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DECODING THE DISCOURSE: HOW TEXT MINING REVEALS SHIFTS IN CAPITAL STRUCTURE DEBATES

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1. INTRODUCTION

Capital structure and its associated constraints represent one of the most actively debated fields in contemporary corporate finance. Decisions related to financing, indebtedness, and resource retention are directly influenced by institutional, economic, and regulatory factors—especially in environments marked by uncertainty (Fazzari et al., 1988; Brav, 2009; Benmelech et al., 2019). Since the 2008 global financial crisis, financial constraints have gained central relevance in studies on capital allocation, financial risk, and public policy, with particular attention to firms operating in emerging markets or under fragile institutional regimes (Campello et al., 2010; D'Mello & Toscano, 2020).

In recent years, the literature has shown growing interest in topics such as financial frictions, governance, climate risk, and financial decision-making in small and medium-sized enterprises (SMEs), particularly in developing countries (Beck et al., 2008; Guiso et al., 2015; Nguyen & Canh, 2021). The traditional focus—centered on models such as the Trade-off Theory, Pecking Order Theory, and Agency Theory—has been expanded to include phenomena such as unequal access to credit, institutional volatility, and the digital transformation of financial instruments (Öztekin, 2015; Liu et al., 2022). However, despite the substantial growth in academic output, the field still lacks a systematic mapping that organizes key research areas, evaluates their thematic interconnections, and identifies emerging gaps—particularly with regard to SMEs and the dynamics of financial constraints under diverse regulatory arrangements.

This article aims to address this gap through a structured bibliometric analysis integrated with text mining techniques, applied to a dataset of 603 articles indexed in the Web of Science between 1991 and 2024. Using TF-IDF vectorization, principal component analysis (PCA), and thematic clustering via K-means, the articles were grouped into clusters and interpreted based on their semantic composition and citation patterns. In addition, the study explores recent trends in the literature, highlighting prominent authors, institutions, emerging topics, and co-authorship networks.

By offering a critical organization of the literature on capital structure under financial constraints, this study provides both theoretical and methodological contributions for researchers, policymakers, and institutional analysts. In particular, it underscores the growing prominence of SMEs as an analytical object, the challenges posed by diverse regulatory regimes, and the limitations of traditional models when confronted with the increasing heterogeneity of empirical contexts.

2. THEORETICAL FRAMEWORK

2.1 Capital Structure and Financial Constraints

The literature on capital structure has evolved considerably over the past decades, increasingly incorporating financial constraints as a central explanatory axis of corporate decision-making. Since Fazzari et al. (1988), the debate has emphasized how market imperfections affect the sensitivity of investment to cash flow. Maksimovic and Sheridan (1991), for instance, highlighted the indirect effects of debt on stakeholder-perceived risk, suggesting that financial limitations may impact not only internal decisions but also interactions with external agents.

Since then, the research agenda has expanded to encompass multiple dimensions. Studies such as those by Korajczyk and Levy (2003) and Benmelech et al. (2019) have explored the role of business cycles and macroeconomic shocks in shaping leverage decisions. Conversely, Guiso et al. (2004) and Liu et al. (2022) have shown how institutional and political factors shape credit access and influence the cost of capital. Additionally, organizational characteristics—such as governance structures and corporate culture—have also been examined as relevant determinants of capital structure (Nguyen & Phan, 2020; D'Aurizio et al., 2015; Fresard, 2010).

As a result, the concept of *financial constraints* has become consolidated as a multifaceted phenomenon that can be measured and interpreted through different theoretical and empirical approaches (Almeida & Campello, 2007; Almeida et al., 2014). Recent contributions can be grouped into three major strands: (i) studies on economic and institutional determinants; (ii) analyses of risk, uncertainty, and perceived value; and (iii) approaches focusing on internal firm characteristics. These categories form the basis of the following section.

2.2 Determinants of Financial Constraints

The financial constraints faced by firms arise from a complex interaction of economic, institutional, perceptual, and organizational variables. Macroeconomic factors—such as the economic cycle and credit availability—directly shape corporate leverage. Studies by Kiyotaki and Moore (1997) and Korajczyk and Levy (2003) showed that financially constrained firms tend to adjust their capital structure in a procyclical manner, unlike those with greater access to external financing.

In times of crisis, these limitations become even more evident, disproportionately affecting firms already facing structural barriers (Benmelech et al., 2019; Brav, 2009; D'Mello & Toscano, 2020). Institutional fragility amplifies this effect: for example, stricter labor regulations encourage the maintenance of precautionary liquidity (Karpuz et al., 2020), while stronger property rights improve access to funding (Liu et al., 2022).

Risk perception also influences capital decisions, especially in uncertain environments. Prospect Theory (Kahneman & Tversky, 1979) suggests that cognitive biases affect the behavior of financial agents, which translates into greater volatility in leverage decisions, particularly among publicly traded firms (Campello & Giambona, 2013). In emerging markets, firms tend to adopt more conservative strategies, prioritizing liquidity and limiting debt—except in the presence of favorable stimuli (Almeida et al., 2014; Duchin et al., 2010). Governance mechanisms, such as risk committees and specialized boards, contribute to mitigating informational asymmetries (Byun et al., 2013; King et al., 2021).

Finally, internal organizational structures and sectoral dynamics also influence firms' exposure to financial constraints. The presence of sound governance practices (Malik et al., 2021), an innovation-oriented organizational culture (Guiso et al., 2004, 2015), and firm size (Almeida & Campello, 2007; Hickey et al., 2021) shape access to external capital. More dynamic and competitive sectors demand greater capital investment, while more stable sectors tend to adopt conservative debt structures (Camacho-Miñano et al., 2015).

3. METHODOLOGY

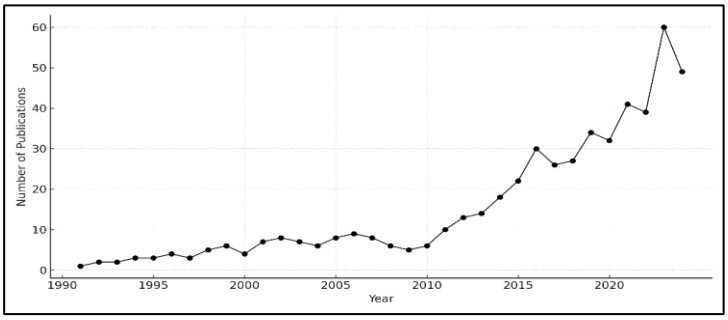
3.1 General Characteristics and Sample

The sample for this study consisted of 603 articles indexed in the Web of Science database, published between 1991 and June 2024, and selected based on the keywords "capital structure" and "financial constraints." After applying filters to eliminate duplicates and out-of-

scope documents, the final dataset comprised studies of high relevance to the field of corporate finance.

The evolution of the number of publications over time reflects a growing academic interest in the topic, particularly after 2008—a year marked by the global financial crisis and the intensification of risks related to leverage and credit access. Subsequent events, such as the European sovereign debt crisis, the Covid-19 pandemic, and recent geopolitical conflicts, have also contributed to the expansion of scientific output in this field.

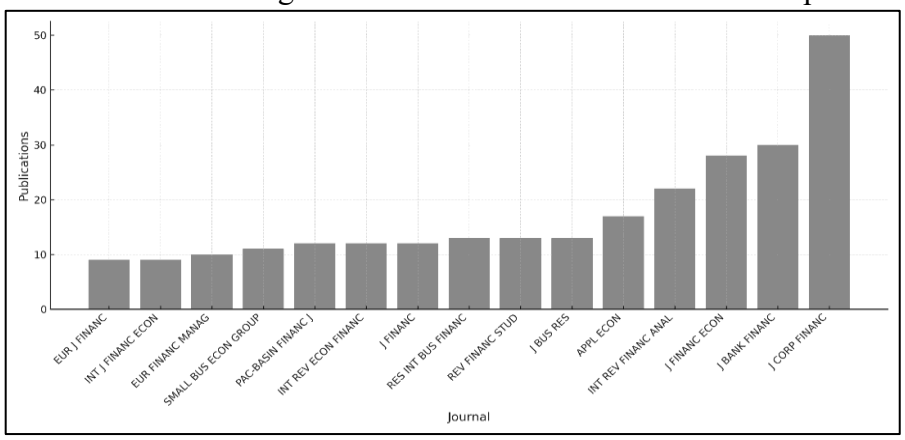
Figure 1 – Evolution of Publications on Capital Structure and Financial Constraints (1990–2024)



Source: elaborated by the authors.

In the journal-specific analysis, the Journal of Corporate Finance emerges as the most influential outlet, with over 40 publications, followed by the Journal of Banking and Finance and the Journal of Financial Economics, each with more than 20 articles. This editorial concentration reflects the central role these journals play in shaping the academic debate on capital structure, financial risk, and corporate financing.

Figure 2 – Journals with the Highest Number of Publications in the Sample



Source: elaborated by the authors.

Based on this general characterization of the sample, the following analysis explores the thematic segmentation of the articles through clustering techniques, allowing the identification of the main research focuses in the recent literature.

3.2 Clusters

To analyze the evolution of the literature on capital structure under financial constraints, a bibliometric approach was employed in combination with text mining techniques. The dataset

was composed of articles indexed in the Web of Science, and data processing involved title tokenization, TF-IDF vectorization, and cosine similarity calculations.

The frequency of a term *t* in a document *d* is given by:

$$TF\ (t,d) = \frac{f_{t,d}}{\sum_{t' \in d} f_{t',d}}$$

The importance of the term across the entire document set *D* is weighted by the IDF:

$$IDF(t,D) = log\left(\frac{N}{|\{d \in D: t \in d\}|}\right)$$

Thus, the TF-IDF value is given by:

$$\text{TFIDF}\ (t,d,D) = TF(t,d) \times IDF(t,D)$$

The similarity between two documents was calculated using cosine similarity:

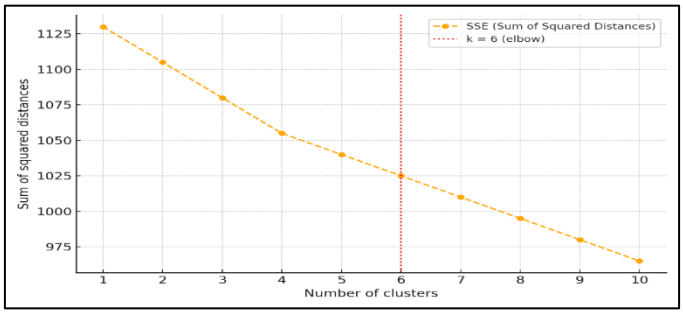
$$\cos\theta = \frac{AB}{\|A\|\|B\|}$$

Based on the similarity measures, the documents were grouped using the K-means algorithm, which partitions *n* observations into *k* clusters by minimizing the sum of squared intra-cluster distances:

$$min \sum_{i=1}^{k} \sum_{x \in C_i} \|x - \mu_i\|^2$$

To define the optimal number of clusters, the elbow method was applied, indicating stabilization of marginal gains at $k = 6$. An additional test using $k = 20$ confirmed that the 6-cluster solution offered a balanced trade-off between simplicity and thematic diversity.

Figure 3 – Elbow Method for K-Means Clustering



Source: elaborated by the authors.

Principal Component Analysis (PCA) was used to reduce the dimensionality of the similarity matrix. The decomposition of matrix *X* was performed as follows:

$$X = USV^T$$

And the principal components were obtained by:

$$PC_1, PC_2, \ldots, PC_k = XV$$

The first two components were used to visualize and label the clusters based on the highest absolute loadings. Semantic interpretation was conducted using the terms most strongly

associated with each component. Terms with low loadings were considered neutral for interpretation purposes.

The separation between clusters was statistically tested using robust ANOVA with trimmed means, appropriate for situations involving heteroscedasticity. The test statistic used was:

$$F_{Robust} = \frac{\sum_{i=1}^{k} n_i^{trim}\left(\bar{X}_i^{trim} - \bar{X}_{trim}\right)^2}{\sum_{i=1}^{k} \frac{s_i^{2(trim)}}{n_i^{trim}}}$$

Where n_i^{trim} is the number of observations after trimming extreme values, $\bar{X}_i^{trim}$ is the trimmed mean of group i, and $s_i^{2(trim)}$ is its trimmed variance.

For multiple comparisons between clusters, Dunn's test was applied. The results were visualized through scatter plots with confidence ellipses, allowing for the observation of thematic cohesion and separation. Additionally, descriptive statistics (mean, variance, and standard deviation) were calculated for each cluster, as well as bibliometric indicators related to the most cited authors, institutional affiliations, and the most frequent journals. The geographic concentration of authors was further assessed using the Hirschman-Herfindahl Index (HHI), which was employed to measure the degree of country-level concentration within each thematic cluster.

3.3 Text Mining on Abstracts and Clustered Articles

In addition to the bibliometric analysis and thematic clustering, this study applied text mining techniques at two levels: (i) to the abstracts of the 603 articles, aiming to identify aggregated linguistic patterns; and (ii) to the full-text content of representative articles from each cluster, in order to compare historical and emerging research trends.

In the abstract analysis, the dataset was segmented into three subgroups: the full sample (603 articles), the 30 most cited articles, and the 30 most recent articles (each representing approximately 5% of the total sample). This segmentation aimed to capture differences between well-established literature and emerging research agendas. The abstracts were processed using tokenization and removal of irrelevant words (stopwords), allowing for the extraction of relative word frequencies for each subgroup (Feinerer, Hornik & Meyer, 2008).

To compare the subgroups, the difference in word frequency was calculated $(Diff = Cited - Recent)$ along with standardized residuals, according to the following formula::

$$Residual = \frac{O - E}{\sqrt{E}}$$

Where *O* represents the observed frequency of the word and *E* the expected frequency. Pearson's chi-squared test (χ^2) was also applied to assess the statistical significance of the differences.

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

The study adopted a statistical significance threshold of $p < 0.05$. To control for potential editorial biases, tests were replicated using articles from the same journals as the most cited papers, ensuring comparability in terms of publication source.

The second stage consisted of topic modeling based on the full text of representative articles from each cluster. Three most cited and three most recent articles were selected per

cluster, totaling 36 texts. This sampling approach balanced historical relevance with recent developments and allowed for a comprehensive representation of the core themes within each group, even in the presence of semantic overlap as indicated by the Kernel density around the principal components (Feng et al., 2017).

The texts, extracted from PDF files (Ooms, 2024), underwent preprocessing — including lowercasing, punctuation removal, number filtering, and stopword elimination — in line with standard linguistic cleaning procedures in text mining (Feinerer, Hornik & Meyer, 2008). Subsequently, a Document-Term Matrix (DTM) was constructed, and the Latent Dirichlet Allocation (LDA) model was applied to extract dominant topics (Grün & Hornik, 2011):

$$LDA(DTM, k = 3)$$

The relevance of therms was assessed based on the following matrix:

$$Terms\ by\ topic = terms(lda\_model, 10)$$

This approach made it possible to identify the most recurring topics within each group of articles and to compare them using chi-squared tests, aiming to determine whether the most cited and the most recent articles exhibited thematic convergence or divergent trends.

4. RESULTS

4.1 Descriptive analysis

Economic crises directly affect capital structure decisions, leading firms to adjust debt levels, equity issuance, and profit retention in response to credit scarcity. To assess the impact of these events on scientific output, the sample was divided into two periods: pre- and post-2010, using the 2008 Financial Crisis as the reference point.

Shapiro-Wilk tests indicated non-normality in both samples. Consequently, the Mann-Whitney test was applied, revealing a statistically significant difference ($p < 0.001$) between the two periods.

Table 1 – Normality and Difference Tests Between Periods

Teste	**Pre-2010**	**Post-2010**
Shapiro-Wilk (p-value)	0,00016	$1{,}19e^{-14}$
Number of papers	77	526
Mann-Whitney (p-value)	$7{,}24e^{-46}$	

Source: elaborated by the authors.

The significant increase in publications in the post-crisis period reflects heightened risk perception, the role of public policies, and renewed interest in how capital structure contributes to corporate resilience. Events such as the 2008 Financial Crisis and the Covid-19 pandemic reinforced this research agenda, as evidenced in studies on tangibility, liquidity, and financial frictions (Almeida & Campello, 2007).

Of the 603 articles in the sample, only 117 (19.4%) received citations, totaling 19,147 mentions. The 25 most cited articles account for 41.5% of this total, with just three of them responsible for approximately 10% of all citations:

Table 2 – Most Cited Articles in the Sample

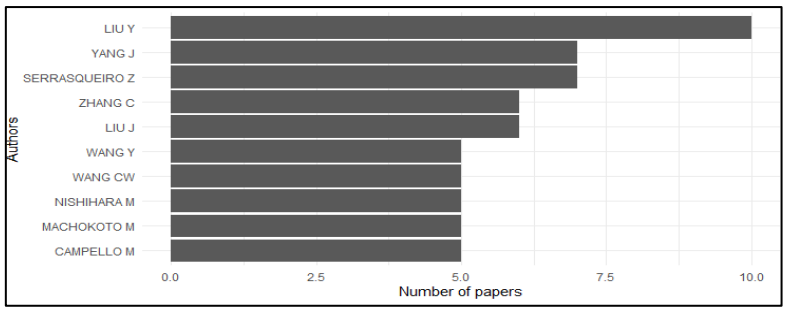
Article	Journal	Citations	Year	Authors
Corporate Financial Policy and the Value of Cash.	Journal of Finance	786	2006	Michael Faukender e Rong Wang
Financing patterns Around the world: Are small firms diferente?	Journal of Financial Economics	549	2008	Thorsten Beck, Asli Demirguc-Kunt e Vojislav Makisimovic
Does local financial development matter?	The Quarterly Journal of Economics	500	2004	Luigi Guiso, Paola Sapienza e Luigi Zingales

Source: elaborated by the authors.

These seminal studies address foundational themes in the literature: Faulkender and Wang (2006) analyze how corporate cash policy influences firm value, particularly in environments with varying degrees of capital market access; Beck, Demirguc-Kunt, and Maksimovic (2008) examine financing patterns among smaller firms in countries with weaker institutions; and Guiso et al. (2004) investigate how local financial development affects business activity, highlighting the institutional environment's role in small firm growth.

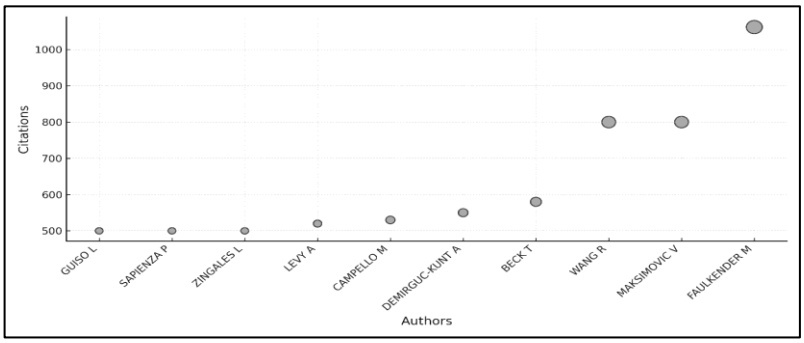
The ten most productive authors each published more than five articles, as shown in Figure 4. Figure 5 presents the most cited authors, revealing a low correlation between publication volume and impact (corr = 0.20), which underscores the seminal nature of some individual works.

Figure 4 – Top Ten Most Productive Authors in the Sample



Source: elaborated by the authors.

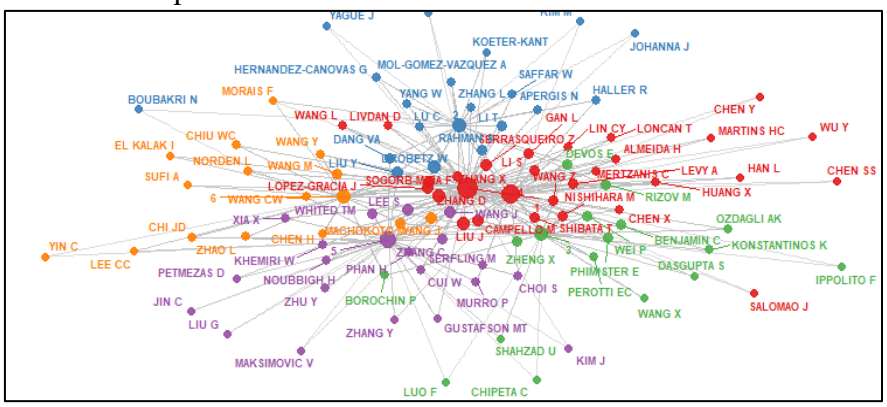
Figure 5 – Most Cited Authors in the Sample



Source: elaborated by the authors.

Finally, the mapping of co-authorship networks (Figure 6) reveals the formation of cohesive clusters of scientific production. Some authors act as bridges between distinct groups, suggesting their influence on the thematic and methodological diffusion within the field.

Figure 6 – Co-authorship Networks



Source: elaborated by the authors.

4.2 Description of Clusters

To understand how the literature on capital structure under financial constraints is thematically organized, the articles were grouped using cluster analysis. This segmentation resulted in six main clusters, described as follows:

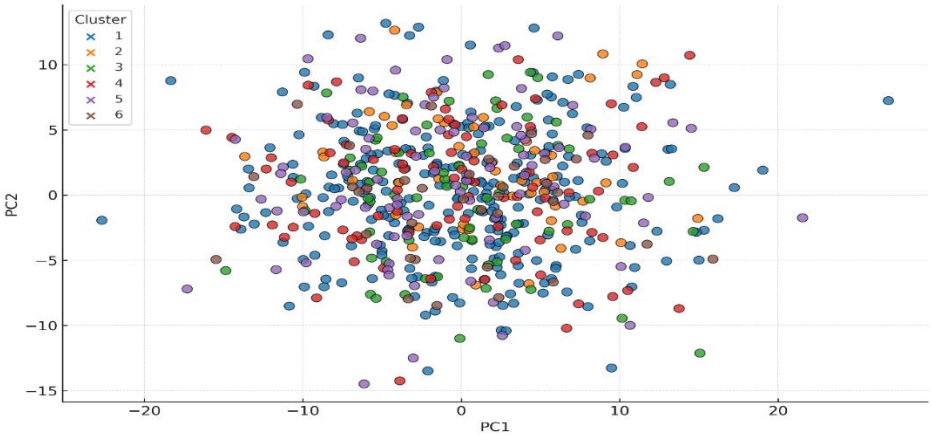
Table 4 – Cluster Description

Cluster	No. of Articles	Theme	Justification
1	265	Development and Corporate Financial Structure	Capital structure in institutional and regulatory contexts, with a focus on emerging markets.
2	52	Financial Risk and Asset Management	Financial risk, corporate health, and asset management in uncertain environments.
3	71	Corporate Finance Management and Cultural Influences	Organizational culture and social factors in debt decision-making.
4	86	Financial Strategies and Market Dynamics	Leverage strategies, cash management, and market responses.
5	93	Financial Strategies and Corporate Asset Management	Contractual clauses and accounting practices affecting corporate debt.
6	36	Financial Constraints and Market Innovations	Financial constraints linked to innovation and deregulation.

Source: elaborated by the authors.

Cluster 1 contains the largest number of articles and covers broader themes, reflecting the importance of institutional and regional factors in the capital structure debate. The diversity across clusters was further explored through Principal Component Analysis (PCA), which enabled the visualization of underlying patterns in the groupings.

Figure 7 – PCA Analysis with Identified Clusters



Source: elaborated by the authors.

The variance explained by the first ten principal components totals approximately 25%, with PC1 (4.89%) and PC2 (3.28%) being the most relevant for interpretation. Based on the term loadings and central articles, PC1 was labeled *Corporate Financing*, representing themes related to leverage, liquidity, and strategic capital decisions. PC2, in turn, was interpreted as *Regulatory Impacts*, reflecting the role of laws, regulations, and public policies in shaping financial structures.

Table 5 – Representative Articles in Each Component

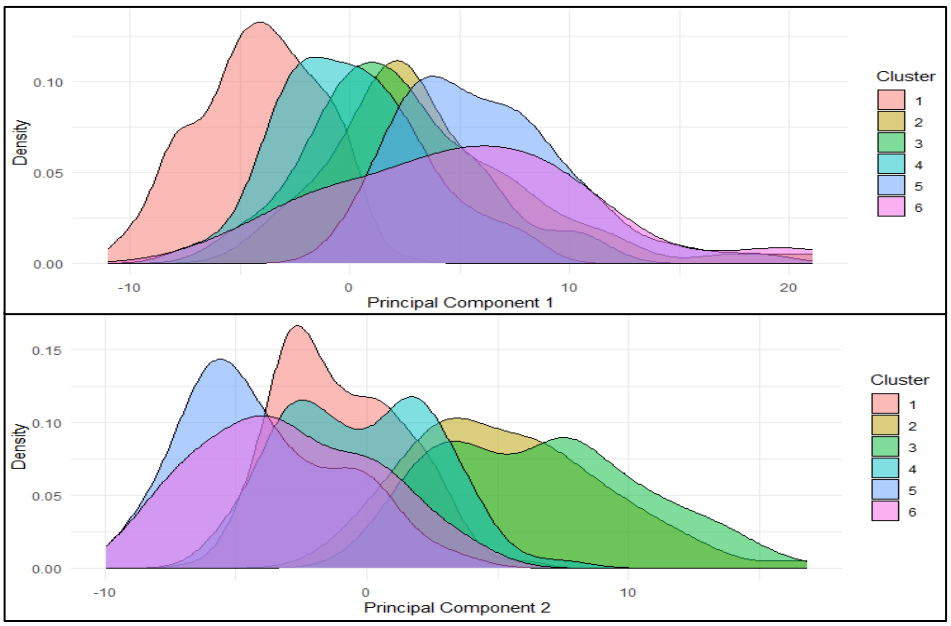
Principal Component	Article	Author and Year
PC1 - Financiamento Corporativo	Leverage and strategic preemption: Lessons from entry plans and incumbent investments	Cookson (2017)
	Financial frictions and the cash flow – external financing sensitivity: evidence from a panel of Pakistani firms.	Rashid & Jabeen (2018)
PC2 - Impactos Regulatórios	The flip side of the coin: how entrepreneurship-oriented insolvency laws can complicate access to debt financing for growth firms.	Forier et al. (2023)
	The interaction of bank regulation and taxation.	Horvath (2020)

Source: elaborated by the authors.

The Kernel density analysis of the first two principal components revealed patterns of thematic overlap and dispersion among the clusters. Clusters 2, 3, and 4 exhibited significant areas of intersection, while clusters 1 and 6 showed more distinct patterns — the former with high thematic concentration and the latter with broader dispersion, reflecting diversity in financial innovation topics.

These results reinforce that the literature on capital structure under restrictive conditions is organized around two major interpretive axes: (i) corporate financing strategies and (ii) institutional and regulatory effects on capital decisions.

Figure 8 – Kernel Density for PC1 and PC2



Source: elaborated by the authors.

The statistical robustness of the clusters was assessed using robust ANOVA with trimmed means, applied to the first two principal components (PC1 and PC2). The results indicate statistically significant differences between the groups, with p-values < 0.001 in both cases.

Table 6 – Robust ANOVA of Clusters

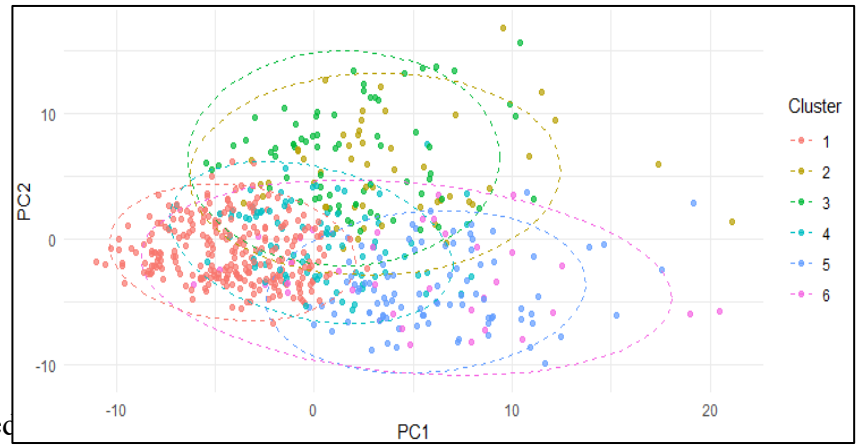
PC	F-statistic	df (between group)	df (residuals)	p-value	Effect	Confidence Interval (Bootstrap)
PC1	121,90	5	95,21	<0,001	0,70	[0,60; 0,81]
PC2	79,77	5	95,04	<0,001	0,87	[0,81; 0,96]

Source: elaborated by the authors.

As a post-hoc procedure, Dunn's test was applied to identify which cluster pairs exhibited statistically relevant differences. The results point to Cluster 1 as the most distinct across both components, particularly when compared to Clusters 5 and 6. In contrast, the pairs 2 vs. 3 and 5 vs. 6 showed no significant differences, indicating thematic proximity.

The graphical analysis supports these findings: in PC1, which represents organizational financing strategies, there is a clear overlap between Clusters 2, 3, and 4. PC2, associated with regulatory impacts, shows more defined groupings and specific peaks, especially in Clusters 1 and 6. While Cluster 1 demonstrates high thematic cohesion, Cluster 6 exhibits considerable dispersion, reflecting its innovative and heterogeneous nature.

Figure 9 – Scatter Plot with Confidence Ellipses



Source: elaborated

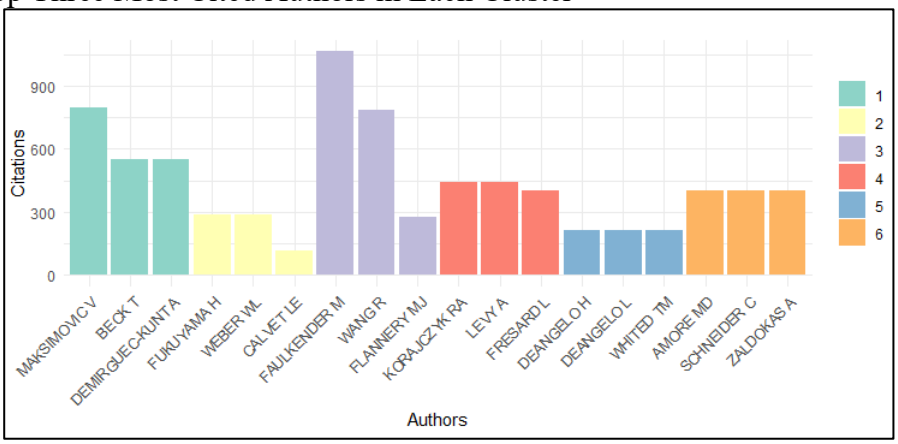
Additionally, the citation profile was assessed across clusters. Cluster 1 holds the highest total citation volume, reflecting its broad thematic scope. However, Cluster 6 exhibits the highest average number of citations per article, highlighting the relevance and growing impact of the emerging topics addressed within that group.

Table 7 – Descriptive Statistics of Citations by Cluster

Cluster	Total of Citations	Mean	Median	σ
1	8066	30.43774	10.0	67.08828
2	1283	24.67308	7.5	45.62409
3	2586	36.42254	9.0	102.10788
4	3569	41.50000	10.5	82.27797
5	1988	21.37634	8.0	35.54083
6	1655	45.97222	13.5	93.88579

Source: elaborated by the authors.

Figure 10 – Top Three Most Cited Authors in Each Cluster



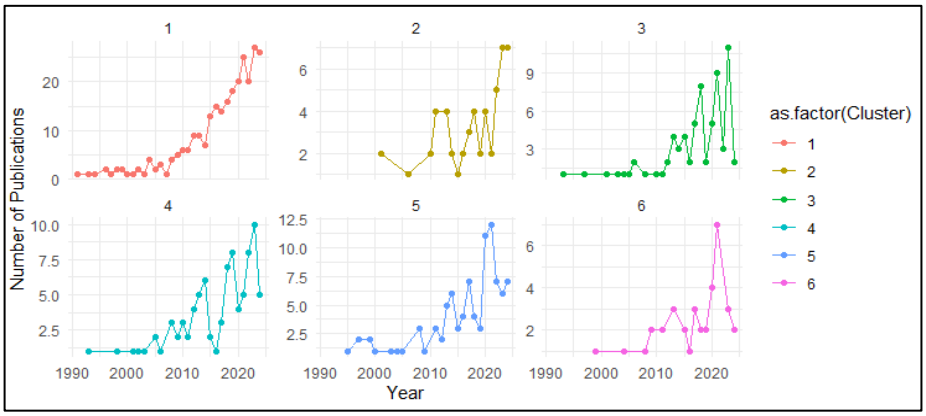
Source: elaborated by the authors.

The visualization shows that, although Cluster 1 includes a greater number of highly cited authors, the individuals with the highest citation impact—such as Faulkender and Wang—are associated with Cluster 3. Cluster 4 is marked by the presence of Amnon Levy, while Cluster 6 stands out for its lower author density but high average citations per article.

The temporal analysis indicates a steady increase in the number of articles across clusters over time, with Cluster 1 displaying the most consistent growth. Other clusters exhibit more

sporadic peaks. Notably, Cluster 6 has experienced significant expansion since 2020, reflecting the rise of topics such as fintechs and regulatory innovation.

Figure 11 – Evolution of the Number of Articles per Year Within Each Cluster



Source: elaborated by the authors.

The table below presents the three most frequent journals in each cluster, based on publication count. Together, these journals account for 116 articles, representing 19.24% of the total sample. This outcome highlights a notable editorial concentration, with particular emphasis on journals specialized in corporate finance that exert significant influence on the dissemination of research concerning capital structure and financial constraints.

Table 11 – Representative Journals per Year in Each Cluster

Journal	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Impact Factor (Clarivate)
Journal of Corporate Finance	1º (19)	1º (6)	2º (4)	1º (8)	1º (10)	1º (3)	7.2
Journal of Banking & Finance	2º (16)	-	3º (3)	-	2º (6)	-	3.6
Research in International Business and Finance	3º (8)	-	-	-	-	-	6.3
International Review of Financial Analysis	-	2º (4)	1º (4)	3º (5)	-	-	7.5
European Journal of Finance	-	3º (3)	-	-	-	-	2.2
Journal of Financial Economics	-	-	-	2º (7)	3º (6)	-	10.4
Applied Economics	-	-	-	-	-	2º (2)	1.8
European Financial Management	-	-	-	-	-	3º (2)	2.1

Source: elaborated by the authors.

The data underscore the prominence of the Journal of Corporate Finance, which appears in all clusters and frequently ranks first—reflecting its broad thematic coverage and strong influence on corporate finance debates. The Journal of Banking & Finance stands out in clusters

focused on capital structure under risk, particularly within banking and sectoral contexts (Clusters 1, 3, and 5). The International Review of Financial Analysis contributes significantly to clusters dealing with asset management, uncertainty, and financial performance. Lastly, the Journal of Financial Economics features among the leading journals in Clusters 4 and 5, reinforcing its role in studies on leverage, contractual covenants, and financial adjustments. All these journals rank among the top 15 in the Journal Citation Reports™ 2023, attesting to their academic and editorial relevance.

To assess the geographical distribution of scientific output on capital structure under financial constraints, the institutional affiliations of all authors in the sample were analyzed. The review identified 1,595 authors affiliated with institutions in 64 countries, with a high concentration in the ten most represented nations, which account for approximately 74% of the total.

Table 12 – Country Concentration of Researchers

Country	Authors	%
United States	459	28,78%
China	224	14,04%
United Kingdom	205	12,85%
Italy	57	3,57%
Spain	47	2,95%
France	42	2,63%
Australia	40	2,51%
Portugal	39	2,44%
Netherlands	34	2,13%
Germany	32	2,01%

Source: elaborated by the authors.

To measure the degree of concentration, the Hirschman-Herfindahl Index (HHI) was used, which ranges from 0 (completely dispersed) to 10,000 (monopolized). The overall sample yielded an HHI of 1,265.85, indicating a moderate level of concentration, despite the dominance of a few countries.

The cluster-level analysis reveals variation in concentration levels. Cluster 2 is the only one with low concentration (HHI < 1,000), while Clusters 4 and 5 show the highest indices, indicating greater geographical concentration of research output in those thematic areas.

Table 13 – HHI-Index by Cluster

Cluster	Nº de autores	% dos top 10 países	HHI
1	707	71,85%	1.168,77
2	121	70,25%	850,35
3	193	77,20%	1.241,11
4	240	78,33%	1.427,78
5	246	74,39%	1.678,23
6	88	78,41%	1.146,69

Source: elaborated by the authors.

These results reveal that scientific production on the topic remains highly concentrated, albeit with relevant variations across clusters. While some groups exhibit greater institutional

diversity, others remain centered around established academic networks from a limited number of countries.

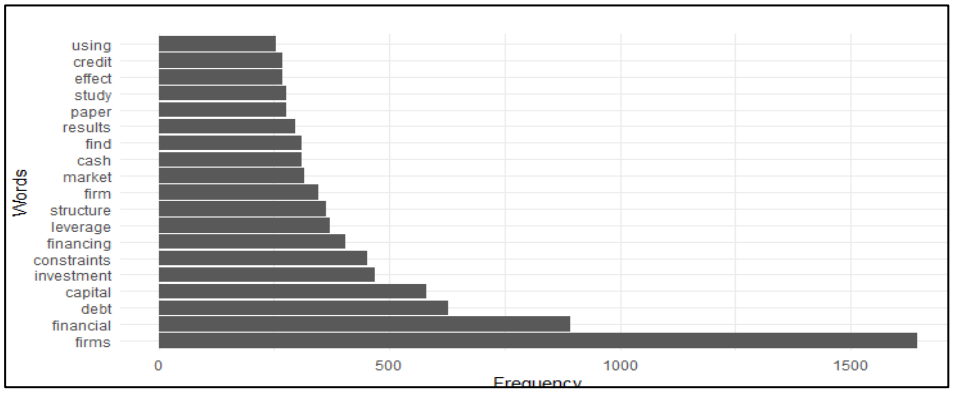
4.3 Abstract Analysis

The analysis of abstracts is divided into two components: the first consists of a quantitative assessment of the content of the article abstracts in the sample, while the second applies post-hoc tests to evaluate the main emerging trends.

4.3.1 Quantitative analysis of abstracts

The first stage of the textual analysis involved identifying word frequencies in the abstracts of the full sample of 603 articles, as well as in two specific subsets: the 30 most cited articles and the 30 most recent ones. The decision to select 30 articles per group (approximately 5% of the sample) aimed to avoid overlap between the most influential and most recent publications, considering that only about 20% of the dataset received substantial citations.

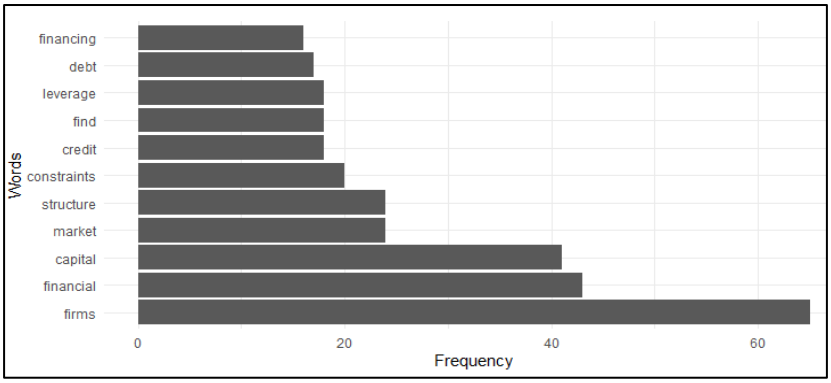
Figure 12 – Word distribution in the full sample (603 articles)



Source: elaborated by the authors.

Among the words with more than 250 occurrences, “firms” stands out, followed by terms such as “investment,” “constraints,” and “cash,” which reflect the link between capital structure, financing decisions, and cash flow sensitivity. Words like “find,” “results,” and “using” are methodological in nature and are commonly found in academic articles.

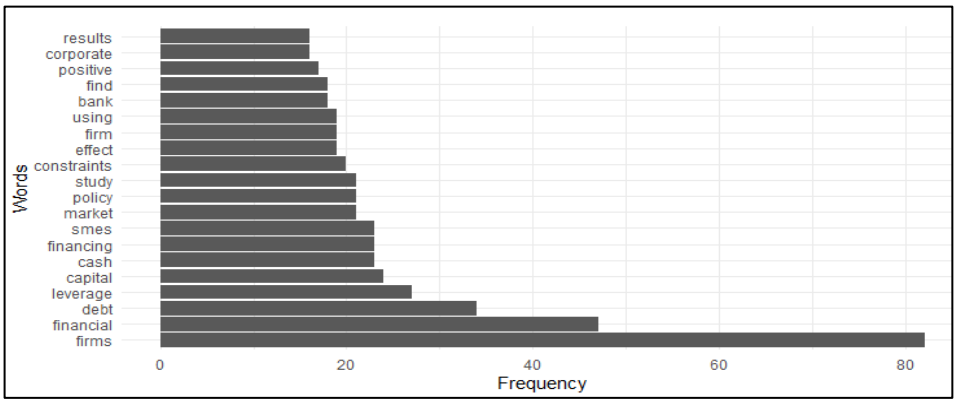
Figure 13 – Word distribution in the 30 most cited articles



Source: elaborated by the authors.

In the most cited articles, there is clear thematic convergence around core concepts in corporate finance. “Constraints,” “investment,” and “leverage” remain among the most frequent terms, with no off-topic or unrelated terms appearing. The concentration of terms suggests a strong analytical focus on classical foundations.

Figure 14 – Word distribution in the 30 most recent articles



Source: elaborated by the authors.

In the most recent articles, there is greater terminological diversity. In addition to traditional terms, new expressions such as “smes,” “bank,” and “cash” appear more frequently, indicating a shift in analytical focus toward issues related to small and medium-sized enterprises and the role of the banking system. This evolution reflects the expansion of the literature beyond large corporate groups, in line with post-crisis trends and the growing relevance of financial constraints under different institutional regimes (Almeida & Campello, 2007; Almeida et al., 2014).

4.3.2 Post-hoc test of differences between most cited and most recent articles

To complement the quantitative analysis of the abstracts, post-hoc tests were conducted to verify whether there are statistically significant differences in word choice between the 30 most cited articles and the 30 most recent ones. Initially, the two groups were compared independently, without considering their journals of origin. Then, a second comparison was performed restricted to the subset of journals that included the most cited articles, in order to control for potential editorial bias.

Table 14 – Frequency and Standardized Residuals of Words in the Most Cited vs. Most Recent Articles

Word	Most Cited	Most Recent	Residuals Most Cited	Residuals Most Recent
Structure	24	8	3.7459418	-3.7459418
Capital	41	24	3.4256917	-3.4256917
SMEs	3	23	-3.2692486	3.2692486
Policy	3	21	-3.0410072	3.0410072
Credit	18	9	2.5429192	-2.5429192
Effect	7	19	-1.6609044	1.6609044
Market	24	21	1.4629237	-1.4629237
Debt	17	34	-1.4074734	1.4074734
Financial	43	47	1.0028047	-1.0028047
Constraints	20	20	0.9396629	-0.9396629

Nota: |resídual| < 1 (noise); 1 ≤ |residual| < 2 (trend); |residual| ≥ 2 (significant); |resíduo| ≥ 3 (alta significância, $p < 0,01$).

Source: elaborated by the authors.

This initial comparison shows that classical terms such as *structure* and *capital* are more frequent in the most cited articles, while terms like *SMEs* and *policy* appear more prominently in the most recent articles. This suggests a shift in the literature's focus, with more recent works exploring new contexts—such as capital structure in small and medium-sized enterprises and the influence of public policies. The interpretation is based on standardized residuals: the column "Residuals Most Cited" indicates whether a word appears more (positive residual) or less (negative residual) than expected among the most cited articles; the same applies to "Residuals Most Recent." Absolute values between 1 and 1.96 indicate moderate trends; values equal to or greater than 2 reflect approximate statistical significance at the 5% level, while residuals above 3 are considered highly significant ($p < 0.01$). To validate these differences, a chi-squared test was applied, with results shown below.

Table 15 – Pearson's Chi-squared test (most cited vs. most recent articles)

Component	Result
χ^2	75.648
df	21
p-value	<0,001

Source: elaborated by the authors.

The chi-squared test applied to the comparison between the most cited and most recent articles revealed a highly significant difference in word frequencies between the two groups ($\chi^2 = 75.648$; $df = 21$; $p < 0.001$). This statistically confirms the shift in focus observed in the standardized residuals and reinforces the notion that recent literature has incorporated new topics and approaches, moving away from the traditional foundations of capital structure.

To strengthen the robustness of the findings, the analysis was replicated considering only the articles published in the same journals as those containing the most cited works. This strategy aims to control for potential editorial effects, ensuring that the detected differences are truly due to thematic evolution in the literature—rather than differences in editorial scope. The results are presented below.

Table 16 – Frequency and Standardized Residuals of Words in the Most Cited vs. Most Recent Articles (same journals only).

Word	Most Cited	Most Recent	Residuals Most Cited	Residuals Most Recent
SMEs	3	23	-3.4821536	3.4821536
Capital	41	24	3.0604259	-3.0604259
Market	24	12	2.6776186	-2.6776186
Structure	24	12	2.6776186	-2.6776186
Banks	4	17	-2.4187453	2.4187453
Credit	18	40	-2.2126849	2.2126849
Risk	7	18	-1.7317888	1.7317888
Financing	16	12	1.3184444	-1.3184444
Constraints	20	16	1.3068126	-1.3068126
Financial	43	42	1.1016211	-1.1016211

Nota: $|\text{resíduo}| < 1$ (ruído); $1 \leq |\text{resíduo}| < 2$ (tendência); $|\text{resíduo}| \geq 2$ (significância estatística); $|\text{resíduo}| \geq 3$ (alta significância, $p < 0,01$).
Source: elaborated by the authors.

The analysis of standardized residuals limited to the same journals confirms the previously observed trend. Terms such as *SMEs*, *banks*, *credit*, and *risk* appear more frequently

in the most recent articles, indicating a thematic shift toward emerging topics like SME financing, the role of the banking system, and financial risk management. Notably, *SMEs* show the highest residual of the sample, highlighting their centrality in current research agendas. These results are consistent with post-2008 crisis literature, the Covid-19 pandemic, and the debate on zombie firms and excessive leverage (Jordà et al., 2020).

To ensure greater robustness, a new chi-squared test was applied to verify the existence of statistically significant differences between the two sets.

Table 17 – Pearson's Chi-squared test (most cited vs. most recent articles within the same set of journals)

Component	Result
χ^2	54.942
df	17
p-value	<0,001

Source: elaborated by the authors.

The chi-squared test applied to the subset controlled by journal again revealed a statistically significant difference between the two groups ($\chi^2 = 54.942$; df = 17; $p < 0.001$). This reinforces the notion that the observed changes in term usage are not due to editorial variation, but rather to substantive transformations in the thematic focus of recent literature. The persistence of this difference, even within the same journal set, confirms a reorientation in studies on capital structure toward new audiences, institutions, and risk environments.

5. DISCUSSION OF THE CLUSTERS

5.1 Most Cited Articles by Cluster: Historical Contributions

The analysis of the most cited articles in each cluster reveals the core conceptual pillars that have shaped the literature on capital structure under financial constraints over the past decades.

In Cluster 1, emphasis is placed on the relationship between financial development and credit access. The seminal work by Guiso, Sapienza, and Zingales (2004) demonstrated how local financial development influences firm performance, while Beck, Demirguc-Kunt, and Maksimovic (2008) highlighted structural financing differences across firms of varying sizes, particularly in emerging economies. Complementing this, Ji and Zhang (2019) explored the role of finance in the energy sector, indicating an expansion of the debate into regulated and sustainable industries.

Cluster 2 focuses on the relationship between risk, financial behavior, and liquidity. Fukuyama and Weber (2010) introduced inefficiency metrics in financial systems with undesirable outputs, while Gryglewicz (2011) developed theoretical models integrating solvency and liquidity in financing decisions. Calvet and Sodini (2014) analyzed risk allocation in household portfolios, showing how household behavior influences large-scale financial markets.

In Cluster 3, the selected works address how internal factors shape financial decisions. Faulkender and Wang (2006) discussed the value of holding cash, whereas Faulkender et al. (2012) examined leverage adjustment over time. Zheng et al. (2012) showed how national culture affects corporate debt maturity, revealing interactions between institutional variables and internal financial practices.

Cluster 4 includes research on leverage, cash policy, and capital management in unstable environments. Korajczyk and Levy (2003) studied financial constraints and macroeconomic conditions, while Fresard (2010) analyzed how cash reserves influence firms' market behavior.

Byoun (2008) added to the discussion by examining adjustment mechanisms toward target capital structures.

Cluster 5 investigates the role of accounting and contractual rules in capital structure. DeAngelo, DeAngelo, and Whited (2011) explored transitory debt dynamics, while Christensen and Nikolaev (2012) compared performance and capital covenants in debt contracts. Byun et al. (2011) evaluated how business group affiliation and ownership structure affect the cost of debt.

Finally, Cluster 6 covers themes related to financial innovation and institutional constraints. Amore, Schneider, and Žaldokas (2013) analyzed how credit supply influences corporate innovation, while Nini, Smith, and Sufi (2009) examined how creditor rights shape investment decisions. Chen (2004) discussed the determinants of capital structure in Chinese firms, highlighting the interplay between institutional characteristics and financial practices.

Collectively, these highly cited articles reveal the conceptual foundations of the field, outlining its main analytical paths — from credit access and cash value to governance, systemic risk, and regulatory change.

5.2 Most Recent Articles by Cluster: Thematic Reorientations

The analysis of the most cited articles from the last five years in each cluster reveals a clear shift in the literature's focus, with increasing emphasis on institutional factors, environmental risks, and financial decisions in smaller firms.

In Cluster 1, recent studies address political uncertainty and climate risk as key determinants of financing decisions. Nguyen and Phan (2020) examined the impact of carbon risk on capital structure, while D'Mello and Toscano (2020) investigated the effects of economic uncertainty on short-term credit. Loncan (2020) expanded the discussion by exploring how foreign institutional investors influence cash holdings in emerging economies.

Cluster 2 maintains its focus on financial frictions and economic shocks. Benmelech, Frydman, and Papanikolaou (2019) reassessed the Great Depression through the lens of employment and credit restrictions. Liu et al. (2022) analyzed how property rights protection affects capital structure, and Malik, Nowland, and Buckby (2021) explored the voluntary adoption of risk committees as a response to financial constraints.

Cluster 3 revolves around institutional reforms, labor protection, and environmental risks. Liu, Wang, and Zhu (2021) examined the effect of privatization on ownership structure and financing access. Karpuz, Kim, and Ozkan (2020) demonstrated how employment protection laws influence corporate cash management, while Shu, Tan, and Wei (2023) investigated the impact of carbon policy risk on capital structure decisions.

Cluster 4 highlights political risk and liquidity strategies. Nikolov, Schmid, and Steri (2019) analyzed corporate liquidity under volatile conditions, while King, Loncan, and Khan (2021) investigated the effects of political risk on foreign investment projects. Chen, Maslar, and Serfling (2020) examined how asset redeployability influences the choice between bank and public debt.

In Cluster 5, the prevailing themes include executive incentives, debt renegotiation, and investment policy. Dang, De Cesari, and Phan (2021) linked employment protection laws to share repurchase decisions. Castro et al. (2021) explored how executive compensation structures affect debt concentration, and Zhao, Feng, and Hu (2022) analyzed fiscal incentives and labor share in investment decisions.

Cluster 6 focuses on informal financing, energy transition, and business succession. Nguyen and Canh (2021) studied financing decisions in small businesses under varying institutional arrangements. Hickey et al. (2021) examined asset management in European utilities under net-zero carbon targets, while Lee et al. (2021) addressed how CEO succession affects firms' debt capacity.

These recent contributions point to a reconfiguration of the literature, with growing attention to fragile institutional contexts, environmental regulation, small business governance, and nontraditional risks. Capital structure transformations are increasingly analyzed through multiple lenses that incorporate political, environmental, and cultural variables alongside classical financial decisions.

5.3 Robustness Tests Based on Article Content Analysis

The final stage of the content analysis consisted of a robustness test to verify whether the themes discussed in the most cited and most recent articles (within the top journals of each cluster) presented statistically significant differences. This step complements previous findings by integrating the results of frequency analyses, topic modeling, and textual segmentations per cluster, thereby consolidating a more robust evaluation of thematic transformations over time. To this end, the chi-squared test (χ^2) was applied within each cluster, comparing the topics of the most cited and most recent articles. The results are presented below.

Table 18 – Chi-squared Test for Thematic Differences in Classic vs. Recent Articles.

Cluster	χ^2	df	p-value	Interpretation
Cluster 1	9301.4	584	<0.01	Null hypothesis rejected: significant theme shift
Cluster 2	4656.7	390	<0.01	Null hypothesis rejected: significant theme shift
Cluster 3	9425.4	762	<0.01	Null hypothesis rejected: significant theme shift
Cluster 4	9435.7	747	<0.01	Null hypothesis rejected: significant theme shift
Cluster 5	7777.1	658	<0.01	Null hypothesis rejected: significant theme shift
Cluster 6	6640.0	655	<0.01	Null hypothesis rejected: significant theme shift

Source: elaborated by the authors.

The results reveal high χ^2 values and p-values below 0.01 in all clusters, indicating statistically significant differences between the topics addressed in the most cited and most recent articles. For instance, Cluster 1 exhibited $\chi^2 = 9301.4$ (df = 584), reflecting substantial thematic variation. Cluster 4 stood out with the highest χ^2 value (9435.7), suggesting even greater heterogeneity in its evolving topics.

These findings reinforce the validity of the cluster segmentation and confirm that the most recent articles within each cluster not only introduce new approaches but also represent substantive reorientations from classical contributions. The thematic diversity observed over time supports the view that the literature on capital structure under financial constraints has undergone meaningful transformations — both theoretically and empirically.

5. CONCLUSION

This article analyzed the evolution of the literature on capital structure under financial constraints by combining bibliometric techniques, text mining, and thematic cluster analysis. Based on a sample of 603 articles indexed in the Web of Science database between 1991 and 2024, the study identified significant transformations in the themes, approaches, and institutional contexts addressed by the academic literature.

The results showed that the literature, initially centered on classical foundations such as leverage, cost of capital, and cash policy, has progressively incorporated topics related to regulatory risk, governance, sustainability, and, in particular, the specificities of small and medium-sized enterprises (SMEs). This transition was evidenced through word frequency analysis, standardized residuals, and thematic robustness tests, which revealed statistically significant differences between the most cited and most recent articles across all clusters.

The application of clustering and Principal Component Analysis (PCA) enabled the identification of six well-defined thematic groupings, each with distinct emphases—ranging from the role of financial institutions in regional development to the impacts of contracts, innovation, and external risks on capital structure. The comparative analysis across clusters demonstrated not only the diversity of approaches but also a growing specialization and thematic expansion in recent literature.

From a methodological standpoint, this study contributes by demonstrating how quantitative and computational methods can be integrated into content analysis in corporate finance, offering a more in-depth understanding of the directions and reconfigurations within a well-established field. Furthermore, by highlighting the emergence of topics related to SMEs, public policy, and climate risk, the study engages with contemporary challenges faced by firms operating in transitional markets.

As a limitation, the analysis relied primarily on data available in titles and abstracts, which may constrain the semantic depth captured by automated techniques. Future research may combine this approach with systematic qualitative reviews or metasyntheses to deepen the understanding of core arguments and methodologies employed.

In summary, the literature on capital structure under financial constraints has been expanding and diversifying, reflecting a dynamic field that is increasingly responsive to the institutional, regulatory, and economic transformations shaping the corporate financing landscape.

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