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Blockchain-Enabled Supply Chain Finance: A Bibliometric Review and Literature Review

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Abstract: Supply chain finance (SCF), as an emerging financial industry, is crucial in addressing the financial challenges and elevated financing costs faced by small and medium-sized firms. Recently, conventional supply chain financing has encountered obstacles including difficulties in acquiring transaction information, convoluted and inefficient processes, credit evaluation, and credit fraud. The advancement and ongoing maturation of blockchain technology have increasingly made it a trend to enhance traditional supply chain financing through its application. Despite ongoing advancements in the utilisation of blockchain-based technologies within supply chain financing, the existing literature remains lacks in a thorough review of its current research developments and future trajectories, thereby impeding a thorough understanding of both academic inquiry and practical implementations. This paper uses a combination of bibliometrics and content analysis methods to examine the attributes and content of 610 pertinent documents, subsequently developing a research framework for supply chain financing with blockchain technology. The research findings demonstrate a swift increase in literature articles after 2021, accompanied by a transition in research emphasis from finance, economics, and enterprise management to technological implementation. Research focal points encompass the optimization of supply chain financing models utilizing blockchain-based technologies, the application of blockchain to mitigate financing challenges for medium- and small-sized businesses, and the exploration of principal innovation trajectories in supply chain finances within the context of blockchain-based technology.

Keywords: Blockchain technology, supply chain finance, smart contracts, bibliometric analysis

1 Introduction

The continuing growth of the worldwide financial system and the escalating intricacy of supply chain management present significant difficulties to conventional supply chain financing models. The primary aim of supply chain financing is to enhance the distribution of money, logistics, and information, offering accessible financial options for small and medium-sized enterprises (SMEs). Although supply chain finance offers distinctive alternatives for funding tiny and medium-size firms, various problems remain in its execution. The fundamental issue stems from insufficient knowledge regarding actual trade and logistics activities, inadequate credit transfer, and elevated operational and regulatory expenses linked to conventional supply chain finance. Various fields are progressively implementing blockchain technology, distinguished by decentralisation, consensus procedures, immutability, transparency of information, and traceability [1]. Supply chain finance has swiftly advanced due to blockchain technology, leveraging its distributed storage to dismantle data silos and guarantee the secure and efficient circulation and sharing of data assets. The consensus mechanism of blockchain enables credit transfer throughout all tiers of supply chain financing. Smart contracts on blockchain enhance conventional supply chain financing management frameworks by removing inefficient manual processes and facilitating automated intelligent transactions. This innovation mitigates trust concerns among parties, diminishes performance risks associated with supply chain finance, and streamlines operational procedures while reducing costs [2]. Financial challenges for SMEs are a worldwide concern, and supply chain finance is an essential instrument for mitigating these concerns. Blockchain-based technology address the deficiencies of conventional supply chain financing and is inherently compatible with it.

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In recent years, blockchain has empowered the inventive advancement of SCF, becoming as a hot topic of research for scholars both domestically and internationally. Wang Wenjie examined the obstacles encountered by SMEs in conventional supply chain financing, highlighting that blockchain might mitigate the problems of credit self-evidence and financing hurdles for these enterprises (Wang Wenjie, 2018). Feng Shanshan et al. [3] examining the categories and determinants of credit risks in supply chain financing, clarified the benefits of blockchain technology in managing credit risk within this domain. Guo et al. [4] addressing the financing requirements of SMEs, has established a blockchain-based supply chain financial credit network and introduced a credit evaluation system for this network. Biswas posited that blockchain traceability can address the issue of identifying upstream supply chain assurances within the supply chain system (Biswas, Muthukkumarasamy, & Tan, 2017). Hand et al. developed a blockchain financial service system for supply chains utilizing a consortium chain, improving the transparency and traceability of transactions while mitigating financial risks (Han, Ulhøi, & Song, 2024). Raj et al. indicated that blockchain smart contracts might facilitate cash flow management in transactions, hence enhancing the coordination and collaboration of transaction networks in supply chain finance (Raj, Jauhar, Ramkumar, & Pratap, 2022). Yang et al. [5] asserted that blockchain can address the trust issue in the supply chain and diminish risk control costs. Current literature indicates that scholars investigating the innovation of blockchain in SCF primarily focus on optimizing finance models within this framework, addressing financing challenges faced by SMEs, and examining the principal innovative avenues of SCF enabled by blockchain technology.

This study aims to carefully evaluate the literature concerning the implementation of Supply Chain Finance (SCF) with blockchain technology and to employ the *CiteSpace* tool for both quantitative and content analysis of the literature. The study addresses the following research issues:

1. What is the trend in research publications?
2. Which journals, authors, and fields are most significant in contemporary research?
3. What are the primary research focal points in this domain?
4. What issues does blockchain technology resolve in SCF?
5. In what ways does blockchain technology enhance SCF?

This paper is organized as follows. After the introduction, Section 2 elaborates on data collection and research methodologies. Section 3 presents the bibliometric analysis of the literature. Section 4 assesses the content measurement of the literature. Finally, Section 5 presents the study's conclusions and outlines prospective research directions.

2 Data collecting and research methodologies

2.1 Data Collecting

Table 1 lists the literature search and screening process for this article. To ensure that the selected literature has strong scientific rigor and high quality, this article focuses only on English-language documents indexed in Scopus, with all document types being journal articles, excluding conference papers, reviews, monographs, and other types of literature. We specifically retrieved a total of 1534 documents from the Scopus Core Collection database using the search term ALL=("block chain" AND "supply chain finance"). We manually read the titles, abstracts, keywords, and main content of the documents to exclude some less relevant and non-academic research documents. We ultimately used 610 English-language documents for bibliometric analysis.

Table 1: Literature review process

Literature Review	Scopus
Search Subjects	("block chain") AND ("supply chain finance")
Number of Search Results	1534
Type of Source	Journal
Type of Document	Article
Conclusive Number of Literature	610
Last Retrieval Time	February 2025

2.2 Research Methodologies

This article employs both bibliometric and content analytic research methods to methodically analyze the innovative development patterns and trends of supply chain finance under blockchain technology. Bibliometrics employs mathematical statistical principles and computer analysis techniques to quantitatively study the external characteristics of literature. It examines the knowledge framework and developmental trajectories of pertinent study subjects, illustrating them visually. This includes aspects such as the number of publications, core authors, and keyword clustering. While bibliometrics can comprehensively and objectively summarize and identify the evolutionary trajectory and research layout of a specific research topic, its disadvantage is its inability to deeply analyze the specific research content.

Content analysis is a qualitative assessment that methodically organizes, synthesizes, and summarizes the essential content of literature to comprehensively assess the present status of research. This method accurately represents the fundamental attributes of the research issue and offers comprehensive insights for pioneering studing

on blockchain technology in SCF. Nonetheless, content analysis is constrained by limits in selecting samples and inherent subjectivity. This research employs a mixed methodology that amalgamates quantitative and qualitative methodologies: it utilizes bibliometrics to comprehensively analyze research trends in SCF within the context of BlockChain-Based Technology, while also applying content analysis to explore critical issues and prospective developments in this domain. This hybrid research technique enhances comprehension of the field's existing status but also providses profound insights for future research and development.

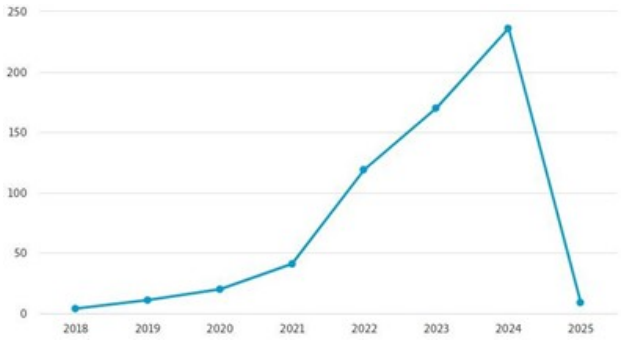

Fig. 1: Number of Articles from 2018 to 2025.2

3 Bibliometrics Analysis of Literature

3.1 Analysis of Publication Years

The quantity of papers published on a certain topic reflects the degree of attention paid by society to the field. The time distribution of papers reveals the popularity of research topics. Figure 1 shows the publication year of the retrieved literature. Based on the annual data of literature publication, the first research in the field of SCF using BlockChain Technology was published in 2018. This is because Ethereum, based on smart contracts, first appeared at the end of 2015, opening the application journey of blockchain technology. Subsequently, the quantity of papers published showed a steady growth trend year by year. The official release of the "Blockchain 3.0 Consensus Blue Book" in September 2018 ushered in a new wave of academic research. The quantity of articles published in the domain of SCF based on blockchain technology has seen a strong development trend since 2021.

A comprehensive research indicates that before to 2021, there were a mere 35 pertinent articles. The quantity of publications rises annually from 2021 to 2024, with 41 in 2021, 119 in 2022, 170 in 2023, and culminating at 236 in 2024. These results illustrate that research in SCF using BlockChain Technology remains very pertinent and indicates a substantial rise in scholarly interest. This growing trend signifies the academic community's sustained emphasis on dual-chain integration and underscores the extensive demand for blockchain technology in practical applications. The growing volume of data and technological advancements have intensified research on the novel evolution of supply chain finance propelled by blockchain technology, revealing extensive potential.

3.2 Analysis of Publication Domains

The examination of 610 publications indicates that the convergence of supply chain finance and BlockChain resides in the interdisciplinary sphere of computer science and economics, with its research being utilized across several sectors. Figure 2 illustrates that papers in the domain of computer science comprise 26.2% of the whole publications, underscoring preeminent importance in blockchain-based supply chain finance research. Engineering publications constitute 20.3% of the total, and economics papers represent 15.6%. This indicates that a growing number of scholars are shifting their focus from finance, economics, and business management to the technological application of blockchain in SCF.

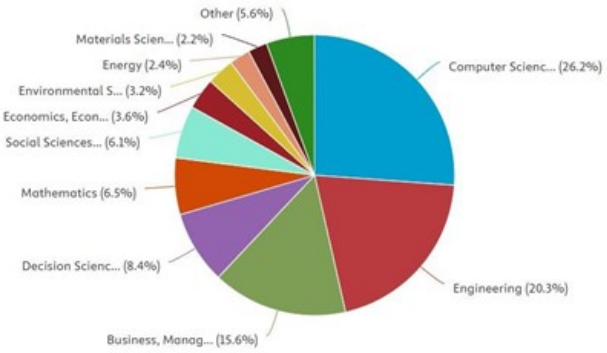

Fig. 2: Documents by subject area.

3.3 Analysis of Journal Publication

Figure 3 shows the yearly publishing totals of the ten leading sources in the domain of SCF research pertaining to blockchain technology. The analysis of this figure indicates that the leading 10 journals in the field are IEEE Access (25 articles), IEEE Transactions on Engineering Management (20 articles), Computers and Industrial Engineering (16 articles), Sustainability (Switzerland) (15 articles), and International Journal of Production Research (15 articles). Table 2 provides detailed

information on the names of core regional journals, research fields, publication counts, and impact factors for 2023-2024.

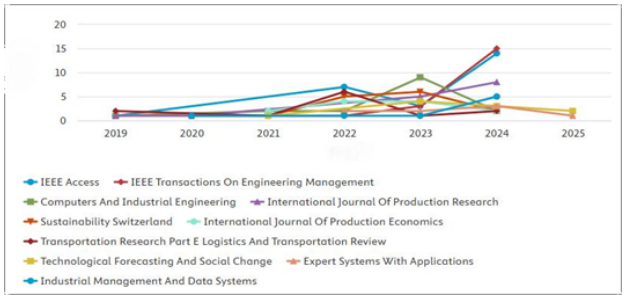

Fig. 3: Transmission of Academic Publications Categorised by the Ten Sources.

3.4 Core author distribution

Core authors refer to researchers who have a strong influence in the field and a certain influence on the journal. This article analyzes the authors of 610 documents related to supply chain finance application research using blockchain-based technology. Based on the frequency of authors' publications, we can identify high-impact authors (those with the highest citation weight) in the research field and their corresponding articles. We can also display the co-citation relationships among authors and identify those who have similar and closely related research topics. According to the core author paper publication analysis data (Figure 4), [2], Lim MK, Chen L, Jia F, Tseng ML, Gunasekaran, Han D, Kumar A, and Luthra S have a relatively large number of publications, each with 10 or more papers. The cooperation relationship among the aforementioned TOP scholars is relatively close, and they frequently collaborate with each other.

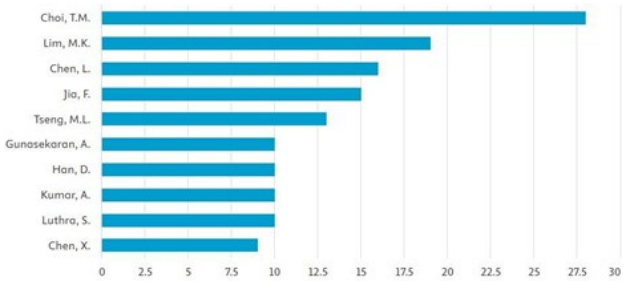

Fig. 4: Core author analysis.

4 Content-Based Bibliometric Analysis

The research subject demonstrates the progression of study perspectives and focal points in a specific discipline during a designated timeframe. Keywords are crucial in representing the main body of an article. Co-occurrence and cluster analysis of keywords can provide insight into the changing trends of popular words in this field, while a time view can provide insight into the development trend of research in this field.

4.1 Keywords Co-occurrence Analysis

We can analyze the theme and hot spots of the literature by using keywords, which serve as a general summary of the literature's content and represent its main discussion points. After processing, this paper obtained the keyword co-occurrence map and co-occurrence intensity words of English literature, which were subsequently employed to examine the research trajectory and developmental context of SCF within the framework of Blockchain-based Technology. Figure 5 depicts the strength of keyword co-occurrence within English literature. Each node represents high-energy terms. The node's size reveals the strength of keyword co-occurrence, with lines linking them together. This study employs CiteSpace software to conduct keyword clustering analysis, determining the frequency and centrality of various keywords in the collected literature. Upon the removal of duplicate content, the ten foremost English phrases ranked by co-occurrence intensity are blockchain technology, supply chain, supply chain finance, supply chain management, smart contract, Hyperledger Fabric, blockchain adoption, privacy protection, distributed ledger technology, among others.

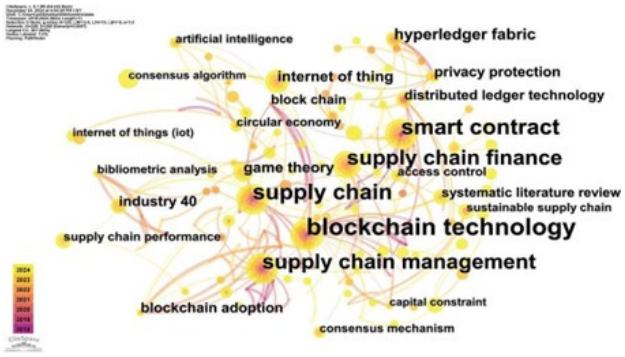

Fig. 5: Keyword co-occurrence analysis .

The findings of the keyword co-occurrence analysis elucidate the main research trajectories and technical emphases within the domain of SCF study pertaining to BlockChain Technology. Table 3 indicates that

Table 2: Journal Publications List

No.	Primary Area Journal	Field of Study	Quantity of Publications	Impact Factor 2023–2024
1	IEEE Access	Electrical engineering, Computer science	25	6.4
2	IEEE Transactions on Engineering Management	Electrical and Electronic Engineering	20	6.37
3	Computers and Industrial Engineering	Computing & Interdisciplinary Applications	16	6.7
4	Sustainability (Switzerland)	Computer Science, Social Sciences	15	6.8
5	International Journal of Production Research	Engineering technology, Economics	15	9.0
6	Transportation Research Part E: Logistics and Transportation Review	Economics, Engineering	12	8.3
7	International Journal of Production Economics	Engineering technology	12	11.25
8	Technological Forecasting and Social Change	Management	10	12
9	Expert Systems with Applications	Computers, Artificial Intelligence	8	7.5
10	Industrial Management and Data Systems	Computers, Engineering technology	8	4.22

Table 3: High Frequency Keywords

No.	Keywords	Frequency	Centrality
1	Blockchain technology	97	0.54
2	Supply chain	55	0.36
3	Supply chain finance	48	0.19
4	Supply chain management	45	0.28
5	Smart contract	59	0.36
6	Hyperledger Fabric	16	0.05
7	Blockchain adoption	11	0.03
8	Privacy protection	11	0.05
9	Distributed ledger technology	10	0.02
10	Distributed ledger technology	9	0.04

”blockchain technology,” ”supply chain,” and ”supply chain finance” are the three most prevalent keywords in this domain, appearing 97, 55, and 48 times, respectively, markedly surpassing the frequency of other keywords. Intermediary centrality denotes the linkage among various knowledge units and illustrates the mediating function that a specific knowledge unit serves concerning other knowledge units inside the network graph. Table 3 demonstrates that ”blockchain technology” possesses the highest intermediary centrality of 0.54, signifying its pivotal function as a hub in the study domain of this article. ”Supply chain” and ”supply chain finance” have intermediary centralities of 0.36 and 0.28, respectively. Tables 3 and 4 indicate that ”blockchain technology,” ”supply chain finance,” ”supply chain,” and ”smart contracts” are the primary research focal points in the domain of SCF utilizing blockchain-based technology.

4.2 Keyword Clustering Analysis

Modular clustering of keyword-sharing networks can more accurately represent the distribution of themes in the field and efficiently identify the research hotspots and trends in SCF inside blockchain technology. The CiteSpace software offers three tags on the clustering label: title, keyword, and abstract. These tags correspond to three algorithms: LSI, LLR, and MI, with the LLR (log-likelihood ratio) algorithm being the most commonly used. The LLR algorithm is used to cluster the keywords, and the clusters are named using keywords (K). Figure 6 illustrates the ten main cluster classifications.

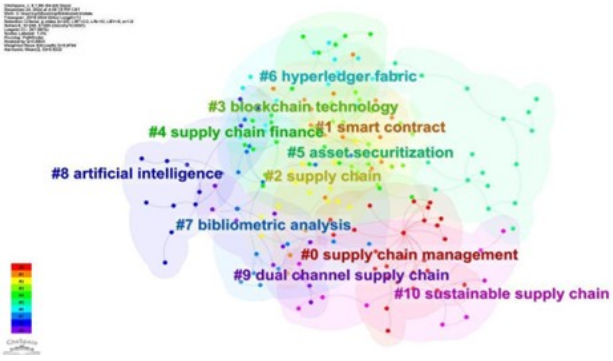

Fig. 6: Keywords clustering analysis.

The clustering conclution show that ”blockchain technology,” ”supply chain management,” ”smart contracts,” and ”supply chain finance” are the four largest clusters. Generally, two indicators determine the quality

of clustering. The clustering module value indicates that a bigger value often signifies superior clustering performance. When Q exceeds 0.3, the network community structure is substantial; Q values ranging from 0.4 to 0.8 are appropriate for clustering. The second component is the mean silhouette value of clustering. If S ¿ 0.5, the clustering is deemed acceptable; the nearer the value is to 1, the greater the homogeneity of the network. The topic clustering results indicate Q=0.8489 and S=0.9767, demonstrating robust and credible clustering outcomes.

Table 4 illustrates that the three most substantial clusters are cluster 0, cluster 1, and cluster 2, containing 26, 22, and 20 documents, respectively. Moreover, five out of the 12 clusters, namely ”blockchain technology,” ”supply chain management,” ”supply chain,” ”hyperledger fabric,” and ”artificial intelligence,” have an average cluster profile value of 0.9. This indicates that their network homogeneity is extremely high, and their clustering effect is optimal. Cluster 5 and cluster 10 exhibit the lowest homogeneity, with respective values of 0.914 and 0.923, suggesting that the overall cluster is quite reasonable. Furthermore, the average publication year for most clusters is 2022, suggesting that these clusters serve as hotspots for current research trends in this field.

4.3 Further Study Based on Literature Content

By looking at how often keywords appear together, researchers in blockchain-driven supply chain financing are mostly interested in three things: first, how to make supply chain finance models work better with blockchain technology; second, how blockchain can help SMEs with their money problems; and third, the most innovative ways to do supply chain finance with blockchain technology. We attempt to construct a foundational research framework, as shown in Figure 7, to further clarify the research trajectory of BlockChain-driven supply chain financing.

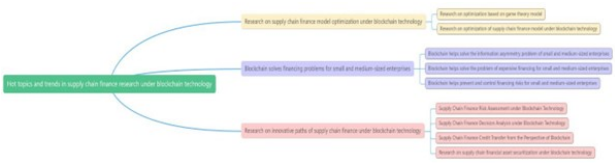

Fig. 7: Research framework.

4.3.1 Research on optimization of SCF model under blockchain

1. Research on Optimization of Game Theory Model: Game theory models generally delineate the cooperative and competitive behaviors among firms in SCF. The primary actors consist of core firms, SMEs, and financial institutions, whose interactions influence capital flow, credit risk, and financing costs. Enhancing game theory models is an effective approach for examining the mechanics of blockchain technology in supply chain financing [6]. It delineates the fluid procedure for stability development under conditions of constrained rationality among participants. The main focus of research on optimizing game theory models is on how to choose the optimal financing plan. How to balance credit risk and financing costs? How can we make decisions in situations where information is incomplete? How can suppliers and buyers achieve cooperation through games? Designing incentive mechanisms can optimize the interests of all parties. Zhou et al. formulate an evolutionary game model to analyse the interactions of financial institutions, SMEs, and core enterprises, investigating the impact of blockchain on improving supply chain finance (Zhou Lei, Deng Yu, & Zhang Yuyan, 2021). Their investigation reveals that for financial institutions, using blockchain technology has grown to be a crucial strategy, facilitating SMEs in making informed decisions by optimizing credit allocation, augmenting financial efficiency, escalating default-related expenses, and minimizing inefficiencies. According to Sun et al. [7], They created an evolutionary game framework that examines the interactions between SMEs and financial institutions to evaluate the potential of blockchain in mitigating the financial uncertainties encountered. Wang et al. [8] discovered that BlockChain mitigates financial risks for banks and alleviates the financing obstacles encountered by SMEs. A team of researchers developed an evolutionary game framework between financial institutions and small and SMEs, focusing particularly on how the maturity of blockchain and the risk preferences of financial institutions influence the evolution of accounts receivable financing strategies between financial institutions and SMEs. The research shows that blockchain technology can help lower supply chain finance risks, fix problems with uneven information, and make it easier for financial institutions and small businesses to work together. It can also make it much less likely that people will work together to steal money Throughout the accounts receivable financing procedure. Zhu et al. [9] Created a tripartite stochastic evolution game framework to examine fraudulent defaults in accounts receivable financing within SCF, incorporating the integration of BlckChain Technology with SCF platforms. The model involves financial institutions, core enterprises, and SMEs. They employed numerical simulation to objectively assess the effects of regulatory severity on financial institutions, information dissemination via blockchain platforms, and variations in

Table 4: Keywords Clustering Table

Cluster ID	The quantity of literature	The metric of the homogeneity	Average year	Cluster Name
0	26	0.997	2021	supply chain management
1	22	0.973	2021	smart contract
2	20	0.990	2020	supply chain
3	20	1.000	2021	blockchain technology
4	19	0.974	2022	supply chain finance
5	18	0.914	2022	distributed ledger technology
6	16	0.988	2022	hyperledger fabric
7	16	0.939	2022	bibliometric analysis
8	13	0.982	2022	artificial intelligence
9	11	0.970	2022	dual channel supply chain
10	11	0.923	2022	sustainable supply chain
11	9	0.949	2023	access control

incentive factors on the strategic decisions of game participants. The analysis indicates that the sharing information incentives factor encourages financial institutions to engage with blockchain platforms, whereas the risk coefficient and regulatory intensity exert contrary impacts on the development of blockchain platforms. The allocation of incentive equity significantly affects core enterprises. Despite advancements in pertinent research, the exploration of blockchain Systems in SCF remains inadequately profound, with limited scholarly attention on the adoption elements and the responses of banks and small to medium-sized firms.

2. Research on optimization of financing mode:
In the progression of SCF, there are primarily three financing models: accounts receivable financing, warehouse receipt pledge financing, and accounts payable financing. The primary participants in these models of the supply chain consist of suppliers, purchasers, financial institutions, and intermediaries. Despite the widespread use of these financing models in the supply chain, they continue to encounter challenges such as information asymmetry, high credit risk, high financing costs, complex processes, and fraud risks. Blockchain technology offers technical solutions for SCF, enabling it to mitigate credit risks, optimize business processes, and reduce financing costs. Blockchains, decentralized, immutable, and transparent distributed ledgers, as well as smart contracts, can effectively address the problems existing in traditional financing models. Blockchain technology innovates financing models as shown in Table 5. Therefore, blockchain technology significantly impacts corporate financing model innovation and efficiency improvement, which has led to high attention from both academia and industry in research driven by blockchain technology for supply chain finance model innovation. Numerous scholars have synthesized the literature on blockchain-based technology and its application in innovating supply chain finance models, seeking to utilize blockchain to resolve challenges inherent in the financing processes. Study on supply chain finance model innovation predominantly adheres to two trajectories: one emphasizes the content, investigating how blockchain technology might facilitate innovation in supply chain financing. The second method examines supply chain financing models through the lens of commercial banks, specifically highlighting the development of financial platforms and policy analysis. Yuyan et al. [10] proposed that SCF combines the innovative accounts receivable financing model with the utilising of blockchain to foster the creation of a credit system. SU LEI et al. [11] Proposed new business models included online inventory pledge business, online accounts receivable business, and online agency procurement business, optimizing service processes in conjunction with blockchain technology, utilizing transaction data to evaluate users, accumulating data resources, identifying the authenticity of warehouse receipts, achieving big data risk control, core enterprises addressing upstream and downstream financing issues, optimizing cash flow, solving commodity supply chain financing problems, and expanding business scenarios and service content. DU and colleagues Based on the current supply chain dynamics of major steel enterprises, blockchain technology is employed to innovate the SCF business model, reconfiguring the processes and business models of warehouse receipt pledge financing and accounts receivable factoring in SCF and proposing a novel blockchain-based supply chain service platform architecture [12]. Wang R et al. [8] concentrate on developing a supply chain finance alliance framework utilizing blockchain technology, tailored to the foundational model and component technologies of the Ethereum blockchain system for supply chain finance. They utilize a principal-agent model and incentive framework to establish incentive mechanisms between blockchain finance platform service providers and core enterprises within the accounts receivable financing model of SCF, considering the practical operations of blockchain finance platforms. This strategy enhances the integration of blockchain technology in supply chain

finance while simultaneously addressing existing developmental constraints.

4.3.2 Study on Blockchain to Address Financing Problems of SMEs

SMEs are a crucial component of the national economy and a significant force for national economic growth [13]. However, difficulties and high financing costs have long constrained the development of small and SMEs due to poor creditworthiness, weak foundational strength, and issues such as the inability to split core enterprise credit. Therefore, it is imperative for blockchain technology to assist SMEs in financing, which can be analyzed based on the following three aspects: 1) Research on addressing information asymmetry issues for SMEs; 2) Research on addressing the issue of high financing costs for SMEs; 3) Research on preventing and controlling financing risks for SMEs.

1. Research on the utilisation of blockchain technology to address information asymmetry in SMEs:
In traditional supply chain finance, SMEs face severe information asymmetry issues, mainly manifested in the lack of credit information, opaque financial data, and insufficient trust among participants [14]. Due to the lack of complete credit records and transparent financial conditions, financial institutions find it difficult to accurately assess their credit risks, thereby making financing challenging. Blockchain technology ensures that all transactions and data records are publicly transparent and unalterable through a decentralized distributed ledger. With this technology, all parties in the supply chain can share SMEs' credit records, transaction information, and financial conditions in real time, thereby enhancing their credibility, improving the efficiency of financial institutions' credit decision-making, and reducing loan default risks. Simultaneously, the consensus mechanism of blockchain promotes trust and cooperation among enterprises, effectively addressing information asymmetry issues and significantly improving the financing environment for SMEs. Xu et al. [15] posited that blockchain technology can successfully address the information island phenomenon, while the information sharing cost subsidy mechanism may significantly mitigate the financial burden of information sharing and enhance the supply chain framework. Zheng proposed a blockchain-based supply chain shared transaction information access control and management model [16]. The concept employs a consensus mechanism to tackle the challenges of extensive credit reporting data and the safeguarding of credit reporting data privacy, thus facilitating blockchain data sharing and traceability. This subsequently enhances the current credit reporting service system and improves efficiency.

2. Blockchain helps solve the problem of high financing for SMEs:
In the supply chain financing progress, small and medium-sized enterprises (SMEs) face high financing costs, mainly because SMEs upstream in the supply chain cannot obtain high-quality financing without the credit support of core enterprises, leading to high financing costs. The integration of blockchain technology with SCF can facilitate micro, small, and medium-sized firms in accurately verifying the legitimacy of trade activities, disseminating essential enterprise credit, and obtaining cost-effective financing. For instance, blockchain offers a secure and transparent platform for transaction records, enabling financial institutions to rely on on-chain data for accurate credit assessment, thereby reducing risks and costs in traditional credit review processes. Additionally, blockchain automates the execution of smart contracts, thereby reducing intermediary steps and lowering operating costs and transaction fees. Furthermore, blockchain can enhance capital flow and financing efficiency, particularly through supply chain finance platforms, which can assist SMEs in obtaining lower-cost funding sources, thereby alleviating financing burdens. The decentralization of blockchain can improve supply chain financing efficiency by significantly saving human and material resources and ultimately reducing financing costs for SMEs **Liang2020**. Wang et al. [8] also believed that the distributed storage and smart contract mechanisms can improve the management model of traditional trading platforms, monitor information at low cost and high frequency, and perform intelligent and automated operations. These advancements reduce credit investigation and operational costs for SMEs in financing, effectively alleviating the pain points of expensive financing in the operational stage of the supply chain finance business.

3. Blockchain helps to prevent and control financing risks of SMEs:
SMEs often face issues such as document forgery, fictitious transactions, and "puppet seals" during financing processes, leading to higher financing risks. However, blockchain technology, with its immutable nature, can significantly reduce risks in bill financing by ensuring the authenticity of transaction documents. Meanwhile, smart contracts digitize various contracts in the financing process and possess an automatic enforcement mechanism, greatly improving the fulfillment rate and effectively controlling financing risks. Zhang believed that the risk management strategy of double chain fusion can reduce risks and improve financing efficiency in the actual operation of supply chain financing, and use blockchain technology to enhance the financing ability of small and medium-sized enterprises and reduce financing risks(Zhang Hua, 2024). Francisco et al. [17] believed that the application of blockchain in areas such as bank fees and loan approval can play a role in making blockchain technology visible

Table 5: Blockchain Technology Innovation and Financing Mode

Characteristic	Blockchain Technology	Financing Model Innovation
Decentration	The participants are directly and equally connected	Solve information asymmetry and enhance business trust
Trustworthy interaction technology	Immutable and transparent distributed ledger	The authenticity and immutability of the data
Smart contracts	Automatically execute contracts and set up	The automation, real-time and intelligence of transactions
Coordinate the sharing mechanism	All nodes maintain and authenticate together	Data sharing and efficient collaboration of services
Asymmetric encryption algorithm	Virtual encryption digital transmission technology	Data transmission security and privacy protection
Time stamp	Information has the imprint of time and space	Information supervision, traceability and verification

and auditable, reducing fraud in banking busines [17]. Long et al. believed that the rise of blockchain technology has further improved the credit enhancement measures and resource matching of supply chain finance, so that upstream and downstream enterprises can obtain lower bank loans and prevent the risk of bills(Long Juntao, &Yan Ruoting, 2019). Tianlin emphasizes that SMEs can automatically complete repayment and liquidation through blockchain smart contract after financing, which improves the efficiency of financing and reduces financing risks(TianLin, 2020).

4.3.3 Main innovative paths of supply chain finance under blockchain technology

1. Risk assessment of SCF under blockchain technology:
The distributed data structures of BlockChain, including smart contracts and private keys, along with its decentralized architecture, provide the comprehensive and accurate recording of transaction data inside the supply chain, which is crucial for addressing the risk issues associated with supply chain financing [18]. Therefore, the risk evaluation of blockchain technology in SCF has attracted the attention of many scholars. Zhu et al. [18] believed that The blockchain's distributed data structures, including smart contracts and private keys, along with its decentralized designs, allow for the complete and truthful recording of transaction data on the supply chain. This is essential for mitigating risk concerns in supply chain financing. Consequently, the risk evaluation of blockchain technology has attracted the attention of many scholars. Qin et al. [19] constructed a s risk management model based on blockchain, which discussed key elements such as smart contracts, distributed ledgers, and data encryption, reduced credit risk events, improved supply chain transparency, and reduced transaction costs. Xiao et al. [20] investigated the determinants influencing the credit risk of SMEs inside the blockchain-based supply chain financing framework. These findings unequivocally validate the significant benefits of using blockchain into risk management.

2. SCF decision analysis under blockchain technology:
Dong et al. [21] applied blockchain to supply chain finance operation strategies. Their research suggests that if the primary business of the core firm involves selling high-priced products or if The average expense associated with blockchain installation is rather significant, the core enterprise should refrain from creating its own original channel. When the core enterprise creates its own proprietary channel, the maker ought to reduce the wholesale price; nonetheless, the core enterprise should elevate the retail price under specific situations. Ge et al. [22] examined the influence of the decision maker's risk preference on decision-making and analysed the optimal supply chain financing decision under partial credit guarantees and blockchain technology. The findings demonstrate that, within a defined range of risk aversion, the order quantity of shops utilizing the partial credit guarantee model surpasses that of the blockchain technology empowerment model. Likewise, The conditioned risk value of suppliers within the partial loan guarantee framework is markedly inferior to the order quantity facilitated by blockchain technology, suggesting that blockchain technology can substantially mitigate financial risks. Yang et al. [23] analyzed the optimal strategies of various supply chain entities under the supply chain finance financing model driven by blockchain technology. Blockchain can precisely forecast the utility of consumer goods purchases, lower bank loan interest rates, and enhance consumer preferences [24].

3. Credit transmission of SCF under blockchain technology
Within the conventional supply chain finance framework, suppliers can utilise the substantial creditworthiness of core firms for financial support; however, this creditworthiness does not extend to multi-tier providers in the long tail market. In recent years, the inventive advancement of SCF propelled by blockchain technology has positively influenced consumer service trust. Jiang et

al. [25] built a trust transitive model to offer innovative concepts for the trust assessment of SMEs, thereby maximizing the credit enhancement and transmission effects within the manufacturing industry chain and mitigating the financing challenges faced by these enterprises. Shu et al. [26] proposed a supply chain finance transitive trust model under BlockChain to ensure the seamless transfer of trust from core enterprises to underlying suppliers in the credit assessment process of financing enterprises. The model records the transitive signed accounts receivable warrants on the blockchain and allocates the warrants to the underlying suppliers in a separable format. Research indicates that the transitive trust model can bolster the trust of small and medium-sized firms at the lower end of the supply chain, therefore mitigating their financing challenges.

4. Research on securitization of supply chain financial assets under blockchain technology:
As a financial innovation method to convert underlying assets into securities for circulation, supply chain finance asset securitization aims to improve the liquidity of funds and the utilization rate of capital. However, in the traditional asset securitization process, information asymmetry, credit risk, high transaction costs, and operational complexity often lead to inefficiency and difficulty in risk management. The emergence of blockchain technology provides new possibilities for solving these problems. Schmidt et al. are very optimistic about the application prospects of blockchain's distributed ledger model in supply chain finance asset securitization, believing that it is a revolutionary technology that has an important impact on reducing opportunism in supply chain finance [27]. Liu discussed the credit risk problem in the process of supply chain finance asset securitization and believed that blockchain technology can promote the stability of the financial market in the process of SCF asset securitization (Liu Wanchao, 2021). Meng studied the risk management in SCF asset securitization and believed that blockchain can help solve credit risk and operational risk (Meng Jing, 2021). Meralli focuses on the study of privacy protection in asset securitization, using a blockchain platform to facilitate interactions among all market participants throughout the securitization lifecycle on a singular decentralized platform, while preserving the confidentiality of loan-level data, thus delivering the industry with prompt analysis and performance metrics [28].

5 Study Conclusions and Prospective Research Direction

5.1 Study Conclusions

The quantitative analysis of SCF research results under blockchain technology reveals that the relevant literature in this field has been steadily increasing since 2018, starting to double in 2021. Computer science has significantly more papers than other fields, indicating a greater tendency towards technical realization in SCF based on BlockChain-based technology. Analysis of the research hotspots of SCF under blockchain-based technology found that:

The clustering label words are "supply chain management," "smart contract," "supply chain," "blockchain technology," "supply chain finance," "asset securitization," "hyperledger fabric," "bibliometric analysis," "artificial intelligence," "dual channel supply chain," and "sustainable supply chain."

Keyword co-occurrence analysis found that "blockchain technology," "supply chain," "supply chain finance," and "smart contract" are the main research hotspots in the field of SCF under blockchain technology in China. Driven by policies and practical needs, the research on SCF under blockchain technology has developed rapidly, paying more attention to depth while paying attention to breadth. Blockchain technology helps small and medium-sized enterprises to finance, which is the focus of SCF research under blockchain, and the construction of supply chain finance platforms and the innovative development of SCF are hotspots.

5.2 Prospective Research Directions

Future research on the application of blockchain technology in SCF could take the following directions:

Encourage the systematization of SCF supervision using blockchain technology. While recognizing the openness and transparency of supply chain finance transaction information, the distributed ledger of blockchain should also prioritize protecting the privacy of traders. At the same time, too thorough privacy protection will increase the difficulty of supervision, leading to inevitable gaps in the development of supply chain finance under blockchain. Therefore, in the face of the problems brought about by the supervision of supply chain finance under blockchain, the optimization and integration of the supervision system still needs in-depth research [29].

Achieve breakthroughs in "blockchain" + "supply chain finance" technology. Despite the rapid development of blockchain technology, it still suffers from instability in its functions. If an intruder manages to crack the block technology, they can withdraw cash by inflating the underlying assets, thereby compromising the credibility of the entire supply chain finance platform. Therefore, only by strengthening the breakthrough of the basic technology of "blockchain" + "supply chain finance" can the stability and security of the supply chain finance platform be enhanced and the credibility of the entire platform transaction be strengthened.

Strengthening the privacy protection of supply chain financing transaction data utilizing blockchain technology. Blockchain technology enhances the reliability and shareability of transaction data, while it also heightens the potential of commercial privacy breaches for organizations. Researchers may implement asymmetric encryption methods, zero-knowledge proofs, homomorphic encryption algorithms, and similar techniques to safeguard the privacy of supply chain finance data [30].

Enhance the utilization of cross-chain technology in supply chain finance. Cross-chain technology facilitates the transfer of information and value between disparate blockchains, enabling the conversion of value originally recorded on one blockchain into value on another, thereby achieving value mobility. Multi-chain symbiosis has become the predominant concept for the future evolution of blockchain systems(Liu Junlong, 2020).

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