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Bibliometric Analysis of Publication Trends in Supply Chain Finance

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Abstract

Supply chain finance has received global concern as a research focus in recent years, which plays an important role in alleviating capital shortage of SMEs and optimizing capital flow in supply chain. Although the existing literature has explored supply chain finance from a variety of theories and subject perspectives, the vigorous development of supply chain finance practice has provided a numerous topic to be studied for the academic community. Therefore, the paper is to investigate the research direction and classification in the field of supply chain finance and bridge this gap in the literature. R software was adopted as bibliometric analysis tools in this paper to obtain a comprehensive overview of supply chain finance and grasp the current research emphases. The Web of Science core collection database was used as the primary source for data collection. The data were collected from 380 articles published from 1997 to 2021. Finally, the paper draw conclusions based on publication years, authors, sources, countries, topics and keywords, and finds out the development status and research hotspots of the supply chain finance research field. It is expected that the conclusions from this study provide a better perspective on the future research direction and mining the underling opportunities for applying the theory to the practical financial management.

Keywords: Supply Chain Finance, Bibliometric Analysis, Publication Trends

Introduction

Supply Chain Finance (SCF) have drawn broad attention internationally, a lot of researchers have studied SCF from different aspects. SCF is originally defined as a short-term financing solution (Camerinelli & Systems, 2009; Lamoureux & Evans, 2011; More & Basu, 2013). Moreover, SCF is regard as the capital flows within a supply chain (Liu et al., 2015), which is a series of financial solutions provided by financial institutions to suppliers and customers facing demands on their working capital (Zhang, Hu, & Zhang, 2015), its purpose is to offer financing solution for small and medium enterprises (Li, Jiang, & Li), and to improve the efficiency, speed and accuracy of responses to rapidly changing customer requirements through the coordination and integration of materials, information and financial flows (Chen et al., 2020). A general SCF business comprise three major participants that are SCF providers, SCF receivers and a focal company (Bals, 2019). Furthermore, the types of supply chain

finance are accounts receivable finance, inventory finance, account payable finance (Wang et al., 2020). The primary purpose of innovation in the field of supply chain finance is to better alleviate the financing difficulties of small and medium-sized enterprises. However, the proportion of financial institutions willing to provide funds and credit to SMEs is decreasing (Song et al., 2021). What is more, supply chain finance is an interdisciplinary research field that covers logistic, finance, management, computer science, mathematics and sociology. In order to get a comprehensive understanding of the publication trends in supply chain finance, a bibliometric analysis is needed.

Bibliometric analysis provides statistical data analysis consisting of author, affiliating and keywords (Garfield, 2009). In recent years, the bibliometric analysis has been carried out to visualize the knowledge status, features, evolution, and emerging trends in various professional fields (Guo et al., 2021). The bibliometric method associate science mapping approaches with performance analysis (Cobo et al., 2011). There is a sorts of software tools for analyzing science mapping (Börner et al., 2015). Mirabelli & Solina (2020) Used the VOSviewer to dig the number of documents and citations, López-Robles et al (2019) applied SciMAT as a bibliometric analysis software. Therefore, this paper will use the map generated by R software to conduct a comprehensive and bibliometric analysis of supply chain finance research. This research is structured as follows, First, the data source and methods are introduced. Second, the bibliometric analysis results are presented from six main aspects, publication years, authors, sources, countries, topics, keywords. Finally, some conclusions and future research directions will be proposed. This research will provide a useful guideline for scholars who are interested in supply chain finance field and help them to find opportunities to cooperate with other scholars and research institutions by systematic study. In addition, the predictions based on the bibliometric analysis can also provide reference for future supply chain finance research.

Methodology

Trend in the research field can be assessed through bibliometric study. This paper search title about “supply chain finance” OR “supply chain financing” through Scopus and Web of Science (WOS) to select the preferred database for data collection. A total of 380 titles came from WOS (SCI, SSCI, ESCI, A&HCI, 235 title from Scopus. WOS is regarded as one of the largest and most trustworthy databases for literature review and analysis (Agarwal et al., 2016). The sources from Web of Science (WOS) have higher average citations per documents and longer timespan than Scopus. Therefore, the paper collects data from WOS for analysis.

Table 1: Summary of the Main Information of Collected Bibliometric Data

Scopus		Web of Science	
Description	Results	Description	Results
Documents	385	Documents	380
Sources (Journals, Books, etc)	205	Sources (Journals, Books, etc)	163
Keywords Plus (ID)	1385	Keywords Plus (ID)	771
Author's Keywords (DE)	902	Author's Keywords (DE)	1109
Timespan	2006:2021	Timespan	1997:2021
Average citations per documents	6.236	Average citations per documents	16.01
Authors	702	Authors	832
Authors of single-authored documents	57	Authors of single-authored documents	40
Authors of multi-authored documents	645	Authors of multi-authored documents	792
Authors per Document	1.82	Authors per Document	0.457
Collaboration Index	2.06	Collaboration Index	2.34

Sources: Web of science and Scopus

Table 1 shows a summary of the primary information on collected Bibliometric data through Scopus and WOS. There are 385 documents, 205 sources in Scopus and 380 documents and 163 sources in WOS. The figure for Keywords Plus from Scopus is twice as much as the WOS. But the number of Author's Keywords from Scopus is lesser than that from WOS. The quantitative and qualitative analysis of the data comes in the following sections. The sources from Web of Science (WOS) have higher average citations per documents and longer timespan than Scopus. Authors per Document from Scopus are four times as many as from WOS. Therefore, we choose the information of WOS database for bibliometric analysis, and use R software to analyze the publication trends of supply chain finance from six aspects.

Quantitative Analysis

Analysis of Publication Years

Figure 1 shows the yearly scientific production of published papers about supply chain finance within the period of 1997 to 2021. The number of articles rise constantly throughout the period. There are five turning points during this period, In the first stage, there are only a few numbers of scientific productions from 1997 to 2005, then it began to rise slowly, but it has fallen sharply since 2009, and stood at low points in 2010. From 2009 to 2014, there were frequent fluctuations. It has risen sharply since 2017, then reached its peak points in 2019, which was more than three times as much as in 2017.

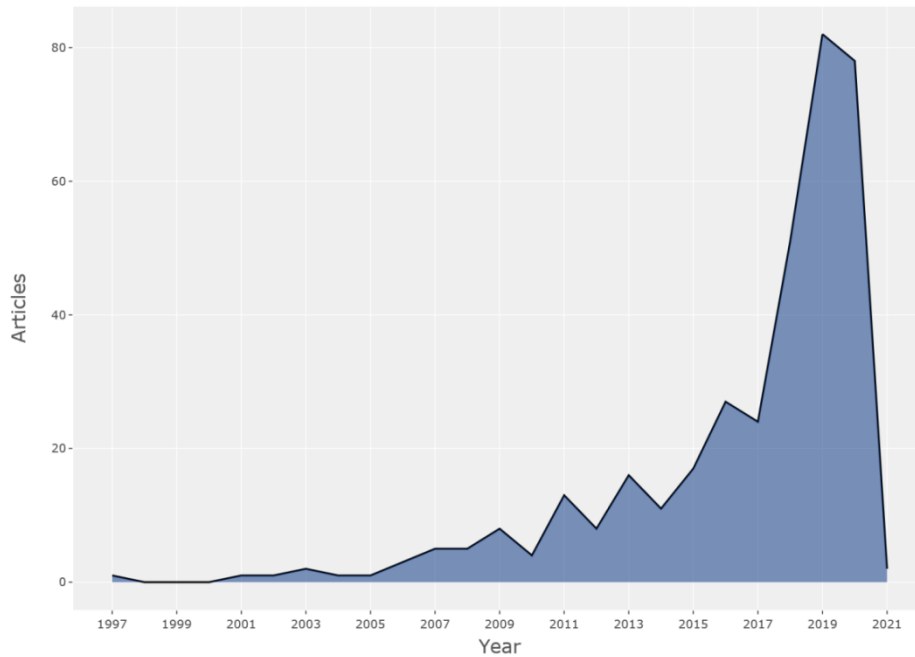


Figure 1: Annual scientific production of supply chain finance research field within 1997 to 2021 period

Sources: Web of science

The average article citations per year from 2006 to 2020 are shown in Figure 2. According to the trend, the highest number of average citations per year were collected by 20 articles published in 2003. It then dropped to around 3 in 2019.

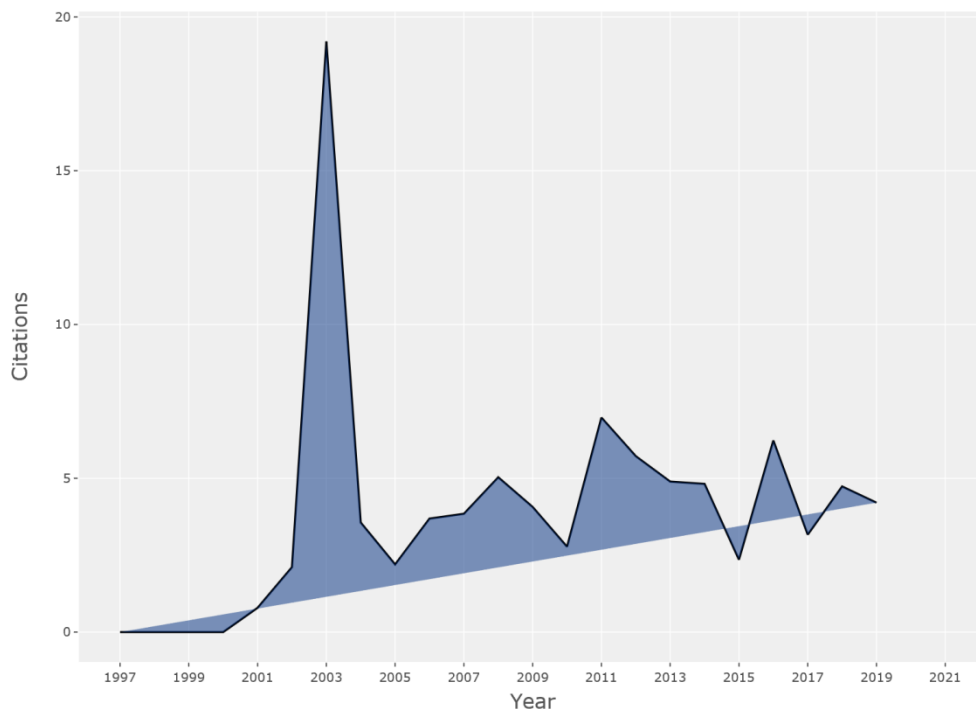


Figure 2: Average article citations per year for supply chain finance research field within 1997 to 2021 period

Sources: Web of science

There are 380 citing documents in this bibliographic collection. Figure 3 shows the most local cited documents in the period of 1997 to 2021. The bar chart shows the top two highly local citations belong to the documents published in 2013 and 2016. Local citation evaluates the

number of records citations received from papers involved in the analyzed set. The figure indicates the top highly local citations belong to the articles published in 2013, which gathered under 60 local citations.

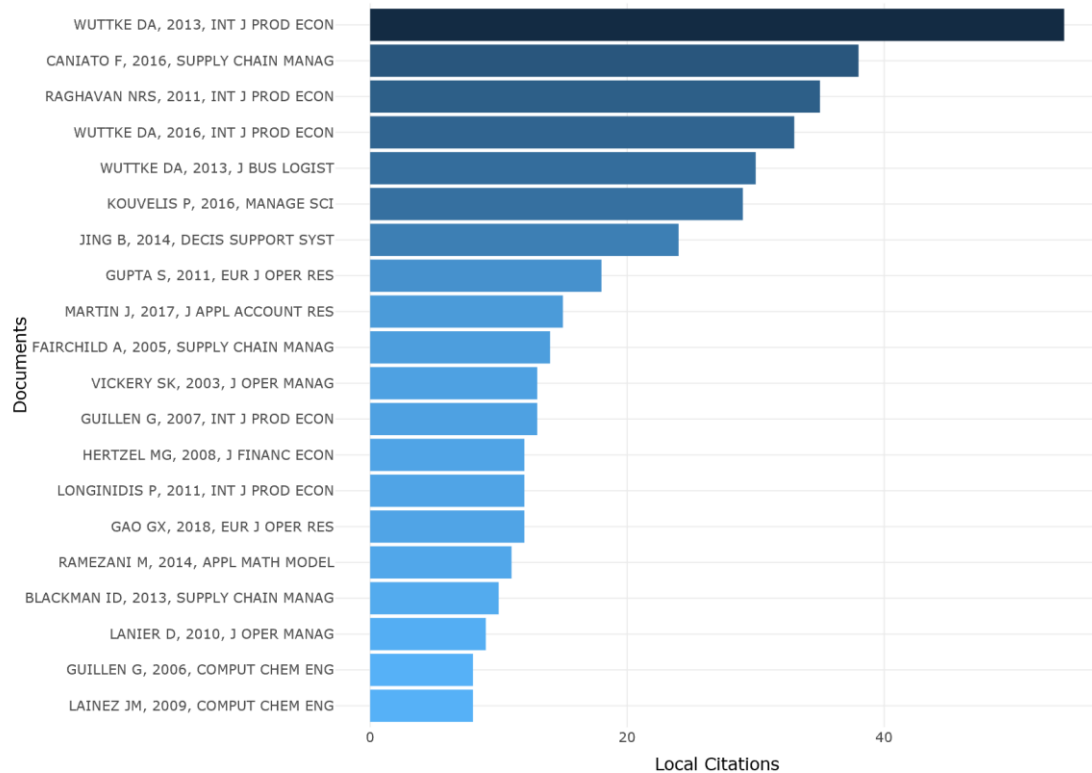


Figure 3: Top 20 most local cited documents published on supply chain finance research field
 Sources: Web of science

Analysis of Authors

There are total number of 832 research works publishing their scientific accomplishments in the field of supply chain finance from 1997 to 2021. Figure 4 represents the most relevant author's production over time from 2008 to 2020. The red line shows the author's timeline. LIU Y has published seven articles in this field, meanwhile he has the most persistent timeline among other authors, that the time span is from 2008 to 2020. The bubble color intensity represents the total citations per year. CHEN X has the largest publications in 2019. Besides, the overall number of publications is the largest between 2018 to 2020.

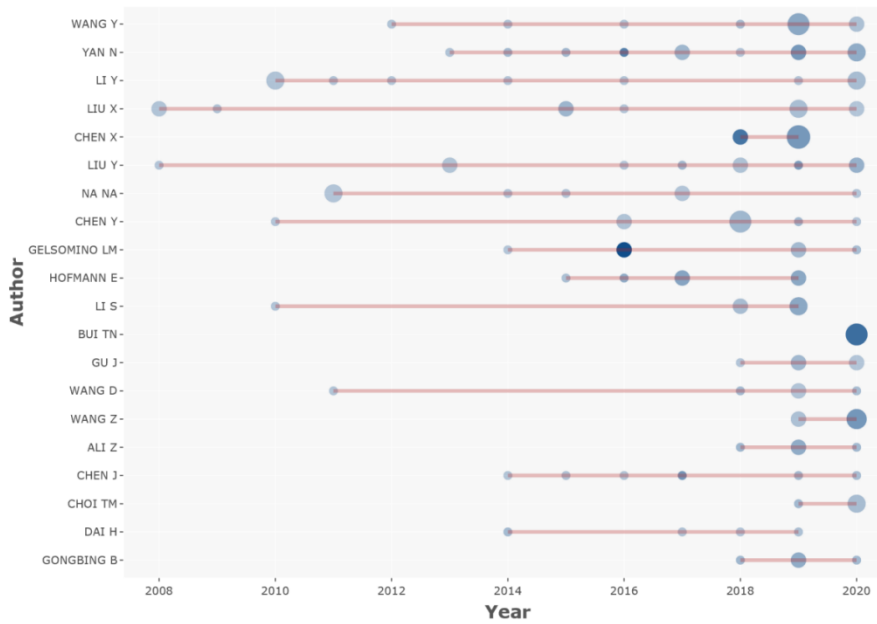


Figure 4: Top 20 most relevant author’s production on supply chain finance research field from 2008 to 2020
 Sources: Web of science

Analysis of Sources

There are 163 sources such as journals, books, conference in this bibliographic collection. Figure 5 shows the most relevant sources in the field of supply chain finance. The International Journal of Production Economics is the top critical journal in the area. According to the bar chart, the most relevant sources come from International Journal of Production Economics, which are more than 30 documents published in the source. The second top journal is Sustainability, about 18 documents are published in this source. The Computers & Industrial Engineering and the journal of Purchasing and Supply Management have the same figures in documents.

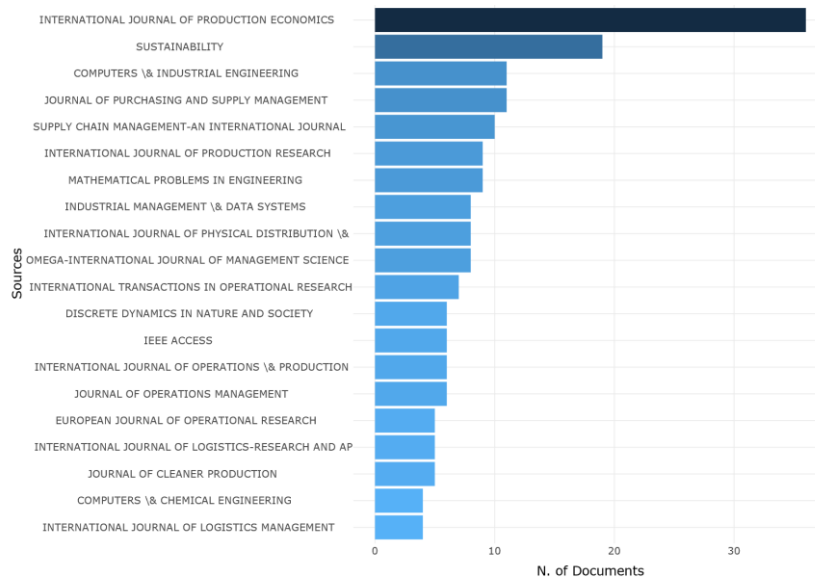


Figure 5: Top 20 most relevant sources by the number of documents published on supply chain finance research
 Sources: Web of science

Figure 6 shows the number of sources occurrences in the interval of 2001 to 2021. The annual occurrences have been sluggish until 2005 except the mathematical problems in engineering. There are even three resources showing negative growth between 2011 to 2012. The “International Journal of Supply Chain Management” has a rapid growth since 2009, which become the leader in publishing the most relevant articles. On the other hand, the source growth in “Supply Chain Management an International Journal” has declined since 2009. The Sustainability, Journal of Purchasing and Supply Management, Computer & Industrial Engineering have rapid growth.

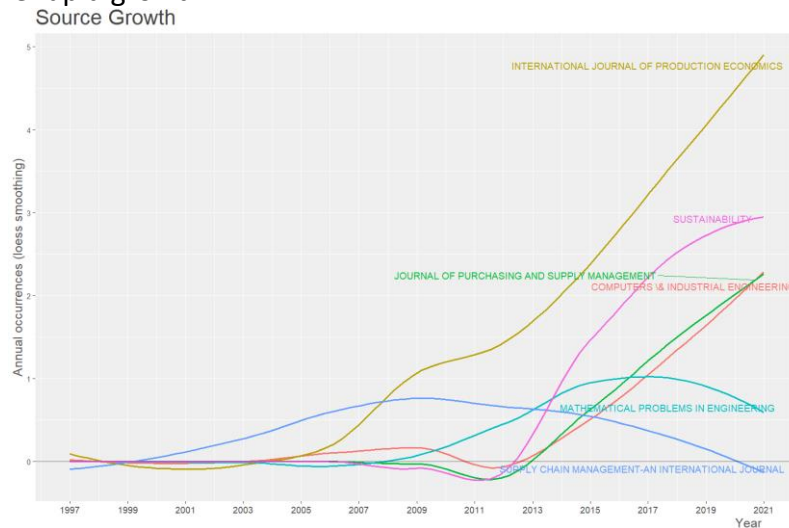


Figure 6: Annual occurrences of five most relevant sources in supply chain finance research within 2006 to 2021 period (method: loess smoothing)

Sources: Web of science

Analysis of Countries

In Figure 7, top 20 countries were ordered by their count of scientific productions. The red bars indicate the publications rate by corresponding author’s country, which have least one foreign co-author exists. While the blue bars demonstrate the number of publication come from authors who are in the same country. They are referred to Multiple Countries publication (MCP) and Single Country Publication (SCP) respectively. The China with 180, USA with about 60, and United Kingdom with 20 approximately publications are considered as the top three most relevant countries. China has more international cooperation than USA.

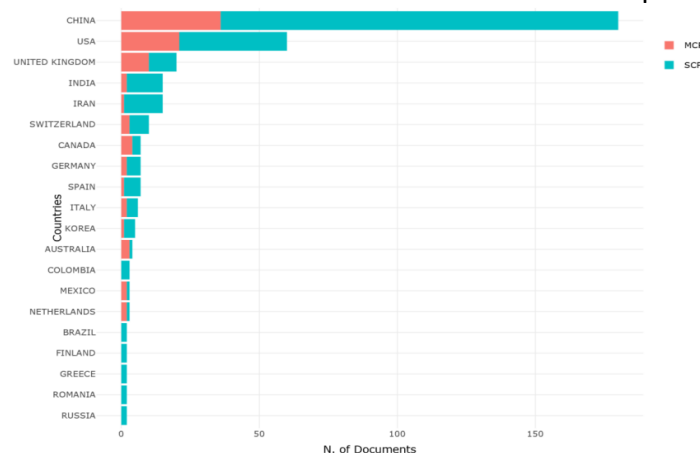


Figure 7: Top 20 corresponding author’s country (red line: Multiple Countries Publication (MCP), blue line, Single Country Publication (SCP))

Sources: *Web of science*

Figure 8 represent an overall picture of the number of authors affiliated with the country of publication and gives the figure of joint documents published by the top countries in the field of supply chain finance. The darker the color of blue, the more authors in the affiliated countries. The USA and China are the two central research powers in supply chain finance research field

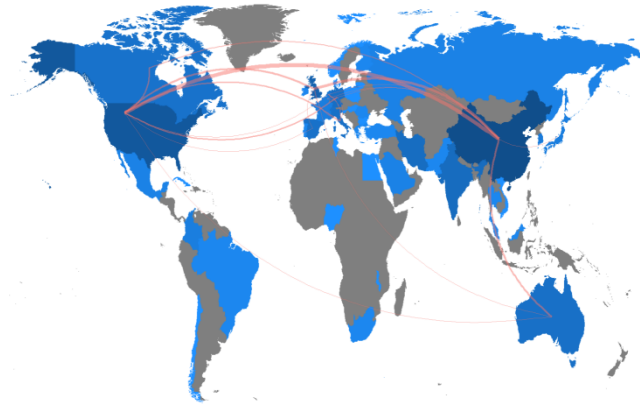


Figure 8: Country collaboration world map of supply chain finance research field (blue color intensity: the number of authors affiliated with each country, grey color: non-relate country, red line thickness: the number of joint publications)

Sources: *Web of science*

Analysis of Topics

In order to analyze the main topic of supply chain finance, keywords networks are used. The density of different keywords was obtained by clustering analysis method. Each keyword belongs to a category. A thematic map is a specific plot that can represent each category. Figure 9 shows the topics about supply chain finance in a thematic map. Each bubble displays a keyword network cluster. The cluster name is the word with the highest occurrence rate. Therefore, management, design, model, selection, EOQ model, market, simulation, panel-data, providers, empirical-analysis, buyer-seller relationship, equity are the most relevant category indicators. The bubble size is related to the cluster word occurrences for its position depends on the cluster centrality and density. Centrality and density represent the theme importance and theme improvement in the supply chain finance research area, respectively. Therefore, highly developed themes are on the top left, object themes are on the top right, declining and isolated themes are on the bottom left, primary and transversal themes are on the bottom right of the thematic topic map (Ebrahim et al., 2020).

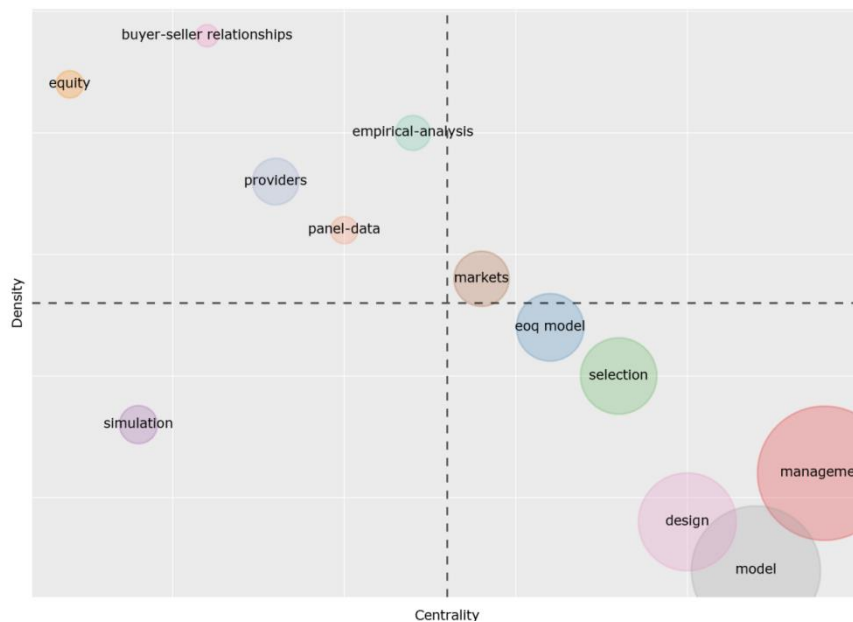


Figure 9: Thematic map of keywords network clusters in supply chain finance research field (bubble size: the clusters word occurrences)

Sources: *Web of science*

Keywords such as equity, buyer-seller relationship, providers, panel-data, empirical-analysis are five cluster representatives with a few numbers of occurrences. They are called as highly developed and isolated themes for their low level of importance and high level of improvement.

On the other side, keywords such as management, model, design, selection, EOQ model, are the five cluster representatives called basic and transversal themes. Management' keywords theme is the most important theme for the highest centrality, among others, design, management and model are the top mostly occurred keyword theme and more likely to be used in future supply chain finance research.

Analysis of Keywords

Three-field plots are created to give a diagram for three different categories. Figure 10 and Figure 11 represent the three-field plots, which mostly focus on the top keywords. Figure 10 is formed by choosing the three main metadata field, authors as the left field, keywords as the middle field and sources as the right field. It reflects the relationship among top keywords, top authors and top journals. According to Figure 10. The most commonly used keywords are supply chain finance, supply chain management, supply chain. Most authors use the keyword about "supply chain finance", which are published in the international journal of production economics mostly. On the other hand, the top keywords plus are management, trade credit, performance and model. Almost every journal use "management" as the keywords plus.

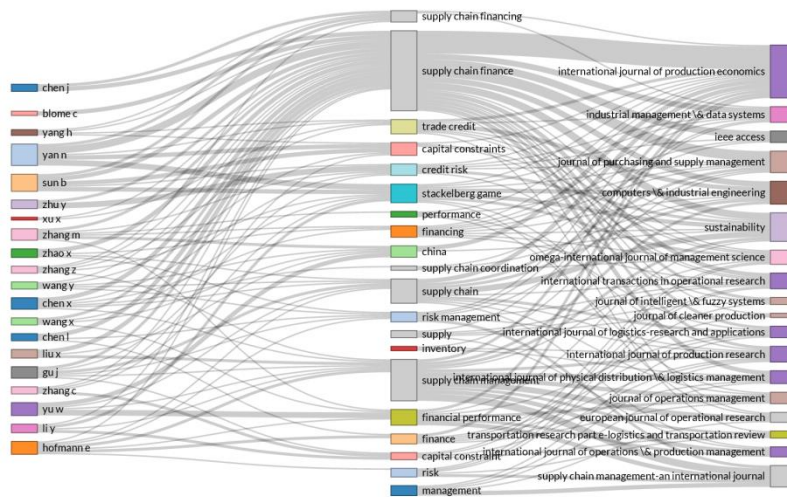


Figure 10: Three-fields plot for the relationship among top keywords (the middle field), top authors (the left field) and top journals (the right field) in supply chain finance.

Sources: Web of science

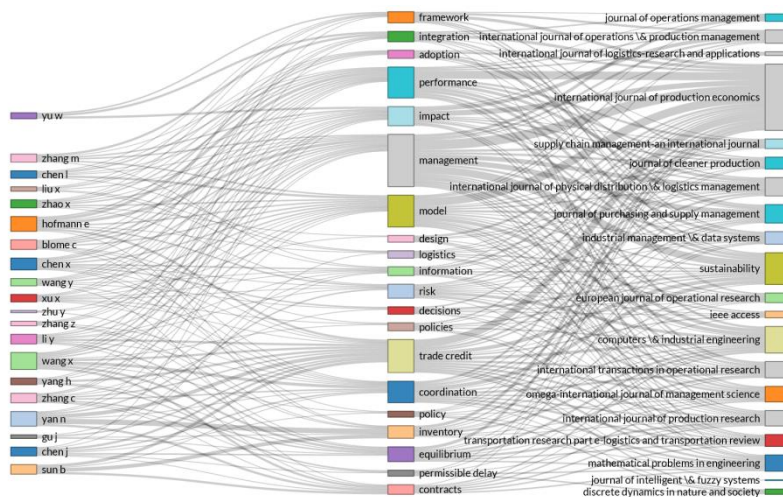


Figure 11: Three-fields plot for the relationship among top keywords plus (the middle field), top authors (the left field) and top journals (the right field) in supply chain finance.

Sources: Web of science

Figure 11 is created by selecting another three metadata fields, authors as the left field, keywords plus as the middle field and sources as the right field. It shows the relationship among top authors, top keywords and top journals. The three top journals that published the most research on this topic are “International journal of production economics”, “Sustainability” and “Computers & industrial engineering”, which is not all the same as Figure 10 shows.

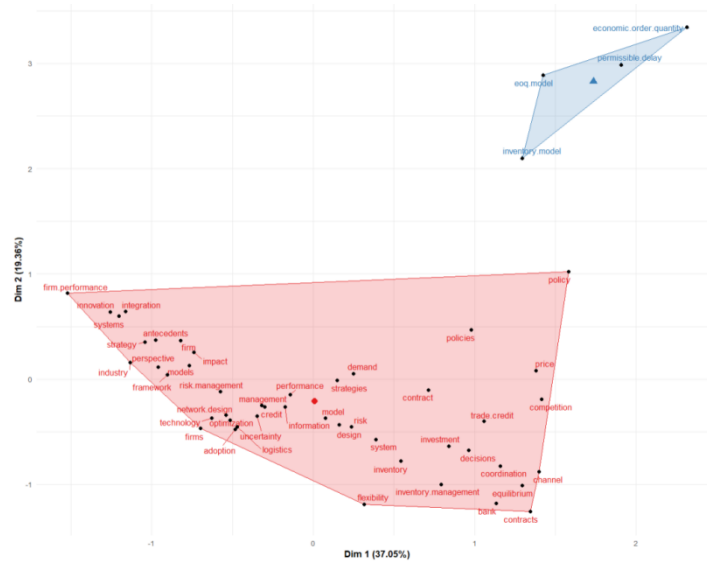


Figure 12: Conceptual structure map of keywords in supply chain finance (Dim.1 and Dim.2: the average position of the articles included in each keyword)

Figure 12 display the link among keywords of the publication set by designing a conceptual structure map, which show the average position of the articles included in each keyword, the dot of the map indicates the center of supply chain finance research field. In a conceptual structure map, document’s words are separated by two cluster, which help the readers to understand preface research field. Applying factorial approaches to reduce data dimensionality and represent it in a low-dimensionality space that can avoid multicollinearity of variables. It is divided into two cluster by cluster analysis, which presented by different color. The blue cluster contains four keywords and show economic order quality, permissible delay, EOQ model, inventory model. The red cluster consists of most of the keywords. Keyword sets such as innovation, integration, systems, strategy, firm, perspective, industry, models, framework and risk management, network design, technology, optimization, management, credit, logistic, adoption, uncertainty and performance are close to each other. Figure 13 shows another form of conceptual structure graph of keywords called dendrogram, which concludes the same information as in Figure 12 by different view.

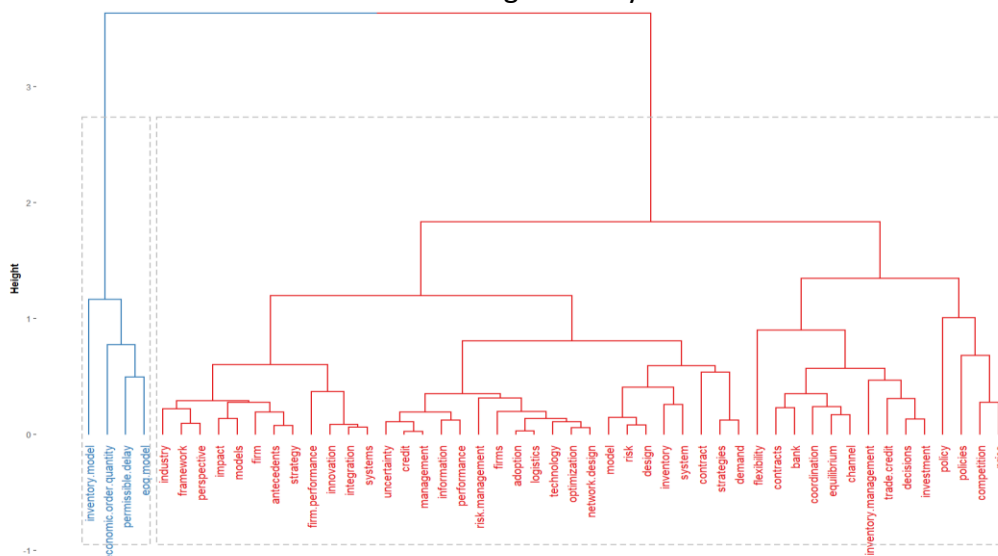


Figure 13: Conceptual structure dendrogram of keywords in supply chain finance (height: the distance among clusters of words)

Sources: Web of science

Sometimes the researcher needs more rapid and effective methods to identify the main research directions in his/her research field. Word cloud is a visual illustration of keywords metadata which directly notes the top words, top keywords plus, top author's keywords, top title words and top abstract words are represented in Figures 14-17, respectively. Scholars can understand the article's in-depth content through the keywords plus, because keywords are extracted by article reference titles. However, Author's keywords are extracted from the author's point of view. There is a total of 771 keywords plus and 1109 author's keywords produced for this analysis. Although keywords plus and author's keywords have the same effect in mining knowledge from bibliometric analysis, author's keywords are more comprehensive in presenting subjects. The top title and abstract words are refined from abstract, work, study and data etc. The keywords plus are visualized at Figure 14 in the field of supply chain finance from 1997 to 2021. The front size or color of these single words shows their importance. The best keywords plus in our research area are performance, model, trade credit, impact and coordination which are the top ranked terms indicated in the picture.

Figure 15 represents the author's keywords, ranging from the total number of 46 to the minimum of two occurrences, with supply chain, financial performance, Stackelberg game, trade credit and management on the top of them. Figure 16 shows the top titles words, ranging from as high as 111 to as low as four times. Where supply, chain, financial, finance, financing are the most relevant words. Figure 17 shows the top abstract words, that are supply chain, financial, financing, model and performance. Summarizes these four words clouds, surprisingly, the pattern in word clouds of author's, title or abstract keywords are not same as in keywords plus word cloud. Therefore, scholar should focus on more relevant words in the word cloud of keyword plus



Figure 14: World cloud of top keywords plus in supply chain finance



Figure 15: World cloud of top author's keywords in supply chain finance



Figure 16: Word cloud of top title words



Figure 17: Word cloud of top abstract words in supply chain finance

words in

Sources: Web of science

Conclusions and Directions for Future Research

Supply chain finance (SCF) has established as an important research area. We have used bibliometric and R software to analyze quantitative SCF literature through WOS database, which has allowed to automatically create bibliometric maps and tables from a large amount of data. This paper uses bibliometric analysis to summarize the research area about supply chain finance through six main aspects: (1) The number of publications grew rapidly from 2018 to 2020, but the average article citations per year was a quarter of what it was in 2003. However, the top highly local citations belong to the articles published in 2013. (2) By analyzing the authors who have published articles in the field, we can find a way to email the authors with some questions, there may even be academic collaboration in the future. (3) The International Journal of Production Economics have the most relevant sources by the number of documents published and annual occurrences. (4) The USA and China are the two central research powers in supply chain finance research field. On the other hand, China has more international cooperation than USA. (5) The top mostly occurred keyword theme could to be used in future supply chain finance research. (6) The three-field plots presented correlations between authors, keywords and sources. The paper is crucial for understanding the publication trends of supply chain finance.

There is a wide range of researchers will start working on the mentioned hot research topics of supply chain finance research field with interdisciplinary application. It is expected that the conclusions from this study provide a better perspective on the future research direction and mining the underling opportunities for applying the theory to the practical financial management. The limitation of this paper is that only WOS database is used, and the database will be expanded in future research. In addition, design, management and model are the top mostly occurred keyword theme and more likely to be used in future supply chain finance research.

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