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NAVIGATING THE LANDSCAPE: INVESTIGATING DOMESTIC SUPPLY CHAIN RISKS USING CITESPACE

John Carter

Faculty of Commerce, University of Cape Town, Rondebosch, South Africa

Abstract: The evolution of globalization and recent geopolitical and health crises, including the Sino-US trade war, the COVID-19 pandemic, and the Russia-Ukraine conflict, have exposed supply chain vulnerabilities and disruptions, profoundly impacting global supply chain stability and security. Supply chain risks can impede the seamless progression of supply chains, jeopardizing their ability to meet intended objectives, leading to diminished efficiency and quality, and even culminating in supply chain failure or disintegration. This growing concern has prompted scholars to intensify research on supply chain risk-related issues.

While existing literature primarily relies on case analyses or empirical methods, this paper employs bibliometrics as a novel approach to comprehensively and systematically investigate supply chain risk dynamics, elucidating future research directions. Utilizing Citespace analysis software, this study unveils the evolution of supply chain risk research hotspots, shedding light on current and future trends. Citespace has previously proven effective in delineating research hotspots, frontiers, and emerging trajectories in various domains.

Through Citespace analysis, this paper visually maps the supply chain risk research landscape, identifying key hotspots and frontiers, thereby offering valuable insights for addressing and mitigating supply chain risk in the future.

Keywords: Supply Chain Risk, Globalization, Geopolitical Crises, Bibliometrics, Citespace Analysis.

Introduction

With the development of globalization, as well as a series of events such as the Sino-US trade war, the outbreak of COVID-19, and the conflict between Russia and Ukraine, supply chain risks and supply chain disruptions have occurred, affecting the stability and security of the global supply chain. Supply chain risk will hinder and influence the smooth progress of the supply chain to a certain extent, making it unable to reach the expected goal, resulting in reduced efficiency and quality of the supply chain, leading to the failure or disintegration of the supply chain network. More and more scholars begin to pay attention to and study the related issues of supply chain risk, For example, Xu Jianan [1] et al established the risk identification index system of automobile supply chain through SCOR model. Hao Li [2] et al. used ABC-BP algorithm to give early warning to supply chain collaboration risk. Liu Qiusheng [3] et al.

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established the supply chain risk index model by fuzzy entropy method to identify the supply chain risk of emergencies. For the study of supply chain risk, most of the existing literature adopts case analysis or empirical methods, while few scholars adopt bibliometrics. With the deepening of research on supply chain risk, it is necessary to conduct comprehensive and systematic research on supply chain risk to clarify the future research direction. Based on this, this paper adopts bibliometrics to study the evolution of hot spots of supply chain risk. Citespace analysis software was used to mine and analyze the data. Citespace can well show the research hotspots, frontiers and future trends in the subject field. For example, Tong Pengcheng [4] used CiteSpace to analyze the research hotspots and future research trends in the field of green logistics in China. Yang Guirong [5] used CiteSpace to analyze the evolution of domestic co-distribution, research hotspots and frontier trends. In this paper, the Citespace analysis tool is used to visually analyze the research literature on supply chain risk, obtain the research hotspots and frontiers of supply chain risk, and provide certain references for dealing with supply chain risk in the future.

1. Data sources and methods

1.1. Data sources

In this study, the core set of China National Knowledge Network Database (CNKI) is used as the data source, and the time span is set from January 2003 to October 2022. The retrieval method is as follows: "Subject = supply chain risk, journal source =SCI+EI+CSSCI+CSCD", 1115 literatures were obtained, and manually screened references, call for papers, press releases, etc., which did not fit the subject of this study, and 976 valid Chinese literatures were obtained respectively after weeding out articles without authors, that is, the data obtained by this research institute.

1.2. Research methods

In this paper, Citespace 6.1.R3 software is used to obtain relevant Chinese literature on supply chain risk as research data, and through knowledge graph analysis, the prolific authors and institutions, as well as hot fields and frontiers of supply chain risk research in the past two decades are explored.

2. Literature analysis of supply chain risk research

2.1. Annual literature volume analysis

Domestic research on supply chain risk basically conforms to the characteristics of the S-shaped development of Rogers' new things. The literature distribution diagram of China's supply chain risk is obtained by taking time as a clue, as shown in Figure 1.

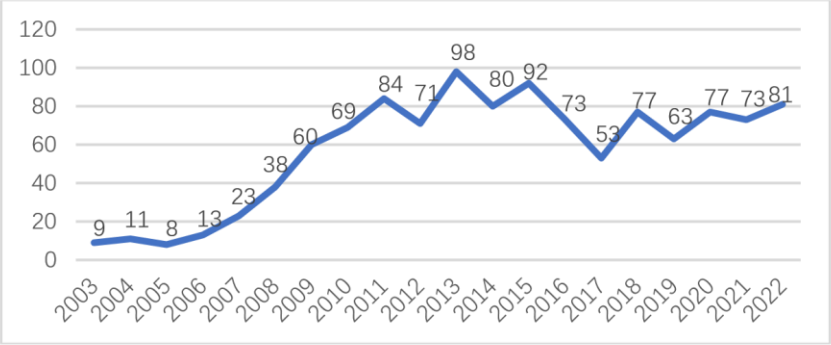

Figure 1 Number of literature publications related to supply chain risk from 2003 to 2022

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As can be seen from Figure 1, 2003-2005 was the embryonic period, when research on supply chain risk began in China, but the number of papers published during this period was relatively small. During the growth period from 2006 to 2013, with the constant occurrence of supply chain risk events, the research on supply chain risk has also been deepened. In 2011, 9.0 magnitude earthquake and tsunami broke out in Japan, causing sudden disruption of supply chain, following the Taiwan earthquake in 1999, the Philips fire in 2000 and the September 11 incident in the United States in 2001, this is a very important risk event of supply chain disruption, which promotes the further strengthening of research on supply chain risk. During this period, the annual literature publication increased significantly and reached a small peak in 2013, when the number of literature publications was 98. 2014-2022 is the mature period, the development trend is relatively stable, the publication volume has little fluctuation, and the annual publication volume is more than 50.

2.2. Author and institutional analysis

The number of published papers can well reflect the academic level of the author. Among them, Dai Jiansheng published the most articles, 13 articles, followed by Tang Xiaomi, Liu Yongsheng, Ni Debing, Dan Bin, 12, 11, 10, 9 articles respectively. Set the node type as "Author", the time slice as 1 year, and the threshold as Top50 to obtain the visual analysis diagram of the author, as shown in Figure 2, with a total of 493 nodes and 263 connections, the overall network density is 0.0022, the node size of the author is proportional to the number of papers, and the lines between nodes represent the relationship between authors and authors. The thicker the line, the closer the cooperation. As can be seen from Figure 2, some scholars have formed an academic community, and the core authors have made great contributions, such as Dai Jiansheng, Meng Weidong and Ding Xu, Fu Hongyong and Dan Bin, Liu Yongsheng and Liu Ying, Ni Debing and Tang Xiaowi, etc., have jointly published papers.

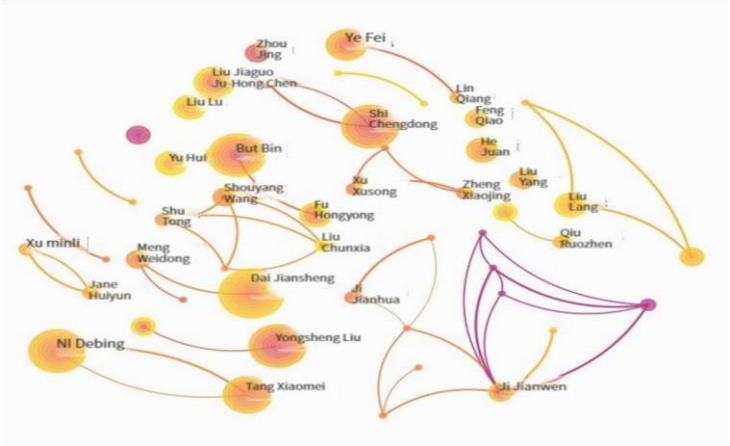

Figure 2 Visualization map of authors of research related to supply chain risk from 2003 to 2022

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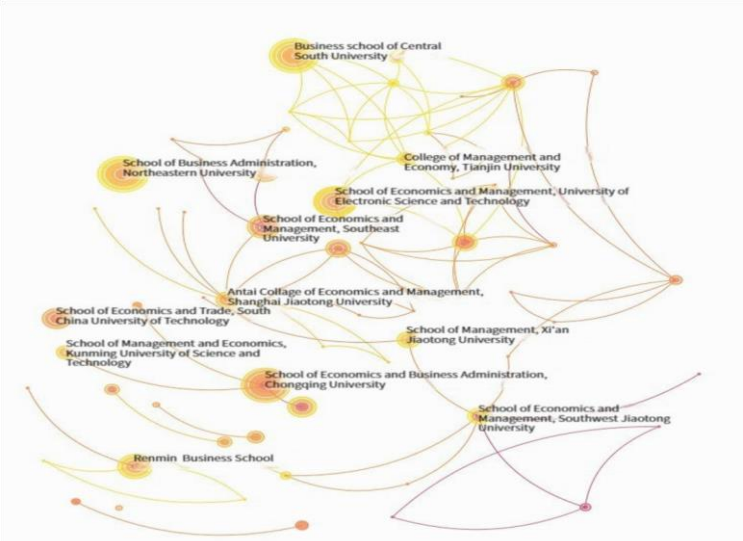

Figure 3 Visualization of research institutions related to supply chain risk from 2002 to 2022

The visualization map of the supply chain risk research institute is shown in Figure 3. There are 368 nodes and 213 connections, and the overall network density is 0.0032. The larger the node, the greater the number of institutional documents, and the thicker the connection between nodes, the greater the institutional cooperation intensity.

The School of Economics and Business Administration of Chongqing University has the largest number of publications, with 27; other institutions with a large number of publications include the School of Business Administration of Northeastern University (26), the School of Economics and Management of University of Electronic Science and Technology of China (24), and the Business School of Central South University (22), with larger nodes. In terms of institutional cooperation, School of Business Administration of Northeastern University, School of Economics and Trade of South China Technology, etc., although the nodes are larger, they lack fewer connections with other nodes, indicating that although they have more publications, they have more independent publications and lack cooperation with other research institutions. Business School of Central South University, Antai Collage of Economics and Management of Shanghai Jiao Tong University, and School of Economics and Management of University of Electronic Science and Technology of China are relatively more connected than other institutions.

In general, scholars and institutions engaged in supply chain risk research are relatively scattered, with few contacts on the whole and most of them independently publish papers, which is due to the complex types of supply chain risks. The strengthening of cooperation between authors and institutions is conducive to the further deepening and innovation of research, so in the future, authors and institutions can strengthen cooperation and conduct further in-depth research on supply chain risk. **Hot spot analysis of domestic supply chain risk research**

4.1. Visual analysis of supply chain risk keywords

Keywords can be used to reflect the hot spot, frontier and future research trend of a certain field, and the results can be displayed intuitively through the visual map.In this paper, the CiteSpace6.1.R3 software is used to analyze

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the keywords, and "keyword" is selected to obtain the visualization map as shown in Figure 4, which has a total of 462 nodes, 668 connections, and a network density of 0.0063.

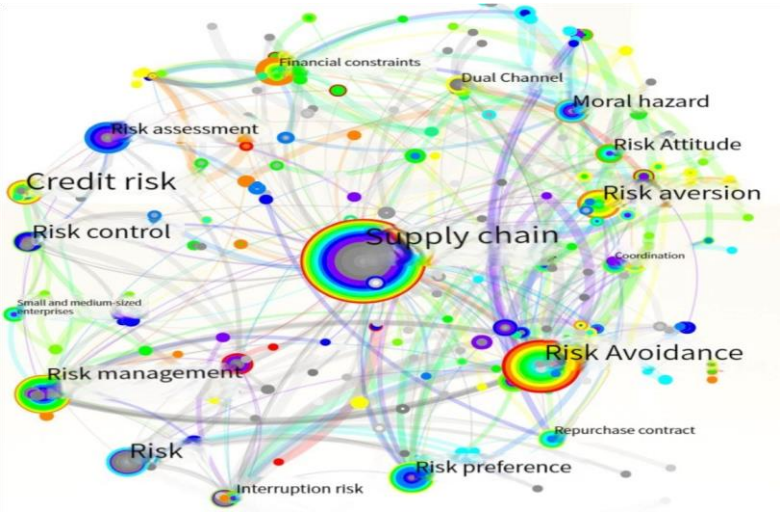

Figure 4 Visualization of keywords related to supply chain risk

It can be seen from Figure 4 that supply chain, risk avoidance, risk management, risk control, risk assessment, etc. have a high frequency in supply chain risk related research, indicating that these nodes are of great importance in supply chain risk related research. Among them, supply chain appeared 213 times, followed by risk avoidance, 106 times.

4.2. Research hotspot analysis

Keyword cluster analysis refers to the clustering of points with similar meanings in the co-occurrence map [6], and the clustering results can reflect the research hotspots in this field. CiteSpace was further used for keyword cluster analysis, and the visualization map obtained was shown in Figure 5.

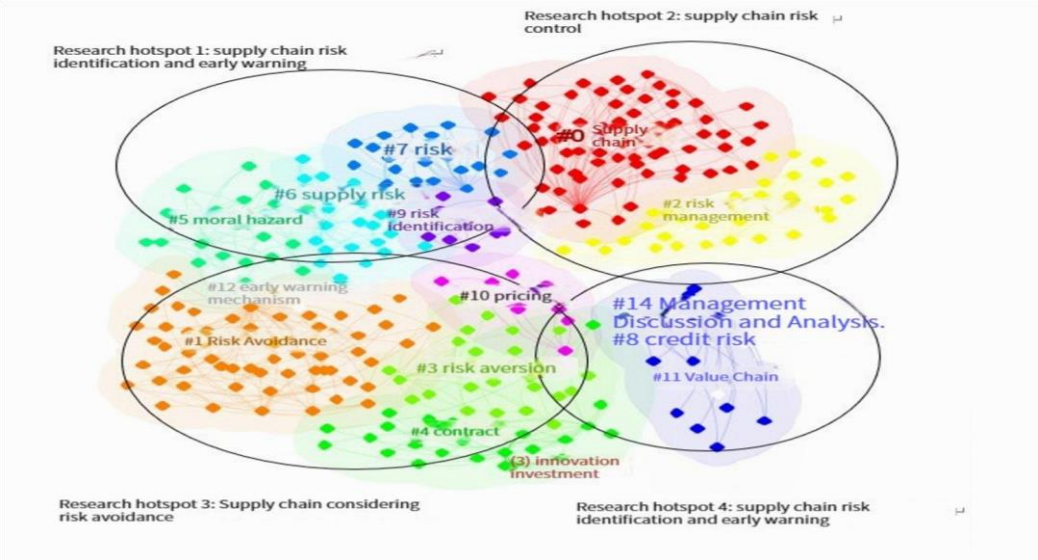

Figure 5 Cluster analysis of keywords related to supply chain risk

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In the visual knowledge graph, when the module value Q is greater than 0.3, the clustering structure is significant. When the average contour value S> 0.5, the clustering result is considered reasonable, and S>0.7 indicates that the clustering result is very significant [7]. In Figure 5, Q value =0.6727, S value =0.9597, indicating that the structure of the cluster is significant and has great value for research. Cluster identification often selects noun phrases with real meaning, but they are too specific, so it is necessary to combine the content contained in sub-clusters and seek the relationship between them. Through a comprehensive and in-depth analysis of the contents contained in each cluster name, the research hotspots of supply chain risk can be summarized as follows.

(1) Supply chain risk identification and early warning. Subclustering mainly includes risk analysis, risk assessment, early warning, risk model, coping strategy and so on. The research on supply chain risk identification and early warning mainly focuses on the identification of supply chain risk indicators and the establishment of supply chain risk framework and index system.Most scholars study the issue of index establishment by establishing models. For example, Zhang Xin [8] believes that the risk identification of supply chain refers to the identification and judgment of the risks that are facing or may be encountered in the supply chain. Wang Yan et al. [9] identified the defects and potential impacts in the supply chain network, as well as the risks caused by personnel errors in the supply chain operation through HAZOP analysis method, identified supply chain risks in a structured way, and provided suggestions and guidelines for the management of supply chain risks. Li Gang [10] believes that the transmission of supply chain risk includes four elements: risk source, transmission medium, transmission node and risk recipient. Understanding the transmission process of supply chain risk can better identify supply chain risk. The second is the research on supply chain risk assessment measurement and early warning. Most of the research on supply chain risk early warning uses intelligent algorithms to early warning risks. For example, Yang Yang [11] et al established a cross-border supply chain risk early warning model based on PSO and CNN algorithms, so as to provide more stable and accurate early warning of cross-border supply chain risks. Li Jian [12] et al. established PSO-SVM early warning model through regression analysis to reduce risk probability.

(2) Supply chain risk control. Subcluster includes interruption risk, information risk, emergency management, risk control and so on. The research on supply chain risk control mainly focuses on making supply chain risk control strategy more targeted, making supply chain risk strategy more effective, and better coping with various supply chain risks. Some scholars also explore the supply chain risk control in the supply chain operation process, and minimize the supply chain risk by coordinating and balancing the components in the supply chain operation process, so as to achieve the purpose of controlling the supply chain risk. Most scholars prefer to build a mathematical model to analyze the uncertainty of supply chain risk. For example, Wang Xiaohong [13] believes that green supply chain risk control includes green procurement risk control, green manufacturing risk control and green sales risk control, and points out through data analysis that controlling green procurement risk can significantly improve the integration level of the supply chain of retail enterprises. By establishing a system dynamics model, Chen Zikang [14] explored the risk trend of the supply chain of fresh agricultural products and the impact of risk control measures on the risk, pointed out that faced with the improvement of supply chain performance, the supply chain risk control strategy has a certain lag and finiteness, and pointed out that there is an equilibrium relationship among control cost, supply chain risk and supply chain performance. Xidong Deng et al. [15] used the IIM model and introduced OWA operator to analyze the simultaneous occurrence of sudden

disturbances in the demand side, supply side and supply side of the five types of supply chain systems, explore the impact of these three types of risks on the supply chain, and provide suggestions on the control of supply chain risks in such cases. It is pointed out that the proportion of investment in preventing supply chain risk and the balance of interests in supply chain can be adjusted according to the non-operational size of each nodal enterprise.

(3) Supply chain pricing decisions considering risk aversion. The subcluster mainly includes supply chain, dual channel, pricing decision, capital constraint, game theory, promotion effort, risk appetite, dynamic pricing, default risk and so on. The outbreak of COVID-19 in 2020 has accelerated the structural changes in the selection of retail channels, and the retail market has entered the era of "post-epidemic normalization". Relying on new technologies such as the Internet of Things and 5G, the new model of the integration of online and offline dual channels has become a new development trend, and the impact of risk avoidance behaviors in the dual-channel supply chain on pricing decisions has also been in-depth. The research of supply chain pricing decision considering risk avoidance mainly focuses on the establishment of game model to analyze supply chain pricing decision under risk avoidance behavior. For example, Zou Hao et al. [16] analyzed pricing decisions of supply chain members under manufacturers' risk avoidance behavior by means of mean-variance supply chain risk management method and Stackelberg game theory. Xiong Feng [17] et al. established a dual-channel green supply chain game model to analyze the impact of risk avoidance behaviors of chain members on product greenness and online and offline sales prices, and provided suggestions for pricing decisions. Wu Yuping [18] et al. analyzed green supply chain pricing by establishing a game model and considering big data marketing and retailers' risk avoidance. Tan Leping et al. [19] established a financing game model of capital-constrained retailers based on the CVaR criterion, and studied the pricing strategy of the dualchannel supply chain consisting of risk-averse retailers and suppliers. Liu Guangdong et al. [20] analyzed the pricing decision of dual-channel supply chain by means of mean-variance method and Stackelberg game, considering the two factors of production cost disturbance and risk avoidance, and explored the impact of production disturbance cost and risk avoidance degree on pricing.

(4) Supply chain finance information risk assessment. The subcluster includes supply chain finance, supply chain financing, financing, investment and financing, audit fees, etc. Supply chain finance is a financial service model in which commercial banks provide financing and other services to core enterprises and provide the same attribute services to small and medium-sized enterprises. In the supply chain finance model, credit risk is a key factor affecting corporate financing. Therefore, research on supply chain finance information risk assessment has become a research hotspot in recent years. The research of supply chain finance information risk assessment mainly focuses on the construction of credit risk index evaluation system. For example, Chen Xiaohong et al. [21] used the improved fuzzy comprehensive evaluation (AFF) model to build the credit evaluation system of smes based on the financing dilemma of smes. Liu Yanchun et al. [22] used confirmatory factor analysis, structural equation modeling (SEM) and gray comprehensive evaluation analysis methods to build a credit risk evaluation model for smes. Dong Jie [23] used analytic hierarchy process (AHP) and risk evaluation method to build credit risk evaluation index system under the account receivable financing model, and analyzed the factors affecting enterprise credit risk. Yi Jianhua et al. [24] constructed an enterprise credit risk evaluation index system and tested the scientificity of the risk evaluation index system through game theory and LR model.

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5. Conclusions

Using Citespace literature measurement tool, this paper analyzes 976 literatures on supply chain risk in CNKI from 2003 to 2022, and draws the following conclusions:

From the time of publication, studies on supply chain risk showed an increasing trend before 2009. From 2009 to 2022, although there were small ups and downs, the number of published papers remained above 50, indicating that the number of published papers in the research field of supply chain risk has stabilized during this period. With the influence of risk factors such as the novel coronavirus epidemic and the Russia-Ukraine war, the number of published papers in the field of supply chain risk has become stable. The research on supply chain risk is more in-depth.

From the perspective of authors and institutions, most of the research on supply chain risk is independent, and there is less cooperation between authors or institutions. However, exchanges and cooperation between scholars and institutions and ideological collision are of great significance to the improvement and development of research and the subsequent research, which is conducive to the further deepening and innovation of research. Therefore, in the future, authors and institutions can strengthen academic exchanges and cooperation, jointly explore related issues in this field, and do further research on supply chain risks.

In the analysis of keywords, supply chain, risk avoidance, risk management, credit risk, risk aversion and other words appear more frequently. From the perspective of keyword clustering knowledge graph, the research hotspots of supply chain risk include supply chain risk identification and early warning, supply chain risk control, supply chain pricing decision considering risk avoidance, and supply chain financial information risk assessment.

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