ISSN 2616-5902 Vol. 7, Issue 3: 17-23, DOI: 10.25236/AJBM.2025.070303

Bibliometric Analysis of Hotspots and Frontiers of Industrial Chain Resilience Research at Home and Abroad

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Abstract: *The Third Plenary Session of the 20th Central Committee of the Communist Party of China emphasized that to promote the high-quality development of China's economy, it is essential to enhance the resilience of the industrial chain and improve the security system, aiming to build an independent, controllable, safe, and reliable industrial chain. Taking "industrial chain resilience" as the thematic term, this study employs the CiteSpace bibliometric analysis software to conduct a visual analysis and map the scientific knowledge graph of 305 documents from the WOS database spanning 2009 to 2024, and 265 related documents from the CNKI database from 2020 to 2024. The analysis covers dimensions such as annual publication volume, publishing authors, keyword co-occurrence, clustering, and prominence. It systematically reviews and compares the research status, hot topics, developmental context, and frontier directions in the field of industrial chain resilience both domestically and internationally, thereby advancing the theoretical research on industrial chain resilience to a deeper level.*

Keywords: *Industrial Chain Resilience; CiteSpace; Visual Analytics; Bibliometrics*

1. Introduction

To expedite the establishment of a modern industrial framework, the 20th National Congress of the Communist Party of China has strategized the enhancement of the resilience and security of industrial and supply chains. It mandates the reinforcement of risk management and early warning mechanisms within these chains to bolster their capacity to counteract external threats [1]. Moreover, during the recent Third Plenary Session of the 20th Central Committee, the Party has consistently underscored the imperative to execute the strategic blueprints laid out at the 20th National Congress, advocating for the modernization of industrial chains as a catalyst for Chinese-style modernization [2]. In recent years, the development of China's industrial chains has achieved considerable progress, yet it is not without challenges and difficulties, such as incomplete industrial chains and insufficient resilience. In view of these issues, this paper utilizes bibliometric analysis to synthesize the current state of research and focal points in the domain of industrial chain resilience, explores its cutting-edge developments, and proposes future research directions, aiming to furnish a reference for subsequent studies pertaining to industrial chain resilience.

2. Data sources and research tools

2.1 Data source

This study's data is sourced from the China National Knowledge Infrastructure (CNKI) Core Journal Database and the Web of Science (WOS) Core Collection Database. Within the CNKI database, a search was conducted using the keyword "industrial chain resilience", and journals from CSSCI and Peking University Core were selected, resulting in a total of 265 relevant documents from 2020 to 2024. Foreign literature was sourced from the WOS Core Collection Database. A precise search was conducted using the keywords "industrial chain resilience" or "resilience of the industrial chain", and the document types included papers, reviews, and online publications. Documents with relatively weak relevance were manually eliminated, yielding a total of 305 relevant documents spanning from 2009 to 2024. Given that research in the field of industrial chain resilience in China began in 2020, while

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related studies abroad started as early as 2009, there is a notable difference in the time range of literature searches between the Chinese and international databases.

2.2 Research methodology

CiteSpace is a software tool for bibliometric visualization analysis developed by Professor Chaomei Chen and his team [3]. This paper utilizes the 6.4.R1 version of CiteSpace to analyze trends in publications, journals, keywords, and their clusters, thereby identifying the research status, hotspots, and emerging trends in the field of industrial chain resilience [4].

3. Current research status of industrial chain resilience

3.1 Analysis of document volume

The number of publications in the field of industrial chain resilience from 2009 to 2024 is shown in the figure below. The number of English-language publications grew relatively slowly from 2009 to 2019, with a low average annual publication count. However, at the end of 2019, the sudden outbreak of the COVID-19 pandemic caused a massive shock to global industrial chains. Scholars further recognized the importance of industrial chains for economic development, leading to a significant increase in international attention to industrial chain resilience. As a result, related research expanded rapidly, and the number of publications exhibited a trend of rapid growth.

As shown in Figure 1, research in the field of industrial chain resilience in China started later than that abroad. After 2020, the development trend of Chinese literature aligns closely with that of English literature, both exhibiting rapid growth. However, compared to English literature, the growth rate of Chinese literature is even faster, achieving a reversal in the number of publications by 2022. With the deepening of a new round of technological revolution and industrial transformation, the resurgence of international trade protectionism, coupled with the impact of the COVID-19 pandemic, has led to weak economic recovery. Against this backdrop, Chinese scholars have gradually recognized the gaps in research on industrial chain resilience. To more effectively ensure the stability and security of industrial chains, enhancing industrial chain resilience has become a focal issue of concern in the academic community.

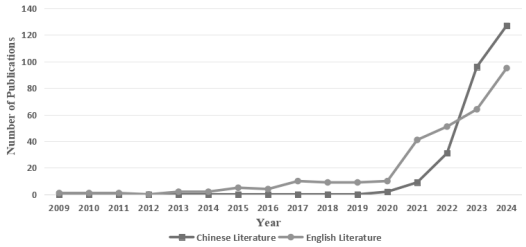

Figure 1: Changes in the number of publications from 2009 to 2024

3.2 Issuing organization analysis

As shown in Table 1, colleges or research institutes specializing in economics and management from major universities are the primary institutions publishing research domestically. Among these, institutions with distinctive expertise in industrial economics occupy a central position. A comparison of publication volumes between institutions in northern and southern China reveals that northern institutions publish significantly more than their southern counterparts. This disparity may be attributed to the northern regions having a higher concentration of traditional industrial sectors and facing greater pressure for industrial restructuring in recent years, leading to more publications in this field. Internationally, publishing institutions are also primarily universities or related research institutes, such as the University of Birmingham and the French National Center for Scientific Research. Compared to other regions, European countries contribute a larger volume of articles, likely due to their more advanced manufacturing industries. In recent years, these countries have faced significant pressure to transform and upgrade their manufacturing sectors, making their research on industrial chain resilience particularly prominent.

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Table 1: Top 10 institutions in domestic and international publications distribution

Source	Institution Name	Number of documents issued
WOS	Bangladesh University of Engineering & Technology (BUET)	7
	Berlin School of Economics & Law	7
	University of Birmingham	4
	Chinese Academy of Sciences	4
	National Center for Scientific Research (CNRS)	4
	Iran University Science & Technology	3
	University of Lisbon	3
	University of Stavanger	3
	Texas A & M University System	3
	Beijing Normal University	3
CNKI	Institute of Industrial Economics of CASS	12
	FACULTY OF APPLIED ECONOMICS, UCASS	6
	School of Economics and Management, Northeast Normal University	6
	School of Economics, Zhongnan University of Economics and law	4
	Dongbei University of Finance and Economics	4
	School of Economics, Nankai University	4
	University of Chinese Academy of Social Sciences	3
	School of Economics and Management, China University of Geosciences (Wuhan)	3
	School of Applied Economics, Renmin University of China	3
	Business School, Xiangtan University	3

3.3 Distribution of document authors

In this study, CiteSpace analyzed author collaboration in the selected literature. Larger labels indicate higher author frequency [4]. Figure 2 shows authors from the CNKI database, with 113 nodes, 38 lines, and a collaboration network density of 0.006, reflecting low collaboration and fragmented research. Cheng Gu and Shushan Zhang, from Northeast Normal University's School of Economics and Management, have the most publications (six co-authored articles), indicating close collaboration. Their research on industrial chain resilience began in 2023, initially focusing on smart logistics' impact and later shifting to enterprise value creation and digital transformation mechanisms [5]. Overall, Chinese scholars in this field remain largely independent, lacking stable research teams. Strengthening collaboration is essential to form cohesive, efficient teams and advance research.

Figure 3, generated through visual analysis of authors in the WOS database, shows 279 nodes, 393 lines, and a network density of 0.0101, indicating a relatively high level of collaboration among authors and concentrated research in this field. Among them, the most prolific author is Ivanov D. Initially, his research focused on designing industrial and supply chain models to optimize efficiency. However, the COVID-19 outbreak severely disrupted global value chains, leading him to recognize the critical importance of industrial and supply chain resilience. In 2023, he published two consecutive articles discussing the pandemic's significant impact on industrial and supply chains and proposing initial strategies to enhance resilience in the post-pandemic era [6]. Recently, with the rapid development of the digital economy and artificial intelligence, he has further explored the impact of digitalization and AI on industrial and supply chain resilience.

Figure 2: Chinese literature author collaboration map

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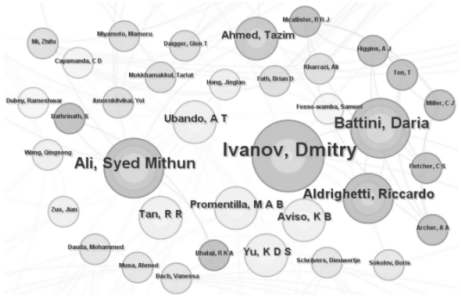

Figure 3: English literature author collaboration map

4. Analysis of hotspots in domestic and international research

4.1 Keyword co-occurrence

Keywords are a crucial component of research topics and are primarily identified based on their co-occurrence frequency and betweenness centrality to determine research hotspots [3]. The higher the frequency of a keyword, the greater the research intensity. Nodes with a betweenness centrality greater than 0.1 are considered key nodes [4].

Using CiteSpace software, a keyword frequency map of the resilience of the Chinese industrial chain was generated, as shown in Figure 4. The network graph consists of 124 keywords and 272 connections, with a network density of 0.0226, indicating relatively dispersed connections between nodes. Similarly, a co-occurrence network was created by retrieving documents from the WOS database with subject terms as nodes, as shown in Figure 5. This network contains 334 nodes and 1,310 connections, with a network density of 0.0236.

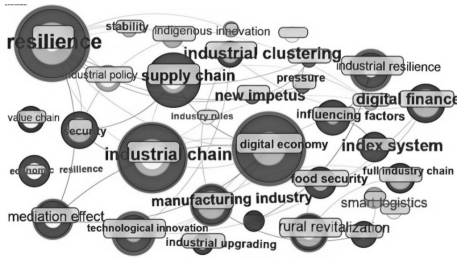

Figure 4: Knowledge graph of co-occurrence of keywords in Chinese literature

Figure 5: English literature keyword co-occurrence knowledge graph

Based on the frequency of keyword occurrences and betweenness centrality, the top ten high-frequency Chinese and English keywords were selected to create Table 2. Analysis of the top ten English keywords reveals that terms such as "resilience," "management," and "supply chain resilience" are the primary research hotspots in the field of industrial chain resilience. Betweenness centrality analysis indicates that terms like "model," "resilience," and "management" have high centrality, highlighting their significant role in the field. From the co-occurrence analysis of Chinese and English keywords, it is evident that "resilience," "industrial chain," and "supply chain" are common research hotspots both domestically and internationally. However, due to differences in national conditions and research development stages, there are notable variations in research focus between domestic and foreign studies. Foreign research tends to emphasize the construction of industrial chain frameworks,

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the design of industrial chain models, and aspects of industrial chain management. In contrast, domestic scholars focus on assessing resilience across various industries' industrial chains, exploring influencing factors, and developing improvement strategies. Additionally, domestic scholars pay significant attention to the digital transformation of industrial and supply chains, which aligns with China's national policy of rapidly developing the digital economy and accelerating industrial digitization.

Table 2: High-frequency keywords in domestic and international research

Source	Serial number	Keywords	Frequency	Centrality	Start time
CNKI	1	Resilience	22	0.31	2020
	2	Industrial chain	21	0.11	2021
	3	Digital Economy	21	0.26	2021
	4	Supply Chain	14	0.09	2021
	5	Manufacturing	7	0.17	2022
	6	Digital Finance	7	0.08	2022
	7	Mediating effect	6	0.16	2021
	8	Safety	6	0.02	2023
	9	Technological innovation	6	0.25	2022
	10	Rural Revitalization	5	0.11	2021
WOS	1	Resilience	58	0.18	2010
	2	Management	50	0.15	2010
	3	Supply Chain	48	0.06	2014
	4	Supply Chain Resilience	40	0.02	2016
	5	Framework	37	0.14	2014
	6	Model	36	0.22	2013
	7	Performance	35	0.04	2011
	8	Impact	26	0.11	2016
	9	Design	23	0.15	2013
	10	innovate	23	0.11	2014

4.2 Keyword emergence analysis in document issuance

Mutation words are a category of vocabulary that experiences a sudden increase or decrease in frequency within a certain period of time, which can identify emerging research fields or new content within specific research areas [7]. The emergence value can reflect the development trends and research frontiers of the relevant research fields [8].

As shown in Figure 6, among domestic studies in related fields, "dual circulation" has the highest salience, followed by "mediating effect" and "Sino-American relations." In recent years, the vulnerability of global value chains has become increasingly apparent due to complex and evolving international geopolitics [9]. To enhance economic resilience, the Party Central Committee proposed in May 2020 to build a new development pattern centered on domestic circulation, with mutual promotion between domestic and international dual circulation. This strategy was incorporated into the national "14th Five-Year Plan" in 2021, making "dual circulation" and related "mediating effects" research hotspots from 2021 to 2022. As the two largest global trading nations with deeply interconnected production and supply chains, China and the United States have seen their relationship grow increasingly tense in recent years, with escalating economic competition [10]. This has significantly impacted the stability and security of China's industrial chains [11]. To promote the healthy development of China's industrial chains, scholars have increasingly focused on the impact of "Sino-American relations," making it a continuing research hotspot. Analysis of keyword salience reveals that research is heavily influenced by external environmental changes and national policy guidance.

From the English keyword emergence map in Figure 7, "complexity" emerges the earliest and has the longest duration, followed by "conceptual framework," "cluster," and "chain," indicating that early research focused on foundational studies such as theoretical frameworks and clusters of industrial chains. As shown in the figure, the emergence of terms like "network system," "evolution," and "uncertainty" continues until 2024, suggesting that the uncertainty of the external environment, the construction of industrial chain networks, and the evolution of industrial chains will become future research hotspots.

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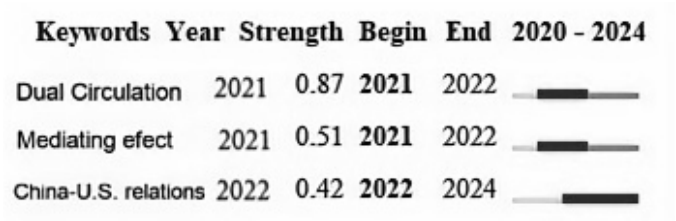

Figure 6: Chinese keyword emergence map

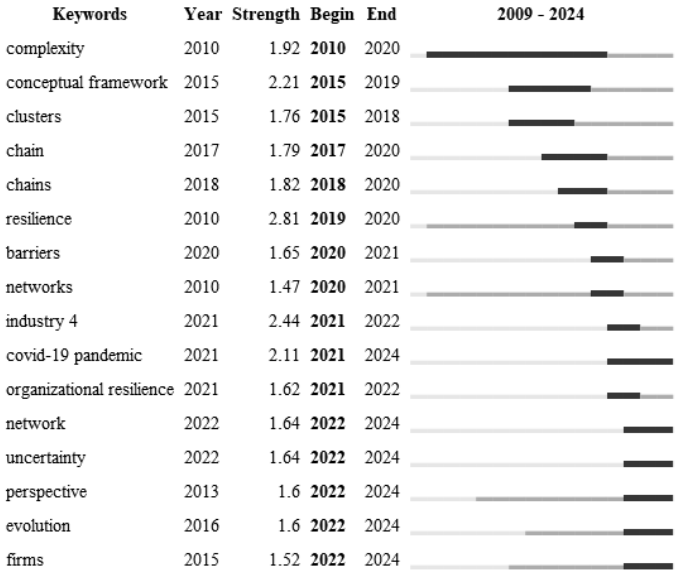

Figure 7: English keyword highlight map

5. Research conclusions

Using CiteSpace, this study analyzed 305 WOS and 265 CNKI documents, focusing on annual publications, organizations, authors, hotspots, and frontiers. Key findings include:(1) Volume of Publications: Industrial chain resilience has gained global attention, with rapid growth post-2020. Domestic research, though later to start, shows strong progress. (2) Organizations and Authors: Collaboration in China remains limited, with low network density among institutions and authors. Domestic research collaboration needs strengthening compared to international efforts. (3) Research Hotspots: Emerging technologies like AI and industrial internet enhance chain stability, while dual circulation, industrial upgrading, and clusters diversify research. (4) Future Frontiers: Research should deepen resilience, sustainability, and flexibility to address environmental uncertainties, while exploring industrial networks for a robust, sustainable system.

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