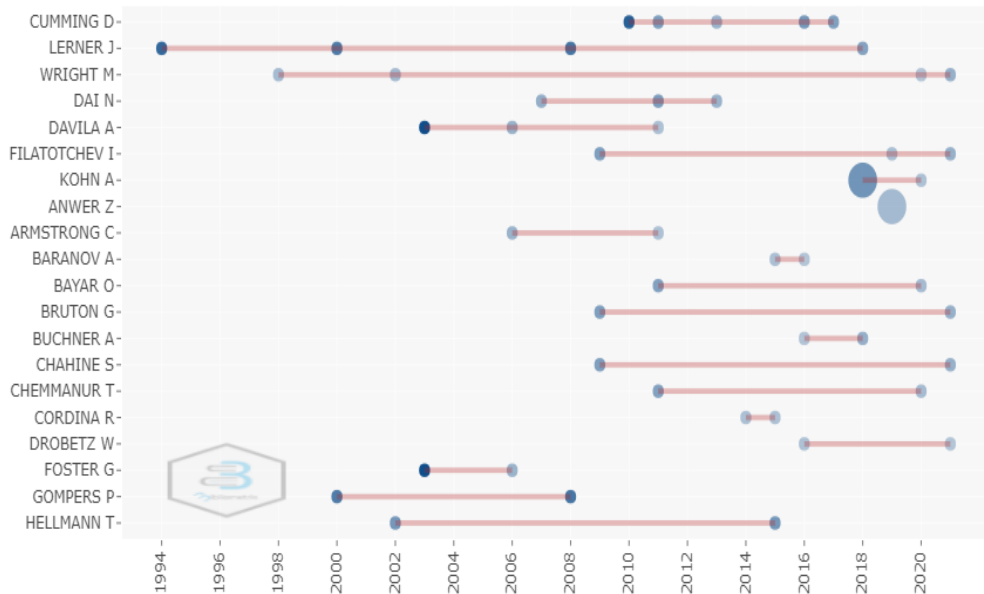
References	Goffman's T	References	Words	Number	Frequency
Hrdy (2015)	59,57	Cumming <i>et al.</i> (2016)	VC	640	9,26%

McNeill (2016)	58,11	Heughebaert and Manigart (2012)	VC	561	8,11%
Smolarski <i>et al.</i> (2011)	57,50	Bayar <i>et al.</i> (2020)	VC	553	8,00%
Iacovides (2016)	54,60	Masulis and Nahata (2009)	VC	519	7,51%
Fernald <i>et al.</i> (2015)	53,79	Barry and Mihov (2015)	VC	492	7,12%
Lerner (1994)	53,07	Bayar and Chemmanur (2011)	Firm	468	6,77%
Lin (2020)	52,30	Jindra and Leshchinskii (2015)	IPO	459	6,64%
Stuart <i>et al.</i> (1999)	51,40	Guo <i>et al.</i> (2015)	Startup	454	6,57%
Boer (2002)	50,41	Tian (2012)	VC	428	6,19%
Claes and Vissa (2020)	50,09	Agrawal and Nasser (2019)	CEO	423	6,12%
Wilkins <i>et al.</i> (1997)	49,92	Kwon <i>et al.</i> (2020)	Mutual	412	5,96%
Gounopoulos <i>et al.</i> (2021)	49,78	Gompers <i>et al.</i> (2008)	Industry	398	5,76%
Malyy <i>et al.</i> (2021)	49,36	Buchner <i>et al.</i> (2018)	VC	378	5,47%
Shafi <i>et al.</i> (2020)	49,30	Nguyen and Vo (2021)	VC	376	5,44%
Lee <i>et al.</i> (2011)	48,76	Armstrong <i>et al.</i> (2011)	Revenue	353	5,11%
Mean	52,53	Total		6.914	100,0%

Source: Own calculation based on Rank Words.

Regarding the authorship of the articles, 389 authors were identified. Of these, 40 publish individually and 349 are co-authors. Figure 1 presents those most relevant in terms of number of publications and total citations per year over time.

Douglas Cumming appears as the most relevant author and co-author, having participated in 5 articles. In them, the author explores: (i) the impact of international VCs on the success of ventures, (ii) the reasons that lead entrepreneurs to change VCs, (iii) the relationship between the size (size) of the venture capital fund and the valuation of SUs supported by VCs, (iv) the quality of information made available to institutional investors about companies invested in by private equity funds, and (v) the origin and effects of the segmentation of corporate finance – by data source, by type of financing, by sector and country.

Figure 1. Most relevant authors

Source: Own calculation based on Biblioshiny.

As for Figure 2, it presents the application of Bradford's Law (1934) on periodicals - there are few periodicals that produce many articles and many periodicals that produce few articles on a given topic. Brookes (1969) mentions that Bradford's Law estimates the degree of relevance of academic periods in specific areas of knowledge. Thus, if periodicals are classified in descending order of productivity, they can be distributed into zones with variation in the proportion 1: n: n² and so on. These zones are formed by dividing the total number of articles published by three.

Thus, in zone 1 – out of a total of 184 articles and 118 journals, 11(9.3%) journals publish 62(33.7%) articles. There are periodicals that publish from 12 - Journal of Business Venturing - to 3 - Journal of Small Business Management - articles. In turn, in zone 2 there are 47 (39.8%) journals that publish 62 (33.7%) of the articles. On average, these journals have 1.56 articles published. Finally, in zone 3, there are 60(50.8%) journals that publish 60(32.6%) articles. It is noteworthy that - in this last area - the average number of articles published per journal is even lower, being 1 article per journal.

In turn, Lotka (1926) states that a small number of authors produce many articles and that the production obtained by this small number of researchers is equal in quantity to the performance of the others. This law is called the inverse square law - see Equation 4.

$$a_n = a_1 / n^2. n = 1.2.3 \quad (4)$$

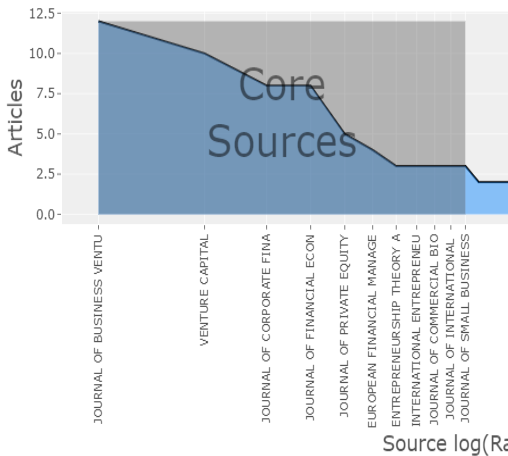
Where: a_n = number of authors who published n articles; a_1 = number of authors who published an article; n = number of articles published by author

In Equation 5, Chung and Cox (1990) clarify that the number of authors with a single published article - according to Lotka's Law - would be 60.8%. Furthermore, the number of authors with two published articles should have a frequency of 15.2% ($60.8\%/2^2$). Authors with three published articles would be 6.8% ($60.8\%/3^2$).

$$a_1 = 6 / \pi^2 = 0,6079 = 60,8\% \quad (5)$$

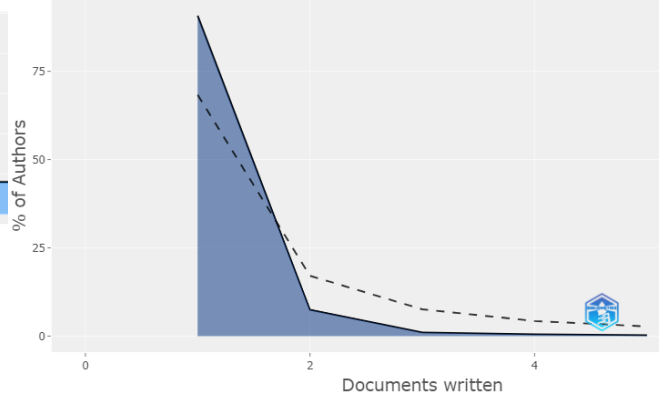
Figure 3 shows the number and percentage of articles published by the sample authors. The standard values of Lotka's Law are presented in the variations of Equation 5. It can be seen that, in fact, there is a smaller percentage of authors publishing a greater number of articles, confirming Lotka's Law. 29 (7.5%) of the 389 authors - from the final sample - are responsible for publishing 2 articles related to the topic determining the value of SUs by VCs. 7 (1.8%) authors publish between 3 and 5 articles on the topic. Another 353 (90.7%) publish a single article related to this topic, which represents an even lower productivity than the standard reference obtained by Lotka (60.8%).

Figure 2. Bradford's law



Source: Own calculation based on Biblioshiny

Figure 3. Lotka's law



Source: Own calculation based on Biblioshiny

4.2 Systematic Review

The systematic review seeks to identify knowledge gaps related to a given topic. In the case of this study, the idea is to develop an agenda that points to future avenues regarding the main determinants of the value of SUs in the view of the VCs. To this

end, Steps 6 and 7 of item 3 - Methodology clarify that, initially, there is the definition of a (sub) categorization matrix – see Table 2.

After reading the 184 articles in the final sample, they are classified and coded into non-exclusive categories and subcategories. This means that the same article can be classified into more than one subcategory, which allows the sum of the frequency of classifications to be greater than 100%. Next, the frequency of subcategories is counted - and analysis of their less frequent combinations - in order to enable the identification of the aforementioned gaps.

Figure 4 summarizes the most and least frequently used subcategories – those with the potential to be used in future research. In category 1, subcategory A - Qualitative determinants of the value of SUs - is the one with the highest frequency (73.9%).

This result indicates that most studies prioritize non-traditional determinants in the SUs valuation process - e.g.: development stage, sector of activity, location, management team, number of patents, etc. On the contrary, there is a low volume of investigations on the topics of subcategories B - Financial determinants of the value of SUs (4.3%), C - Types of VCs (6.5%) and D - SUs valuation methods (10.9%)

This fact points to an opportunity to analyze financial variables - e.g.: research and development expenses, sales growth, profitability, etc. - for SUs that are in more advanced stages – scale-up and mature. Another gap identified refers to the analysis of the types of VCs as determinants of the value of SUs – e.g. crowdfunding, angel investors, mutual funds, etc. Furthermore, the relevance of investigating alternative methods for evaluating SUs stands out, such as – First Chicago, Scorecard, Venture capital, etc.

The theories presented in subcategories 2A to 2K are those that support the hypotheses of the articles in the sample. In turn, these hypotheses point to negative and positive relationships between the determinants and the value of SUs. The most frequent theories in these studies are B - agency (14.1%) and A - signaling (10.9%).

Thus, the opportunity to investigate the following theories C – games (3.3%), D – network (2.7%), E – real options (2.2%), F – human capital, G – institutional and J – perspective (1.1%), as well as H – entrepreneurship, I – life cycle and K – social judgment (0.5%). Fujiwara (2014) integrates the theories of real options and games, through a new approach – that of options games. The author optimizes the expectation of a trade-off between the flexibility of the value of real options and the commitment to prevent rivals from entering the market.

As for category 3, there is a preference for using the econometric model C – regression analysis with cross-sectional data (39.7%). This fact is due to obtaining a sample with a greater number of observations, since the events for obtaining the

value variables are more dispersed – e.g.: financing rounds, IPOs, other forms of divestment, etc.

The low frequency of method D – regression analysis with panel data (1.6%) confirms this understanding. Given this, the other most frequent methods are E – qualitative analysis (21.7%) and A – theoretical/conceptual (19.6%). Therefore, the opportunity to carry out studies that combine quantitative and qualitative methods stands out, in order to enable a deeper understanding of the hypotheses developed.

The study by Kleinert and Volkmann (2019) makes use of both types of data. Using qualitative data, the authors verify that investors are concerned about high information asymmetries and agency risks. The quantitative data regressions indicate that such discussions boost investments.

In turn, in category 4 - main dependent variables - subcategory D – IPO presents the highest frequency (13%). Other value proxies that stand out in the sample articles are: B – funding value (9.2%), F – value multiples (7.6%), A – pre-money valuation (6.5%) and K – information from VCs (5.4%).

Thus, a possible future research agenda is highlighted that considers the following value proxies: H – information from SUs (4.3%), E – remuneration of founders and I – divestment (1.1%), G – participation corporate and J – discounted cash flow (0.5%). Regarding corporate participation, Erzurumlu *et al.* (2019) verify that the interaction - between the value of the investment and the investor's level of know-how - positively affects the entrepreneur's shareholding.

Category 5 indicates the most mentioned independent variables. Subcategory B - non-financial data from SUs - is the most frequent (17.9%). This result corroborates that obtained in the analysis of subcategory 1A. The qualitative determinants of the value of SUs concentrate 73.9% of the themes of the 136 articles in the sample of this research.

It is understood that subcategories F – market data (2.2%), C – founder and manager data (1.1%) and E – sector/industry data (0%) are the most used as variables of control in econometric models – not being related to the main hypotheses of the studies. Therefore, there is an opportunity for researchers to investigate more deeply the characteristics of the sectors - for the purpose of evaluating SUs. According to Campani *et al.* (2021), independent sector variables are not related to post-money valuation – growth, return on equity (ROE) and sector size.

As for category 6 - origin of the data, subcategory B - North America - presents the highest frequency (38%). On the contrary, the subcategories with the lowest frequency are C – Europe (18.5%), D - Asia/Oceania (19%), A – Global (4.9%), E - Latin America (0.5%). It is also noteworthy that the final sample does not have any

study with data from African companies - subcategory F - Africa (0%) - which indicates a gap to be explored by researchers.

Category 7 deals with analysis periods. It appears that there is a relative balance in the sample deadlines, with subcategory C - more than 10 years - being the most frequent (30.4%). As for the other terms, we have: B – from 6 to 10 years (22.3%) and A – less than 5 years (17.9%).

Aggarwal *et al.* (2012) verify the effect of electronic word-of-mouth on venture capital financing - over a five-year period. They find that the volume and valence of blog coverage are positively related to venture financing, regardless of blog popularity.

As for category 8 – results, subcategory A – new perspectives, presents the highest frequency (55.4%). These studies expand the frontier of knowledge, signaling positively about the many possibilities for investigating the topic of value determinants of SUs. In turn, category 9 deals with conclusions about the hypotheses. Subcategory A – confirmation of the main hypothesis – is the most frequent (83.7%). Thus, the innovations discussed in the studies are, for the most part, verified.

Finally, category 10 indicates avenues for future studies or knowledge gaps – from the perspective of the 184 articles in the final sample. Subcategory B points out that the unconventional determinants of the value of SUs must continue to be explored (37%), despite the fact that they are already widely investigated – see subcategory 5B. Another highlight refers to subcategory A - conventional determinants of the value of SUs - which presents a frequency of 18.5%. The relevance of your investigation is mentioned in the analysis of subcategory 5A.

As for the other subcategories, there are the following frequencies that point to other equally relevant themes: C – Non-conventional sources of financing for SUs (4.3%), D - Level of professionalization of VCs (3.3%) and E - Remuneration policy (0.5%). Regarding the latter, Hellmann (2002) highlights that many VCs are seeking comprehensive strategies to invest in entrepreneurial companies. To do so, they consider issues related to organizational design and the remuneration structure of SU managers.

In summary, the present study highlights the following main knowledge gaps to be investigated by researchers - related to the topic of value determinants of SUs by VCs: a) consideration of value proxies as dependent variables related to SU information, founders' remuneration, divestment, equity participation and discounted cash flow; b) analysis of network theories, games, real options, human, institutional and perspective capital, etc.; c) use of independent variables with financial, VCs, market, founder and managers and sector/industry data; d) adoption of

unconventional valuation methods – First Chicago, Scorecard, Venture capital, Berkus, etc.; e) analysis of companies located in Latin America and Africa.

5. Conclusion

With a focus on the customer, the new economy brings growth opportunities to companies willing to innovate and adapt quickly. In this way, SUs stand out for considering factors related to creativity, technology, data analysis and digital channels as a central part of the business.

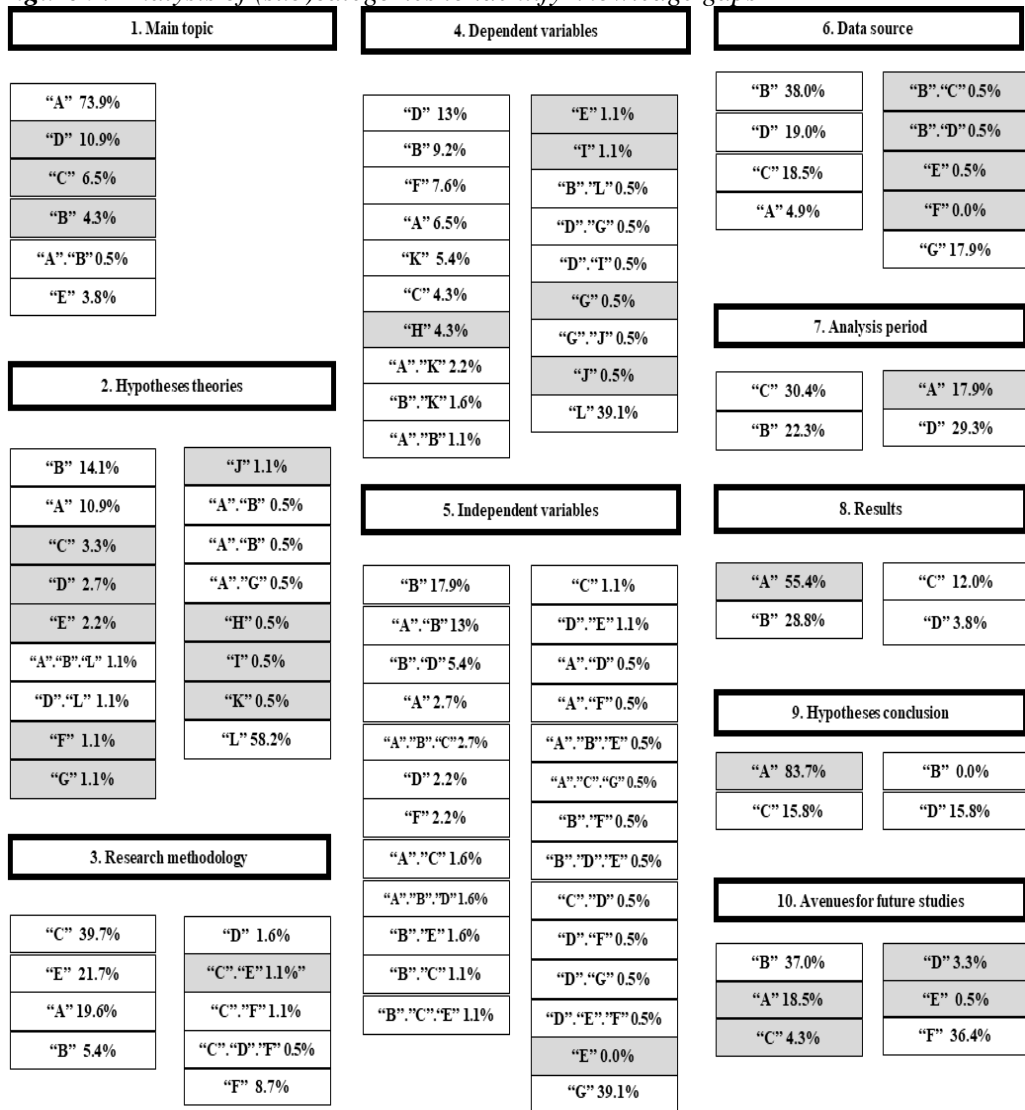
However, to evolve to the next levels of maturity, they need the resources made available by the VCs. In turn, these analyze qualitative and quantitative aspects of the SUs in their decision-making. Therefore, this study aims to gain an understanding of the main issues related to the determinants of the value of SUs by VCs.

To this end, 184 articles – which make up the final sample – are analyzed through a bibliometric analysis and systematic review. They are obtained from the period between January 1, 1985 and February 19, 2022, from the Web of Science and Scopus databases. The first methodology refers to a quantitative analysis, being developed by counting frequencies and co-citations via RStudio, Biblioshiny and Rank Words software. It also verifies the main bibliometric laws - Lotka (1926), Bradford (1934) and Zipf (1949). The second methodology refers to a qualitative analysis of the texts, for the purpose of identifying knowledge gaps - addressing an agenda of relevant topics for future studies

The results obtained allow us to answer the research problems initially presented:

- (1) What are the keywords, authors and journals that have the greatest impact on the topic of this research? The most frequently used keyword is venture capital. The most cited journals with the largest number of articles published are Administrative Science Quarterly and Journal of Business Venturing, respectively. Douglas Cumming is the author with the most citations.
- (2) What are the main value proxies and their determinants? The dependent variable that is most repeated in the articles is IPO. The independent one that most characterizes its value determinants is the non-financial data of the SUs.
- (3) What are the main theories that support the hypotheses of these studies? Theories that support most hypotheses are agency and signaling.
- (4) What are the main econometric methods adopted in these studies? There is a preference for using the econometric regression analysis model with cross section data.
- (5) What are the main characteristics of the samples considered in these studies? The samples are predominantly from North American companies, whose data are obtained for a period of more than 10 years.

Figure 9. Analysis of (sub)categories to identify knowledge gaps



Relevant themes for a future research agenda related to startup determinants' value by venture capitalists

Source: Own calculation.

In turn, the results of the systematic review indicate that the following questions are the most investigated:

- i) qualitative determinants of value of SUs,
- ii) agency and signaling theories,
- iii) cross section regression model,
- iv) IPO as a proxy for value of SUs,
- v) data from North American companies.

Thus, there is an opportunity to investigate the following aspects - related to the determinants of the value of SUs by VCs: i) financial determinants of the value of SUs that are in more advanced stages - scale-up and mature - e.g.: research expenses and development, sales growth, profitability etc., ii) types of VCs as determinants of the value of SUs – e.g. crowdfunding, angel investor, mutual funds etc., iii) alternative methods of evaluating SUs, such as – First Chicago, Scorecard, Venture capital, Berkus etc., iv) theories of real options and games, v) association of quantitative and qualitative methods, vi) remuneration of founders as a proxy for value, vii) data from companies in developing countries – e.g. America Latin and Africa. This information answers the question (6) “what are the avenues for future studies on the topic analyzed?”

Regarding the limitations of this study, the results presented refer to the set of articles from journals that meet the established selection criteria and the databases used – WoS and Scopus. Furthermore, the analysis of articles - exclusively with empirical tests - may have excluded the examination of studies with mathematical modeling, research and essays that also have relevant contributions.

Therefore, for the evolution of this study, we suggest the analysis of articles that consider qualitative research methodologies, other academic article bases other than WoS and Scopus, comparison between periods before and after the Covid-19 pandemic, analysis of specific industries with different degrees of technological influence and samples from developing countries.

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