

Exploring the Research Journey of Investment-Cash Flow Sensitivity: A SLR, Bibliometric and Content Analysis

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ABSTRACT

This paper undertakes a novel endeavour to identify the knowledge gap on Investment-Cash Flow Sensitivity (ICFS) through Systematic Literature Review (SLR), bibliometric and content analysis taking data from Scopus and Web of Science databases spanning over 1988-2022. The study not only identifies influential authors and papers but also illuminates major themes, publication trends, active institutions and countries, thereby delineating the intellectual landscape of ICFS. Moreover, it evaluates current themes, identifies barriers to literature growth and proposes directions for future research. Furthermore, it is documented that there is a lack of cross-national collaboration in ICFS research, particularly among researchers from developed and developing nations. Notably, the underrepresentation of macroeconomic, firm-specific factors and Environmental, Social and Governance (ESG) considerations in the ICFS research domain is highlighted and can be used in future studies.

Keywords: Investment, Cash flow sensitivity, Bibliometric analysis, Scopus, Web of Science.

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INTRODUCTION

Corporate investment decisions are vital in a firm's establishment, growth and survival.^[1,2] Such a decision comprises short-term and long-term investment decisions.^[1] However, long-term investment decisions are more crucial for firm sustainability as they provide long-term cash flow, widen business operations,^[3] improve production capacity and strengthen the firm's solvency position.^[3] At the same time, long-term investment decisions need utmost care as they involve large cash outlay, irreversible in nature and greatly influence a firm's earnings and growth potential.^[4,5] Implementing such investment decisions requires adequate funds, which can be arranged from external and internal sources.^[6] According to Modigliani and Miller's proposition,^[7] the world is friction-free and there is no hurdle in raising external finance, making external and internal finance a perfect substitute of each other. Thus, in such a context, investment decisions are independent of financing decisions.^[8] However, such a perfect capital market does not exist in the real world^[9-13] as there are many frictions in the market.^[14-16] The pecking order theory argues that such frictions arise due to information asymmetry.^[14] Further, information asymmetry, occurs when one party (insiders) holds superior information than another (outsiders), resulting in an unequal distribution of transaction costs. Hence, within the

pecking order theory framework, external financing options like debt or equity financing, which entail fees for obtaining external funds are given less priority and internal financing given more priority as it is economical funding source.^[17,18] Likewise, agency problems highlighted in the agency theory, taxes and various transaction costs, discussed in the static trade-off theory, also evidenced that the real world market is imperfect due to frictions in the market.^[8,9] Consequently, such imperfectness in the market creates a wedge between the cost of internal and external sources of funds.^[19,20] In line with this, Gupta^[21] argued that external funds is costlier than internal funds due to imperfect capital markets. Hence, making the right financial decision in the imperfect capital market is challenging for every financial manager.^[22,23] Earlier studies^[24-26] have shown that cash flow (internal funds) is crucial for firm's investment decisions, mainly when there are high cost for external fund.

Thus, realizing the significance of cash flow in investment decisions, substantial attention has been paid by researchers across the globe to examine the dependency of investment on the firm's cash flow, which is known as Investment-Cash Flow Sensitivity (ICFS).^[5] However, despite the growing interest in ICFS topic in corporate finance literature, a dearth of literature focuses on systematic literature reviews, bibliometric analysis and thorough evaluations of available work in this field. This study pinpoints the crucial regions, current trends and recommends further study on ICFS. Using a SLR and bibliometric analysis, we highlighted the publishing patterns and intellectual structure in this field of literature. To the best of our knowledge, this work



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is the first in-depth study on investment-cash flow sensitivity literature that combines an SLR and bibliometric analysis. By doing so, we respond to the following Research Queries (RQs):

RQ1: What is the recent publication trend in the field of investment-cash flow sensitivity?

RQ2: What are the factors that are shaping the publication trends?

RQ3: What is the most relevant investment-cash flow sensitivity research themes?

RQ4: What is the intellectual framework in this area?

RQ5: What are the dry research areas of investment-cash flow sensitivity that need more attention from researchers?

By performing an extensive evaluation of prior work, this paper attempts to fill the research gap and adds to the body of knowledge on investment-cash flow sensitivity. It gives a complete knowledge structure of the subject field and synthesizes the literature. It is distinct from earlier studies as it has made a novel attempt to conduct a comprehensive review by combining both SLR and bibliometric analysis on the investment-cash flow sensitivity topic, which is the first of its kind in the global arena. Secondly, most studies have extracted bibliographic data from Scopus or the Web of Science database. However, very few studies have considered both databases for conducting bibliometric analysis in general. The SLR and bibliometric analysis in the investment-cash flow sensitivity area is absent globally. So, in this paper, we have made a unique attempt by extracting data from both Scopus and Web of Science databases to make the study more comprehensive and reduce biases. Thirdly, this study has used the latest tools for analysis, like Biblioshiny and Vosviewer software, where we introduced the Sankey diagram (three-field plot analysis), in the field of investment-cash flow sensitivity and made the necessary analysis and visualizations. Lastly, this study helps the researchers to identify literature growth roadblocks and the current status as well as the future direction of research in this area.

The methodology, analysis and conclusion are covered in the following sections of the paper.

MATERIALS AND METHODS

A mix of SLR, bibliometric and manual content analysis tools have been used for analysis. SLR ensures a scientific, transparent and imitable process.^[27] SLR is superior to traditional narrative reviews^[28] in various ways, such as better quality of review process and results;^[28-30] curtailing bias and errors,^[31] strong validity of the process as its steps are replicable at the time of review,^[32] offers data synthesis and literature mapping of a specific research topic^[28] and it also provides an outline that incorporates existing knowledge to academics and practitioners.^[28,31]

Bibliometric analysis is a quantitative method that provides deep insight into the literature^[33,34] and aids researchers in forming

new knowledge.^[35-38] At the same time, content analysis is a method of analysing selected papers and deriving a synthesis.^[39-41] Bibliometrics encompasses a variety of techniques, including co-word analysis for keywords,^[42] co-author analysis, citation analysis, co-citation analysis and bibliographic linking.^[34] The steps involved in data retrieval are detailed next section.

Database, keywords and search strategies

Data are mined from the Scopus and Web of Science (WoS) databases, the global premier databases for published articles, abstracts and citations and used by earlier studies.^[43-47] This paper has made a different attempt by considering both databases to make the study comprehensive. The data was collected from the default publication year i.e., from 1988 to 2022, in both databases. A string of appropriate search terms “Investment-Cash Flow Sensitivity” OR “Cash-Flow Sensitivity” OR “Operating Cash-Flow Sensitivity” OR “Cash Flow Sensitivity*” OR “Investment-Cash Flow Sensitivity*” are used to identify the papers from title, abstract and keywords which resulted into 940 documents comprising of 381 documents from Scopus and 559 documents from Web of Science. Then, such documents were further refined to English language and other languages (Portuguese-03, Chinese-02, Spanish-02 and Japanese-01) were excluded, yielding 932 documents. Further, all the titles, abstracts and keywords are reviewed manually. Those titles, abstracts and keywords found irrelevant to our main theme (288 documents) were removed, resulting in 644 documents. As we have considered both Scopus and WoS databases, certain documents are common in both databases, so proper attention has been given and duplicate documents (242 documents) are removed by the help of the ‘R-studio’ software package. Finally, 402 documents were found to be eligible for analysis.

Software and methods of analysis

After shortlisting the final 402 documents, all the documents are exported to ‘Biblioshiny’ (‘a shiny app providing a web interface for bibliometric analysis’) and ‘VOSviewer’ (version 1.6.16), a bibliometric mapping and visualization software tool. Figure 1 illustrates the analytical structure of the research.

RESULTS AND DISCUSSION

Descriptive analysis

To understand the current trend of publication in this area, a descriptive analysis of 402 documents are performed. Table 1 summarises the essential information on the bibliographic data used in the study.

Annual growth trend of publication

Our RQ1 is “What is the recent publication trend in the field of investment-cash flow sensitivity?” and RQ2 is “What are the factors that are shaping the publication trends?”. We have

analysed the annual publication trend of investment-cash flow sensitivity to answer these questions. The annual publication trend of research in Investment-Cash Flow Sensitivity (ICFS), as depicted in Figure 2, reveals three distinctive stages of growth and academic focus on this area. These stages provide significant insights into the evolution and scholarly attention to ICFS over time.

Initial Stage (1988-2002)

During this period, publications on ICFS were minimal, with only 11 documents published across 14 years, reflecting limited scholarly interest or awareness about the topic. Notably, the field experienced a publication hiatus between 1994 and 2000, suggesting either stagnation in research activity or a lack of access to data and tools for ICFS analysis during that time. The highest impact work during this phase is attributed to 1997, which stands out for being the most influential year in ICFS literature in terms of citations. This suggests that although the volume of publications was low, key foundational work was being laid.

Pre-Expansion Stage (2003-2010)

A steady growth trajectory emerges in this phase, with 83 documents published, marking a notable shift in academic interest. The year 2008 represents a pivotal moment when the number of publications first entered double digits, signalling the

beginning of a robust academic engagement. One possible reason is that the global financial crisis began in 2007 and triggered scholars' worldwide interest in exploring firms' financial behaviour, including ICFS. The literature by Arslan *et al.*^[48] and Machokoto *et al.*^[49] have also evidenced that ICFS is one of the crucial factors for decision-making during a crisis. Hence, ICFS has gained a momentum after financial crisis and very pertinent to address at the time of economic downturn.

Expansion Stage (2011-2022) and beyond

The number of publications accelerates significantly during this stage, with 308 documents published, accounting for over 75% of the total literature on ICFS. The sharp spike in publications in 2022 (47 documents) underscores the heightened global academic interest, possibly driven by the need to understand ICFS in light of contemporary crises such as COVID-19, which has profound implications for firms' financial decision-making. This stage also reflects the growing interdisciplinary nature of ICFS research, as scholars explore its intersections with themes such as ownership structure, macroeconomic risks, information asymmetry etc.

The growing interest in ICFS amid global crises suggests that research will continue to expand, possibly focusing on emerging economies, ESG integration and technological disruptions. However, this expansion also calls for critical reflection on maintaining the quality and relevance of contributions in a

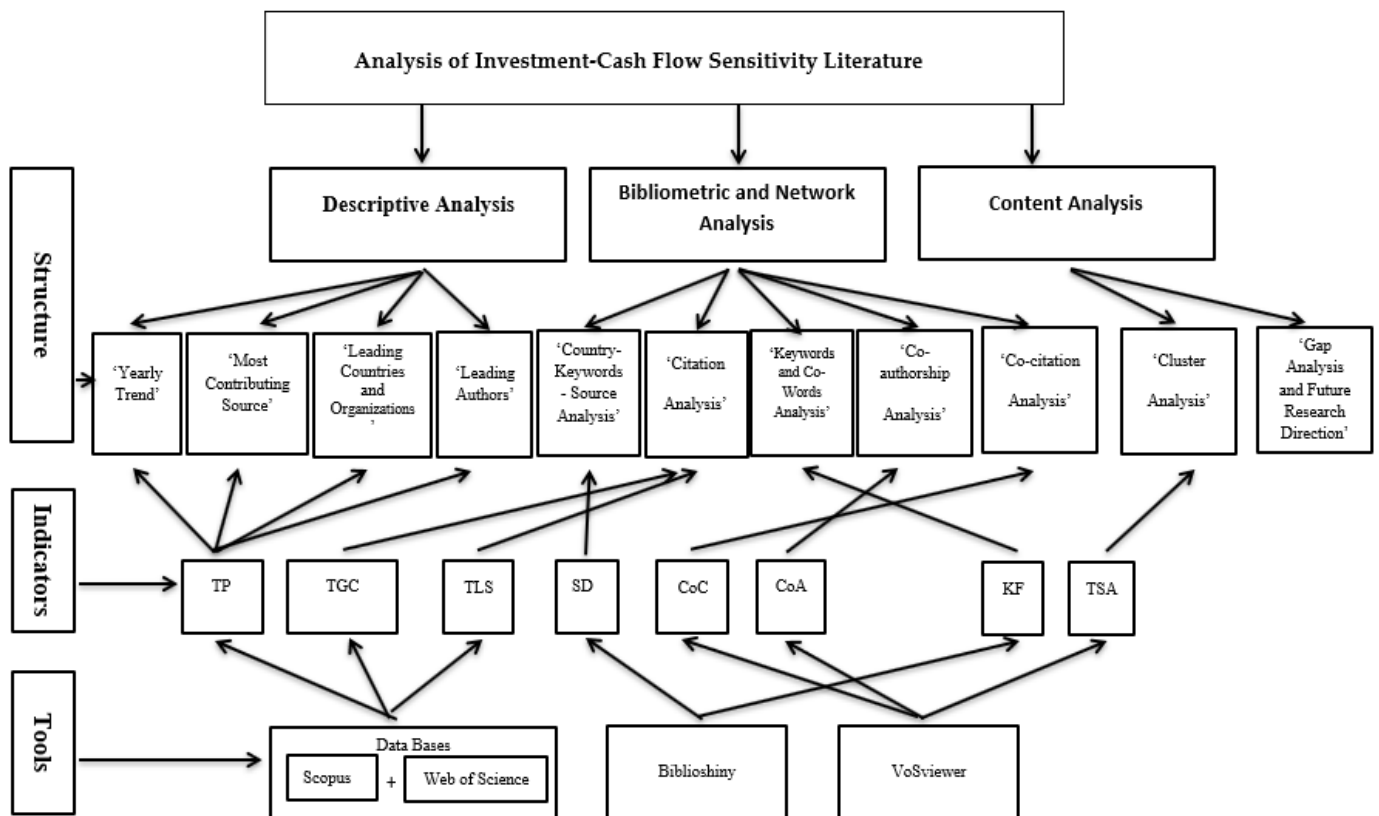


Figure 1: Analytical structure for the study. Where TP=Total Publications; TGC=Total Global Citations; TLC=Total Local Citations; SD=Sankey Diagram; CoC=Co-citation Count; CoA=Co-authorship Count; KF=Keywords Frequency; TSA=Thematic Structure Analysis. Source: Authors' compilation.

rapidly evolving field. The upward trend in publications indicates a maturing research domain that has gained momentum in response to global economic events. The delineation of stages and correlation with crises highlight ICFS as a vital area of study with significant implications for policy and practice. To sustain meaningful growth, future research must strive for deeper theoretical advancements and practical applications beyond crisis-driven inquiries.

Top contributing journals

Table 2 highlights the top 10 contributing journals in the field of ICFS which have most impact in this area. This analysis not only identifies the most productive journals but also offers insights into the structural and dynamic landscape of ICFS research. Further, the study explores why are these journals leading contributors? and how do leading journals shape the field?

The reasons for the journals being considered as leading contributors are their relevance to the field, publisher strengths and prestige supported by quality metrics. Journals like the 'Journal of Banking and Finance', contributing 24% of the publications among the top 10, focus on critical financial topics such as firm behaviour, corporate finance and investment decisions, aligning closely with the core themes of ICFS research and making them preferred outlets for scholars. Elsevier's dominance, with four journals in the top 10, underscores its strong presence in financial and management research publishing, as its journals cater to both theoretical and applied studies, attracting diverse contributions. Similarly, publishers like Wiley-Blackwell, Taylor and Francis and Emerald Publishing Group are known for disseminating high-quality business and management research, significantly influencing ICFS literature. Furthermore, most contributing journals are ranked under the ABDC (Australian Business Deans Council) categories 'A*', 'A' and 'B', which highlight their academic rigor and impact. Metrics such as the h-index and CiteScore further validate their prestige and quality in the business and management domains and Impact Factor further solidify their standing as influential platforms for ICFS studies.

The leading journals have shaped the field of ICFS in several key ways, including knowledge dissemination, fostering global research networks and guiding thematic evolution. High-impact journals like the Journal of Finance (ranked 6th in terms of publications) play a pivotal role in shaping the field through their significant citation influence, despite publishing a relatively smaller number of articles (7 documents). With a cite score of 11.2 and an Impact Factor of 7.544, these journals set benchmarks for quality and drive scholarly discourse on critical ICFS topics. By providing a platform for diverse researchers to engage with cutting-edge financial theories and empirical studies, these journals foster international collaboration and build global research networks. This concentration of high-impact research within selected journals helps to create a cohesive and evolving

research agenda in ICFS. Additionally, the editorial policies and focus areas of these journals guide the thematic evolution of ICFS research. For example, journals such as the Journal of Corporate Finance and the Journal of Financial Economics often emphasize firm-specific determinants of ICFS, while others may prioritize macroeconomic or policy-level impacts.

The journals imply structure and dynamics of the ICFS field in the following ways. The dominance of four publishers (Elsevier, Taylor and Francis, Wiley-Blackwell and Emerald) in the top 10 journals highlights a centralized structure in the dissemination of ICFS research. While this centralization reflects a concentration of quality, it also poses challenges such as potential exclusivity, making it difficult for some scholars to access or contribute to these journals. The distribution of publication volumes and citation metrics underscores the emphasis on quality over quantity, as exemplified by journals like the Journal of Finance, which, despite publishing fewer articles, achieves the highest cite score and Impact Factor by prioritizing ground-breaking research. The strong presence of high-ranking ABDC journals indicates that ICFS is well-integrated into the broader business and management research ecosystem, emphasizing its relevance not only within corporate finance but also in areas like organizational behaviour, policy-making and strategy. However, the analysis also reveals opportunities for expanding the diversity of journals contributing to ICFS. The underrepresentation of non-western publishers and emerging market perspectives highlights the need for greater inclusivity in shaping the field's future research agenda. Overall, the influence of leading journals on ICFS research through their focus, quality metrics and international collaboration reflects the field's maturity while emphasizing its potential for diversification. Enhancing representation from a broader range of journals and publishers could make ICFS research more globally inclusive and interdisciplinary, further enrich the field's dynamics.

Leading countries working on ICFS

The data highlights that ICFS has garnered contributions from 49 countries, showcasing its global relevance. The leading 10 countries information is highlighted in Table 3. The Table indicates China, USA and UK are the leading contributors to ICFS research. However, a deeper analysis of the distribution of contributions and citations highlights significant disparities and provides insights into the structure and dynamics of ICFS research. China, USA and UK are considered as leading contributors to the ICFS research due to their research infrastructure, funding and unique economic and institutional contexts. China, contributing 24% of the academic output and USA, with 19%, are global leaders in research, driven by robust funding, infrastructure and institutional support. These nations prioritize corporate finance and macroeconomic topics, placing ICFS as a key area within their broader research agendas. UK, contributing 8%, leverages its strong academic tradition in business and finance to advance ICFS literature, particularly in cross-border and policy-related

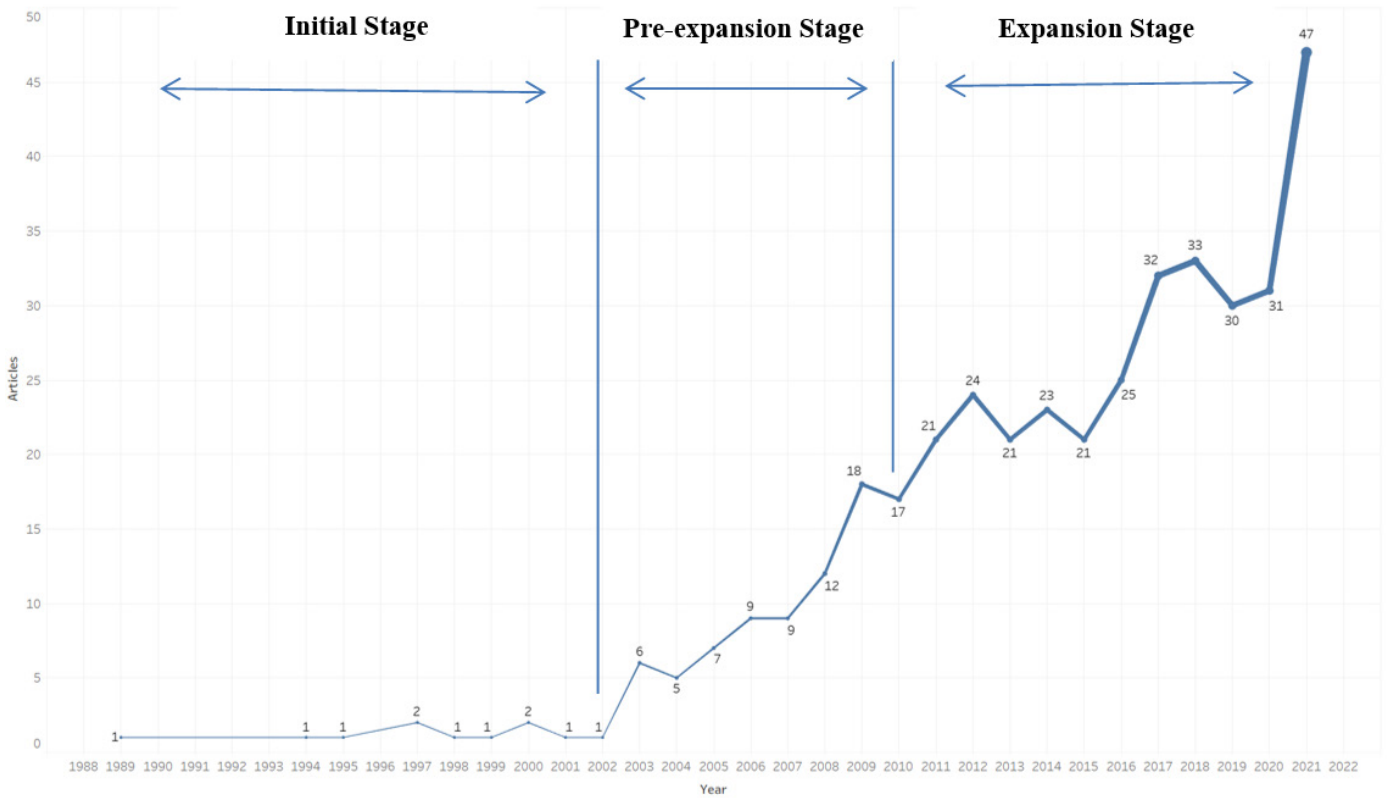


Figure 2: Annual publication trend. Source: Authors' compilation.

Table 1: Key information about the data.

Description	Results
Timespan	1988:2022
Sources (Journals, Books, etc.)	217
Documents	402
Number of countries worked on ICFS	49
Average years from publication	7.94
Average citations per document	28.25
Average citations per year per document	2.078
References	10334
Authors keywords	713
Authors	744
Authors of single-authored documents	74
Authors of multi-authored documents	670

Source: Author's compilation.

This Table highlights the basic information of our study.

studies. The rapid economic growth in China has fuelled interest in understanding firms' financial behaviour, as they navigate challenges during periods of expansion. Meanwhile, the USA's mature financial markets and diverse corporate structures provide a rich foundation for exploring ICFS dynamics. As a global financial hub, the UK focuses on the interplay between financial institutions and corporate decision-making, further enriching the field.

China's leadership in corresponding author contributions underscores its dominant role in shaping recent research in ICFS. This trend reflects China's growing influence in global academic research, driven by substantial investments in education and research institutions over the past two decades. Meanwhile, the USA, despite a lower share of publications than China, leads in citations. This suggests that American studies are viewed as foundational or highly impactful, likely due to their methodological rigor or theoretical contributions. It emphasizes that quality and influence can outweigh sheer publication volume in shaping the field's dynamics.

However, much of the world remains underrepresented in ICFS research. Among 49 countries contributing to the field, 25 have contributions ranging from 1% to 4% and 21 countries contribute less than 1%. This highlights a concentration of research activity in a few leading nations, leaving many regions underexplored. Such underrepresentation implies that ICFS research is still nascent or under-researched in several parts of the world, presenting opportunities for expansion.

The centralized nature of ICFS research, with publications concentrated in a few countries, shapes the field's structure and dynamics. While this centralisation drives theoretical and methodological advancements, it risks marginalising region-specific challenges and insights. The emergence of new entrant countries with minimal contributions highlights ICFS as an underexplored area, especially in developing countries with

Table 2: Most contributing journals in the area of investment-cash flow sensitivity.

Sl. No.	Journal name	TP	TC	SPY	h-index	Publisher	ABDC Ranking	SCS	ISSN	JIF
1	Journal of banking and finance	20	843	2004	14	'Elsevier'	A*	4.4	0378-4266	3.700
2	China economic review	14	719	1999	11	'Elsevier'	A	4.6	1043-951X	4.227
3	Applied economics	8	54	2006	5	'Taylor and Francis'	A	2.3	1466-4283	1.880
4	Emerging markets finance and trade	8	35	2012	4	'Taylor and Francis'	B	2.6	1540-496X	2.315
5	Accounting and finance	7	58	2009	4	'Wiley-Blackwell'	A	3.3	1467-629X	2.942
6	Journal of finance	7	1864	2003	7	'Wiley-Blackwell'	A*	11.2	1540-6261	7.544
7	European financial management	6	221	2005	3	'Wiley-Blackwell'	A	2.3	1468-036X	1.800
8	Finance research letters	5	12	2004	2	'Elsevier'	A	5.3	1544-6123	5.596
9	International journal of managerial finance	5	32	2005	3	'Emerald Group Publishing'	A	2.5	1743-9132	1.737
10	International review of economics and finance	5	57	2010	3	'Elsevier'	A	3.6	1544-6131	2.520

Note- Here, TP is total publication, TC is the total citation, SPY is starting publication year, ABDC is ranking of journal quality (given by Australian Business Deans Council), 'A*' is the highest quality indicates top 5%- 7% journals in the field, 'A' is the 2nd highest quality indicating next 15% to 25% journals, 'B' is the third highest quality journals indicating 35% to 40% journals in the field, 'C' is the fourth highest quality journals showing rest of the journals and NR stands for 'Not Rated/ranked', SCS is the Scopus Cite Score, 2021 obtained from Scopus site, JIF is journal impact factor.

Source: Authors' compilation.

This Table highlights the most contributing journals in the field of ICFS.

unique financial and institutional contexts. This offers researchers the chance to explore context-specific applications of ICFS.

Additionally, the disparity between contributions and citations points to significant potential for international collaboration. While China leads in output, the USA's citation dominance suggests opportunities for cross-country partnerships to enhance the global impact of ICFS research. Expanding the scope of inquiry beyond leading nations to include emerging markets, regional financial systems and global crises could further diversify the discourse, making the field more inclusive and holistic.

The analysis of country contributions highlights the duality of strengths and challenges within ICFS research. While leading nations like China, the USA and the UK play pivotal roles, the underrepresentation of many countries reveals vast potential for future exploration. For the field to evolve, ICFS research must accommodate diverse perspectives, fostering a comprehensive understanding of its dynamics across varied economic and institutional landscapes.

Leading institutions in the field of ICFS

So far, our dataset shows that 752 institutions have paid attention to ICFS and published papers on that. Table 4 shows that out of such institutions, the "University of Salamanca" is the most active one and has contributed six papers. As evidenced by the country's productivity, Chinese institutions are most active in ICFS research.

Leading authors working on ICFS

As per the information given in Table 1, 744 authors worked on ICFS literature, composing 74 single-author documents and 670 multi-author documents. Table 5 indicates that out of such authors, the most contributing author is 'Moncef Guizani', who has published 06 papers on the topic, followed by 'Ezzeddine Ben Mohamed' and 'Yuhuilin Chen', who has 05 papers each. Interestingly, 'Moncef Guizani' has published most of his papers within the last three years and his publication start year is 2019. So, in a short span, he made a major contribution. However, regarding citation, h-index and g-index, 'Sean Cleary' is the leading.

Further, the h-index is a robust estimator of the total impact of a scientist's contribution in a given research field. This index is a novel and simple measure capturing both the quantity and the visibility of authors' published work". At the same time, the g-index developed by Egghe^[50] is an improvement over the h-index. The g-index also shows the relationship between published papers and the level of citations.^[51] Similarly, the m-index is also an h-index variant measured by the median value of the citations received by documents in the Hirsch core.^[52] It is presumed that the h-index is sensitive to the career length, the g-index is sensitive to citation and the m-index is sensitive to the length of the scholar's research life or the length of a journal.^[53,54] In the context of ICFS, 'Gaurav Gupta' is having highest m-index score, while 'Sean Cleary' has highest score in both h-index and

Table 3: Ten leading countries on investment-cash flow sensitivity.

Country	Frequency	% of Contribution	Total Citations	AAC	CACD
China	156	24%	994	10.688	93
USA	123	19%	6143	90.338	68
UK	53	8%	401	17.435	23
Canada	25	4%	327	36.333	9
India	25	4%	180	12.857	14
Italy	24	4%	386	25.733	15
South Korea	18	3%	50	5	10
Tunisia	15	2%	72	8	9
Japan	14	2%	58	7.25	8
Australia	13	2%	45	9	5

AAC=Average article citations, CACD=Corresponding author country's document.

Source: Authors' compilation

This Table compares leading countries that are active in ICFS studies.

in g-index. Further, 'Annalisa Croce' has also the highest score in g-index.

Figure 3 depicts the top authors on ICFS and their publications over time. This Figure shows that 'Tseng T' is the most extended serving author. In the field of ICFS 'Kaplan S.N.' has the highest citation. However, the recent work on ICFS shows that 'Tran Q' is the highest-cited author among the top contributing authors during last two decades. The line represents the author's timeline, the size of the bubble is proportional to the number of documents published and the colour intensity of the bubble is proportional to the total citations received by the document.

Most relevant documents on ICFS

There are 402 articles have been published on ICFS. Out of such 402 articles, the most relevant articles in terms of global and local citations are presented in Table 6. Citation represents the impact of the document on the scientific community and its popularity.^[46] According to Kent Baker *et al.*,^[55] "global citations refer to the number of times other works cite an article in the database, including works in other research areas and disciplines. Local citations show an article's popularity within the network". From Table 6, it is found that the document authored by 'Kaplan S.N.' is the most relevant. The paper's title is "Do investment-cash flow sensitivities provide useful measures of financing constraints?" published in 'The Quarterly Journal of Economics in 1997. This paper examines the relationship between financial constraints and ICFS. The study concludes that less financially constrained firms have more ICFS. This paper is one of the initial contributions to the ICFS literature.

Three-field analysis through Sankey diagram

Figure 4 demonstrates the three-field plot for the country, keywords and journal on ICFS. A Sankey diagram was used to

visualise the interaction of these three fields. Sankey diagram is used primarily to visualise the flow of energy or materials in various networks and processes^[56] and are now popularly used in other domains also.^[57] We have generated this diagram using Biblioshiny software. In this diagram, the size of the rectangular boxes is proportional to the frequency of occurrences.^[56] Thus, it can be inferred that China is the leading country with maximum work on investment-cash flow sensitivity and the researchers have mostly worked on two major key themes, i.e., financial constraint and investment-cash flow sensitivity. These two terms are prevalent in the Journal of Banking and Finance and Journal of Corporate Finance. Followed by China, USA is the second leading country and its scholars have mostly worked on financial constraint, investment-cash flow sensitivity, corporate governance and cash flow. Similarly, financial constraint and corporate governance are also popular among researchers of UK and India. The keyword-wise analysis demonstrates that financial crisis; information asymmetry and cash holdings are the less researched themes in the field of investment-cash flow sensitivity and have a scope for researchers to work.

Citation network analysis

Citation analysis determines a research paper's impact.^[55] Figure 5 illustrates the prominent nodes in the citation network created through VoSviewer software with many citations. The threshold of at least 50 citations is taken and 45 documents meet the threshold limit for analysis. The result also aligns with Table 6 and indicates that Kaplan and Zingales (1997) is the most relevant document in the field of ICFS.

Keyword co-occurrence analysis

The third research question of our study, i.e. RQ3: What are the most relevant investment-cash flow sensitivity research themes? can be answered by analysing keyword co-occurrences analysis.

Table 4: Leading institutions working on investment-cash flow sensitivity.

Sl. No.	University Name	Country	Documents
1	University of Salamanca.	Spain	6
2	Hong Kong University of Science and Technology.	Hong Kong, Peoples R. China	5
3	Islamic Azad University.	Iran	5
4	London School of Economics and Political Science.	UK	5
5	Penn State University.	USA	5
6	Prince Sattam Bin Abdulaziz University.	Saudi Arabia	5
7	St Mary's University.	UK	5
8	City University of Hong Kong.	Hong Kong, Peoples R. China	4
9	Dalian University of Technology.	China	4
10	Fordham University.	USA	4

Source: Authors' compilation.

This Table shows most active institutions who are conducting research on ICFS.

Table 5: Leading authors working on investment-cash flow sensitivity.

Sl. No.	Authors	DP	h-index	g-index	m-index	TC	PY_start
1	Moncef Guizani	6	1	2	0.25	5	2019
2	Ezzeddine Ben Mohamed	5	3	4	0.273	46	2012
3	Yuhuilin Chen	5	3	3	0.3	56	2013
4	Sean Cleary	5	4	5	0.222	218	2005
5	Annalisa Croce	5	3	5	0.231	108	2010
6	Gaurav Gupta	5	3	4	0.6	32	2018
7	Aquiles Elie Guimarães Kalatzis	5	2	3	0.4	12	2018
8	Yan Xi Li	5	2	2	0.167	4	2011
9	Massimo G. Colombo	4	3	4	0.231	105	2010
10	Wolfgang Drobotz	4	3	4	0.429	35	2016

DP=Document Published, TC=Total Citation, PY Start=Publication Year Start.

Source: Authors' compilation.

This Table compares the top 10 authors who are working on ICFS.

Analysing the keyword co-occurrences is always an insightful practice as keywords provide logical explanations about the document's content.^[58,59] The link between two keywords represented by numerical value expresses the relationship between them and it is presumed that the higher the value, the stronger the link strength will be.^[59] The link strength between two keywords indicates the frequency of these keywords mentioned in the same paper.^[59] The aggregate number of these links refers to the total number of these keywords mentioned jointly. The default settings of the 'VoSviewer' software is the five in the keywords occurrence analysis, which denotes only those two keywords will highlighted in the bibliographic network if those two keywords co-occurred in a paper five times or more. In this study, we have analysed 1,218 keywords, of which we have considered the author's keywords (714) of 402 documents and 42 met the threshold limit. The results depicted in Figure 6 show that there are nine clusters available as per the author's keyword analysis and a separate group represents each cluster.

Out of all keywords, 'financial constraint' has attracted the highest attention of the investment-cash flow sensitivity topic researchers. The details of top keywords with their frequencies and total link strength are provided in Table 7.

Co-authorship analysis

To understand what is the status of collaboration among the authors in the ICFS domain is, we analysed the authors' collaboration network. Collaboration among researchers represents intellectual association in scientific research.^[60] Figure 7 indicates that prominent authors in terms of collaborative effort are Colombo M, Croce A and Guerini M from Italy, Khurana I, Martin X and Pereira R, from USA. Thus, it can be inferred that most of the collaborative efforts are confined to author's own nations. These results also align with the findings of^[59] on cash holdings domain that "research concentrates around a few authors and most of the nodes appear to form a network of two". The co-authorship network on ICFS can thus be considered a

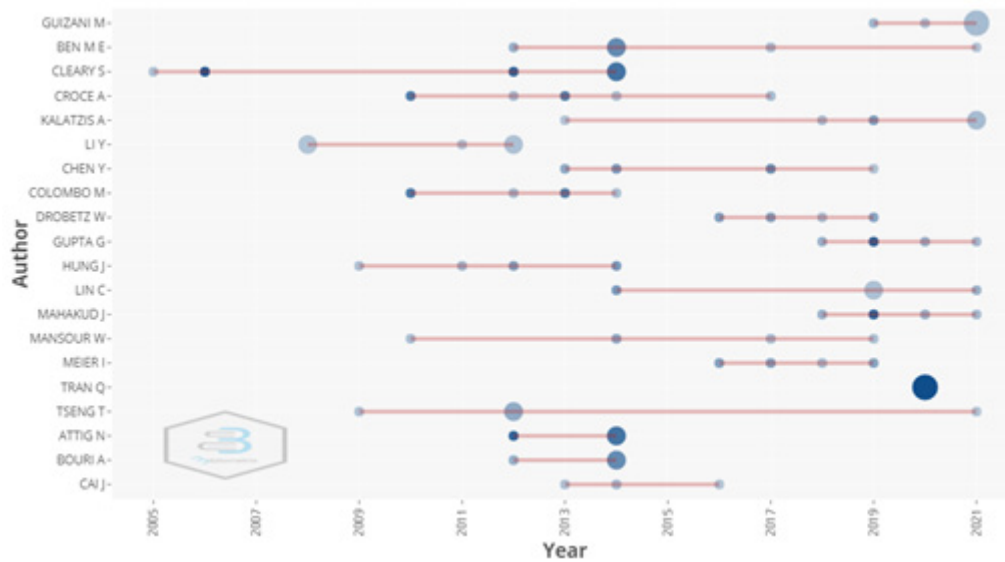


Figure 3: Top authors on ICFS and their production over time. Source: Authors' compilation.

Table 6: Most relevant documents on investment-cash flow sensitivity.

Sl. No.	Document	DOI	Year	LC	GC	LC/GC Ratio (%)	Normalised LC	Normalised GC
1	Kalplan and Zingales (1997)	10.1162/003355397555163	1997	164	2050	8.00	1.99	1.86
2	Almeida <i>et al.</i> (2004)	10.1111/j.1540-6261.2004.00679.x	2004	100	1018	9.82	2.35	3.60
3	Allayannis and Mozumdar (2004)	10.1016/S0378-4266(03)00114-6	2004	60	131	45.80	1.41	0.46
4	Alti (2003)	10.1111/1540-6261.00542	2003	58	264	21.97	5.27	4.63
5	Chen and Chen (2012)	10.1016/j.jfineco.2011.08.009	2012	56	129	43.41	11.89	4.23
6	Kalplan and Zingales (2000)	10.1162/003355300554782	2000	53	369	14.36	1.06	1.08
7	Moyen (2004)	10.1111/j.1540-6261.2004.00692.x	2004	53	225	23.56	1.24	0.80
8	Fazzari <i>et al.</i> (2000)	10.1162/003355300554773	2000	47	313	15.02	0.94	0.92
9	Brown and Petersen (2009)	10.1016/j.jbankfin.2008.10.009	2009	46	191	24.08	7.60	4.68
10	Pawlina and Renneboog (2005)	10.1111/j.1354-7798.2005.00294.x	2005	41	106	38.68	4.70	2.23

DOI=Digital object identifier, LC=Local citations, GC=Global citations.

Source: Authors' compilation.

This Table highlights the leading ten documents on ICFS with their citations.

closed network, highlighting few interactions among authors. Collaboration among researchers is indispensable for developing a research field;^[55] hence, more cross-country collaborations are desirable in the ICFS area.

Co-citation analysis and clustering

According to Small,^[61] “co-citation is the number of times two articles are cited together.” It means two papers are appearing together in the reference list of a single paper. It also indicates that the two papers are related and belong to the same study area.^[62] The co-citation analysis is one of the prominent

analyses in the bibliometric network analysis, highlighting the intellectual structure.^[45,55,57,63-67] This analysis is also worthwhile for illuminating a study area's developments, directions and structure.^[55] The fourth research question (RQ4: What is the intellectual framework in this area?) of our study can be studied by using co-citation and content analysis. The co-citation analysis consists of a set of nodes and edges; nodes symbolise the referred papers, while edges indicate the links that demonstrate the co-occurrence of nodes.^[65] For co-citation analysis, we used ‘Biblioshiny’ software, where the top 100 cited documents are analysed and the minimum link strength is 2, which is the default function of Biblioshiny. Using such software, we got 4 clusters

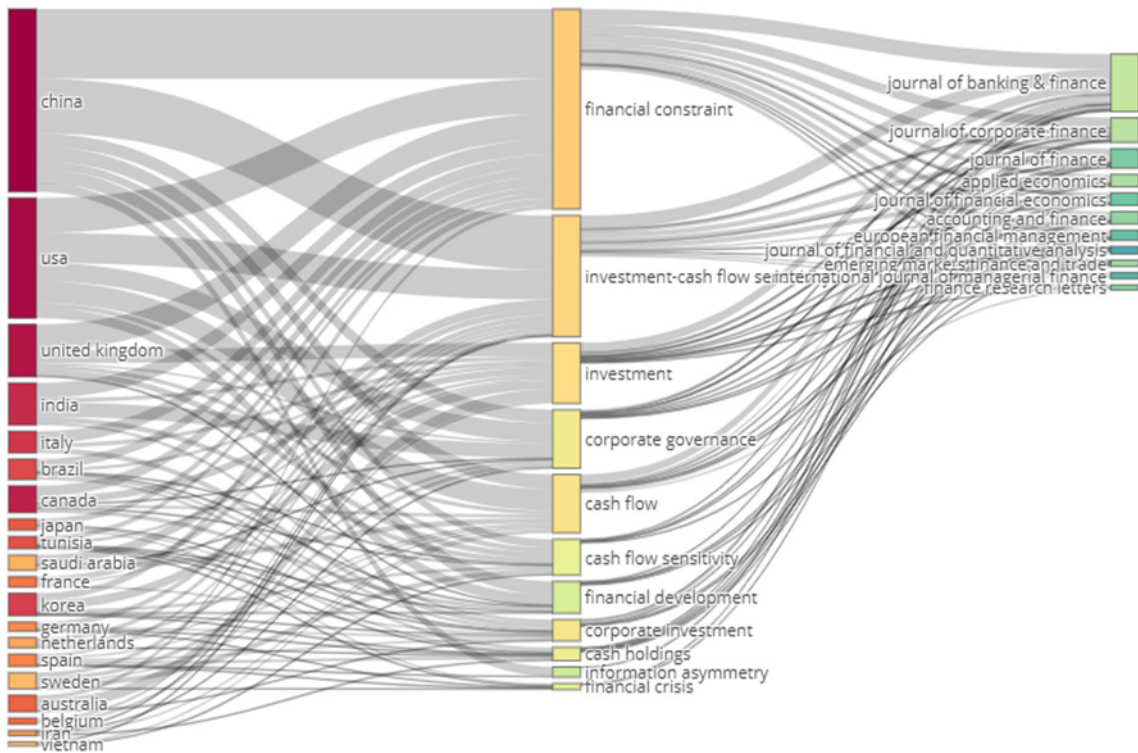


Figure 4: Sankey diagram of country, keywords and journal. Source: Authors' compilation.

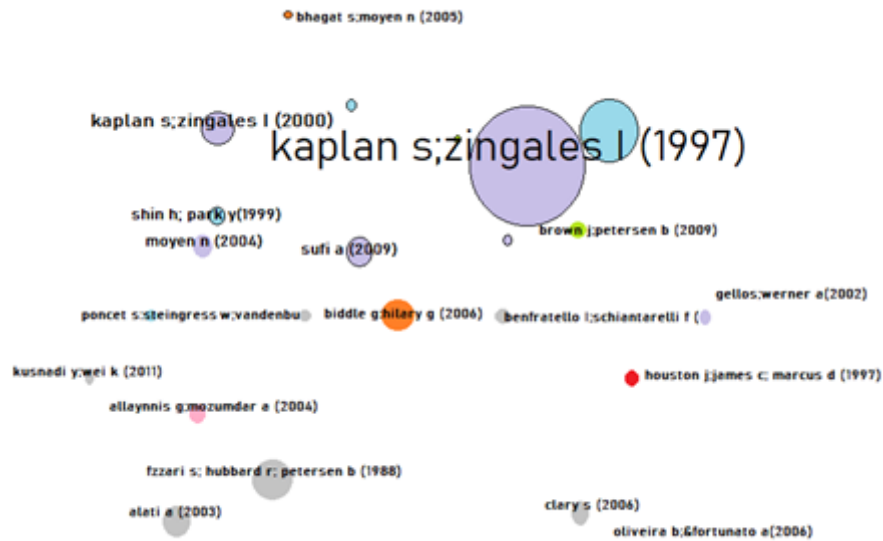


Figure 5: Citation network on investment-cash flow sensitivity. Source: Authors' compilation.

in the domain of investment-cash flow sensitivity. The sizes of clusters vary from one another. Cluster 1 is the largest cluster consisting of 36 documents, followed by cluster 2 (28 documents), cluster 3 (13 documents) and cluster 4 (11 documents).

CONTENT ANALYSIS

To determine the research emphasis for each cluster, we have identified the top 10 lead papers in each cluster by following the methodology of Kumar.^[68] The lead papers usually provide an overall description of each cluster.^[69] According to Xu *et al.*,^[69] a Page-Rank measure can be used for this purpose. In a co-citation



Figure 6: Keywords occurrence network analysis of investment-cash flow sensitivity. Source: Authors' compilation.

network, “the PageRank algorithm takes into account how many times a research paper is co-cited with other research papers (the popularity measure) and how many times it is co-cited with highly co-cited papers (the prestige measure)”. Most of the papers in this study with a high PageRank also have a high citation count. We have calculated PageRank through ‘Biblioshiny’ software to identify lead papers in each cluster. A comprehensive content-based narrative of 40 articles (10 from each cluster) is presented below.

Cluster 1: Investment-cash flow sensitivity as a measure of financial constraint

This cluster, which underlines the financial constraints in 36 articles, is the biggest cluster. This cluster focuses on the use of “investment-cash flow sensitivity” as a metric of financial constraint. The cluster demonstrated that there are many frictions in the actual world and that there is no ideal capital market. According to Altaf and Ahmad,^[70] information asymmetry, taxes, transaction costs and agency costs all contribute to frictions magnified by the imperfect capital market. The cost of internal and external funding sources differs due to the imperfection of the capital market^[19,20,71,72] financial constraints and unconstrained conditions for the firm result from this cost differential between external and internal financing. Therefore, a financial constraint is a situation in which a firm is prevented from obtaining funding from outside sources, which also prevents it from making the best investment choice.^[73,74] In a study on ICFS, Fazzari *et al.*^[75] argued that firms with high investment-cash flow sensitivity

are financially constrained firms because they primarily rely on internal funds for their investments and limit their use of external funds because doing so is expensive. Furthermore, the investigations proved that constrained firms are young, small in size and pay lower dividends. After categorizing firms based on a variety of firm-specific parameters such as firm size, age, dividend payment status, etc., that are intended to evaluate the degree of financial constraints faced by firms.

Cluster 2: Investment-cash flow sensitivity and information asymmetry

This cluster is the second largest, covering 28 articles emphasizing information asymmetry. Asymmetric information is a significant factor responsible for positive ICFS.^[76] In the seminal work of Myers and Majluf in the year 1984,^[14] it is observed that insiders in the firm and informed current investors intend to transfer wealth from new shareholders to existing investors. Because of the information asymmetry, new shareholders expect insiders to raise fresh capital when the latter is overvalued. This contrary selection infers that managers and firms face a premium on external financing, making a wedge between the cost of internal and external funds. Thus, the firm meets financing constraints, forcing it to follow credit rationing; as a result, the firm restricts itself from external borrowing.^[77] Information asymmetries hinder the firm’s investment with growth opportunities, which results in the form of under-investment. In this situation, investment fluctuates with a firm’s investment opportunities and changes in its cash flow availability.

Table 7: Top keywords on investment-cash flow sensitivity and their occurrences.

Keywords	Occurrences	Total Link Strength
Financial Constraint	159	254
Investment-Cash Flow Sensitivity	97	138
Investment	80	108
Cash Flow	50	83
Cash Holdings	28	41
Corporate Governance	23	25
Cash Flow Sensitivity	18	18
Information Asymmetry	18	28
Financial Crisis	14	39
Financial Development	13	33
Cash Flow Sensitivity of Cash	11	15
Monetary Policy	10	27
Ownership Structure	9	15
Over Investment	8	15
Business Groups	7	15
Family Firms	7	11
Overconfidence	7	11
R and D	7	12
Free Cash Flow	6	10

Source: Authors' compilation.
This Table highlights the major keywords on ICFS and their frequencies.

Cluster 3: Investment-cash flow sensitivity and Firm Characteristics

The importance of cash flow in investment decisions known as investment-cash flow sensitivity, documented by Fazzari *et al.*,^[75] has triggered a substantial interest among financial economics researchers to explore further the factors underlying such phenomenon. Out of such factors some prominent factors are highlighted in the literature, such as financial slack or cash holding behaviour of the firm, growth opportunities, firm size, age, dividend pay-out, asset tangibility, bond rating, etc.

Financial slack is used as a measure of internal liquidity, much like cash flow, immediately influence business investment. Several research shows that internal liquidity has a direct impact on company investment. It is a crucial component of investment-cash flow sensitivity because it reveals a business's capacity to raise funds for projects without turning to the capital markets. Uncertainty exists about the relationship between internal liquidity stock metrics and cash flow sensitivity. According to earlier studies, businesses with significant cash are not at a liquidity disadvantage because they may utilize it to fund desirable projects.^[78] However, companies are not required to have substantial cash reserves on hand unless they anticipate a lack of internal liquidity and have trouble obtaining external financing. Higher amounts of financial slack may, therefore, signal possible liquidity issues.

For various reasons, the market-to-book ratio, utilised as a proxy for growth opportunities, is anticipated to be tied to ICFS. A survey by Graham and Harvey^[79] found that market-to-book ratios are a significant factor in deciding whether to issue shares of stock.



Figure 7: Co-authorship network on investment-cash flow sensitivity. Source: Authors' compilation.

These studies contend that these ratios can be used as indications of equity under and overvaluation. For instance, Loughran and Ritter^[80] find that equity issuers' long-term performance has been below average. Like growth opportunities, it has been predicted that firm size will influence how sensitive investments are to cash flows. Raising money is projected to present greater challenges for smaller businesses. First, it is anticipated that their borrowing costs will be higher. Second, due to issues with adverse selection, they receive less analyst coverage and might find it harder to attract external sources of finance.^[14] Third, transaction costs for security-related concerns decrease with issue size, but these costs are probably higher for larger companies. Younger businesses may have a more significant gap between external and internal

capital costs for similar reasons. As a result, it has been predicted that smaller and younger enterprises will exhibit greater ICFS. Yet in other research links, it is observed that large firms are exposed to a more dispersed ownership structure, a higher risk of overinvestment agency issues and more flexibility in timing investments, which makes larger enterprises more sensitive to cash flow.^[81] As a result, it's unclear how firm size and cash flow sensitivity relate to one another. Age is also one of the variables that moderate the link between investment and cash flow, just like size does. Since smaller and younger businesses should have more prospects for growth. Further, the dividend pay-out behaviour of the firm, such as low-paying dividend are considered as more ICFS while it also signals firms having future growth opportunities.

Table 8: Comparative analysis of ICFS clusters.

Cluster	Description	Research Fronts	Comparison
Cluster 1: Investment-Cash Flow Sensitivity as a Measure of Financial Constraint.	It focuses on ICFS as a proxy for financial constraints, emphasizing frictions in the capital market, such as information asymmetry, taxes and agency costs. Discusses how financial constraints impact firm investment decisions.	Review studies highlight financial frictions (information asymmetry, transaction costs, agency costs) and their impact on ICFS. They use ICFS to measure firms' financial constraints and discuss how constrained firms rely heavily on internal funds.	This cluster strongly aligns with the research front, as both focus on ICFS as a financial constraint measure and emphasize the role of financial market imperfections.
Cluster 2: Investment-Cash Flow Sensitivity and Information Asymmetry.	Explores the role of information asymmetry in ICFS. It discusses how managers exploit information asymmetry to transfer wealth between shareholders, leading to external financing premiums and under-investment.	Review studies also emphasize information asymmetry as a key driver of positive ICFS. The foundational work by Myers and Majluf (1984) is often cited to explain how asymmetric information leads to external financing premiums and credit rationing.	This cluster closely matches the research front, focusing on the negative consequences of information asymmetry on investment decisions and the firm's reliance on internal funds.
Cluster 3: Investment-Cash Flow Sensitivity and Firm Characteristics.	Investigates how firm-specific factors such as size, age, dividend pay-out and internal liquidity affect ICFS. It highlights conflicting evidence on whether smaller or larger firms exhibit greater ICFS.	Review studies consistently explore how firm characteristics, like size and age, influence ICFS. They address the role of financial slack, growth opportunities and the firm's ability to raise funds for investment.	The focus on firm characteristics in this cluster aligns with a well-established research front, where firm-specific factors are frequently analysed in relation to ICFS. The cluster also acknowledges the ongoing debate on firm size and ICFS, a common theme in the literature.
Cluster 4: Investment-Cash Flow Sensitivity and Investment Opportunities.	Discusses the relationship between ICFS and investment opportunities, emphasizing the historical debate on Tobin's Q and cash flow as predictors of investment. It questions whether Tobin's Q captures all investment opportunities.	Review studies also examine Tobin's Q and its limitations in capturing investment opportunities. They suggest that cash flow may be complementary for investment opportunities when external capital markets are imperfect.	This cluster aligns well with the research front, as both discuss the limitations of Tobin's Q and the potential for cash flow to reflect missed or insider-determined investment opportunities.

Source: Authors' Analysis.

This Table shows the comparative analysis of clusters on ICFS.

Similar to that bond rating, asset tangibility also influences a firm's creditworthiness, which is crucial for investment-cashflow sensitivity.

Cluster 4: Investment-cash flow sensitivity and Investment opportunities

The history of the connection between investment and financing decision has been uneven. In the 1950s and 1960s, it was extensively researched.^[82] The focus has shifted to cash flow following the empirical breakthrough in 1988 by Fazzari, Hubbard and Petersen. They discovered that enterprises more likely to experience financial restrictions tend to have investments that are more heavily influenced by cash flow and they concluded that this was proof of information-driven inefficiencies in the capital market. Following their work,^[75] there is a vast body of literature on the connection between cash flow and investment, many of which use comparable methods.

Nevertheless, it is debatable whether cash flow is essential for investing. According to some studies, the connection between cash flow and investment may result from the association between cash flow and missed or incorrectly estimated investment opportunities that are not considered by common measurements, like Tobin's Q (hereafter Q). Numerous attempts have been made to determine whether cash flow still significantly impacts firms' investment decisions even after alternative measures of investment opportunities are constructed.^[70,71] The use of Q is predicated on the notion that players in the equities market who are also forward-looking can catch forward-looking investment opportunities. The keystone of articles based on the Q-theory is securities prices and, by extension, financial markets' assessments of investment prospects. However, using Q immediately creates tension when information asymmetries exist in the capital markets. Suppliers of external funds cannot evaluate enterprises' investment potential in such situations appropriately and there may be gaps in the company's insider and outsider information sets. Q will only record opportunities that are evaluated by outsiders. Cash flow may have a large impact on investment merely because it is connected with insiders' assessments of opportunities, which Q does not account for. However there is not significant attention has been made on capturing the insider's investment opportunities which strongly contributes scope for future research.

ROADBLOCKS TO CURRENT RESEARCH

By this comprehensive review of the literature, we find several aspects that impede growth in the field of ICFS despite its continuing progress.

Insufficient academic cooperation

Collaboration among academics enhances researcher efficiency, lowers costs associated with conducting research and facilitates

better quality research.^[55] However, in the case of ICFS, it is found that the number of publications in the respective field is less, there are few collaborations among countries and universities, etc. Hence, increased international cooperation is highly desirable to create a globally recognized framework for ICFS.

Deficiency of attention on industry-specific and cross-industry comparisons

Some researchers prefer multi-industry datasets to generalize the study of ICFS across the sectors. However, industries may vary in the nature of products and services, working durations, asset allocations and other factors that affect the mode of financing and its investment approach. Hence, Sector-specific ICFS studies need more attention, as the investment and financing pattern varies from industry to industry. Further sector-specific studies also help in developing the right investment plan and mode of finance. In addition, comparison among various sub-industries (intra-industries comparison) like pharmaceuticals, cement, fast-moving consumer goods, etc., under the manufacturing sector will add more insight to the existing body of knowledge. Similarly, cross-industry studies will help in taking comparative studies. However, most of the studies on ICFS are manufacturing firm-centric and very few studies made intra-industry comparisons.

Lack of cross-country studies

Cross-country studies promote more collaboration and universal findings.^[65] However, as per the co-author analysis in ICFS, we have found a lack of cross-country studies.

Poor emphasis on smaller firms

The SME (Small and Medium Enterprises) sector is one of the thriving sectors in any economy and contributes significantly to Gross Domestic Product (GDP).^[83,84] Yet, there is no significant work on ICFS by taking small firms. Very few studies have been attempted on ICFS, as most of the studies are confined to larger firms.

IMPLICATION OF THE STUDY

The findings of this analysis have several implications for both researchers and practitioners. Firstly, the increasing interest in ICFS research accentuates its significance in understanding firm behaviour, especially during economic uncertainty. Secondly, concentrating research efforts within specific countries and institutions requires greater collaboration to foster a more inclusive and diverse research environment. Thirdly, identifying top journals and influential documents provides valuable guidance for researchers seeking to publish and engage with the latest developments in ICFS literature. Overall, this analysis contributes to a better understanding of the current landscape of

ICFS research and highlights avenues for future exploration and collaboration.

CONCLUSION AND FUTURE RESEARCH DIRECTION

Regardless of the increasing interest among academics in studying "investment-cash flow sensitivity," systematic literature reviews and thorough evaluations in this field have fallen short. This paper attempts to fill a knowledge gap in the literature on ICFS by identifying and assessing the research progress. For analysis, 402 English-language documents were extracted from the Scopus and Web of Science databases spanning more than three decades (1988-2022). The annual publication trend indicates a surge in interest since 2008-2009, potentially driven by the global financial crisis. This trend suggests that scholars have increasingly focused on understanding firms' economic behaviour during crises, highlighting the relevance of ICFS. Identifying three stages in the evolution of research further underscores the growing attention to this area. Top contributing journals, such as the "Journal of Banking and Finance," are crucial in disseminating research in this field, indicating their significance as platforms for scholarly discourse. Leading countries like China, the USA and the UK dominate research efforts, with opportunities for collaboration and exploration in under-researched regions. The analysis of leading organizations and authors highlights vital contributors and their impact on the literature. Co-authorship and co-citation analyses reveal collaboration patterns and intellectual structure within the field. Additionally, content analysis of clusters indicates prominent themes such as financial constraints, information asymmetry, firm characteristics and investment opportunities, providing insights into the direction of research and potential areas for future exploration. Collectively, these findings contribute to a deeper understanding of ICFS and its implications for financial decision-making and policy development.

From the study, it is found that there are many dry areas in the investment-cash flow sensitivity literature which can be researched in the future. Out of such areas, one of the first areas is investment-cash flow sensitivity during the COVID-19 pandemic. As we know, the COVID-19 pandemic has impacted trade and commerce around the globe and it is obvious that it affects ICFS. Such impact can vary due to the status of economies, Govt. support and density of COVID-19 infection in that region. Hence, this area can be studied in the future. Likewise, SMEs (Small and Medium Enterprises) are playing a crucial role in the economy and now they have enlarged their financing sources from traditional financing institutions like banks to SME exchange. However, no significant attention has been taken regarding SMEs' cash flow sensitivity, which can be addressed in future research.

Further, in the globalized world, every firm is exposed to the fluctuation of macroeconomic factors, geopolitical risk and political uncertainty, which may affect its investment cash flow

sensitivity and can be studied in the future. Similarly, most of the cash flow sensitivity literature studies are confined to long-term investment. At the same time, very little attention has been paid on short-term or Working capital investment decisions and cash flow, which can be explored in future research. Though investment dependency on cash flow has been studied in earlier studies, whether a linear or nonlinear association exists between them has not been given proper attention. The optimal investment-cash flow sensitivity is also one of the unexplored areas in the cash flow sensitivity literature field. Further, firm-specific determinants, CEO and project manager's characteristics can be studied in relation to ICFS. Further, in the present juncture, a firm's performance is not judged by only its financial performance; instead, environmental, social and governance (ESG) parameters are considered as new indicators of a firm's sustainable performance. However, there is a poor attention has been given to such ESG parameters in the ICFS literature, which can be addressed in future research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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