

Research on Risk Management of Digital Technology Empowering Supply Chain Finance

-- Based on CiteSpace Knowledge Graph Analysis

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Abstract. In the era of digital economy, supply chain finance plays an important role in solving the financing difficulties of small and medium-sized enterprises. However, at present, the development of supply chain finance has entered into a bottleneck, and the risk management field of supply chain finance is also facing optimization and innovation. This paper takes WoS and CNKI databases as the data source, and with the help of CiteSpace software, combined with the rapid development of digital technology in recent years, conducts a visual comparative analysis of risk management of supply chain finance at home and abroad from 2000 to 2023, and explores the research hotspots; analyzes the strategic matrix diagram of risk management research of supply chain finance at home and abroad, and determines the hotspots and trends of the future thematic research; compares the China's digital technology about empowering risk management of supply chain finance part, further summarize the defects of risk management of traditional supply chain finance and the advantages of digital technology empowerment, and make a future outlook on risk management of supply chain finance empowered by digital technology.

Keywords: Supply Chain Finance; Risk Management; Digital Technology; Knowledge Map.

1. Introduction

In April 2021, the China Banking and Insurance Regulatory Commission (CBIRC) issued the Notice on Further Promoting the High-Quality Development of Financial Services for Small and Micro Enterprises in 2021, proposing that, on the basis of legal compliance and risk controllability, it should fully utilize financial technologies such as big data, blockchain, artificial intelligence, etc., and build supply chain industry chain financial platforms in key areas to provide convenient and fast online financing services [1]. Compared with traditional credit, supply chain finance significantly improves the financing efficiency of small and medium-sized enterprises and reduces their financing costs. However, the shocking "Treasure Island mine", "Shanghai steel trade fraud case", "Dalian machine tool loan fraud case" and other events reflect the existence of huge risks in supply chain finance. At present, the development of supply chain finance has entered a bottleneck, showing an extremely contradictory development situation. On the one hand, supply chain finance has been elevated to the national strategy and policy direction and received high attention from the government, on the other hand, the regulators and management departments are extremely worried about the potential risks of supply chain finance.

Risk management in supply chain finance has been a hot topic for scholars' research. Especially with the rise of fintech represented by big data, blockchain, artificial intelligence, etc., the research in the field of supply chain finance has also triggered new thinking. How does digital technology integrate and empower the risk management research of supply chain finance? How should the risk management path of supply chain finance be optimized and innovated? At present, there is little research literature focusing on the research status, hotspot analysis and trend outlook, which is not conducive to other scholars or readers to systematically grasp the logic and hotspot frontiers of supply chain finance risk management from the vast amount of literature information.

In view of this, this paper follows the logic of "identifying research hotspots → sorting out research trends → exploring risk management → digital technology empowerment" [2], with the help of CiteSpace visualization and analysis software, based on the WoS and CNKI databases, it presents a clearer picture of supply chain financial risk management empowered by digital technology, from a comprehensive perspective. The hotspot analysis and cutting-edge picture of financial risk management is presented more clearly from a comprehensive perspective.

2. Statistical Analysis of Literature Volume

2.1 Research Methodology

The software version used in this paper is CiteSpace 6.2.R4, which can systematically analyze the main authors, research institutions, research hotspots and research frontiers in the field of "Risk Management in Supply Chain Finance Empowered by Digital Technology", so as to better judge the logical evolution of the academic research in this field and the future outlook.

2.2 Data Source

The domestic data source takes China Academic Journal Full Text Database (CNKI for short) as the data source of research results in the field of risk management of supply chain finance. Through the exploration of the definition of supply chain finance and related theoretical research, supply chain finance mainly focuses on supply chain and finance [3-7]. The keywords included in supply chain are supply chain, inventory, stock, receivables, and the keywords included in finance are finance, financing. Through appropriate combinations, the final search terms for supply chain finance are "supply chain finance", "supply chain financing", "inventory pledge financing", "Inventory financing", "accounts receivable financing" with "risk management" as the search term. In view of the small amount of publications on supply chain finance risk management before 2000, the time period is set as 2000-2023, and the journal type is 2000-2023. Given the small number of publications on supply chain finance risk management before 2000, the time period was set as 2000-2023, and the types of journals were SCI, core and CSSCI journals, with a total of 511 journal articles retrieved.

The foreign data source is Web of Science (WoS) core collection database as the foreign data source, and the research related to the field of risk management in supply chain finance is searched. This paper searches 1068 articles with the keywords "supply chain finance" and "risk management". In order to exclude the interference of irrelevant articles, this paper defines the type of literature as "Article", and finally obtains 1030 articles. It is worth noting that when analyzing the existing literature, the domestic literature database CNKI and foreign literature database WoS are called "domestic" and "foreign" respectively, in order to distinguish between.

In China, the concept of digital transformation first appeared in Made in China 2025 in 2015. On this basis, in 2016, the State Council issued the "13th Five-Year Plan for National Informatization" and the "Internet Plus" Action Plan. On the one hand, these two documents clarify the new orientation of digital transformation and put forward the goals and paths for accelerating the development of industrial digitization and informatization; on the other hand, they implement the "Strong Nation Strategy", actively promote the application of new-generation information technology, such as Big Data, Cloud Computing, and the Internet of Things, and resolutely take the innovation-driven road of development to provide comprehensive support for the realization of the country's new development concept. comprehensive support for the realization of the country's new development concept. Therefore, this paper takes "digital technology" as the search term, and the time period is set as 2015-2023. Under this search condition, CNKI searched 2920 journals, excluding the interference of irrelevant articles, this paper finally obtained 2916 documents. 13417 journals were searched by WOS, excluding the interference of irrelevant articles, this paper finally obtained 12106 documents.

From the summarized data table 1, it can be seen that although the time span of the research field of digital technology is much less than that of the risk management research field of supply chain

finance, yet the number of journal articles published in it is much more than that of the risk management research field of supply chain finance. It further indicates that the development of digital technology has been a research hotspot, so how digital technology can empower the risk management field of supply chain finance should be more worthy of attention.

Table 1. Classification of data sets

Domestic and international databases	Journal Source	Time span of the paper	Number of papers (articles)
Internal (a country)	CNKI	2015-present	2916
		2000-present	368
Global	Web of Science	2015-present	12106
		2000-present	1030

3. Characterization of Literature Research

3.1 Analysis of Authors' Cooperation in the Field of Risk Management in Supply Chain Finance

The structural characterization of the issuing authors and their cooperation network can reflect the core group of authors and their cooperation in this field. In the foreign literature, Prof. Chou, Tsan-Ming has the largest number of publications (12), followed by Prof. Ali, Zulqurnain (5); in the domestic literature, the top 4 authors are Li Yixue, Feng Gengzhong and He Juan, with more than 5 co-occurrences, followed by Song Hua, Wang Shouyang and Shi Jinzhao, with a co-occurrence frequency of 4 times. From the perspective of cooperation network, the risk management research of domestic supply chain finance presents the characteristics of small concentration and large dispersion, and a core research team has been formed, but there are differences in the research direction of each team, which leads to a relatively weak association strength. Through analysis, it can be seen that compared with foreign research teams that have formed a certain scale, the domestic team in the supply chain finance risk management extension research has not yet formed a complete set of research results, but the network density are smaller, indicating that the domestic scholars in the field of fusion and collaboration of the academic scientific research atmosphere is not strong enough, and the scholars should strengthen the cooperation, broaden the circle of academic exchanges, and give play to the advantages of teamwork [8].

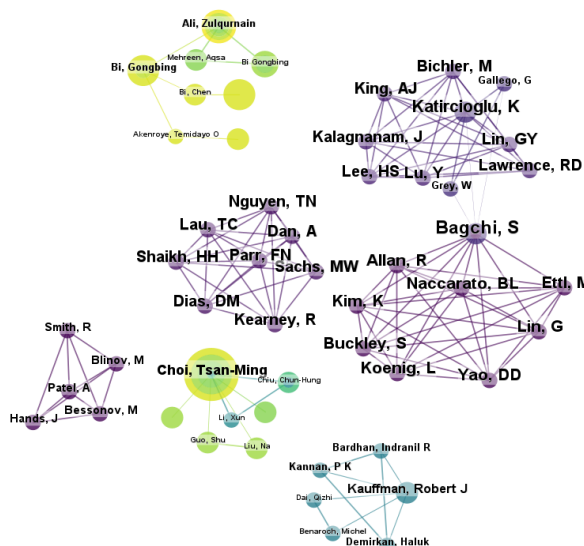


Figure 1. Collaborative mapping of foreign study authors

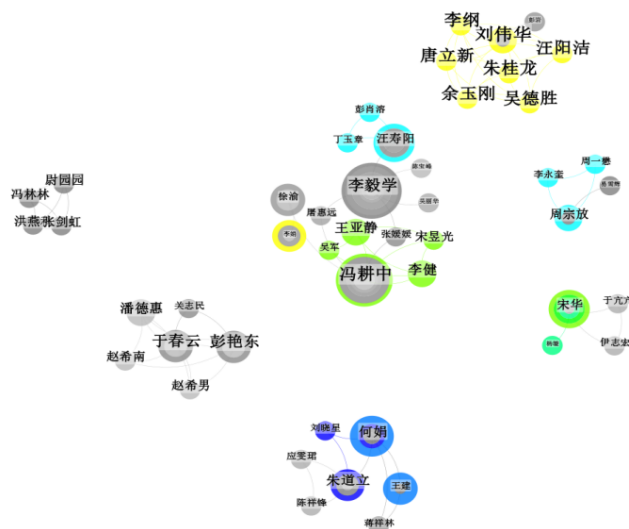


Figure 2. Collaborative mapping of national study authors

3.2 Institutional Cooperation in the Field of Risk Management in Supply Chain Finance

Co-occurrence analysis of the issuing institutions in the research field of risk management in supply chain finance can reflect the geographical distribution and inter-institutional cooperation of the research community in this field. In the institutional cooperation map, the nodes indicate the research institutions, the node size represents the amount of articles issued by the team, and the thicker the connecting line between the nodes reflects the intensity of inter-institutional cooperation [9].

In foreign studies (Figure 3), the core institutions of international research on supply chain finance risk management can be understood by analyzing the institutions of the authors of the published articles, and the institutions with the highest total number of published articles include Chinese Academy of Sciences, Hong Kong Polytechnic University, University of Chinese Academy of Sciences, Hong Kong Polytechnic University, University of Hong Kong, State University System of Florida, etc. It can be seen that research institutions in China, the United States and India have rich research results in this field, and the research strength and contribution of Chinese scholars to supply chain financial risk management in the international field can be seen. The research strength and contribution degree of our scholars in the international field of supply chain finance risk management can be seen.

In the domestic research (Figure . 4), a few institutions have partially cooperated in the risk management field of supply chain finance, however, most of the institutions have mainly binary cooperation, and have not yet formed a mesh-like multi-dimensional cooperation relationship. (1) In terms of the number of publications, the institutions with more publications are the School of Economics and Management of Nanjing University of Technology, the School of Transportation and Logistics of Southwest Jiaotong University, the School of Management of Xi'an Jiaotong University, the School of Economics and Management of the University of Chinese Academy of Sciences, and the School of Business of Renmin University of China, which form the main institutions in the research of risk management in supply chain finance. Most of the cooperation among research institutions is in the same city, and there are fewer cross-province cooperative researches. (2) From the perspective of the type of issuing institutions, higher education institutions are the main ones, indicating that universities occupy an important position in risk management research on supply chain finance by virtue of their excellent research capability. (3) From the perspective of the region of the issuing organization, there are more research results in the southwest region, Jiangsu region, Shanghai region and Beijing region. Considering that the regional environmental problems are more prominent, and the more economically developed regions have more demand for supply chain services, as well as the greater influence of national policies on the industry, the research results of the organizations in these regions are relatively abundant. The analysis shows that there is less cooperation and low

concentration among scholars in the risk management research field of supply chain finance, and there is no scale formation of risk management research groups in supply chain finance, and cooperation and communication among scholars of different disciplines and regions should be strengthened.

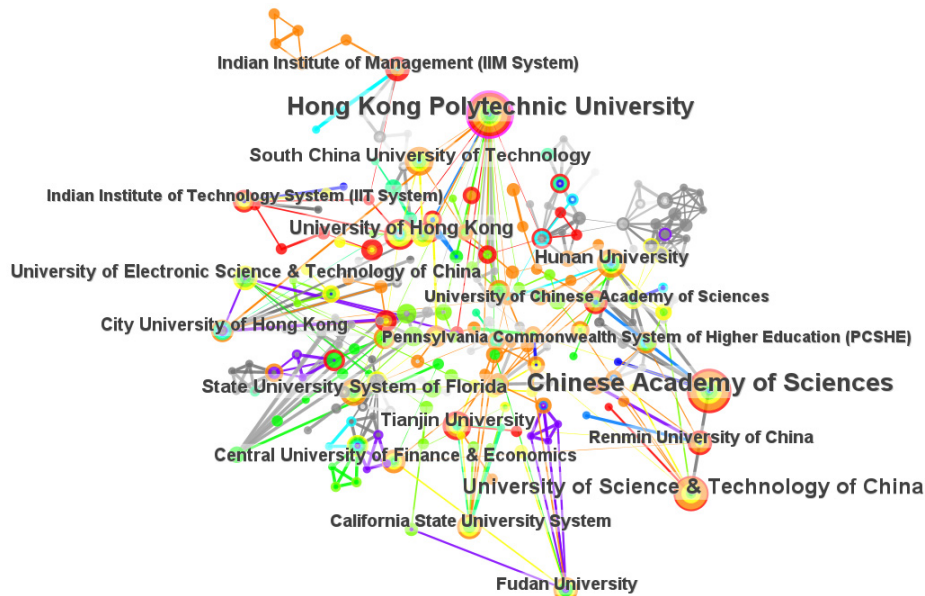


Figure 3. Collaboration mapping of foreign research institutions



Figure 4. Mapping of cooperation among domestic research institutions

3.3 Analysis of Keywords Co-Occurring in the Research Field of Risk Management of Supply Chain Finance

3.3.1 Keyword Co-occurrence Analysis of Risk Management in Supply Chain Finance

The results of co-occurrence analysis of keywords can reflect the research hotspots in a research field. Among them, the foreign keyword map contains 634 nodes, 2160 lines, with a network density of 0.0108; the domestic keyword map includes 467 nodes, 795 lines, with a network density of 0.0073. Among them, the lighter color of the lines means the more current the keywords are; the larger the nodes mean the higher the keywords' frequency of occurrence.

3.4 Hot Spot Analysis of Risk Management Research Field of Supply Chain Finance

From the keywords of supply chain finance risk management research literature, we extract the professional words with high citation frequency in a certain period of time to get the emergent words in the field, and then analyze the frontiers and development trends of supply chain finance risk management. Node Type selects "Keyword", and we get the main emergent words in the field.

From Table 2 and Table 3, it can be seen that: (1) Since 2000, domestic literature mainly focuses on traditional modes of supply chain finance, such as "accounts receivable" and "logistics finance", while English literature begins to focus on "Electronic Commerce" and "supply chain finance". "Electronic Commerce", "supply chain management", "internet" and "edi(Electronic Data Interchange)". "Electronic Data Interchange", although there are key words appear, but the time of appearance is relatively short, indicating that a sustainable research hotspot has not been formed before 2009; (2) Between 2007 and 2013, the focus of domestic research began to shift to the direction of logistics finance, commercial banks, small and medium-sized enterprises, etc. With the emergence of domestic Internet finance in 2008, the focus of domestic Internet finance has been on logistics finance, commercial banks and small and medium-sized enterprises. With the rise of domestic Internet finance in 2008, core enterprises and financing models gradually became research hotspots, especially with the outbreak of the first year of Internet finance in 2013 and the continuous heating of digital technology in recent years, the empowerment of digital technology such as blockchain, big data artificial intelligence has become the focus of attention in this field. (3) From 2010 to 2018, the time span of keyword emergence in the English literature is not much different, and there is a certain overlap in the time cycle, which shows that there is a continuous change in the research hotspots in the English literature, while all the keywords in the domestic literature have a shorter duration of emergence, and most of them are from the perspective of the core enterprises in the supply chain finance, such as "inventory pledge financing", "pledge financing", "inventory pledge financing", "pledge financing", "inventory pledge financing", "pledge financing", "pledge financing", "pledge financing", "pledge financing", and so on. (4) Starting from 2012, the English literature began to pay continuous attention to "supply chain coordination" and "inventory management", indicating that the English literature has been focusing on "inventory management" and "supply chain coordination", which indicates that the English literature has been focusing on "inventory management" and "inventory management". inventory management", indicating that the English literature has begun to focus on supply chain finance coordination and inventory management; (5) From 2018 to the present, the domestic literature focuses on "blockchain", "fintech", "small and medium-sized micro-technology", "financial technology", "financial services", "financial services", "financial services", "financial services", and so on., "small and medium-sized enterprises", it can be seen that the research hotspot of domestic literature focuses on the construction of risk assessment model, especially the use of fintech represented by blockchain in the risk control of supply chain finance.

Table 2. Keyword emergence in WOS-related literature

Keywords	Year	Strength	Begin	End	2000 - 2023	
					Emergence	End
electronic commerce	2000	12.45	2000	2010	Emergence	End
supply chain management	2000	10.38	2000	2011	Emergence	End
internet	2000	4.43	2000	2006	Emergence	End
edi	2000	3.82	2000	2013	Emergence	End
information technology	2002	6.91	2002	2015	Emergence	End
supply chain	2000	5.07	2010	2015	Emergence	End
risk management	2010	3.9	2010	2017	Emergence	End
supply chain coordination	2012	4.8	2012	2020	Emergence	End
inventory management	2014	5.96	2014	2019	Emergence	End
contracts	2009	5.57	2016	2018	Emergence	End
policy	2013	4.54	2017	2019	Emergence	End
vs. bank	2020	5.56	2021	2023	Emergence	End

Table 3. CNKI related literature keyword emergence
Top 12 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2002 - 2023
应收账款	2003	3.13	2003	2007	[Red bar from 2003 to 2007]
物流金融	2007	3.83	2007	2013	[Red bar from 2007 to 2013]
供应链	2005	6.11	2008	2009	[Red bar from 2008 to 2009]
商业银行	2002	3.22	2008	2012	[Red bar from 2008 to 2012]
存货质押融资	2007	3.27	2010	2016	[Red bar from 2010 to 2016]
质押率	2011	4.01	2011	2015	[Red bar from 2011 to 2015]
中小企业	2004	2.54	2011	2013	[Red bar from 2011 to 2013]
线上供应链金融	2015	3.42	2015	2016	[Red bar from 2015 to 2016]
信用风险	2009	2.54	2015	2018	[Red bar from 2015 to 2018]
区块链	2018	5.4	2019	2023	[Red bar from 2019 to 2023]
金融科技	2019	2.73	2019	2020	[Red bar from 2019 to 2020]
中小微企业	2020	2.77	2020	2021	[Red bar from 2020 to 2021]

4. Comparative Analysis of Keyword Clustering for Risk Management of Domestic Digital Technology and Supply Chain Finance

The data of domestic digital technology group and risk management group of supply chain finance were merged and analyzed by keyword clustering with CiteSpace software, and keyword clustering mapping was obtained Figure 9.

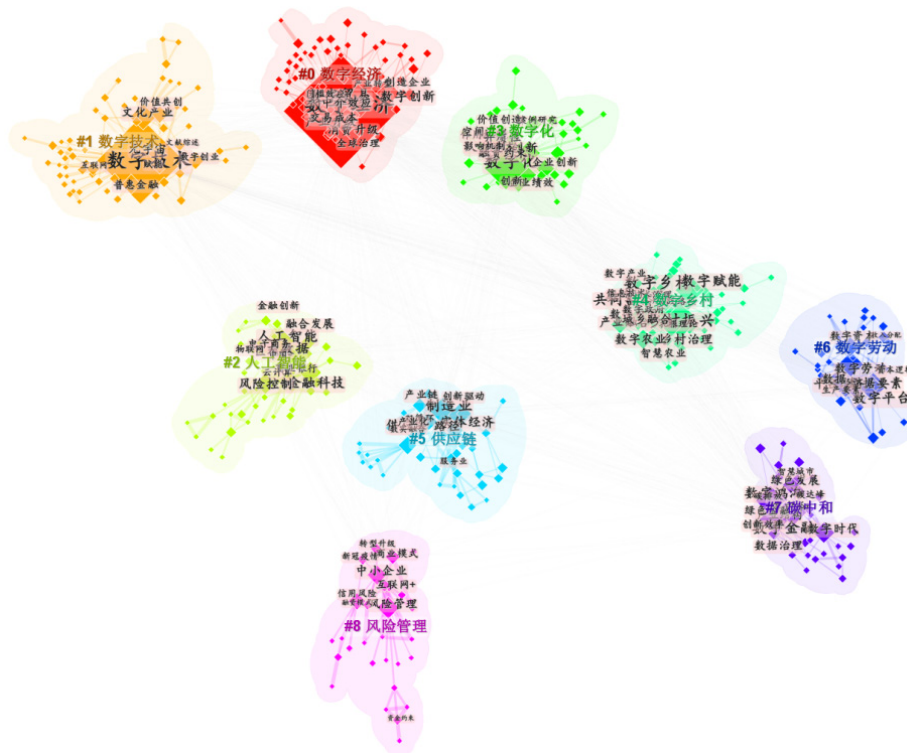


Figure 9. Clustering of risk management keywords for digital technology and supply chain finance in China

The two sets of data co-clustered nine keywords, from the perspective of keyword clustering, the clustering between Cluster #2 artificial intelligence, big data, Internet of Things, risk control, fintech, financial innovation has a high degree of coupling, indicating that the domestic research on risk control of supply chain finance based on fintech is relatively rich, focusing on the development of cross-field integration and innovation [11]. Cluster #8 Risk management, small and medium-sized

enterprises (SMEs) and credit risk are closely related, indicating that the current domestic risk management for supply chain finance is still mainly focused on such groups as small and medium-sized enterprises (SMEs), and the focus of risk management is in the field of credit risk. Cluster #1 digital technology is coupled with inclusive finance and the Internet, while Cluster #4 digital countryside is partially coupled with digital empowerment, digital agriculture and smart agriculture, indicating that the research on the integration of digital technology for rural revitalization is still in its infancy.

5. Strategy Matrix Diagram Analysis

5.1 Strategy Matrix Diagram of Risk Management Research on International Supply Chain Finance

The keyword strategy matrix diagram can determine the hotspot and trend of future topic research. As shown in Figure 10, the frequency of keyword occurrence is the X-axis, and the centrality is the Y-axis. The origin is the coordinate median, and the keywords related to the topic will be displayed in the strategy matrix diagram. Figure 10 shows the strategy matrix diagram of keywords related to the topic of risk management in supply chain finance in foreign countries.

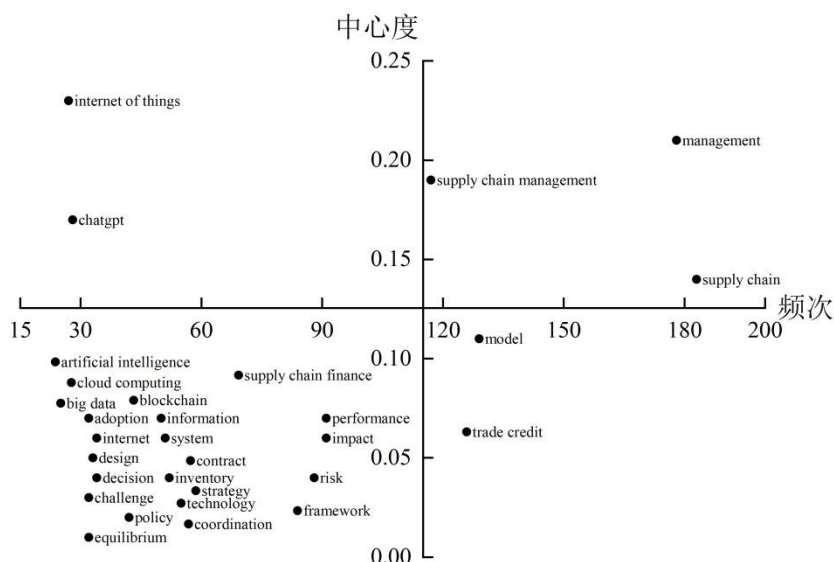


Figure 10. Keyword Strategy Matrix for Risk Management Research in Supply Chain Finance

5.1.1 Quadrant 1: Mainstream

The keywords "supply chain management", "supply chain" and "management" belong to the first quadrant. The keywords "supply chain management", "supply chain" and "management" belong to the first quadrant, which has the characteristics of high frequency and high center. The topics represented by the keywords are the focus and hotspot of current research, and the research results are more numerous and closely related to other topics. Related studies include: Xiaoyang Liu [12] used CiteSpace to establish a cooperative network of institutions, countries and keywords, as well as the cooperative relationship between writers, and used quantitative methods to reveal the evolution of supply chain management research

5.1.2 Quadrant 2: High Potential Hot Spots

The keywords "internet of things" and "ChatGPT" are characterized by low frequency and high centrality. This indicates that although the research may still be in the early stage, it is closely related to other research topics. It indicates that the keywords in this quadrant have research potential. Aram Bahrini [13] suggests that ChatGPT can analyze supply chain data to identify potential risks and

provide recommendations to mitigate the risks such as identifying alternative suppliers in case of supply chain disruptions.

5.1.3 Quadrant 3: Siloed Areas

Keywords such as "supply chain finance", "big data", "artificial intelligence", "blockchain" and "cloud computing" are located in the third quadrant. Keywords such as "blockchain" and "cloud computing" are located in the third quadrant. The frequency and centrality of keywords in this quadrant are not high, but they need to be discussed in different situations. Some keywords belong to the hotspot retreating, gradually reducing the relevance of research with other topics; others belong to the emerging keywords, which are not so hot at present but need to receive more attention in the future. Representative studies such as Kathuria [14] suggest that information technology applications can facilitate information sharing and help firms coordinate, integrate and strengthen supply chains across organizational boundaries.

5.1.4 Quadrant 4: The Marginal Zone

The keywords "model" and "trade credit" are characterized by high frequency and low centrality. They have low relevance to other research topics, and can be combined with other topics for cross-study to expand new research dimensions. For example, Lin Chen et al. [15] found that uncertainty analysis and optimization modeling (UAO) has been widely used in decision-making in supply chain management, and proposed that future research can combine uncertainty theory with supply chain management segmentation (e.g., emergency management, resilience management, security management), behavioral factors, big data technology, and artificial intelligence.

5.2 Strategy Matrix of Domestic Research on Risk Management in Supply Chain Finance

Figure 11 shows the strategy matrix of keywords related to the topic of risk management in supply chain finance in China.

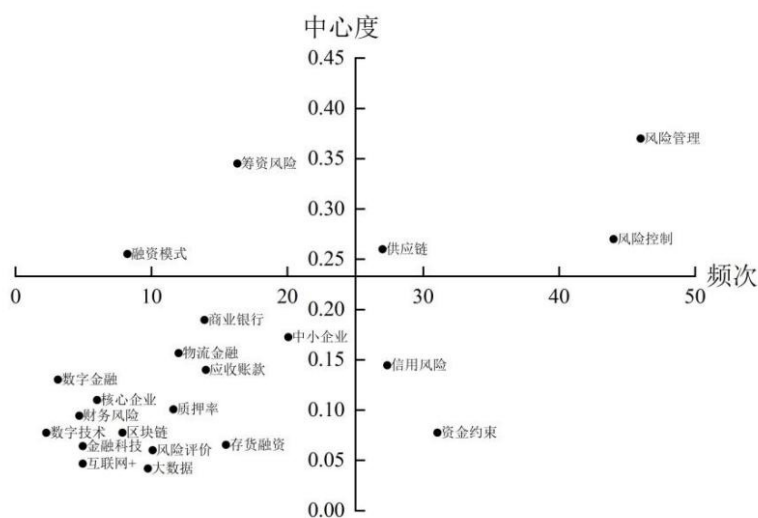


Figure 11. Keyword strategy matrix for risk management research in supply chain finance

5.2.1 Quadrant 1: Mainstream

The keyword "risk management" has high frequency and centrality, is the hot spot and focus of current research, and is closely connected with other topics. At present, domestic research focuses on the risk management of supply chain finance in different scenarios, such as small and medium-sized enterprises, banks, agricultural products and other subjects. Representative papers include Song Hua [16] and others from the perspective of the focus of the enterprise proposed to build a reasonable

supply chain network, coordinate supply chain transaction activities, and improve the management level.

5.2.2 Quadrant 2: High Potential Hot Topics

The keywords "financing risk" and "financing model" are characterized by low frequency and high centrality, which are important topics with research potential. Dou Yaqin [17] emphasized that the source of risk should be controlled to avoid risk, and accelerate the digital technology-enabled supply chain financial innovation model.

5.2.3 Quadrant 3: Siloed Domains

The frequency and centrality of keywords in this quadrant is low. Some of them may be at the edge of the research, while "small and medium-sized enterprises", "commercial banks" and other related research may receive more attention. Zheng Yu [18] from the perspective of small and medium-sized enterprise financing, based on the practice of Jinan, proposed that we should focus on the degree of stability of the supply chain and the characteristics of the core enterprise, so as to improve the level of risk monitoring of the whole process of commercial banks.

5.2.4 Quadrant 4: Marginalized

"Credit risk" and "financial constraints" are characterized by high frequency and low centrality. Research on related topics has the potential to be both peripheral to research and a basis for future research. Future research may need to be more refined and incorporate other topics. For example, Liu Xuewen [19] suggests that commercial banks should improve the credit risk evaluation system of agricultural supply chain finance, and do a good job of early warning, emergency response and post-loan monitoring of agricultural supply chain finance credit risk.

5.3 Comparison of International and Domestic Risk Management Research Strategy Matrix Diagrams for Supply Chain Finance

Table 4. Comparison of international and domestic supply chain finance risk management research strategy matrix keywords

	Global	Internal (a country)
First quadrant (of the coordinate plane, where both x and y are positive)	Supply chain management, supply chain, management	Risk management, risk control
Second quadrant (of the coordinate plane, where both x and y are positive)	Internet of things, ChatGPT	Financing risks, financing modalities
Third quadrant (of the coordinate plane, where both x and y are positive)	Supply chain finance, artificial intelligence, blockchain, big data, cloud computing	SMEs, commercial banks, logistics finance, receivables, pledge rates, digital technology
Fourth quadrant (of the coordinate plane, where both x and y are positive)	Model, trade credit	Credit risk, capital constraints

From Table 4, we can see the current domestic and foreign research hotspots, potential research hotspots, and foundational keywords. These are conducive to pointing out the direction for the next research. Firstly, risk management in supply chain finance has always been a popular field of research, both in international and domestic research; for the current research hotspots, international research focuses on applied research based on specific cases of emerging digital technologies, while domestic research has long focused on the financing mode and financing risk of supply chain finance, and the theoretical exploration of digital technologies such as AI, blockchain, big data and other digital technologies has formed preliminary research results; secondly, international research focuses on the financing mode and financing risk of supply chain finance. Secondly, the international research

focuses more on the macro level, such as "ChatGPT" has developed into an emerging research hotspot and tried to be applied in different industries, while the domestic research focuses more on the micro level, such as the research on logistics finance, accounts receivable and pledge rate.

For the emerging hotspots that may develop, the international tendency is more towards the study of the use of emerging technologies in real cases, combined with emerging and popular topics, such as "internet of things" "ChatGPT". Domestically, there is a greater tendency to study risk management in the core circle of the supply chain, such as focal firms and commercial banks. Finally, the keywords in the fourth quadrant are all high-frequency words in previous research, which may become the basis of future research. This quadrant focuses on trade credit both at home and abroad, and most of the international research is related to "model", and the credit loan problem arising from SMEs' lack of credit has been a major factor affecting the sustainable development of SMEs in China. Based on this, the credit risk and financial constraints of SMEs have been the hotspot and focus of China's research. It is worthwhile for future researchers to think about how to utilize digital technology empowerment in the risk management field of supply chain finance and continue to explore it.

6. Comparison of Risk Management in Traditional Supply Chain Finance and Risk Management in Digital Technology Enabled Supply Chain Finance

Based on the above Citespace literature visualization analysis, this paper compares the traditional risk management of supply chain finance with the advantages of digital technology-enabled risk management of supply chain finance.

6.1 Defects in the Risk Management of Traditional Supply Chain Finance

6.1.1 Low Supply Chain Transparency Affects the Effective Transmission of Trust, and the Cost of Risk Control is too High

Supply chain transparency (SCT) is now widely recognized as one of the four supporting aspects of a sustainable supply chain framework (i.e., risk management, strategy, transparency, and organizational culture) [20]. Companies have resisted transparency in an effort to maintain their competitive advantage. Each entity within the supply chain is independent, and due to the concern that business data needs to be kept confidential, many core companies are reluctant to share information, and trust cannot be effectively transferred to achieve correction of the truthfulness, accuracy, and timeliness of various information in the supply chain [21]. In particular, there are serious data barriers such as the difficulty of accounts receivable verification and the low participation of core enterprises. Therefore, for the purpose of risk prevention and control, financial institutions will increase the number of personnel stationed in enterprises and spend a lot of operational costs to ensure the authenticity of supply chain transaction data [22], resulting in excessive risk control costs

6.1.2 Risk Metrics are Difficult to be Precise, and There is a Lag in Risk Early Warning

At present, most of the research focus on quantitative management of supply chain financial risk is concentrated on the assessment of credit risk and pledge rate, but most of the important indicators such as interest rate, maturity and loan pledge rate used for risk evaluation are still determined empirically [23], and the influencing factors involving SMEs' credit risk are intricate and complex, which greatly affects the accuracy of credit risk assessment of supply chain finance as a whole. Financial institutions in the supply chain are mainly based on the previous information of SMEs to identify and screen enterprises [23], and are unable to implement dynamic credit assessment of enterprises, which will lead to a series of "butterfly effect" in case of chain breakage. In addition, there is also the problem of accurate assessment and effective collection in the acquisition of SME data, which also interferes with the accuracy of risk measurement, leading to a lag in risk early warning, and failing to realize effective prediction beforehand.

6.2 Welfare Effects of Digital Technology-enabled Supply Chain Finance Risk Management

6.2.1 ChatGPT Identifies Potential Risks in Supply Chain Finance and Improves Risk Management Capability

The core of digital technology is information, and ChatGPT's powerful natural language processing, data organization and data analysis capabilities have injected new energy into supply chain finance in terms of risk management. Supply chain financial services have their inherent vulnerability, especially when engaging in supply chain financial business, which often involves a variety of different economic subjects, including upstream and downstream enterprises in the supply chain, platform service providers, risk managers and liquidity providers. Traditional data analysis is to analyze the various types of economic data that have been generated to predict future economic conditions, often with a certain lag. ChatGPT, trained on massive data, analyzes supply chain data, assists in analyzing various unstructured data from customers and markets, increases the identification of potential risk factors, intelligently evaluates and automatically generates a more comprehensive risk report, and provides alternatives to mitigate risks, thus improving the efficiency and accuracy of risk management.

6.2.2 AI Predicts Demand and Develops Integrated Strategies to Meet It

AI can forecast demand and develop integrated strategies for meeting demand, including sourcing, production, distribution, and customer service activities. It may also extend alternative strategies to provide decision makers with a range of options. AI introduces an element of creativity and the ability to generate new ideas [24]. In the area of supply chain management, Microsoft has introduced a new feature called Dynamics 365 Copilot as part of its supply chain management platform [25]. This feature utilizes AI to assist organizations in monitoring and responding quickly to disruptions that may affect their supply chain. After identifying a possible risk, the system can automatically craft a message and send it to the supplier in question. With this AI application, Microsoft aims to enhance supply chain resilience and promote more efficient and smarter business operations strategies.

6.2.3 Promoting the Integration of Digital Technologies to Realize Whole-Process Risk Monitoring

Smart contracts are built on the basis of blockchain, which can automatically fulfill certain obligations and exercise prescribed rights, greatly reducing the transaction costs in financial activities. Smart contracts based on blockchain technology do a good job of integrating effectiveness and credibility, on the one hand, solving the problem of increased costs due to reduced credibility, and on the other hand, improving the speed of supply chain finance circulation, significantly improving the level of risk control, and enhancing the security of financing. Through resource integration and cross-chain cooperation, based on personalized supply chain finance scenarios, build digital credit risk evaluation of enterprises with industry differentiation, improve the foresight of risk approval, and realize full-process risk monitoring.

6.2.4 Build a Blockchain Digital Platform to Realize Data Value-Adding

In the era of digital economy, data has become the core resource of enterprise competition. The key to supply chain financing is the effective transfer of credit between multiple participants. By creating a digital platform with the help of blockchain technology, all data information in the supply chain is encrypted based on the attribute classification and encrypted storage of blockchain to protect the true reliability of data. At the same time, it utilizes big data technology and consensus technology to maintain the transaction data on the chain and enhance the true reliability of the data. Under the premise of realizing data protection, financial institutions, core enterprises and upstream and downstream enterprises can break through information barriers, which in turn leads to actual transaction penetration. At the same time, the digital platform can realize the authorized sharing of debt data, break the original information asymmetry, release enterprise credit, realize the detachable

digital assets, and can be traded and circulated within the supply chain [26] to realize the value-added data.

7. Research Outlook

The risk management application of digital technology in supply chain finance has attracted the attention of more and more scholars. Based on the above analysis, this paper puts forward some outlooks on future research.

7.1 Seize the Policy Dividend of New Digital Infrastructure

In recent years, the government has continued to introduce favorable policies to promote the innovative development of digital technology-enabled supply chain financial risk management. For the current development of the risk management model of digital technology-enabled supply chain finance in China, it should be a mandatory option to enhance digital technology and financial literacy into the supply chain financial risk control skills training, promote the all-round upgrade of supply chain financial business entities under the wave of the new generation of digital industrial revolution, prevent all kinds of financial fraud, standardize the market order of digital supply chain financial risk management, and cultivate a sustainable development of the supply chain finance environment.

7.2 Strengthening Technology-Based Regulation of Supply Chain Finance

Cybersecurity has always been a key concern. Taking ChatGPT as an example, ChatGPT can be used to create beneficial applications such as voice assistants, customer service and virtual coaches. However, it can also be used by unscrupulous individuals for malicious purposes, such as disinformation, fraud and scams, which can also lead to privacy and security concerns. In addition, there have been media reports and academic studies highlighting many examples of AI systems exhibiting biased behaviors, which can arise due to a variety of factors, including historical data containing biases, lack of minority representation, and creators' perspectives influencing the data collection process [27]. All of these potential problems can lead to flawed predictions and suboptimal decision making, which can seriously affect the efficiency and effectiveness of supply chain finance risk management. Digital technology-enabled risk management in supply chain finance can effectively break the time and space constraints and information blocking [28], continue to increase the application of new technologies such as the Internet, big data, the Internet of Things, blockchain, and other new technologies, the deep integration of digital technology and supply chain finance, the establishment of a new supply chain finance model with multi-party participation and cooperation, and the assessment and detection of the authenticity and actual value of the transaction data, pledges, warehouse receipts, etc., in the supply chain and thus reduce manual supervision costs and operational risks. In addition, the introduction of regulatory nodes in the alliance chain will enable the government and other public sectors to participate in supply chain finance regulation, and the supply chain finance information processing center will be connected to the official credit collection platform, so as to establish an official-civilian combined credit collection platform to make up for the shortcomings of insufficient depth and breadth in the official credit collection platform, so as to reasonably prevent the risks of supply chain finance.

7.3 Growing the Supply Chain Finance Digital Talent Pool

All industries are accelerating digital transformation, and the application of risk control software for digital supply chain finance has shifted the regulatory focus from financial institutions and practitioners to the technology itself, and the supply chain industry's demand for digitized talents has grown dramatically. However, the supply of digital talents exceeds the demand, and there is a shortage of composite digital talents who understand both technology and business. Many financial technology enterprises, in the absence of core technology and professional talents, force the launch of not-so-mature products in order to seize the market opportunity, which leads to a mixed bag of related market

products. The realization of modern supply chain financial risk management depends on digital technology, and digital technology ultimately depends on talent. The construction of supply chain financial digital talents not only involves scientific and technological talents in the field of digital technology, but also involves the construction of digital talents in the whole process of supply chain financial operation activities. Focus on cultivating composite talents with both digital technology capabilities and supply chain expertise to provide talent protection for the integration of digital technology into the risk management of supply chain finance. Enterprises and universities should strengthen in-depth cooperation, enter into directional training cooperation, build industry-university-research bases, form a mechanism for cultivating digital transformation talents, and grow a composite digital talent cultivation team to meet the employment needs of the supply chain finance industry.

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