



Scientific and Quantitative Analysis of Blockchain in Digital Currency Applications

Ziqi Zhou¹, Tongyan Yao^{2*}, Chung-Lien Pan³

Dongguan University of Technology, Guangdong-Taiwan College of Industrial Science & Technology, Dongguan, China

¹20411163542@qq.com, ²2413246231@qq.com,

³2024032@dgut.edu.cn

Abstract. As the core mechanism of distributed ledger, blockchain technology has gradually become an independent research field since the advent of the Bitcoin white paper in 2008. Its application in digital currency has attracted extensive attention from researchers due to its decentralized characteristics and potential for financial system change. Using scientometric analysis, this paper will systematically search the Web of Science (WoS) database and screen 404 relevant research papers from 1975 to 2024. This paper's data will be visualized by VOSviewer and Bibliometrix software. Research shows that the blockchain and digital currency fields can be divided into four clusters: digitalization, financial technology (fintech) integration, etc. China and the United States lead the research. China has close cooperation with India, Brazil, and other countries. The popularity of bitcoin is rising, the discussion of blockchain security is increasing, and the central bank digital currency is a hot topic.

Keywords: Digital currency; Blockchain; Scientometric analysis

1 Introduction

As an emerging underlying technology architecture, blockchain technology is deeply integrated with the field of digital currency. It is reshaping the issuance, trading, and management mode of digital currency[1], which has had a profound impact on the entire financial system[2]. Traditional digital currency systems often rely on a central authority to maintain trust, while blockchain, with its decentralized nature, builds a distributed trust mechanism[3]. Each node keeps a full ledger[4]. The consensus algorithm ensures ledger consistency and tamper-proofing[5]. Digital currency transactions don't rely on third-party trust agencies, thus solving the trust problem among participants effectively. Blockchain uses cryptography algorithms to encrypt the transaction information of digital currency to ensure the security of transaction data[6].

However, the development of blockchain in digital currency applications has not been smooth sailing; digital currencies face risks at the technical, legal, and financial system levels[7]. To this end, scholars have proposed a series of risk management strat-

egies and evaluation methods to better deal with these risks[8,9]. In short, the convergence of blockchain technology and digital currency is demonstrably reshaping the global financial system[10].

2 Data and Methodology

To further obtain the relevant literature on the application of blockchain in digital currency, this paper uses the Scientific Network WoS database to conduct an "advanced search". TS=("Digital Currency") AND TS=("Blockchain").

As of March 7, 2025, a total of 404 articles were included in this study, covering the two core databases of SCI-EXPANDED and SSCI. VOSviewer visual analysis tool combined with Bibliometric software, was used to analyze the research data and construct a knowledge graph. The Sum of the Times Cited is 11022, the Average Citations per Item is 27.28, and the h-index is 42.

3 Research Results

This paper presents a map based on the co-occurrence network of all keywords, as well as the author's country relations, and the graph based on literature coupling cluster analysis.

3.1 Mapping Based on the Co-occurrence Network of all Keywords

Figure 1 shows a map of the co-occurrence network of 28 author keywords, which can be divided into four main clusters.

In a red cluster, the keywords such as security, privacy, and smart contracts reflect the attention to technical security, privacy protection, and smart contract applications in digital transformation. This cluster also showed the research direction of multi-faceted technology collaboration and security assurance in the digital development.

In the green blockchain cluster, focusing on Bitcoin, digital currency, and cryptocurrency. This indicated that the cluster pays attention to the research of digital currency and its related technologies and monetary systems.

In the blue cluster about fintech convergence. This showed that fintech has a close connection with blockchain and cryptocurrencies. That reflected the integration of fintech with blockchain, cryptocurrency, and other technologies, and implies the application and development of fintech in the field of digital currency.

In a yellow cluster, with smart contract as the key node, it is connected to distributed ledger and virtual currency, which shows the expansion of distributed ledger technology and virtual currency on the basis of smart contract.

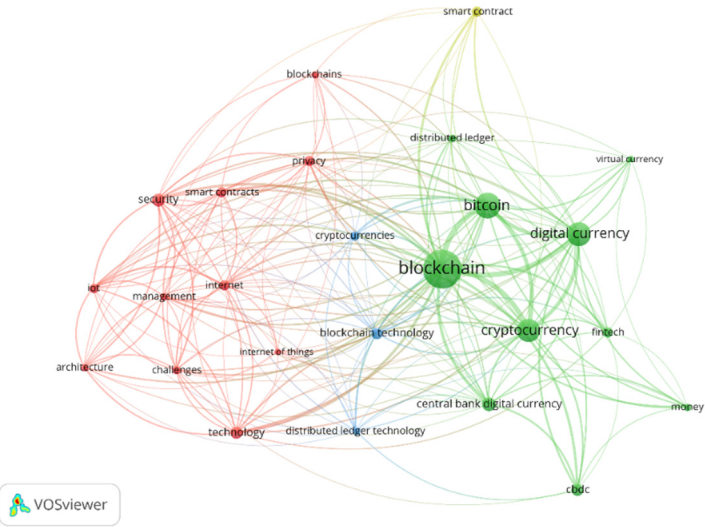


Fig. 1. Map based on the co-occurrence network of all keywords: clustering results

3.2 Analysis of the Author's Relations with the Country

Figure 2 illustrates the author-country relationship in the field of Digital Currency and Blockchain, involving multiple clusters. The green community, led by China, includes Canada and Russia, and forms strong ties with the United States, while connecting the United Kingdom, Germany, and Australia, showing that China is leading the way in the research and application of blockchain technology. Germany, Italy, Spain, and other countries in Figure 2 participate in the cooperation through the United States as a bridge, indicating that these countries have relatively little research in the field of blockchain, but still maintain a certain level of activity. Overall, China and the United States dominate the field, with other countries working together to advance blockchain technology through cooperation with these two major research powers.

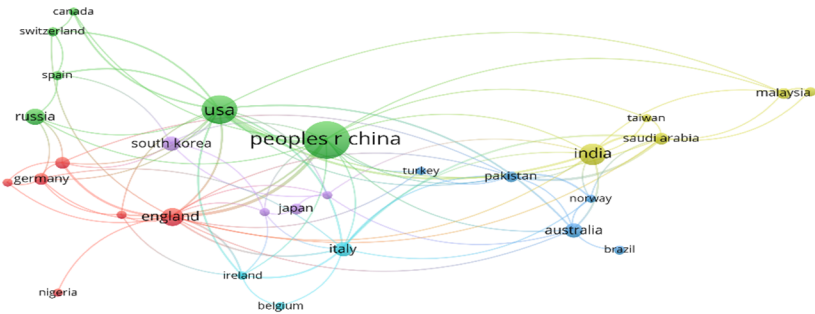


Fig. 2. Map of the author's country network

3.3 Clustering Analysis Graph based on Literature Coupling

In Figure 3, the abscissa, representing "Centrality", denotes the degree to which a particular topic functions as a nexus within the network. Higher centrality scores suggest that research within that area is highly interconnected and influences numerous other areas of study.

The analysis of academic literature reveals a nuanced landscape of influence and centrality across different research areas. The Upper Right Quadrant, dominated by Internet of Things (IoT), demonstrates a confluence of high centrality and impact, signifying its prominence within academic networks. Conversely, while current-cy-related research exhibits similar impact in the Upper Left Quadrant, its peripheral position suggests a less central role within the broader academic discourse. The Lower Right Quadrant, encompassing topics like Bitcoin, Technology, and the Internet, highlights areas central to research networks but with limited overall impact. Finally, the Lower Left Quadrant, containing terms like Bitcoin, Volatility, and Blockchain, represents subjects on the periphery of academic networks, yielding research with comparatively lower impact. This analysis underscores the diverse roles and varying levels of influence held by different research areas within the scholarly community.

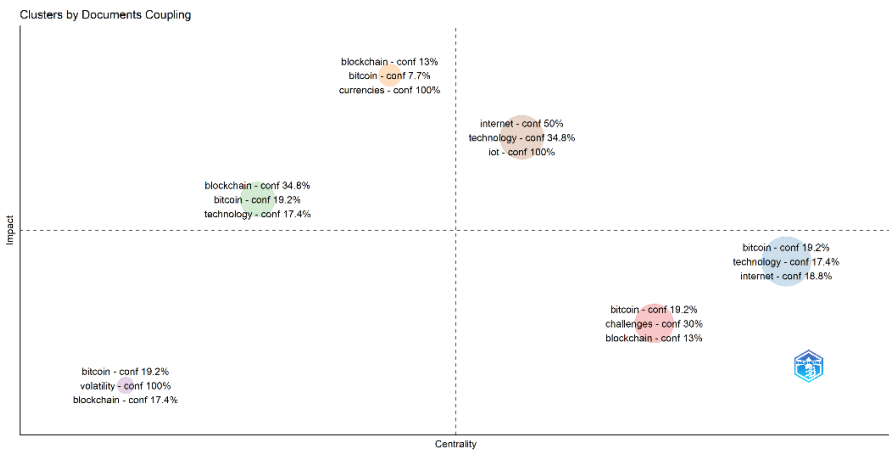


Fig. 3. Clustering analysis based on literature coupling

4 Conclusion

Blockchain technology has become the cornerstone of the evolution and implementation of digital currency. Decentralization may be its most notable feature as it eliminates dependence on intermediaries such as banks and enables peer-to-peer transactions. Additionally, the transparency inherent in a public, distributed ledger enhances trust and accountability. The integration of smart contracts could enable automated, self-executing agreements, further streamlining processes and eliminating the need for third-party oversight.

Keyword frequency analysis from 2015-2024 confirms the dominance of "blockchain" and "bitcoin," reflecting the sustained attention these topics command. International research collaborations are prevalent, positioning countries like China, the United States, and India as central hubs. Furthermore, distinct research clusters are evident, revolving around blockchain and digital currencies, each exhibiting varying influence and centrality within the field. The strong correlation between "blockchain," "digital currency," and "cryptocurrency" underscores the cohesive nature of this research domain. This bibliometric overview provides a valuable framework for future research, offering a comprehensive and insightful perspective on the applications and potential of blockchain technology within the evolving landscape of digital currencies.

References

1. Y. Lee, B. Son, H. Jang, J. Byun, T. Yoon and J. Lee, *Atomic cross-chain settlement model for central banks digital currency*, *Information Sciences*, volume 580, page838–856, Nov 2021, doi: 10.1016/j.ins.2021.09.040.
2. *Overview of business innovations and research opportunities in blockchain and introduction to the special issue | Financial Innovation | Full Text*. 2025-3-30.
3. M. S. Ali, M. Vecchio, M. Pincheira, K. Dolui, F. Antonelli and M. H. Rehmani, *Applications of Blockchains in the Internet of Things: A Comprehensive Survey*, *IEEE Communications Surveys & Tutorials*, volume 21, period 2, page 1676–1717, 2019, doi: 10.1109/COMST.2018.2886932.
4. O. I. Khalaf and G. M. Abdulsahib, *Optimized dynamic storage of data (ODSD) in IoT based on blockchain for wireless sensor networks*, *Peer-to-Peer Networking and Applications*, page 1–16, 2021, doi: 10.1007/s12083-021-01115-4.
5. Du Mingxiao; Ma Xiaofeng; Zhang Zhe; Wang Xiangwei; Chen Qijun, *A review on consensus algorithm of blockchain*. see: 2025-3-30
6. G. P. Dwyer, *The economics of Bitcoin and similar private digital currencies*, *Journal of Financial Stability*, volume 17, page 81–91, Apr 2015, doi: 10.1016/j.jfs.2014.11.006.
7. *Research on Risk Management of Digital Currency Based on Blockchain Technology in Mobile Commerce*, Wanfang data knowledge service platform. see: 2025-3-30.
8. Y. Wang, B. Lucey, S. A. Vigne and L. Yarovaya, *An index of cryptocurrency environmental attention (ICEA)*, *China Finance Review International*, volume 12, period 3, Art. period 3, Jan 2022, doi: 10.1108/CFRI-09-2021-0191.
9. *Is Bitcoin Really Untethered? - GRIFFIN - 2020 - The Journal of Finance - Wiley Online Library*. see: 2025-3-30.
10. E. Androulaki, *Hyperledger Fabric: A Distributed Operating System for Permissioned Blockchains*, *Proceedings of the Thirteenth EuroSys Conference*, Apr 2018, page 1–15. doi: 10.1145/3190508.3190538.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

