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Hot Spots and Trends of Credit Research Based on Blockchain Technology—A CiteSpace Visual Analysis

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Abstract: This paper examines the highlights and development trends in blockchain-based credit research based on CiteSpace visualization software. The study found that financial services, smart agriculture, judicial deposit, government services, and double carbon strategy are currently applied scene of credit building based on blockchain technology. Credit research based on blockchain technology has broadly undergone a development process from basic technology research and financial services applications to multidisciplinary advancement. Based on the analysis of the existing research hotspots and hotspot changes, it can be found that the construction of a blockchain-based credit system has not only achieved rich results at the technical level but has also been practically applied in many fields. With the combined effect of policy dividends and technical advantages, future credit construction based on blockchain will be continuously improved and developed at a higher level and in a wider field. Later research can strengthen the integration and innovation with other information technologies such as big data, artificial intelligence, and cloud computing in response to the demand of specific business scenarios, explore the path of technology application scale, and promote industrial development.

1. Introduction

The growth of the digital economy has made traditional trust models face huge challenges [1]. Inaccurate and unsound credit information leads to the lack of the necessary basis for disciplining breach of trust [2], However, credit construction based on digital technology can ensure the accuracy, integrity, and validity of credit information, solve the problem of missing information, and reconstruct the economic and social credit system [3]. Specifically, blockchain distributed storage makes it difficult to tamper with the data in the chain, and the information is more real and reliable, which helps to realize the construction of a trust system and value transfer without third-party endorsement, and becomes an important technology for credit reconstruction in the context of big data era, and its supporting role in establishing a larger and deeper credible value network is constantly highlighted. Therefore, credit construction based on blockchain technology

has become a hot spot for blockchain application research [4]. Blockchain-based credit research has experienced from the initial basic technology to financial services and now cross-field applications. In the future, blockchain technology will continue to deeply integrate and innovate with other information technologies to promote industrial development. Therefore, it is important to clarify the technical advantages of blockchain and its applications in various fields to give full play to the value of blockchain. This paper uses the CiteSpace analysis method to perspective the credit research literature under blockchain technology since 2015, sort out the relevant research hotspots and the pulse of change, and provide a theoretical basis for better playing and researching the application of blockchain technology in the credit system.

First, CiteSpace software was used to analyze the statistical analysis of the number of publications, the analysis of the distribution of literature journal sources and disciplines, and the high-yield authors and their collaboration structure, to have a preliminary understanding of the current status of blockchain-based credit research. Then, based on word frequency statistical analysis, keyword co-occurrence visualization analysis, and clustering analysis of the retrieved literature are conducted to explore the hot spots of blockchain-based credit research. Finally, based on the visualization results of the timeline time-zone diagram of CiteSpace, the development trend of blockchain-based credit research is analyzed to provide a reference for the development of related research work in the later stage.

2. Research Status Description Statistics

In this paper, CNKI was selected as the source database to search all articles under the topic of "blockchain" and "credit" from 2015 to 2022, and a total of 1897 records were retrieved. The date of download was August 20, 2022. After retrieval, the data were first checked article by article, and invalid records such as book reviews, interviews, newsletters, no date, no author, etc. were eliminated, and the data were de-duplicated using CiteSpace software, resulting in the 1892 remaining articles.

2.1. Literature volume and trends

Analysis of the 1892 retrieved documents reveals that blockchain-based credit research literature can be retrieved for the first time in 2015, with only two publications in the current year; from 2015 to 2020, the annual publication volume increases year by year, reaching 508 publications in a single year in 2020; there is a slight fluctuation in research results in this field in 2021, with the annual publication volume dropping to 447. In 2022, the number of publications rapidly resumed to rise, and by August 2022, the annual number of publications exceeded the highest value of 508 and had reached 603. Overall, the research on the blockchain credit field shows a significant climbing trend, as shown in Figure 1.

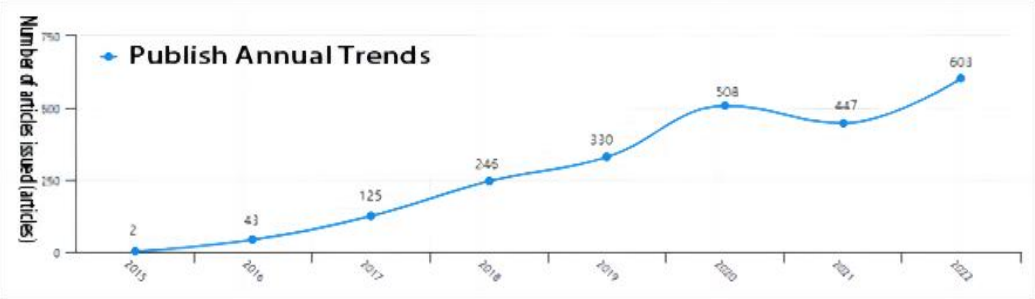

Figure 1: Changes in the number of blockchain technology-based credit published papers

2.2. Journal distribution of the literature

Among the 1,892 papers retrieved from the CNKI database, 1,354 were from academic journals, of which 57% (769) were from general journals, 28% (381) were from PKU core, and only 13% (174) were from CSSCI, most of which were of low grade, of little value, and not well researched, as shown in Figure 2.

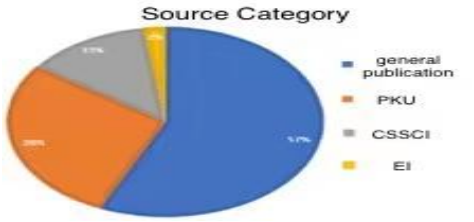

Figure 2: Distribution of the grade of published journals

The top 30 journals published a total of 348 articles, accounting for 18.39% of the total number of articles (Figure 3), indicating that the research journals in this field are more dispersed. Among them, Credit Reference published the most articles on blockchain credit, with 19 articles, accounting for 6.07% of the total number of articles, which is 11 articles higher than the second place Beijing University of Posts and Telecommunications and is an important journal source for researching this field. Seven of the major domestic financial journals (e.g., China Finance, Financial Technology, Time, etc.) are in the top 30, and the number of articles published accounts for 27.31% of the top 30 articles in the ranking, making significant contributions to the research of blockchain credit in the financial field. The subject categories to which the journals belong are mainly finance and economics, indicating that the field of blockchain credit receives more attention in the field of finance and economics.

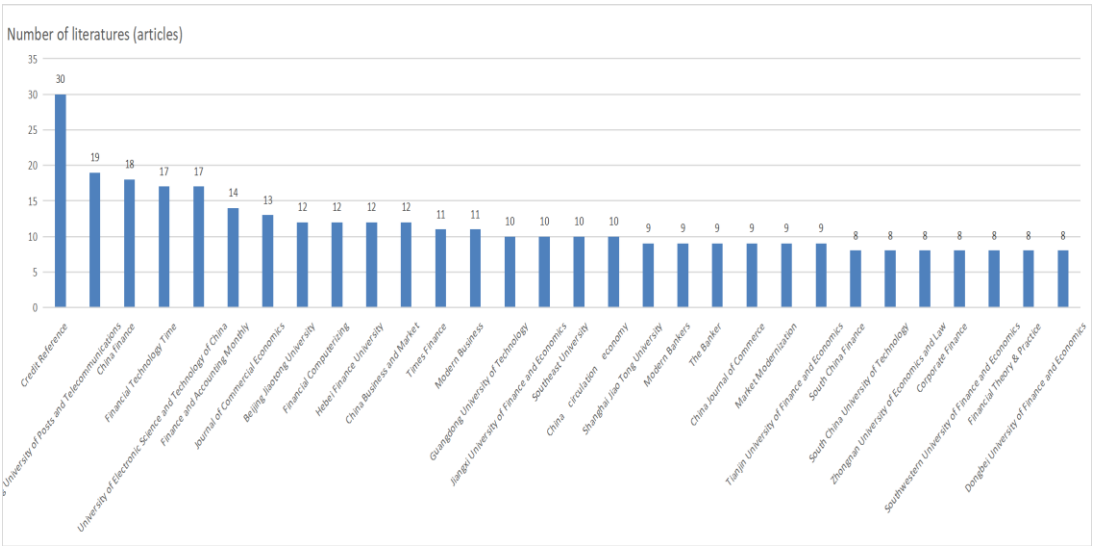

Figure 3: Distribution of Author Units (Top 30)

2.3. Literature Subject Distribution

The number of publications by discipline reflects the status of blockchain credit research in different fields. As shown in Figure 4, the main disciplinary categories of the literature include computer, finance, and economics. Among them, the computer category has the largest number of publications, accounting for 28.81%, and the finance category comes in the second, accounting for 25.70%. It can be seen that blockchain-based credit research is still developing and improving at the

technical level; at the application level, blockchain-based credit research is developing rapidly mainly in the financial field.

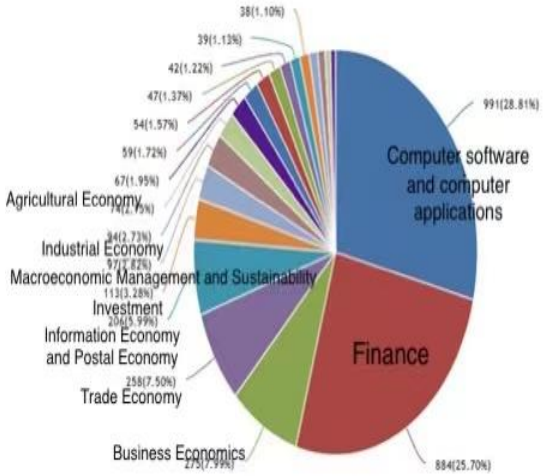

Figure 4: Distribution of disciplines of credit research based on blockchain technology

2.4. High-Yield Authors and Collaboration Veins

High-yield authors are the most active and fruitful scholars in a research field, as well as researchers who have made important contributions to the field in a certain period of time. It is important to understand the research direction, research content, and collaboration of high-yield authors to quickly understand the current research status of the field. In this paper, we set Node Types to author and institution in order in CiteSpace software, with 1 as the cut-off age, to obtain the number of publications by high-yield authors (Table 1) and the visualization map of collaborative veins (Figure 5).

Analyzing Table 1 and Figure 5, we can find that the number of articles issued by high-yield authors of blockchain-based credit research is small and the cooperation among authors is also relatively small. First of all, it can be seen from the number of articles issued by high-yield authors in Table 1 that the relevant research formed by high-yield authors represented by Minfeng Lu, Feng Han, Xin Wang, Yong Wang, Haishu Qiao, Qinghan Hu, Wenqiang Sun, and Lei Zhao, among which, the most Minfeng Lu issued only 6 articles. As can be seen from the visualization mapping of the cooperation of high-yield authors in Fig. 5, the cooperation of the authors of the relevant studies shows a scattered character, most of them are in the state of independent research, and only very few of them have established cooperation, and the cooperation is mainly in a single line, among which, only Wenqiang Sun, Jinlei Qin, Yousan Zhu, and Cheng Li from the same unit have worked together twice in this field. This indicates that blockchain-based research is relatively niche and still in the early stage, which may be related to access to data. Because of the large application cost of blockchain technology, most studies can only be analyzed theoretically, and it is more difficult to obtain relevant data, which to some extent limits the further depth of research. In addition, from the number of papers published by high-yield authors, research topics, and cooperation relationships among them, it can be found that most of the research fields of high-yield authors are technology or financial services, which indicates that the field is more inclined to the field of financial services at the application level while the technical level is continuously developed and improved. In addition, there have been distinguished authors with supply chain, justice, and government as their main research fields, indicating that blockchain-based credit research is expanding and has gradually involved many fields of social economy.

Table 1: Number of articles by high-yield authors

No.	Author(s)	Publication(s)	Research Direction
1	Minfeng Lu	6	Blockchain Finance; Financial Technology; Commercial Banks; Risk Management
2	Feng Han	4	Bitcoin; Trade Economy; Big data
3	Xin Wang	3	Blockchain Finance; Bitcoin; Supply Chain
4	Yong Wang	3	Blockchain Technology; Financial Regulation; Alliance Chain; Private Banks
5	Haishu Qiao	3	Blockchain Finance; Blockchain Technology; Digital Currencies; Sharing Finance
6	Qinghan Hu	3	Digital Supply Chains; Blockchain Finance; Game
7	Wenqiang Sun	3	Consensus mechanism; Auction Algorithm; Micro-grid (MG); Smart Contracts
8	Lei Zhao	3	Consensus Mechanism; Algorithm; Legal Regulation; Credit System

Figure 5: Co-authorship visualization mapping

Figure 6: Visual mapping of research institution collaboration

2.5. Distribution of Research Institutions

The cooperation visualization mapping and frequency ranking of research institutions are shown in Figure 6 and Table 2. As can be seen from Table 2, there are many blockchain-based credit research institutions, and institutions of higher learning are their main components and supporting forces, with Beijing University of Posts and Telecommunications, University of Electronic Science and Technology of China, Hebei Finance University, Southeast University, Beijing Jiaotong University and Tianjin University of Finance and Economics making important contributions to relevant research.

From Table 2 and Figure 6, we can see that the centrality of the top 20 institutions in terms of posting frequency is all 0, indicating that the blockchain-based credit research institutions are relatively scattered, and the cooperation and communication among institutions need to be further strengthened. From the perspective of geographical distribution, the top 20 high-producing institutions are mainly distributed in many cities such as Beijing, Shanghai, Hebei, Tianjin, and Guangdong. The geographical distribution is relatively scattered, which is not convenient for cross-fertilization and innovative cooperative research between cross-regions and cross-fields.

Table 2: Centrality of the top 20 institutions in terms of frequency of publication

No.	Name of institution	Frequency	Centrality	No.	Name of institution	Frequency	Centrality
1	Beijing University of Posts and Telecommunications	19	0	11	South China University of Technology	8	0
2	University of Electronic Science and Technology of China	18	0	12	Liaoning University	8	0
3	Hebei Finance University	16	0	13	Jiangxi University of Finance and Economics	8	0
4	Southeast University	13	0	14	Dongbei University of Finance and Economics	7	0
5	Beijing Jiaotong University	12	0	15	Hebei University of Economics and Business	7	0
6	Tianjin University of Finance and Economics	10	0	16	Southwestern University of Finance and Economics	7	0
7	Shanghai Jiao Tong University	9	0	17	East China University of Political Science and Law	7	0
8	Shanghai Univ. Of Fin. & Econ	8	0	18	Shandong University	7	0
9	Zhongnan University of Economics and Law	8	0	19	Chongqing University of Posts and Telecommunications	7	0
10	Anhui University	8	0	20	Guangdong University of Finance & Economics	7	0

2.6. Research Hotspot Analysis

Based on the statistical analysis of word frequency, 1892 blockchain-based credit research

documents were generated using a keyword co-occurrence visualization map, as shown in Figure 7, with 433 nodes, 764 connections, and a network density of 0.0082.

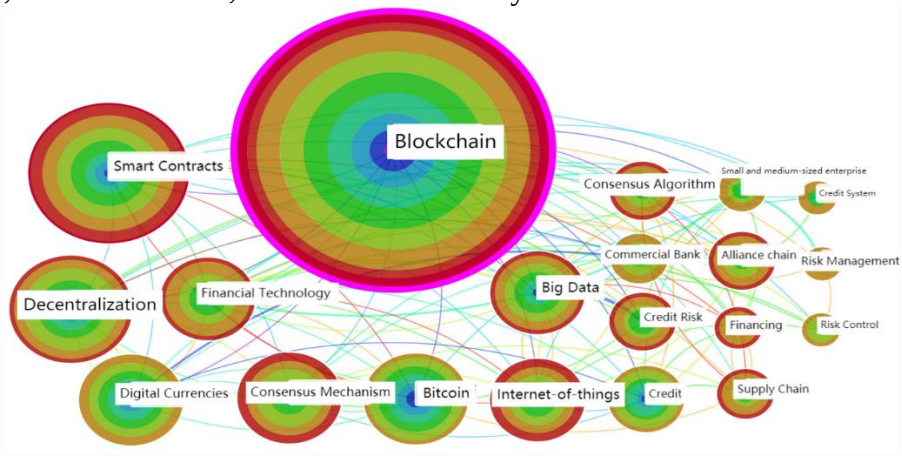

Figure 7: Keyword co-occurrence mapping

In the keyword co-occurrence visualization chart, excluding the keyword "blockchain", the keyword with the highest frequency is "smart contracts", reaching 183 times, followed by "decentralization", "digital currency", "financial technology", "bitcoin" and "consensus mechanism", etc., as shown in Table 3.

Table 3: Keyword frequency table

No.	Keyword	Year of first occurrence	Frequency	Betweenness centrality	No.	Keyword	Year of first occurrence	Frequency	Betweenness centrality
1	Smart Contracts	2015	183	0.26	12	Financial Technology	2016	37	0.03
2	Decentralization	2016	84	0.14	13	Credit Risk	2016	35	0.05
3	Digital Currencies	2015	80	0.14	14	Small and Medium-sized Enterprise (SME)	2016	32	0.04
4	Financial Technology	2017	75	0.07	15	Supply Chain	2018	29	0.05
5	Bitcoin	2015	68	0.20	16	Risk Management	2018	27	0.04
6	Consensus Mechanism	2017	63	0.13	17	Risk Control	2017	25	0.02
7	Big Data	2015	61	0.14	18	Financing	2018	25	0.03
8	Consensus Algorithm	2015	41	0.07	19	Credit System	2017	23	0.03
9	Internet-of-Things (IoT)	2015	41	0.09	20	Digital Economy	2015	21	0.04
10	Alliance Chain	2017	40	0.10	21	Artificial Intelligence	2016	21	0.06
11	Credit	2016	38	0.07	22	Data Sharing	2018	20	0.01

Clustering of keywords to get "blockchain" "smart contracts" "financial technology" "digital currencies" "supervision" "internet" "consensus mechanism" "bitcoin" "decentralization"

"Consensus algorithm" "consensus algorithm" and "inclusive finance". As shown in Figure 8, the clustering index Q=0.6404, which is greater than 0.3; S=0.8814, which is greater than 0.5, and the clustering results are reasonable.

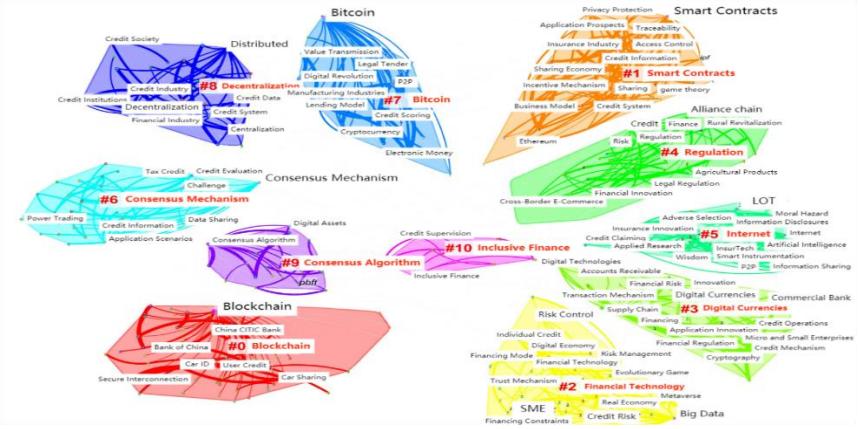

Figure 8: Keyword clustering mapping

Based on the keyword word frequency table, keyword clustering chart, and related literature analysis, we derived the hot spots of blockchain-based credit research.

3. Financial Services

Trust construction based on blockchain technology can effectively regulate enterprise default, improve financing convenience, reduce financing costs, promote trust transmission among multiple subjects, improve business revenue of financial institutions, and solve the pain points of industry development [5]. Based on the literature analysis, the hotspots of credit research in the financial service industry under blockchain technology are: the first is the application of cross-border payment represented by the keyword "cross-border e-commerce", the second is the application in the field of enterprise asset management represented by the keywords "credit risk", "risk management", "financing mode" and "financing constraints", and the third is the application in the field of supply chain finance represented by the keywords "supply chain" and "financing" [6].

Supply chain finance is based on real trade upstream and downstream of the supply chain, and information opacity seriously affects the efficiency of the whole chain; blockchain-based data deposition can effectively solve the problems of the complex cross-territory transaction process, low regulatory efficiency, bill forgery and duplicate pledges involving multiple parties in supply chain finance, reduce the credit risk of transactions, enhance the transparency of transaction flow, and improve the level of supervision [7,8].

3.1. Smart Agriculture

Compared with the application of blockchain-based credit research in the financial field, the application in the agricultural field has only just begun. Due to the unique technical advantages and trust attributes of blockchain and the industrial development needs of digital transformation and upgrading of agriculture, the application of blockchain-based credit construction in smart agriculture has been rapidly developed and now involves agricultural products traceability[9][10], agricultural finance [11], supply chain management [12] and agricultural financing, among many other business scenarios.

3.2. Judicial Deposition

Blockchain-based credit construction has natural advantages in facilitating judicial deposition due to the participation of multiple parties and the difficulty of tampering. The Supreme People's Court first recognized in September 2018 that on-chain data can be used as a basis for judicial admissibility [13], and in May 2021, further clarified the rules for determining the validity of electronic evidence stored on blockchain-based platforms. Based on the trust attribute of blockchain, it can realize the consensus witnessable of the whole node of electronic data, the security and trustworthiness of the whole chain, the record of the whole process, and the difficulty of data tampering, which can solve the painful problems such as difficult to deposit, difficult to obtain, difficult to certify, and difficult to authenticate in the litigation practice.

3.3. Government Services

Blockchain-based credit construction has an important and positive role in improving the efficiency of government services, reducing management costs, alleviating the problem of government data silos, creating a good business environment, and building a wise and trustworthy government. Personal information privacy protection and secure sharing in the Internet era face challenges, and the construction of a blockchain-based multientity participation personal credit system can achieve secure sharing while effectively protecting personal information. Blockchain-based trust construction can reduce the transaction costs of digital government governance, and at the same time, it will face problems such as value identification and resource waste. Therefore, the effective use of blockchains in government information sharing requires continuous optimization at the institutional and technical levels.

4. Hot Spot Change Analysis

Based on the visual analysis results of the timeline time zone diagram of CiteSpace, the evolution vein of credit research hotspots based on blockchain technology from 2015-2022 was obtained (Figure 9). Combining the research hotspot evolution pulse diagram and literature analysis, it is found that blockchain-based credit research has roughly gone through three development stages from 2015-2016, 2017-2018, and 2019-2022, with research hotspots ranging from "Bitcoin", "big data", "Internet-of-things (IoT)", "digital currencies", "smart contracts" "decentralization" and another blockchain basic technology research in 2015-2016, to "financial regulation", "financing", "cross-border payments", "insurance technology" and other financial fields in 2017-2018, and then to "product traceability", "risk prevention and control" "social credit" "three agricultural finance," "credit services," "logistics," "regulatory technology" "food safety" "government services" "security management" and other research in various industries. This shows that while blockchain-based credit research is developing and improving at the technical level, at the application level, it is expanding from the financial field to various fields of society, and the application scenarios are widening.

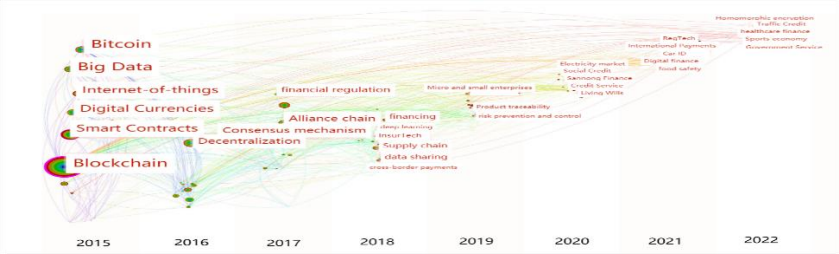

Figure 9: Keyword co-occurrence time zone mapping

Blockchain-based credit building infrastructure technology research. The initial stage of credit construction based on blockchain is mostly for scholars in computer science to focus on basic technologies, such as P2P network technology, encryption algorithm, database technology research, and continuously improve technical security, privacy protection, and efficiency to provide guarantees for the integration and development of blockchain technology and industry. Financial services is the first application field of blockchain technology. The unique advantages of blockchain distributed shared ledgers in low-cost trust building have attracted the attention of financial institutions. In the blockchain 1.0 era, blockchain-based credit construction has been practically applied in the financial sector, such as payments and remittances, smart bonds, asset issuance, and posttrade clearing and settlement. In the era of Blockchain 2.0 represented by smart contracts, increasingly funds and policies have been invested in the R&D and industrial applications of Blockchain technology, and its application scope has been rapidly expanded from the financial field to all aspects of the social economy, and academics have also started to pay attention to the application of Blockchain technology in other industries outside the financial field, such as agriculture, justice, medical care, transportation, energy, government, etc. The new development stage of multiple fields is oriented by the "trust chain". With the increase in data value, the demand for trustworthy circulation of data elements is increasing, and ensuring the authenticity and trustworthiness of the whole process of data sharing has become the key to building a trusted channel for data circulation. With the multiple impetuses of policy, technology, and market, blockchain, with its unique trust-building mechanism, begins to develop from a narrowly defined technical applications to broadly defined credible collaboration network construction and enters the blockchain 3.0 era of cross-chain communication and multichain integration. Based on blockchain, it has become a new hot spot for research in academia and industry to build a trustworthy collaboration "trust chain" across subjects, fields, and regions, and to promote data sharing and close collaboration among industrial subjects.

5. Conclusions

As the technology application continues to be deepened and implemented on the ground, the cognition and understanding of blockchain technology from all walks of life continue to deepen. While fully realizing the positive role of blockchain technology in trust construction, its limitations are increasingly discovered. The advantages of blockchain technology are not only constrained by efficiency, security, and infrastructure, but also by many obstacles such as laws, systems, and value under specific application scenarios. Therefore, later studies need to further clarify the boundaries of the technology's role, prerequisites for its application, and safeguards while focusing on the advantages of blockchain technology, and scientifically and reasonably evaluating the value of blockchain trust attributes and its limitations.

Acknowledgments

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