

Exploring the economic logic of the application scenario of blockchain technology—Analysis based on the perspective of information economics

Deguang Lin

School of Economics, Guangzhou College of Commerce, Guangzhou, Guangdong, China

Keywords: Blockchain technology, information economics, application scenarios, economic logic

Abstract: Blockchain technology, as an emerging distributed ledger technology, has attracted wide attention in various industries. From the perspective of information economics, this paper discusses the application scenarios and economic logic of blockchain technology in economic activities. The basic principles and characteristics of blockchain technology are outlined, emphasizing its advantages such as tamper-proof data records, decentralized trust mechanism and smart contracts. The application scenarios of blockchain technology are analyzed in the fields of supply chain management, financial services, logistics management and so on, combined with the theories of information asymmetry and incomplete information economics, and the economic logic behind the application of blockchain technology is expounded. Finally, this paper summarizes the positive role of blockchain technology in improving market efficiency, reducing transaction costs and improving information symmetry, and prospects the development trend of blockchain technology in the future. This paper aims to provide researchers and practitioners with an economic analysis framework and ideas on the application of blockchain technology, and to promote the in-depth discussion and development of this field.

1. Introduction

In the current digital age, blockchain technology, as a revolutionary distributed ledger technology, is receiving extensive attention and research. The decentralized, non-tamper-free and high security features of blockchain have brought it broad application prospects in many fields. However, with the continuous evolution and popularization of blockchain technology, its application scenarios and economic logic still need to be further explored and studied. Although blockchain technology has made some progress, there are still many challenges and unsolved problems in its practical application in business, finance, supply chain management and other fields. Therefore, it is necessary to further study the development trend, application scenarios and integration of blockchain technology with traditional technologies, so as to promote its wider application in practice, and constantly improve its economic logic and business model, so as to realize the maximum play and commercialization of blockchain technology.

In a theoretical sense, the application scenario exploration of blockchain technology involves the

effective acquisition, transmission and utilization of information, and puts forward new solutions to the problem of information asymmetry. Traditional information transmission methods have problems such as information asymmetry and incomplete information. The application of blockchain technology can improve the openness and credibility of information through the characteristics of decentralization and transparency, so as to eliminate information asymmetry, reduce the cost of information transaction, and promote the effective transmission and utilization of information. In addition, the application of blockchain technology can also realize the security and immutability of data, providing a reliable foundation and guarantee for the development of information economy.

2. Overview of the blockchain technology

2.1. Basic principles of blockchain technology

The basic principle of blockchain technology is a decentralized distributed ledger technology, whose core feature is to store data in the form of blocks and use cryptographic algorithms to ensure the security and immutability of data. Each block contains a certain amount of transaction information as well as the hash value of the previous block, and the blocks are linked by a hash pointer to form a chain. In the blockchain network, the participants reach the consensus of the data through the consensus algorithm, and realize the distributed sharing and joint maintenance of the data.

Blockchain technology is an innovative technology based on cryptography and distributed algorithms, using various means of asymmetric encryption, hash functions and consensus mechanisms to ensure the security, transparency and immutability of data. Through the introduction of decentralized storage and consensus mechanisms, blockchain technology has tamper-proof, anti-censorship and anti-attack characteristics. The storage and transmission of data on the blockchain are encrypted by cryptography to ensure the security of data, while the distributed consensus mechanism ensures the transparency and immutability of data, so that the tampering of any single node will be verified and rejected by other nodes in the system.

2.2. The characteristics and advantages of blockchain

Blockchain is a decentralized distributed ledger technology, whose data is stored on multiple nodes in the network, ensuring the security and reliability of the data, and avoiding the risk of a single point of failure and data tampering. Blockchain adopts cryptography technology to realize the immutability and transparency of the data. Any participant can view and verify the data, ensuring the credibility and transparency of the information. In addition, the blockchain has a smart contract function that can automatically execute contracts without the need for intermediaries, improving the efficiency and security of transactions[1].

Blockchain technology can also reduce transaction costs and reduce intermediary links, accelerate capital flow and information transmission, and promote the development and innovation of economic activities. Most importantly, blockchain technology is open and programmable, providing flexible and powerful support for a variety of application scenarios, covering financial services, supply chain management, the Internet of Things and other fields, and promoting the rapid development and popularization of the digital economy. Blockchain technology, with its decentralized, safe, reliable, transparent and efficient characteristics, provides new possibilities for building a trust mechanism and optimizing the economic model, which will have a profound impact on the future economic development and social change.

3. Application scenario analysis of blockchain technology from the perspective of information economics

3.1. Immutable data recording and information transparency

Blockchain technology, with its immutable data recording and information transparency, has shown great application potential in areas such as supply chain management and digital identity authentication. In terms of supply chain management, blockchain technology can realize full product traceability to ensure the quality and safety of products. For example, Wal-Mart, a world-renowned food retailer, has partnered with IBM to use blockchain technology to track the supply chain information about food, reducing the traceability time of problem products from days to seconds. Such transparency and real-time information disclosure not only improves consumers' trust in products, but also helps enterprises to find and solve supply chain problems in a timely manner and improve operational efficiency. In terms of digital identity authentication, blockchain technology can provide more secure and convenient authentication services. Traditional identity authentication methods have the risk of information leakage and identity fraud, while the blockchain-based digital identity authentication system can ensure that users' personal information is not tampered with and leaked through encryption technology. For example, the government has launched a digital identity authentication system based on blockchain technology, which allows citizens to apply for various services in the government and private sector, such as health care and voting, through one authentication, which greatly simplifies the process for citizens and protects personal privacy[2].

3.2. Decentralized trust mechanism and reduce mediation costs

Blockchain technology, as a decentralized trust mechanism, has brought about revolutionary changes to the financial services field. In the traditional financial system, transactions rely on centralized financial institutions as intermediaries, thus increasing the time and cost of transactions. The emergence of blockchain technology makes it possible to remove intermediaries, thus reducing the intermediary cost of transactions. Cryptocurrencies represented by Bitcoin is a successful application case of blockchain technology in the financial field. The bitcoin network enables direct peer-to-peer value exchange through decentralized blockchain technology, avoiding intermediaries such as banks in the traditional financial system, and thus reducing the cost and time of transactions.

The trust problem between IoT devices has always been a bottleneck restricting its development, and blockchain technology provides a decentralized trust mechanism that can effectively solve this problem. For example, smart contracts based on blockchain technology can ensure secure interactions between Internet of Things devices, thus creating a reliable trust network. Therefore, smart home devices can establish safe and reliable communication channels through blockchain technology, realizing automated management and intelligent control, without relying on centralized control centers or third-party service providers.

3.3. Improving efficiency for smart contracts and automated execution

The analysis of the application scenarios of blockchain technology from the perspective of information economics highlights the importance of the efficiency improvement of smart contract and automation execution, logistics management and intellectual property protection. Smart contracts use the immutability and decentralized characteristics of blockchain technology to realize the automated execution of contracts, and greatly improve the efficiency and security of transactions. For example, contract execution in international trade is often plagued by trust issues,

while blockchain-based smart contracts can be automated for execution, reducing disputes and transaction costs. The application of blockchain technology in logistics management has brought about revolutionary changes to supply chain management. Through the blockchain technology, the real-time monitoring and tracking of the logistics process can be realized to ensure the safety and traceability of the goods. With problems such as cumbersome document process and information asymmetry in international cargo transportation, a transparent and credible supply chain management system can be established to improve logistics efficiency and security. Due to the problems of information asymmetry and difficult traceability in the traditional intellectual property protection methods, an open and transparent intellectual property registration system can be established with blockchain technology to ensure the effective protection of intellectual property rights and interests[3]. For another example, the digital asset registration of some artworks and cultural heritage, which can realize ownership confirmation and tracking through blockchain technology, and effectively prevent the occurrence of piracy and infringement.

4. Economic logic analysis of the application scenarios of blockchain technology based on information economics

4.1. The application value of blockchain under information asymmetry and incomplete information

Information asymmetry and information asymmetry are completely common problems in the market economy, while blockchain technology provides a solution. The decentralized nature of the blockchain and the intamable data recording make the information open and transparent in the network, reducing the disadvantages brought by the information asymmetry. For example, the application of blockchain in supply chain management can ensure the fluency and transparency of information in the production process, eliminating the problem of information asymmetry between manufacturers and suppliers, and thus improving production efficiency and product quality.

The use of smart contracts makes the information more complete and credible, eliminating the problem of incomplete information in the process of contract performance. Taking financial services as an example, smart contracts based on blockchain can realize automated loan approval and execution, ensuring the symmetry of information between borrowers and lenders, reducing transaction risks, and improving the efficiency of the financial market. Blockchain technology has important application value in information asymmetry and incomplete information. Through open and transparent data recording and automatic execution of smart contracts, blockchain technology can effectively improve the problems such as information asymmetry and incomplete market inefficiency and high transaction costs. The successful practice of these application scenarios will further promote the development of blockchain technology, and provide an important theoretical and practical basis for the construction of a more fair and efficient economic system[4].

4.2. The impact of blockchain technology on market structure and industrial ecology

Blockchain technology has broken the monopoly pattern of traditional markets and promoted the intensification of market competition. In the traditional market, due to information asymmetry and centralized market structure, a few enterprises monopolize most of the resources and market share, making it difficult for other small enterprises to enter and survive. However, the decentralized nature of blockchain technology and the intamable information record make the information more transparent and open, lower the threshold of market entry, and provide development opportunities for more small enterprises and innovative enterprises. The application of blockchain technology in the field of financial services, such as decentralized finance (DeFi) platform, realizes the

decentralization and transparency of traditional financial products through smart contracts, provides financial services for more people, and breaks the monopoly position of traditional financial institutions.

Blockchain technology has promoted the upgrading and optimization of the industrial ecology, and built a healthier and more sustainable business ecosystem. The smart contract function of blockchain technology makes business cooperation more automated and transparent, and improves the efficiency and credibility of business transactions. At the same time, blockchain technology also promotes cross-border cooperation and resource sharing, breaks the boundaries of traditional industries, and promotes industrial collaboration and innovation. The application of blockchain technology in the field of supply chain management effectively improves the efficiency and security of the supply chain through the end-to-end traceability and transparency of the supply chain, and promotes the optimization and upgrading of the entire industrial chain. Blockchain technology has many impacts on the market structure and industrial ecology, which not only promotes the intensification of market competition, but also promotes the upgrading and optimization of the industrial ecology. In the future, with the continuous development and application of blockchain technology, its impact on the market and industry will be more profound and extensive.

4.3. Cost and benefit analysis of blockchain technology in economic activities

The introduction of blockchain technology may bring some implementation costs, including investment in technology development, network construction and human training. However, by reducing intermediary costs and improving transaction efficiency, blockchain technology can bring considerable economic benefits in the long term. In the traditional financial field, there are a large number of intermediaries, and the trust services they provide are expensive. However, the decentralized nature of blockchain technology makes the transaction process more efficient, reduces the intermediary cost, and improves the overall efficiency. Take Bitcoin as an example, the application of its blockchain technology eliminates bank intermediaries in traditional currency transactions, making capital transfer more efficient and low-cost, thus bringing practical economic benefits[5].

The application of blockchain technology also needs to take into account the potential costs that it may bring, and not all economic activities are suitable for adopting blockchain technology. In some low-frequency, low-value transaction scenarios, the introduction of blockchain technology may generate unnecessary additional costs, leading to uneconomic resource allocation. Therefore, it is necessary to conduct a comprehensive assessment of the cost and benefit of each specific application scenario to ensure that the application of blockchain technology can truly create value. In the field of logistics management, although blockchain technology can improve the efficiency of cargo tracking and traceability, if the frequency and scale of logistics transportation is small, the cost of introducing blockchain technology may exceed the benefits. Therefore, the application of blockchain technology needs to be carefully analyzed, quantify the cost and benefit, to determine its optimal application in economic activities.

5. Conclusions and outlook

From the perspective of information economics and the characteristics of blockchain technology, we can see that blockchain technology has great potential in solving the problems of information asymmetry and incomplete information. With features such as non-tamper data records and smart contracts, blockchain technology can improve the transparency and verifiability of information, thus reducing information asymmetry among market participants and reducing the cost of information transactions. On this basis, blockchain technology will further promote the innovation and

development of various fields, especially in finance, supply chain management, the Internet of Things and other fields of broad application prospects. In the future, with the continuous evolution and improvement of blockchain technology, we can expect the emergence of more new application scenarios to further promote the development of the digital economy.

We should also recognize that blockchain technology still faces many challenges and limitations in its practical application. The scalability and performance issues of the technology itself need to be addressed to meet the needs of large-scale applications. The uncertainty of laws, regulations and regulatory policies has also brought certain risks to the application of blockchain technology. In addition, privacy protection, data security and other issues also need to be further studied and solved. Therefore, in the development and application of blockchain technology in the future, the government, enterprises, academia and other parties need to work together to strengthen technological innovation, legal and regulation construction and market supervision, promote the healthy development of blockchain technology in the digital economy, and achieve a win-win situation of economic and social benefits.

References

- [1] Yi Li, Lu Xinyu, Tang Kun, etc. Review of blockchain consensus algorithm research [J]. *Electronic Design Engineering*, 2024, 32 (06): 161-170.
- [2] Liu Yang, Wang Feng. "Advanced Distributed System" graduate curriculum reform—takes blockchain technology as the case teaching [J]. *Science and Technology Wind*, 2024, (06): 129-132.
- [3] Jiang Xiao. Application value, system architecture and scenario analysis of financial management research in universities—Based on the thinking and enlightenment for the Construction of Blockchain and Distributed Accounting Technology Standard System [J]. *Business Accounting*, 2024, (04): 27-31.
- [4] Ouyang Shanshan. Application of blockchain technology in the exchange industry [J]. *China Securities and Futures*, 2024, (01): 17-23.
- [5] Liu Wenge, Li Zhiyuan. On the digital transformation of cross-strait judicial mutual assistance—centered on the application of judicial blockchain technology [J]. *Straits Law*, 2024,26 (01): 29-40.