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Credit risk management: bibliometric analysis

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Abstract: The study analyses the available literature on credit risk management using bibliometric approach over 23 years. The data is retrieved from Scopus database using the keywords ('credit risk management' AND 'profitability' OR 'financial performance' AND 'banks') OR ('credit risk management' AND 'profitability' OR 'financial performance'). The result shows a remarkable rise in the publications on credit risk management in the past five years covered in this study (i.e., 2017–2021). Malaysia published a significant number of publications and the research work from the USA received maximum citations. Professor Weber O. is considered as the most prolific author based on the highest number of publications produced. *Journal Business Strategy and the Environment* is found as the most productive journal. Moreover, the findings of the current study will serve as a reference point for those countries, which contribute less besides encouraging them to conduct research on credit risk management.

Keywords: credit risk; bibliometric; VOSviewer; Scopus; profitability.

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Biographical notes: Punyata Butola is a committed research scholar at DIT University's Department of Management Studies. Corporate social responsibility (CSR) and credit risk management are the main subjects of her research. She wants to know how businesses may strike a balance between their ethical obligations to society and risk management procedures. She looks at ways businesses might reduce financial risks while maintaining their commitments to sustainable and socially conscious operations. Her study illuminate's tactics that enable companies to attain both financial stability and beneficial societal impact by fusing the domains of finance and corporate social responsibility. Her research attempts to advance knowledge of how ethical business practices might promote long-term expansion in the intricate business world of today.

Preeti Sharma is currently working as an Assistant Professor (Accounts/Finance) at Faculty of Management Studies (FMS), DIT University, Dehradun. She did her PhD in Finance area from Department of Commerce, HNBGU, Srinagar Garhwal in 2018. She has over eight years' experience in research and academics. She has published many research articles in reputed journals and attended many international conferences. Her area of interest includes corporate governance, sustainable finance and corporate social

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Vijay Kumar Jain is an Associate Professor in the area of Marketing and Decision Science in the Department of Management Studies, DIT University. He received his PhD in Marketing Management from HNGBU (Central University). He has 15year of experience including academics and research and teaches Consumer behaviours, Business Analytics, and Decision Modelling. He has publications in various journals of repute including Elsevier, Sage, and Inderscience publishers, in areas like responsible consumption, sustainable consumption, and consumer behaviours. He has done four months' faculty development program from IIMA Ahmadabad and one week FDP from IIM Bengaluru on machine learning. His areas of research include consumer behaviours, sustainability, CSR and responsible consumption. At DIT University, he aims to imbibe the research culture and drive social changes.

1 Introduction

An efficient banking system promotes economic progress (Barth et al., 2004). One of the major businesses of banks is to lend money to earn interest income, which carries a default risk due to the inability or unwillingness of a borrower to repay the borrowed amount. According to Accornero et al. (2017), the country's banking sector primarily fails because of excessive credit risk. Credit risk is the probability of losses associated with deterioration in the credibility of the debtor or borrower. A bank's credit portfolio is stressed from outright defaults brought on by a borrower's or counterparty's incapacity or reluctance to meet obligations in connection with lending, trading, settlement, and other financial operations (Reserve Bank of India, 2002). When a borrower cannot fulfill his obligation regarding future financial flows, credit risk is anticipated to materialise (Siddique et al., 2022). As per the Reserve Bank of India, any banking organisation's long-term success depends on the effective control of credit risk, which is an essential component of comprehensive risk management. A paper outlining the bank's credit risk policy, duly approved by the board, must be in place. It may be necessary for the document to address risk identification, risk measurement, risk grading, and aggregation processes; reporting; risk control and mitigation measures; documentation; legal issues; and problem loan management. Ineffective credit risk management would cause banking turbulence, if not financial collapse (Berger and DeYoung, 1997).

Risk management is primarily necessary to prevent losses for the company that could result in business failure (Lore and Borodovsky, 2000). Banks encounter a variety of financial and non-financial risks when facilitating financial transactions, like credit risk, interest rate risk, foreign exchange rate risk, liquidity risk, reputational risk, and operational risk. The three most important risks that financial organisations must deal with are operational, liquidity, and credit risks (Abu Hussain and Al-Ajmi, 2012). As these three risks are bank-specific and can be managed by banks, it is crucial to study these risks and their impact on the performance of banks (Hunjra et al., 2020). According to Richard et al. (2008), due to inadequate or insufficient credit risk management guidelines, issues begin at the application stage and continue through the approval, monitoring, and control stages. Loans make up a significant portion of credit risk due to

their typical proportion of 10–15 times a bank's equity (Kitua, 1996). It has been determined that a strong credit risk management system is crucial for banks to reduce loan losses and, consequently, credit risk (Basel, 1999; Santomero, 1997).

The 4Cs of credit – character, capacity, capital, and collateral – are suggested to banks as a means to evaluate credit risk. Credit risk management, along with many other factors, is the most influential factor on bank profitability (Poudel, 2012). The previous literature provides that credit risk has an adverse impact on the profitability of banks (Al-Jafari and Alchami, 2014; Cucinelli, 2015; Gadzo et al., 2019; Saleh and Abu Afifa, 2020). In the banking industry, the probability of credit risk has increased due to the expansion of the credit derivative market (Butola et al., 2022). This research aims to carry out a much more detailed bibliometric analysis and review the databases and sources of the research articles published on credit risk management in banks. We selected SCOPUS as a data source due to its multidisciplinary coverage, which met the requirement for a collection that could reflect the worldwide published research database as done by Leydesdorff and Persson (2010) and Tibaná-Herrera et al. (2018). The Scopus database is the richest article and citation repository of peer-reviewed research that includes science, technology, social sciences, etc. (Ballew, 2009). Moreover, it contains additional pertinent data for the study, such as citations for each document and the affiliation of each author with their respective nation (Hernández-Vásquez et al., 2018). Using a bibliometric approach, this current study attempts to answer the following research questions.

- 1 Which are the most contributive countries, authors, organisations, and journals?
- 2 Which are the most frequently used keywords?
- 3 What are the authorship patterns of credit risk researchers?
- 4 Which paper received the maximum number of citations?

2 Literature review

The bibliometric approach provides great learning by analysing and reviewing the research incorporated in scientific publications like journals and conferences (Tibaná-Herrera et al., 2018). It provides an overview of scientific publications and incorporates analysis that may be more relevant than subjective analysis (Andrés, 2009). It is a useful method for tracing the intellectual history of a particular area of study. It makes it possible to perform a more organised literature study, gathering data and seeing patterns (Vogel and Güttel, 2012). A total of 593 studies published in Scopus (Elsevier B.V., USA)-indexed journals for a period from 2000 to 2022 are systematically reviewed using a bibliometric approach.

On examining the banking risk management studies using bibliometric techniques, it is found that the subject is not comprehensively explored (Yildirim, 2022). It was discovered that the studies were mostly restricted to specific areas and were scarce in the literature. These studies have specifically focused on using AI in credit risk assessment (Assef and Steiner, 2020), examining financial risk assessment (Scacun and Voronova, 2018), and examining the available research work in credit risk management (Ammu et al., 2022). Furthermore, some studies have undertaken the assessment of credit risk and bankruptcies (Prado et al., 2016).

Table 1 An overview of some research work that has used a bibliometric approach in the assessment of credit risk management literature

<i>Author(s)</i>	<i>Objective</i>	<i>Period covered</i>	<i>Methodology</i>	<i>Results</i>
Zamore et al. (2018)	To undertake a thorough analysis of academic papers on credit risk management	1960–2016	The study is conducted using 1,695 articles by 2,928 authors published in 442 journals across 72 countries	Credit risk analysis has several facets and is divided into six streams
Assef and Steiner (2020)	To find out whether, in credit risk assessment research, machine learning techniques are being effectively applied and, over the last ten years, which quantitative technique is being mostly used	2009–2018	The study employs the Pareto analysis method and 285 documents from the Scopus database, 227 from WoS, and 502 from Science Direct	Researchers are increasingly employing artificial intelligence (AI), but in recent studies, its use has been reduced
Scacun and Voronova (2018)	To find out the new trends and developments in scientific research in financial risk assessment and to present key data for further research	2000–2017	The research is focused on the Baltic region – Latvia, Estonia, and Lithuania. For the final analysis, 91 Scopus – generated documents were used	The study revealed that during the years 2000–2004, no document was published and that only one has been published since 2005 in Lithuania
Nobanee et al. (2022)	To keep up with the basic advancements being made in credit risk assessment research in academia	2012–2021	The information is gathered from the Scopus database and includes all cited published studies	According to the survey, there has been a noticeable rise in the domains of credit risk and big data during the past nine years. It also showed that the majority of the researchers in this field are from China

Table 1 An overview of some research work that has used a bibliometric approach in the assessment of credit risk management literature (continued)

<i>Author(s)</i>	<i>Objective</i>	<i>Period covered</i>	<i>Methodology</i>	<i>Results</i>
Ammu et al (2022)	To examine the available research work in credit risk management.	1998–2020	The Science citation index and Web of Science are used to collect data. R software, a bibliometric analysis method, and Biblioshiny are used to analyse a total of 72 publications	The survey found that the majority of the articles with the most credit – risk citations were published in the USA
Syed and Bawazir (2021)	To find out the intersections between risk and finance	2010–2020	Data is collected from the Web of Science database, and a total of 3,024 publications are analysed	The results show that credit risk has been the most prominent topic over the years. Risk- taking and performance are two interconnected words
Yildirim (2022)	To examine the available research work in credit risk and find out the trends and tendencies in this field	2010–2020	Data is collected from the Web of Science database, and a total of 3,806 publications are analysed. Citespace 5.5 software is used	The US-based Journal of Banking and Finance is the most frequently cited journal, and ‘management,’ ‘risk,’ and ‘risk management’ have been the most frequently used concepts
Prado et al. (2016)	To review the research on credit risk and bankruptcies in banks	1968–2014	Data is collected from the Web of Science database, and multivariate analysis was performed to analyse the literature	According to the report, studies on neural networks have been more prevalent in gauging credit risk and bankruptcy risk since the 1990s

Table ‘1’ presents an overview of some research that has used a bibliometric approach in the assessment of credit risk management. The majority of the research work presented in the table spanned the period 2009–2021 (Assef and Steiner, 2020; Syed and Bawazir, 2021; Nobanee et al., 2022; Yildirim, 2022). Some studies spanned a longer time frame between 1960 and 2009 (Zamore et al., 2018; Scacun and Voronova, 2018; Ammu et al., 2022; Prado et al., 2016).

Table 1 depicts that each study has a different approach and focus, which consequently lead to different results. These studies serve as a foundation for comparison with the proposed research. For example, Zamore et al. (2018) performed a bibliometric analysis of credit risk management that sought to uncover those published papers that serve as an easy source for prospective researchers, such as the most cited papers, prominent credit risk journals, etc. The study by Zamore et al. (2018) was conducted using 1,695 articles by 2,928 authors published in 442 journals across 72 countries, covering the period from 1960 to 2016. They found that credit risk analysis has several facets and is divided into six segments: loan loss provisions, defaultable security pricing, comparative analysis of credit models, default intensity modelling, credit default swap pricing, and comparative analysis of credit markets. In addition, Assef and Steiner (2020) conducted a study by employing the Pareto analysis method and using 285 documents from the Scopus database, 227 from WoS, and 502 from Science Direct for a time period from 2009 to 2018. They determined that machine learning, particularly artificial intelligence (AI) technology, is widely employed in the evaluation of credit risk. Scacun and Voronova (2018) conducted bibliometric research on a financial risk assessment that is focused on the Baltic region – Latvia, Estonia, and Lithuania – using 91 documents from the Scopus database covering the time period from 2000 to 2017. They revealed that no document was published during the years 2000–2004, and the first publication was made in 2005 in Lithuania. The study also discovered that as the number of bankrupt enterprises increased, so did research in financial risk assessment.

Nobanee et al. (2022) undertook a study using a bibliometric approach and VOS viewer software to follow the fundamental development in academic research on credit risk assessment by including all cited published studies, which are 214 in number, collected from the Scopus database for a period ranging from 2012 to 2021. They found that in the years 2013, 2015, 2018, and 2020, the number of research articles published was 2, 10, 40, and 60, respectively, which shows a remarkable upward trend in the field of credit risk and also serves to add on to the big data. China’s National Natural Science Foundation, which has published 34 articles on credit risk assessment, is recognised as the leading institution. The journal ‘*Electronic Commerce Research and Applications*’ has topped the list of most-cited journals with 96 citations in just three articles. ‘*Journal of Physics: Conference Series*’ published the highest number of documents (15). Furthermore, as per the study, Zhang is the author of the majority of the research articles – six total. Henan Key Laboratory of Finance is considered the most influential institute, with 13 affiliations.

Ammu et al. (2022) conducted a study to examine the available research work in credit risk management using R-software, bibliometric approaches, and biblioshiny. The data from 72 articles were extracted from the Web of Science database, ranging from the time period 1998–2020. They found that the first article authored by Franco Varetto, titled ‘genetic algorithms applications in the analysis of insolvency risk,’ was published in the year 1998. The year 2010 saw the release of four articles, with the number of publications declining in 2013. The publication of five articles in 2015 and six each in

2019 and 2020 followed. In addition to this, they found that there is an annual growth rate of 11.42% in the publication of credit risk management.

Syed and Bawazir (2021) analysed a total of 3,024 publications extracted from the Web of Science database for a time period between 2010 and 2020 using a bibliometric approach to find out the intersections between risk and finance. They discovered that financial risk publications increased gradually between 2010 and 2020, increasing by 16% annually. The *Journal of Banking and Finance* topped the list of journals with the highest number of citations. The USA produced the largest number of documents on financial risk and has the highest level of collaboration with Western European countries. Out of the top ten countries, eight are developing countries.

Yildirim (2022) analysed 3806 publications using CiteSpace 5.5 software by extracting data from the Web of Science database and applying a bibliometric approach for a time period ranging from 2010 to 2020 to examine the available research work in credit risk and to find out the trends and tendencies in this field. He found that the US-based *Journal of Banking and Finance* is the most cited journal. The USA, followed by China and England, is found to be the most productive country in the field of banking risk management.

Prado et al. (2016) conducted a bibliometric study to examine the literature on credit risk and bank bankruptcy using a neural network on data collected from the Web of Science database using multivariate analysis from 1968 to 2014. They found that the prediction of bankruptcy is a multidisciplinary field that is spread not only over mathematics and engineering but also finance and accounting. Following the 2008 financial crisis, studies on bankruptcy have increased. The results also showed that, compared to the other statistical methods, credit evaluation using a neural network had higher accuracy.

3 Methodology

The following search keywords were entered into the Scopus main search box to retrieve the needed data. ('credit risk management' AND ('profitability' OR 'financial performance' AND 'banks')) OR ('credit risk management' AND ('profitability' OR 'financial performance')) AND (LIMIT-TO (SUBJAREA, 'BUSI') OR LIMIT-TO (SUBJAREA, 'ECON') OR LIMIT-TO (SUBJAREA, 'SOCI') OR LIMIT-TO (SUBJAREA, 'MULT')) AND (LIMIT-TO (LANGUAGE, 'ENGLISH')) AND (LIMIT-TO (SRCTYPE, 'J')). The Scopus category was selected as 'business finance or ethics or economics or business or management or social sciences interdisciplinary,' source types were limited to 'journals,' and the language filter was applied as 'English' while retrieving data. A total of 593 document results were found for data analysis. This process was repeated to ensure the accuracy of the results. VOS-Viewer and Microsoft Excel software were used for data analysis. VOS-Viewer is used to verify the findings and may also be used to 'construct and visualise bibliometric maps' (Van Eck and Waltman, 2014).

4 Results

Figure 1 depicts the publications' chronological order in the field of credit risk management literature. The figure shows that the document, which was published in the year 2000, received no citations. The first notable publication, however, was published in 2003 and received 117 citations. Publications reached the top over the years from 2017 to 2022, with 40, 51, 64, 109, 127, and 79 publications for each year, in that order. 2021 was a remarkable year, with 127 publications. Similarly, these papers received the most citations between 2012 and 2020. The 22 publications of the year 2012 gained a maximum of 961 citations.

Figure 1 Distribution of publications in credit risk management with time (n = 593) (2000–2022) (see online version for colours)

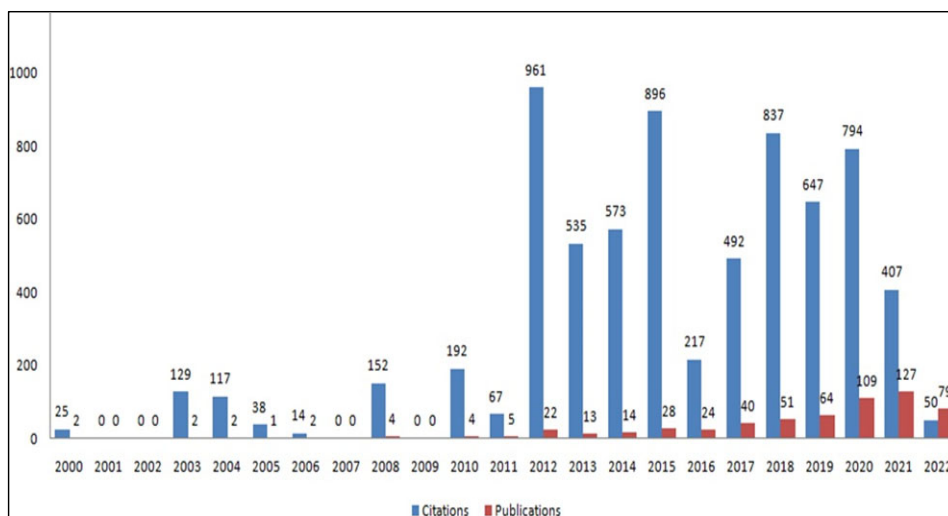


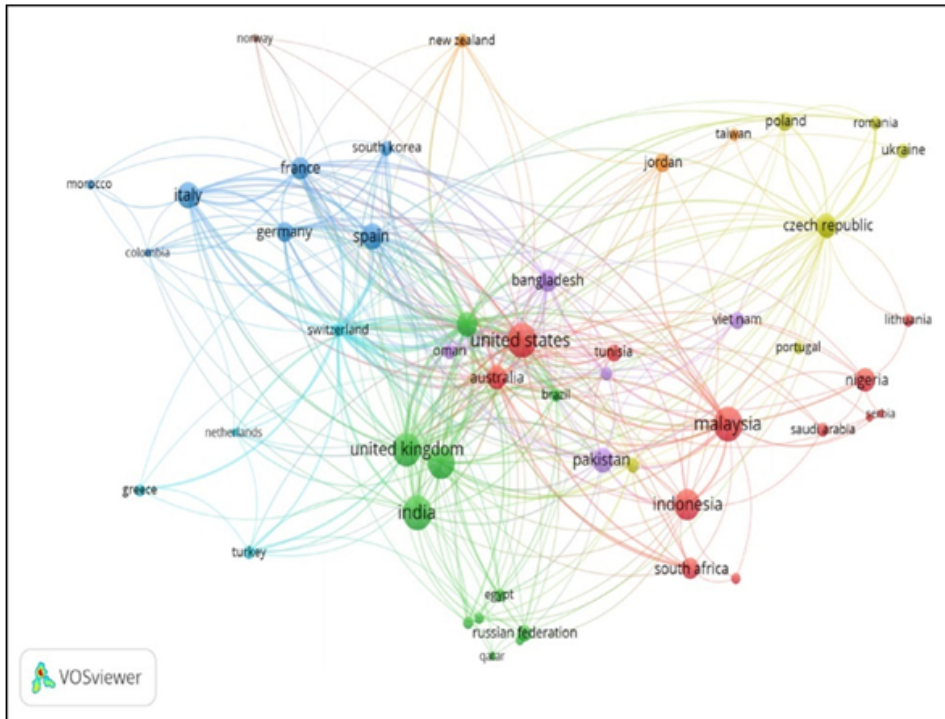
Table 2 Comparison of the top 10 countries' research output in credit risk management

No.	Countries	Publications	Citations	Citation impact
1	Malaysia	49	214	4.36
2	India	46	130	2.82
3	USA	46	1,213	26.36
4	UK	43	980	22.79
5	China	40	627	15.67
6	Indonesia	37	80	2.16
7	Spain	27	690	25.55
8	Italy	26	386	14.84
9	Pakistan	25	223	8.92
10	Canada	24	1,061	44.20

4.1 Country-wise comparison of research on credit risk management

Table 2 presents a comparison of research productivity on credit risk management by the top 10 countries. The table clearly shows that just four nations have more than 40 publications. Malaysia topped the list with 49 records, followed by India and the USA with 46 publications each. Canada came in last place on the list, with 24 publications. Furthermore, the table demonstrates that the USA received the most citations (1,213), followed by Canada and the UK with 1,061 and 980 citations, respectively.

Figure 2 Network visualisation of productivity of the top 10 countries, using VOSviewer software (see online version for colours)



4.2 Most productive journals

The top ten journals publishing literature on credit risk management are shown in Table 3. It shows that *business strategy and the environment* ranked highest, publishing 30 research papers on credit risk management, followed by *Sustainability* (Switzerland), which published 27 research papers, and *Banks and Bank Systems*, which published 16 research papers. *Cogent Business and Management* and *European Research Studies Journal*, both with seven publications each, are the last in the list of the top 10 journals.

The Business Strategy and the Environment Journal from the UK, which came in first on the list with 30 publications, obtained 919 citations, placing it in first place overall in terms of citations. Similarly, the two journals, *Journal of Cleaner Production and Corporate Social Responsibility and Environmental Management*, both from the UK,

produced nine records each and received 406 and 354 citations, respectively. It is worth noting that the top three journals on the list with the most citations are all from the UK. Moreover, out of the top ten journals publishing credit research, six alone are from the UK. The impact factor of *Business Strategy and the Environment* is 11.28, that of the *Journal of Cleaner Production* is 9.297, and that of *Corporate Social Responsibility and Environmental Management* is 9.254. The three UK-based journals with the highest impact factors are *Business Strategy and the Environment*, *Journal of Cleaner Production*, and *Corporate Social Responsibility and Environmental Management*. This suggests that journals with a high impact factor receive more citations than journals with a low impact factor.

Figure 3 Network visualisation of the journals publishing credit risk research, using VOS – viewer software (see online version for colours)

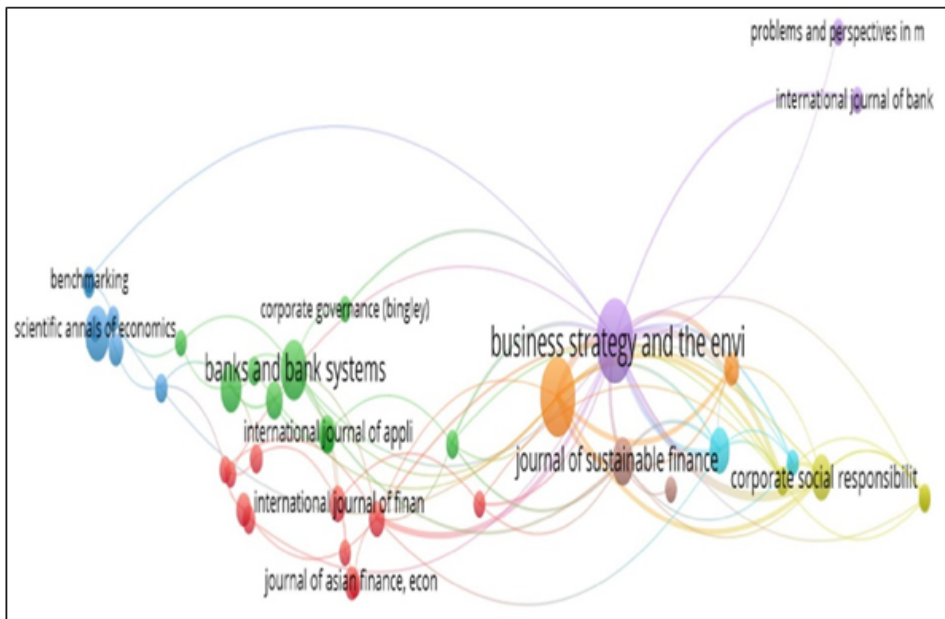
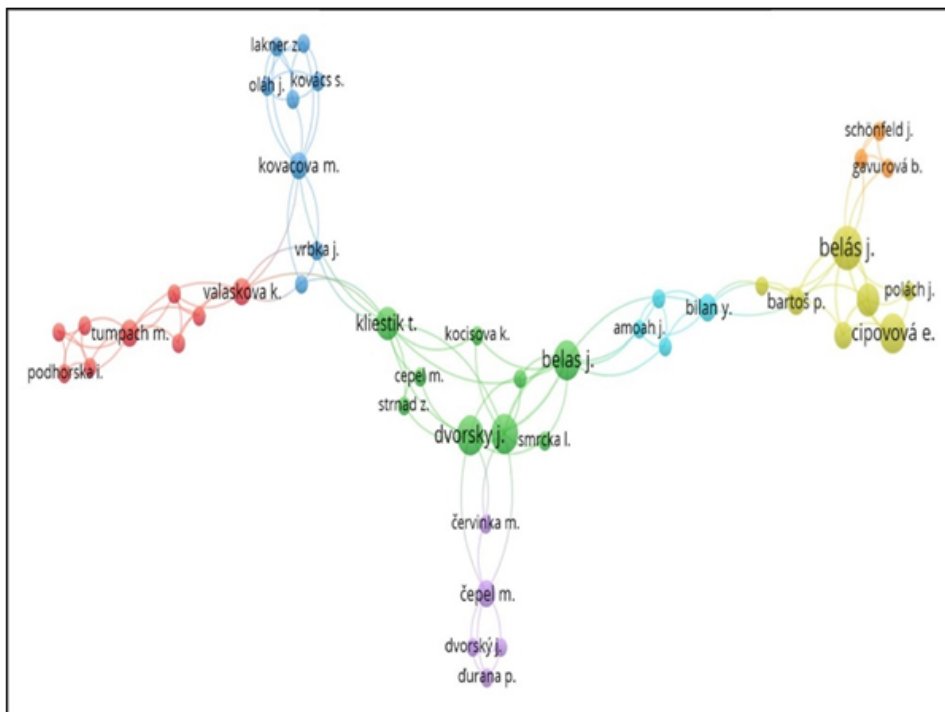


Table 3 Ten leading journals that produce research on credit risk management

Journal	Country	Impact factor	Publications	Citations
<i>Business Strategy and the Environment</i>	UK	11.283	30	919
<i>Sustainability (Switzerland)</i>	Switzerland	4.166	27	292
<i>Banks Systems and Bank</i>	Ukraine	0.932	16	47
<i>Academy of Accounting and Financial Studies Journal</i>	United America of States	0.681	13	21
<i>Journal of Sustainable Finance and Investment</i>	UK	3.655	10	212

Table 3 Ten leading journals that produce research on credit risk management (continued)

<i>Journal</i>	<i>Country</i>	<i>Impact factor</i>	<i>Publications</i>	<i>Citations</i>
<i>Cogent Economics and Finance</i>	UK	1.892	10	62
<i>Journal of Cleaner Production</i>	UK	9.297	9	406
<i>Corporate Social Responsibility and Environmental Management</i>	UK	9.254	9	354
<i>European Research Studies Journal</i>	Greece	1.57	7	39
<i>Cogent Business and Management</i>	UK	2.436	7	7

Figure 4 Network visualisation of co-authorship in credit risk management research publications, using VOSviewer software (see online version for colours)

4.3 Authorship distribution

Table 4 shows the authorship distribution in credit risk management along with publications, percentage of publications, citations, and citation impact. 7,143 citations being made to a total of 593 publications, yielding a 12.04 citation impact. 2 authors produced 176 publications and received 2,239 citations, followed by 3 authors with 172 publications receiving 2,200 citations, and 4 authors with 106 publications obtained 1,480 citations. 7 authors, 8 authors and 9 authors were the least pattern with one publication

each. However, most citations (2,239) were from the 2-author publications, with a 12.72 citation impact. The 4 author pattern, which only published 106 articles, deserves to be mentioned here because it had a highest citation impact of 13.96.

Table 4 Authorship distribution in credit risk management

<i>No. of authors</i>	<i>Publications</i>	<i>Publications (%)</i>	<i>Citations</i>	<i>Citations impact</i>
1-author	85	14.17	678	7.98
2-author	176	29.68	2,239	12.72
3-authors	172	29.01	2,200	12.79
4-authors	106	17.88	1,480	13.96
5-authors	39	6.58	393	10.07
6-authors	13	2.19	142	10.92
7-authors	1	0.16	1	1.00
8-authors	1	0.16	0	0
9-authors	1	0.16	10	10
10-authors	0	0	0	0
<i>Total</i>	<i>593</i>	<i>100.00</i>	<i>7,143</i>	<i>12.04</i>

4.4 The most productive authors in credit risk management

The research examined the most productive authors in credit risk management, which are presented in Table 5. Professor Olaf Weber of the University of Waterloo, Canada, is found to be the most productive author in credit risk management by producing 15 articles and receiving 740 citations. He is followed by Professor Jaroslav Belas of Tomas Bata University, Zlin, Czech Republic, Associate Professor Mohammad Miah of the University of Nizwa, Oman, and Lecturer Rashedul Hasan of Coventry University, UK, with 5 publications each getting 156, 25, and 19 citations, respectively.

Figure 5 Network visualisation of the most productive authors in credit risk management research using VOS – viewer software (see online version for colours)

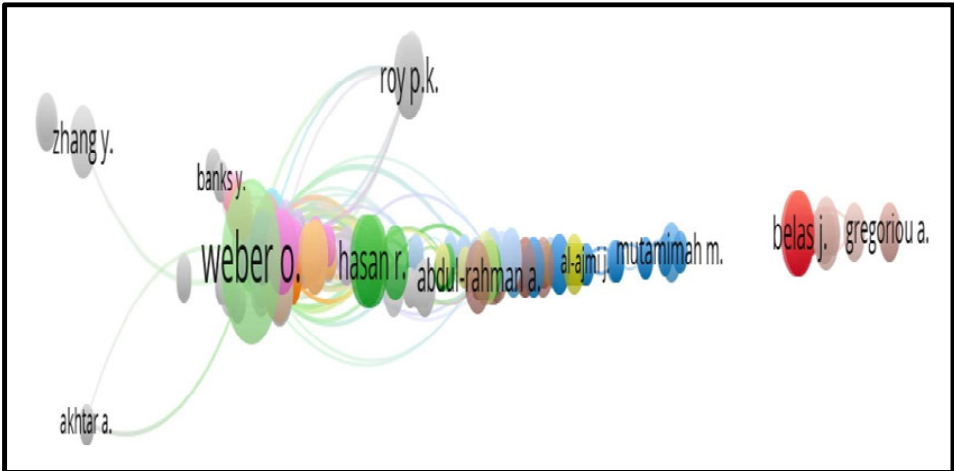


Table 5 Most productive authors in Credit risk management

<i>Author</i>	<i>Affiliation</i>	<i>University, College</i>	<i>No. of publications</i>	<i>Total no. of citations</i>
Weber, Olaf	Professor	University of Waterloo, Canada	15	740
Belas, Jaroslav	Professor	Tomas Bata University, Zlin, Czech Republic	5	156
Miah, Mohammad	Associate Professor	University of Nizwa, Oman	5	25
Hasan, Rashedul	Lecturer	Coventry University, Coventry, UK	5	19
Gavurova, Beata	Associate Professor	Technical University of Kosice, Slovakia	4	104
Crook, Jonathan	Professor	University of Edinburgh, UK	4	84
Dvorsky, Jan	Associate Professor	Tomas Bata University, Zlin, Czech Republic	4	77
Zhiyong, Li	Professor	Southwestern University of Finance and Economics, China	4	52
Roy, Pranith	Assistant Professor	Indian Institute of Management, Raipur	4	21
Galletta, Simona	Professor	University of Catania, Italy	4	12

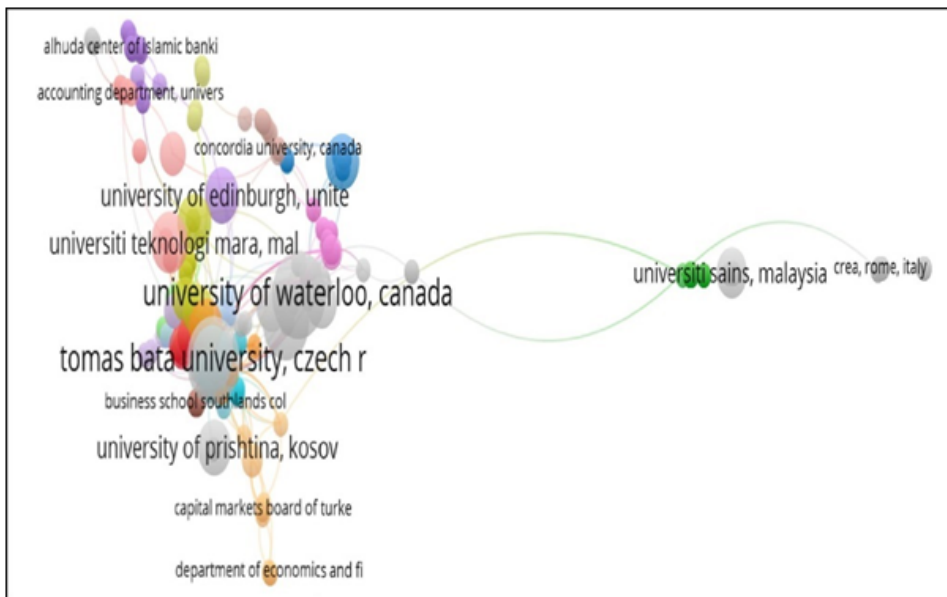
Figure 6 Network visualisation of top-20 research-producing universities in credit risk management, using VOS-viewer software (see online version for colours)

Table 6 Top 20 universities conducting credit risk management research

<i>No.</i>	<i>Universities</i>	<i>Publications</i>	<i>Citations</i>
1	University of Waterloo, Canada	12	224
2	Tomas Bata University, Czech Republic	12	86
3	Universiti Utara Malaysia, Malaysia	9	78
4	Covenant University, Nigeria	7	32
5	Universiti Teknologi Mara, Malaysia	6	56
6	University of Edinburgh, UK	5	88
7	Dalian University of Technology, China	5	46
8	Western Sydney University, Australia	5	11
9	University of Prishtina, Kosovo	5	5
10	University of Nizwa, Oman	5	4
11	Universiti Kuala Lumpur business school, Malaysia	4	35
12	Universiti Kebangsaan Malaysia, Malaysia	4	34
13	Independent University, Bangladesh	4	33
14	Universiti Sains, Malaysia	4	9
15	University of Kwazulu-natal, South Africa	4	7
16	University of Catania, Italy	4	4
17	University of Campania Luigi Vanvitelli, Italy	3	69
18	University of Cape coast, Ghana	3	53
19	University of South Africa, South Africa	3	44
20	Towson University, USA	3	19

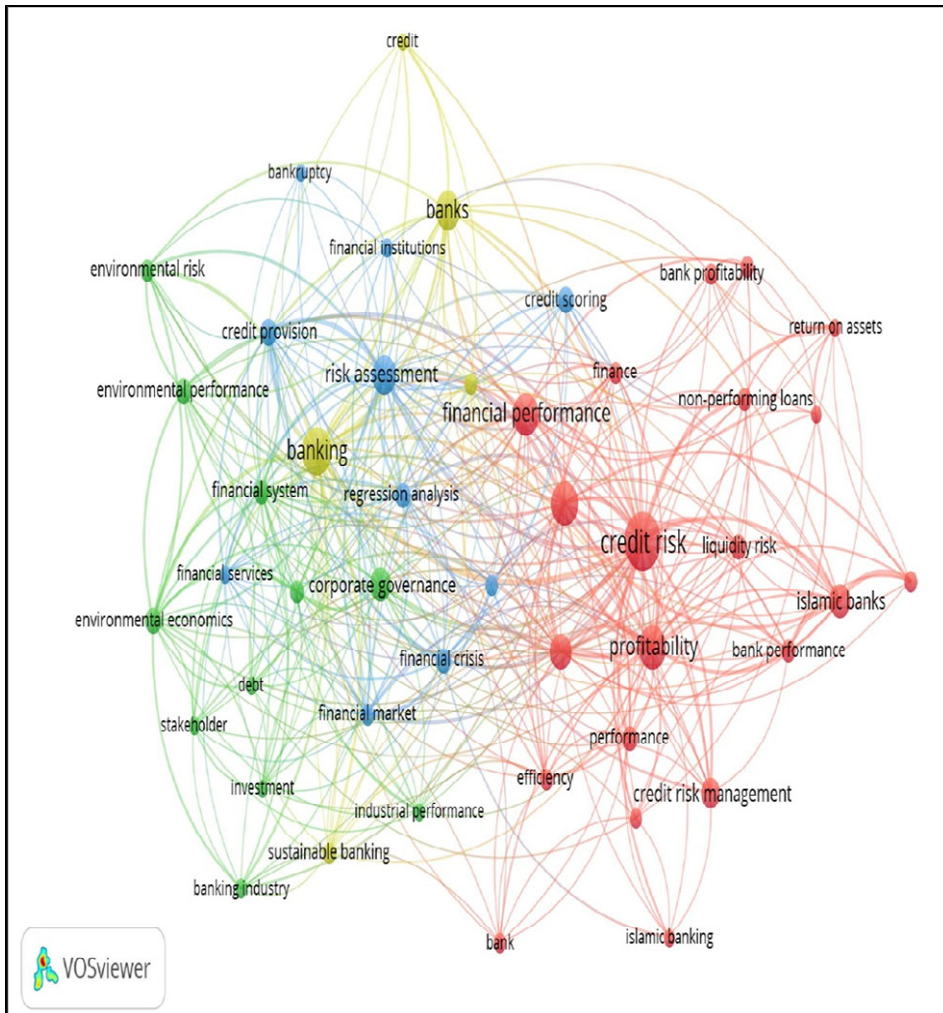
4.5 *The most productive universities in the field of credit risk management*

Table 6 lists the top 20 institutions that conduct research on credit risk management. The University of Waterloo, Canada, and Tomas Bata University, Czech Republic, are at the top of the list with 12 publications each and 224 and 86 citations, respectively, followed by Universiti Utara Malaysia, Malaysia; Covenant University, Nigeria; and Universiti Teknologi Mara, Malaysia, with 9, 7, and 6 publications, respectively, cited by 78, 32, and 56 publications, respectively.

4.6 *Analysis of keywords*

Table 7 lists the keywords that appear most frequently in credit risk management literature. 47 of the 2,087 keywords that were used in the publications fulfilled the threshold requirements (a keyword must appear at least seven times). The VOS-viewer software uses a threshold as a cutoff when generating keywords based on frequency. With a frequency of 76, ‘credit risk’ emerged as the most frequent keyword. Credit risk (76), banking (51), risk management (45), and profitability (44) are the keywords that appeared more than 40 times. The least used keyword ranked in the 20th position is ‘financial crisis,’ with an occurrence of 14.

Figure 7 Network visualisation of the top 20 keywords related to credit risk management research using VOS-viewer software (see online version for colours)



4.7 Articles received most citations

Table 8 contains a list of the top ten articles that have received the most citations. Seven of the top ten articles received more than 100 citations. The study ‘corporate social responsibility and credit ratings’ by Attig et al. (2013) in the *Journal of Business Ethics* obtained the highest number of 256 citations. The next most-cited article is ‘Incorporating sustainability criteria into credit risk management’ by Weber et al. (2010), with 132 citations. There were 114 and 110 citations for the third and fourth articles, respectively. ‘comparative credit risk in Islamic and conventional banks’ by Kabir et al. (2015), with 82 citations, was the least- cited article in the list.

Table 7 The top 20 keywords in credit risk management literature with frequency

<i>Rank</i>	<i>Keyword</i>	<i>Occurrences</i>
1	Credit risk	76
2	Banking	51
3	Risk management	45
4	Profitability	44
5	Financial performance	39
6	Banks	33
7	Risk assessment	33
8	Commercial banks	27
9	Corporate governance	25
10	Islamic banks	25
11	Credit risk management	20
12	Credit provision	16
13	Credit scoring	16
14	Environmental economics	16
15	Environmental performance	15
16	Financial system	15
17	Liquidity risk	15
18	Performance	15
19	Regression analysis	15
20	Financial crisis	14

Figure 8 Network visualisation of highly cited top 10 articles on credit risk management research, using VOS-viewer software (see online version for colours)

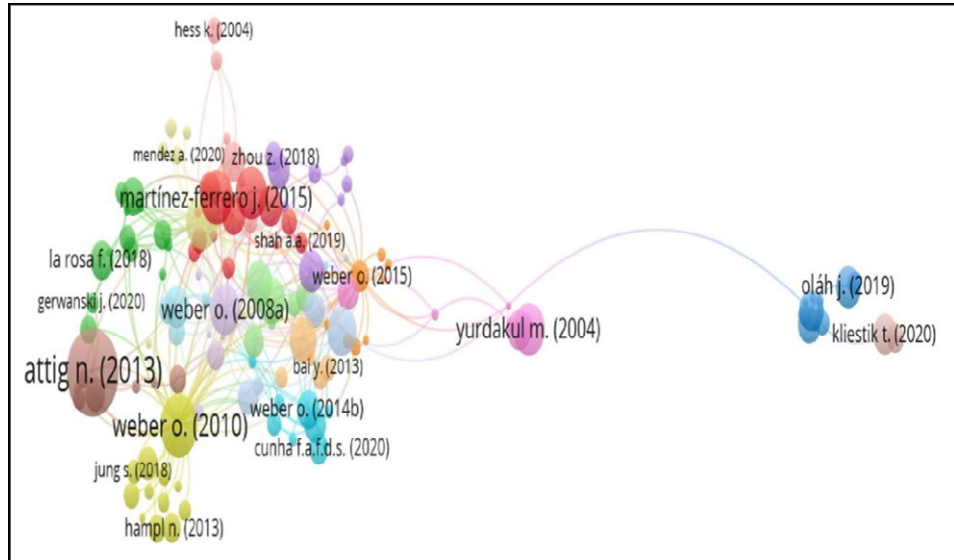


Table 8 Top 10 credit risk management articles with the highest citations

<i>Author</i>	<i>Title</i>	<i>Journal</i>	<i>Citations</i>
Attig et al. (2013)	Corporate social responsibility and credit ratings	<i>Journal of Business Ethics</i>	256
Weber et al. (2010)	Incorporating sustainability criteria into credit risk management	<i>Business Strategy and the Environment</i>	132
Quester and Lin Lim (2003)	A fuzzy neural network for assessing the risk of fraudulent financial reporting	<i>Managerial Auditing Journal</i>	114
Crone and Finlay (2012)	Instance sampling in credit scoring: An empirical study of sample size and balancing	<i>International Journal of Forecasting</i>	110
Weber (2012)	Environmental credit risk management in banks and financial service institutions	<i>Business Strategy and the Environment</i>	103
Martínez-Ferrero and Frías-Aceituno (2015)	Relationship between sustainable development and financial performance: international empirical research	<i>Business Strategy and the Environment</i>	103
Lewellyn and Muller-Kahle (2012)	CEO power and risk taking: evidence from the subprime lending industry	<i>Corporate Governance: An International Review</i>	102
Yurdakul and İc (2004)	AHP approach in the credit evaluation of the manufacturing firms in Turkey	<i>International Journal of Production Economics</i>	94
Weber (2008)	Empirical analysis of the integration of environmental risks into the credit risk management process of European banks	<i>Business Strategy and the Environment</i>	90
Kabir et al. (2015)	Comparative credit risk in Islamic and conventional bank	<i>Pacific Basin Finance Journal</i>	82

5 Discussion

The purpose of this study is to carry out a bibliometric analysis of the development of the credit risk management literature published in journals that are indexed by Scopus from 2000 to 2022, covering 23 years of data. The results section explored a number of interesting points.

Firstly, there was a remarkable rise in the number of publications on credit risk management over the course of the study's five-year period (i.e., 2017–2021). This remarkable increase may be related to a parallel rise in the number of journals that offer the necessary platforms for such publishing. The small number of studies published in Spain, Italy, Pakistan, Canada, and other nations that have added to the literature on credit risk management might be due to the lack of comparable research initiatives.

Secondly, the large volume of publications from the universities in Malaysia, India, the USA, and the UK is due to the favourable environment that the governments and educational and research institutions of these countries have built. Research institutes in

other countries should also be motivated to undertake more studies on credit risk, especially in Germany, Russia, New Zealand, etc.

Thirdly, seven of the top ten most cited articles on credit risk management were published during the last five years. These papers were released from 2010 to 2015, indicating that the study of credit risk is expanding and, as a variable, is a cause of concern for financial institutions. No article was published in the years 2001, 2002, 2007, and 2009. However, it is gaining pace over time, and this momentum needs to explore ways of reducing credit risk to enhance profitability. All relevant entities involved in this expanding domain of research need to keep the pace going.

Fourthly, the current analysis supports past findings in the literature on credit risk management. The current findings show a notable increase in the counting of articles which have previously been issued in reputed publications. Moreover, this work is in certain ways a continuation of earlier research; it has additional themes and 23 years' worth of preceding credit risk management literature covered. On the other hand, Yildirim (2022) examined the available research work in credit risk to find out the trends and tendencies in this field for only 10 years and analysed frequently used keywords, the most cited journals, author co-citations, and country collaboration. Ammu et al. (2022) examined the literature on credit risk for 23 years and analysed the most relevant authors, most relevant sources, most cited countries, top author's production, most cited documents, and most frequent words using the Web of Science database and biblioshiny software. Scacun and Voronova (2018) conducted a study only for 18 years; Nobanee et al. (2022) and Assef and Steiner (2020) analysed the available data on credit risk assessment for 10 years each.

Fifthly, the results of this current study contradict Ammu et al.'s (2022) findings on the trend of publishing documents. The current study found that since 2010 to 2012, there has been an increasing trend of publishing documents, while Ammu et al. (2022) reported a bearish decline during this period. The reason behind this contradiction may be that Ammu et al. collected the data from the Web of Science database.

Our study confirms the findings of Ammu et al.'s (2022) study, which identified Weber O. as the most prominent author, but contradicts having other authors with the same number of publications, such as Jaroslav Belas and Weber M., even though in current research Jaroslav Belas is listed as having the second highest number of publications. Our finding also contradicts Ammu et al.'s (2022) finding of the '*Journal of Banking and Finance*' as the most relevant source, as the current study found '*Business Strategy and the Environment*' to be the most productive journal. Ammu et al. (2022) reported that the developing countries do not contribute significantly to research on credit risk management and found the USA as the most productive country; however, in the current study, the developing countries like Malaysia, India, and China contribute significantly with 49, 46, and 40 publications, respectively. In fact, Malaysia topped the list of the most productive countries, followed by India and the USA. Our analysis supports the findings of Nobanee et al. (2022), who discovered that, in addition to China, the USA, the UK, and India are the major contributors to the study of credit risk.

6 Conclusions

This paper analyses the growth of credit risk management literature in Scopus-indexed journals for the period 2000–2022, using a bibliometric approach. In recent years, there

has been a remarkable rise in the number of publications on credit risk management, especially in the past five years, i.e., 2017–2021. However, the large volume of publications from the universities in Malaysia, India, the USA, and the UK is due to the favourable environment that the governments and educational and research institutions of these countries have built. Developed countries like Germany, New Zealand, France, Canada, and Spain, as well as developing nations such as Pakistan, South Africa, and Bangladesh, should also be encouraged to publish more articles on credit risk. To minimise the credit risk impact on the profitability of banks and financial institutions and to bring out a pragmatic literature on credit risk, the government, along with the collaboration of the respective central banks, scheduled commercial banks, and educational institutions of the countries, should encourage and facilitate their employees who have expertise in credit risk management to undertake research on credit risk to improve research in this area.

7 Limitations

This bibliometric analysis is confined to only one indexing and abstracting repository, i.e., Scopus. Furthermore, this study was restricted to the credit risk management literature only published from 2000 to 2022 and covered ‘research papers’ as the only document type. More research on the quality of publication, comparison of results, and the study of the reasons for those countries publishing minimum credit risk management research work could be conducted.

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