

Visualization and Analysis of China Supply Chain Finance Research Based on CiteSpace

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Abstract: With the development of science and technology and the clear refinement of each production factor, the market competition has been transformed from the competition at the enterprise level to the competition at the supply chain level, and the in-depth study of the current situation and hot trends of the development of supply chain finance, which in turn promotes the upgrading of the status of supply chain finance, is a must in the process of China's high-quality development. The article study uses CiteSpace as a tool to visualize and analyze the relevant literature on supply chain finance in CNKI in the past ten years from 2014-2024. The study finds that the overall trend of Chinese research on supply chain finance in the past ten years is flat, and the current hot spots of supply chain finance research mainly focus on the application of blockchain technology in supply chain finance, the impact of fintech on supply chain finance, the promotion of the development and formation of green supply chain finance through financial means, the risk management and control of supply chain finance, the application of digitalization in supply chain finance, and cross-border supply chain finance Integration and Innovation^[1].

Keywords: supply chain finance; bibliometric analysis; CiteSpace; visualization

1. Introduction

At present, the trend of economic globalization is intricate and complex, and the international division of labor is becoming increasingly clear, specialized and refined. Enhancing the competitive advantages of China's supply chain finance, strengthening the global competitiveness of enterprises' supply chain finance, and ultimately promoting the upgrading of China's position in the global value chain is a serious challenge that must be dealt with in the process of China's pursuit of high-quality development^[2]. Following China's first separate mention of the supply chain finance model in 2021, the second meeting of the 14th National People's Congress in 2024 once again explicitly proposed in the government's work task for 2024: to promote the optimization and upgrading of the industrial chain supply chain, and to implement the action of high-quality development of the key industrial chain, which implies the gradual elevation of the supply chain finance in China's national strategic position.

The concept of supply chain finance was first put forward by IBM in the late 1990s, aiming to provide financing, settlement, risk management and financial services for enterprises in the upper, middle and lower reaches of the industrial chain, optimize the flow of funds throughout the supply chain through the integration of finance, logistics and information technology, improve the efficiency of capital utilization and reduce the cost of financing for enterprises, thus promoting the benign interaction between the banks and the enterprises and the mutually beneficial win-win situation^[3]. To realize the coordinated, sustainable and healthy development of the industrial supply chain. However, small and medium-sized enterprises in the supply chain often encounter financing difficulties and high financing costs, which has become a key issue limiting the competitiveness of the whole supply chain finance. With the continuous development of supply chain finance, it has experienced the evolution from traditional supply chain finance to Internet online supply chain finance to blockchain supply chain finance^[4], and supply chain finance at different stages has different mechanisms and practical performance, so the study of supply chain finance is of great significance in enhancing the financial efficiency of enterprises and the whole industrial chain, reducing costs, promoting synergistic development, and upgrading the industry. Therefore, the study of supply chain finance is of great significance in enhancing the financial efficiency of enterprises and the whole industrial chain, reducing costs, promoting synergistic development and promoting industrial upgrading. At present, few scholars have analyzed the development status and hot trends of supply chain finance in China. Accordingly, the article analyzes the literature on supply chain

finance in China to comprehensively sort out the overall research progress and hot trends of supply chain finance, so as to provide more effective guidance for the research and application of supply chain finance.

2. Data sources

In this paper, CNKI database is used as the data source, and "supply chain finance" is used as the subject search term. In order to ensure the validity of the data and the reliability of the research, the data of the last ten years are usually more in line with the standards and requirements of the current research, so the time range is set as January 2014 to January 2024, the data collection and retrieval, the type of literature selection of academic journals, the source of the literature is set as the core of the NLB, CSSCI, CSCD, a total of 1,115 pieces of literature were screened out for literature screening to eliminate the weakly relevant and other irrelevant literature, and a total of 551 pieces of valid literature were retrieved as data samples. And other irrelevant literature, a total of 551 valid documents were retrieved as data samples.

3. Research methods and tools

CiteSpace software is a visual scientific citation analysis tool, which was developed by the research group of Prof. Chaomei Chen at Drexel University in the United States, and can statistically analyze and display the current status, hotspots, frontiers, and future development trends of research in a particular research topic or subject area. In this paper, CiteSpace 6.3.R1 is used to visualize the above retrieved data for knowledge mapping analysis, to understand the current research status in the field of supply chain finance in China through the analysis of the number of articles, authors and institutions, and to summarize the hotspots and development trends in the field of supply chain finance through the analysis of the keyword clustering, timeline, and salient value, so as to provide useful references for the future related research.

4. Basic Characteristics of Literature

4.1. Spatial and temporal characterization of the literature

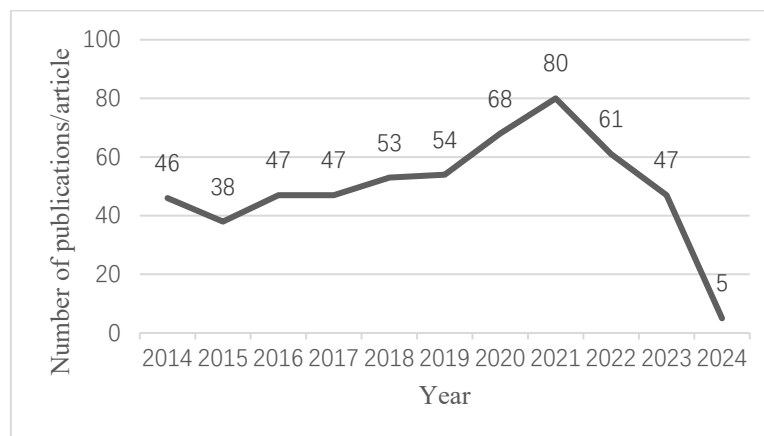


Figure 1: Line graph of the number of articles on supply chain finance in China in the past ten years

Generally speaking, the total number of articles issued in a certain field can reflect the overall development level of research in this field, and the dynamic change of the number of articles issued in each year can reflect the change of the heat of research in this research field. As can be seen from Figure 1, the domestic supply chain finance in the field of nearly a decade of the total number of articles shows a general trend of first rise and then decline, roughly divided into three stages: the first stage, 2014-2019 solid stage, supply chain finance articles in the amount of 50 pieces of low-level fluctuations in the upper and lower levels of growth in the number of articles for each year is relatively flat, this stage of the research attention, although less, but laid the foundation of knowledge of the supply chain finance. In the second stage, 2019-2021, the high-speed growth stage, the number of articles increased rapidly and peaked in 2021 (80 articles), which is closely related to the "innovative supply chain financial service model" mentioned in the closing part of the State Council work report in 2021, "Opinions on regulating

the development of supply chain finance to support the stable cycle and optimization and upgrading of the supply chain industry chain". "Has a close connection. In the third stage, the number of articles on supply chain finance tends to mature in 2021-2024, the number of articles declines, and the research heat returns to the state before 2021, which indicates that there is a stable number of scholars conducting research on supply chain finance.

4.2. Analysis of Literature Authors

Price's Law is based on the observation in the field of scientific research that a small number of core authors produce a large number of papers and that the works of these core authors are widely cited. The formula is:

$$M = 0.749\sqrt{N_{\max}} \tag{1}$$

The author with the highest number of publications is Song Hua, from which $M \approx 4$ is calculated, indicating that those who have published more than four articles are core authors, and there are currently 14 authors with a cumulative total of 88 articles, accounting for 16% of the total number of articles, which differs somewhat from Price's Law of fifty percent, indicating that a core group of authors has not yet been formed in the field of supply chain finance at the present time.

To some extent, the number of articles an author has published in the relevant field can reflect their academic status in the field. Analyzing the number of articles published by authors in the field of supply chain finance can identify the representative scholars in the field, and the degree of collaboration among scholars in the field of supply chain finance can be seen from the authors' collaborative network mapping. According to Table 1, the author with the most publications is Song Hua, followed by Chu Xuejian. Using CiteSpace software to analyze the collaboration network of authors in the literature, as shown in Figure 2, there are 281 nodes and 114 connecting lines in the graph, and the network density is 0.0029, in which the size of the nodes is positively proportional to the number of publications, and the number of connecting lines between the nodes is positively proportional to the degree of closeness of the connection between the authors. As can be seen from Figure 2, the four authors with the largest nodes are Song Hua, Chu Xuejian, Luo Yong and Chen Zhiya, and there are also more connecting lines between nodes and other nodes, which indicates that they are prolific authors in the field of supply chain finance and that their research results are of some relevance.

Table 1: Highly productive authors of supply chain finance research (TOP20)

author	volume of publications	author	volume of publications
Song Hua	26	Shi Jinzhao	4
Chu Xuejian	7	Pan Ailing	4
Luo Yong	6	Zhou Jian	4
Chen Zhiya	6	Ling Runze	4
Lu Qiang	5	Fu Weiqiong	3
Yang Xuan	5	Zhuang Xintian	3
Li Juan	5	Li Guangrong	3
Chen Jinlong	4	Li Jian	3
Yu Hui	4	He Juan	3
Zhan Zhiyong	4	Ren Bo	3



Figure 2: Author Collaboration Network Diagram

4.3. Analysis of Research Institutions

The literature data collected in CNKI is imported into CiteSpace for analysis, and the collaborative knowledge graph of supply chain finance research institutions can be obtained, as shown in Fig. 3, which has a total of 243 nodes, 83 connecting lines, and a network density of 0.0028, in which each node represents an institution, and the larger the node means the higher the frequency of the issuance of articles, and the connecting lines between the nodes represent the closeness of the cooperation between institutions. As can be seen from the mapping, the top three institutions are Renmin University of China Business School, Shanghai University School of Management, Xi'an Jiaotong University School of Management, with 26, 10 and 6 articles respectively, all kinds of colleges and universities are the main force in the field of supply chain finance research, and in-depth study of supply chain finance lacks practical cooperation with related enterprises.



Figure 3: Knowledge mapping of research organization collaboration

5. Analysis of Supply Chain Finance Research Hot Spots

5.1. Keyword co-occurrence graph analysis

Keywords are used to reflect the topic, research field, methodology and other aspects of the literature, to help readers quickly understand the main idea and content of the article, but also to condense and summarize the core content of the article, and mastering the keywords will help to excavate the main research content of the field. The keywords in the literature from 2014 to 2024 are counted using the keyword co-occurrence analysis method proposed by Callon, keyword co-occurrence analysis is a statistical method that takes keywords as nodes and characterizes the co-occurrence relationship between keywords by the association between the nodes, and the strength of the co-occurrence relationship can be measured by the cosine index. The specific formula is as follows:

$$\cos \frac{F(X, Y)}{\sqrt{F(X)F(Y)}} \quad (2)$$

In the above formula, we consider the variables $F(X)$ and $F(Y)$ as the frequency of occurrence of keywords X and Y within a specific set of keywords. Meanwhile, $F(X, Y)$ is used to identify the frequency of occurrence of keywords X and Y at the same time. The value of this index is between 0 and 1. The larger the value, the closer the co-occurrence relationship between the two keywords. By deeply analyzing the co-occurrence relationship graph of keywords, we can identify the core research topics in the field of supply chain finance. As the data presented in Figure 4 and Table 2, the keyword co-occurrence graph contains 261 nodes, 664 connecting lines, and a density of 0.0196. Blockchain is the keyword with the highest centrality, with a centrality as high as 0.23, which means that blockchain is an important keyword in the given dataset, is closely connected to other keywords, and plays an important role as a bridge between these keywords that has a pivotal position in the research collaboration network of supply chain finance. Other keywords with strong centrality are: small and medium-sized enterprises (SMEs), financial technology, and credit risk.

First of all, in the study of supply chain finance for small and medium-sized enterprises, experts generally agree that supply chain finance plays a key role in improving the operational efficiency of the entire supply chain and alleviating the difficulties of SMEs in accessing capital. In recent years, supply chain finance mechanisms have significantly reduced the cost of financing for these enterprises and effectively enhanced their operational efficiency and management quality. At present, the combination of blockchain technology to strengthen the traditional supply chain finance model has gradually formed an emerging trend. Blockchain technology not only lays the foundation for innovation, digital transformation and intelligent development in the financial sector, but also serves as the core for realizing high-quality economic growth. In addition, blockchain technology can enhance the efficiency of green certification, risk management, monitoring, and services, thus cracking the problem of green supply chain finance development.

Secondly, in the field of financial technology, the integration and application of financial technology and its related products have, to a certain extent, facilitated the transformation of traditional supply chain finance in the direction of intelligence, a process that has a far-reaching impact on the continued evolution and progress of supply chain finance.

Finally, regarding the issue of credit risk, since it is difficult to identify and prevent credit risk faced by SME financing, in supply chain finance, financial institutions usually need to assess the credit status of the participants, so as to determine the financing amount, interest rate and other conditions. The use of big data technology is of key significance to improve the assessment and management of credit risk in supply chain finance, and effective credit risk management is an important premise to ensure the sound development of supply chain finance, which can effectively reduce the credit risk in supply chain finance and promote the healthy development of the industry through the establishment of a perfect credit assessment system, the strengthening of information sharing, and the adoption of risk diversification.

Table 2: Supply chain finance high-frequency keywords (TOP10) statistics

serial number	Keywords	frequency	centrality
1	blockchain	46	0.23
2	middle and small-sized enterprises	29	0.14
3	financial technology	22	0.14
4	credit risks	33	0.14
5	financing restriction	24	0.08
6	supply chain	18	0.06
7	big data	11	0.05
8	risk management	18	0.04
9	financing mode	8	0.04
10	evolutionary game	8	0.04



Figure 4: Keyword co-occurrence map of supply chain finance

5.2. Keyword clustering graph analysis

Although the above has identified the keywords of the domestic literature in the field of supply chain finance and regarded them as the main content of the research in the field of supply chain finance, the high-frequency keywords individually cannot represent nor cover all the issues in the entire field of supply chain finance, and it is still necessary to further integrate the high-frequency keywords into the cluster analysis, which summarizes the research clustering of the research on supply chain finance in China in the period of 2014-2024, as shown in Figure 5 Shown. Through quantitative calculation, the 260 keywords finally formed eight effective clusters. The analysis shows that all eight clusters Silhouette value is greater than 0.7, so it can be considered that the clustering results are credible, and the network modularity value $Q=0.617$, which is greater than 0.3, indicating that the results are significant between the data. Its eight clusters are: blockchain, fintech, SMEs, credit risk, financing mode, financing performance, commercial banks, and blockchain technology, and the keyword clustering is followed by a wide range of themes. The most critical theme is blockchain, which can be seen from the keyword clustering knowledge graph with large corresponding nodes and many connecting lines, indicating that the research and application of blockchain in the field of supply chain finance has a high degree of attention, and blockchain technology has the potential to play an important role in supply chain finance.



Figure 5: Clustering diagram of supply chain finance keywords

5.3. Analysis of emergent words

The emergent word analysis through CiteSpace provides a better understanding of the high-frequency keywords in a certain time period, so as to understand the research dynamics and trends in the field of supply chain finance, discover new research directions, and assess the academic impact. Through the emergent word analysis, a total of 32 emergent words were found, and the top 20 emergent words in terms of intensity are shown in Figure 6: financing model, commercial bank, Internet +, industrial chain, blockchain, artificial intelligence, core enterprise, credit risk, etc. These are key keywords in the field of supply chain finance, and the keywords that have appeared in the last three years are: core enterprise, digital transformation, blockchain technology, and case study. With the continuous advancement of digital transformation, academics are paying more and more attention to digital technology and launching in-depth case studies on related core enterprises, making a large number of new information technologies combined with supply chain finance. Blockchain technology, as an effective means to solve the information asymmetry, fraud and many other problems in traditional supply chain finance, can improve the effectiveness and security of supply chain finance, prompting the field of supply chain finance to continuously absorb new knowledge, theories and technologies^[5].

Top 20 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2014 - 2024
融资模式	2014	1.63	2014	2015	█
商业银行	2015	2.86	2015	2017	██
互联网+	2015	2.25	2015	2018	███
互联网	2016	1.52	2016	2019	███
融资绩效	2017	3.1	2017	2018	██
信息不对称	2017	2.02	2017	2018	██
供应链能力	2017	1.54	2017	2018	██
关系嵌入性	2017	1.54	2017	2018	██
电商平台	2019	3.23	2019	2020	██
应收账款融资	2019	2.77	2019	2020	██
物联网	2019	2.53	2019	2021	███
智能合约	2019	2.3	2019	2020	██
小微企业融资	2019	2.21	2019	2021	███
大数据	2019	2.21	2019	2021	███
产业链	2019	1.61	2019	2020	██
区块链	2018	4.78	2020	2021	███
核心企业	2016	1.86	2021	2024	███
数字化转型	2021	1.69	2021	2024	███
区块链技术	2020	2.44	2022	2024	███
案例研究	2022	2.01	2022	2024	███

Figure 6: Analysis of supply chain finance emergent terms (Top20)

5.4. Keyword Timeline Chart Analysis

Timeline analysis of the keywords in the field of supply chain finance can show the evolution trend of the keywords in the time dimension, and understand the research and development process of the topics in a certain time period after the integration of supply chain finance clustering. Figure 7 shows the timeline knowledge graph, where the size of the nodes represents the frequency of the keywords, and the connecting line indicates the time span of the keywords, and the starting point is the year when the keywords first appeared. The density of keywords reflects the extent of research results in that time period. The development of supply chain finance in China in the past decade can be divided into two stages:

The first stage, 2014-2018, is the rapid development stage, during which scholars have conducted extensive research on the theoretical framework, practice models and policy implications of supply chain finance in order to better understand and promote the development of this field, while at the same time, the government and the industry have increased their support and investment in supply chain finance research, which has pushed forward the continuous expansion and improvement of the related fields. The main keywords are supply chain, internet, big data, credit risk, emphasizing the use of intelligent technology in supply chain finance to realize the intelligence of supply chain financing operations, mostly simple information technology system applications, with a high overall dependence on manual labor.

In the second stage, 2018-2024, the main keywords are blockchain, digitization, Internet of Things, financial technology, artificial intelligence, China's supply chain finance research has entered a stage of in-depth exploration, and scholars have conducted a large number of theoretical discussions and empirical studies in this field. On the one hand, the rapid development of digital technology provides new development opportunities for supply chain finance. The application of blockchain, big data, artificial intelligence and other technologies has greatly improved the risk control, information sharing, capital flow and other aspects of supply chain finance, and increased the efficiency and transparency of supply chain financial services. On the other hand, the continuous improvement of regulatory policies has also promoted the healthy development of supply chain finance. Relevant government departments have introduced a series of policies to support the development of supply chain finance, strengthened the supervision of platforms, standardized the order of the industry, and guaranteed the security and stability of supply chain financial services.

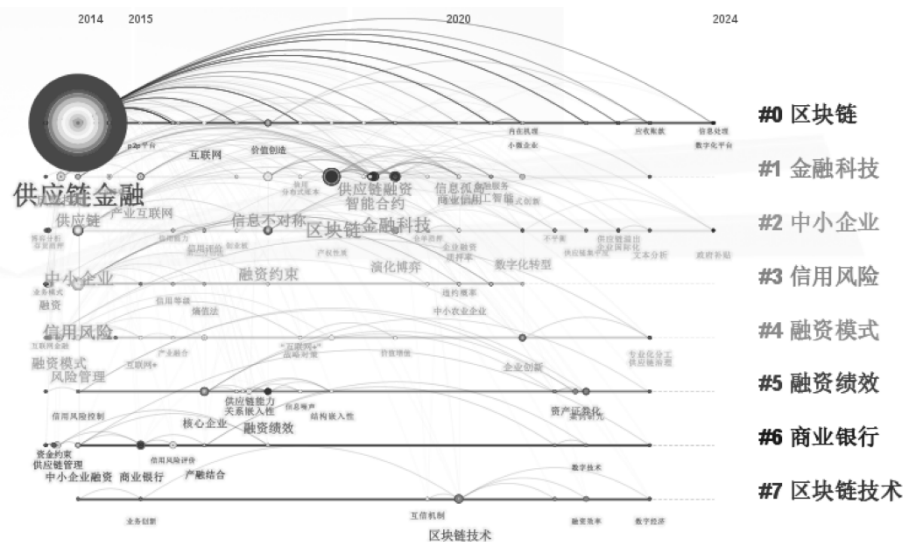


Figure 7: Supply Chain Finance Time-Line Diagram Analysis

6. Conclusions

At present, under the national trend of accelerating the formation and development of new quality productivity, supply chain finance has gradually emerged as a hot research direction, this paper uses CiteSpace software to visualize and analyze 551 pieces of literature about supply chain finance in the past ten years in the core journals, CSSCI and CSCD journals in the CNKI database, and the main conclusions are:

(1) The overall trend of China's research on supply chain finance in the past ten years is stable, and it will reach the research peak in 2021, the industry scale is small, the number of articles is not big and the concentration in this field is low, a real core area has not been formed yet, the cooperation between institutions needs to be strengthened, and there is still a lot of space for development and a broad research prospect in the future.

(2) The keyword mapping in the field of supply chain finance shows that the current supply chain finance research hotspots mainly focus on the application of blockchain technology in supply chain finance, the impact of fintech on supply chain finance, the promotion of the development and formation of green supply chain finance through financial means, the risk management and control of supply chain finance, the application of digitalization in supply chain finance, and cross-border integration and innovation of supply chain finance.

(3) Future supply chain finance will still pay more attention to the application of blockchain technology and artificial intelligence technology in supply chain finance. Supply chain finance is not only an issue in the economic field, but also involves social and environmental impacts. Future research could focus on how to consider social responsibility and sustainability factors in supply chain finance.

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