Economic Analysis of Cryptocurrency: Technical Foundations, Monetary Policy Logic, and Regulatory Challenges

Yuhan Yan

Business School, University of Birmingham, Birmingham, United Kingdom
YXY468@student.bham.ac.uk

Abstract. Since the time of Bitcoin's issuance, cryptocurrencies have gradually become an important development trend in the field of financial science and technology, and their operating logic is fundamentally different from that of the traditional monetary system. The rules for the issuance and distribution of cryptocurrencies are usually built into the program code, and the total amount, the pace of issuance, and the incentive mechanism are all set by algorithms, forming a decentralized and self-executing 'monetary policy', thus replacing the regulatory function of the central bank. At the same time, it realizes the functions of data tampering, node consensus, and automatic execution of smart contracts through blockchain technology, and builds a financial infrastructure without the need for trust intermediaries. Based on the technical principles of cryptocurrencies, this paper focuses on analyzing their intrinsic laws of operation and economic implications, assessing their feasibility as a monetary tool, and exploring the challenges facing the existing regulatory system. The study aims to clarify the institutional logic of cryptocurrencies and enhance the systematic understanding of their economic functions and policy risks.

Keywords: Bitcoin, Cryptocurrencies, Finance, Blockchain, Monetary policy.

1 Introduction

Since the issuance of Bitcoin in 2009, cryptocurrencies have gradually become an important development trend in the field of financial technology. However, initially, the recognition of digital currencies by various countries was not high. It was not until 2019 that Facebook's first version of the Libra cryptocurrency white paper made a significant impact on the positive views of the world towards cryptocurrencies, promoting the development of cryptocurrencies. The world's cryptocurrencies can be roughly divided into private cryptocurrencies (such as Bitcoin) and central bank cryptocurrencies (such as CBDC). However, the monetary operation logic of both still has essential differences from the traditional monetary system. Traditional currencies rely on the unified management of the central bank, while cryptocurrencies achieve decentralized transactions. As a type of private cryptocurrency, the issuance and distribution rules of Bitcoin are usually built into the program code, with the total amount, issuance rhythm, incentive

A. J. Moshayedi (ed.), *Proceedings of the 2025 International Conference on Hybrid Commerce, Human Capital, and Economic Dynamics (ICHCH 2025)*, Advances in Economics, Business and Management Research 374,
https://doi.org/10.2991/978-2-38476-585-0_7

mechanism, etc. set by algorithms, forming a decentralized, self-executing "monetary policy", thereby replacing the regulatory functions of the central bank. At the same time, the birth of Bitcoin brought about blockchain technology. Through blockchain technology, Bitcoin achieved functions such as data tampering, node consensus, and automatic execution of smart contracts, building a financial infrastructure without the need for trusted intermediaries, laying the foundation for the subsequent birth of stablecoins marked by Libra and Tether, as well as the approximately 8,866 cryptocurrencies that have emerged so far. This article, based on the technical principles of cryptocurrencies, focuses on analyzing their internal operating rules and economic implications, assessing the feasibility of cryptocurrencies as a monetary tool, discussing the challenges faced by the existing regulatory systems for cryptocurrencies, and conducting analysis and research based on some documents. The aim of this article is to clarify the institutional logic of cryptocurrencies, strengthen the systematic understanding of their economic functions and policy risks, and discuss the development of cryptocurrencies under regulatory policies. Through case studies, it will be discussed, and relevant regulatory suggestions will be made.

2 Theory

2.1 Technological Infrastructure

The principle of cryptocurrency is analyzed and its technological basis is blockchain, and “it is a digital blockchain, where cryptography is used to encrypt transactions” [1], which has the characteristics of decentralization, means no need to trust third-party institutions; distributed ledger, means all nodes work together to maintain the consistency of data; and consensus mechanisms, such as PoW and PoS, which can be referred to as an example of the introduction of smart contracts in Ether. The introduction of smart contracts on the Ethernet provides the basis for decentralized finance (DeFi) by making it possible to automatically enforce rules on the chain through pre-set rules and logic. In contrast to traditional financial institutions, which essentially enable the allocation of funds, risk management and exchange of value through a set of institutionalized and technological systems, blockchain technology will help to reduce the complexity that exists in the business, including that caused by the involvement of multiple parties in the system. The main problem in the business is the involvement of core people at every stage. By using blockchain technology, core personnel can be eliminated, and transactions can be allowed to take place between the parties involved in the blockchain collaboration, thus executing innovative contracts. It can be said that with blockchain technology, it can remove redundant personnel from the system. Blockchain has numerous highlights that can help various industries to utilize the technology profitably [1]. These technologies of cryptocurrencies fundamentally break the “monopoly of trust” of traditional financial institutions, but they also pose risks.

2.2 The Logic of Monetary Policy

Based on the analysis of whether cryptocurrencies can circulate as formal currencies, it mainly depends on their operation rules. Comparing the operating rules of traditional

currencies and cryptocurrencies, it can be found that traditional monetary policy is led by the central bank, and the regulatory means include interest rates, open market operations, etc., whereas cryptocurrencies usually have their monetary rules embedded in the code, and provide payment records for the transactions through the distributed bookkeeping technology used in blockchain technology, and achieve decentralized transactions through the "mining" mechanism to achieve "peer-to-peer" transactions between the buyer and the seller. Cryptocurrency rules are usually embedded in the code, while cryptocurrency rules are usually embedded in the code, and cryptocurrency rules are usually embedded in the code [2]. For example, Bitcoin uses a combination of a total limit and a halving mechanism, with a constant total of 21 million bitcoins and a halving of the reward for every 210,000 blocks generated Bitcoin uses a constant total of 21 million bitcoins, a halving of the reward for every 210,000 blocks generated, and a difficulty adjustment algorithm to achieve a constant and stable issuance rate Stable coins such as USDT and DAI attempt to anchor to fiat currencies, with a 1:1 ratio, and a 1:1 ratio for all coins. Fiat currencies, with 1:1 transaction; and algorithmic stable coins such as UST rely on code to regulate supply and demand. These mechanisms seem to have a certain degree of stealth and stability, but due to the lack of central bank credit endorsement, their operational stability is questionable [3].

2.3 Regulatory Challenges and Global Responses

The nature of cryptocurrencies is a ‘technology-driven de-trusted system’, whose anonymity, cross-border nature and volatility increase the difficulty of regulation, and the lack of uniformity in transaction addresses and identities may involve risks such as money-laundering, tax evasion and illegal financing [4]. As a matter of fact, cryptocurrencies are more dependent on market demand and supply and user consensus, and the regulatory policies for cryptocurrencies vary from country to country, so price fluctuations or system failures may threaten financial stability. Countries have adopted different policies in this regard, such as the United States, which adopts partial regulation, with the SEC and the CFTC sharing responsibilities to achieve regulatory activities, China, which bans related trading activities, and the European Union, which has established the MiCA unified regulatory framework. So, does regulation focus on the technology itself or the consequences of behavior? Due to the decentralized nature of blockchain, it is more difficult to directly regulate the technology itself; public chains cannot be shut down directly and can only be regulated at the point of access, and then again, for example, privacy coins or fully anonymized networks, which will be harder to track. The regulation of behavioral consequences usually occurs after the violation of the law, when the subject is clear, and can be directed at the exchange, the project side, users, and other actors, rather than the blockchain protocol itself.

3 Case Study

3.1 Bitcoin

In relevant literature, Bitcoin is often compared to gold and is even referred to as "digital gold" or "new gold". The similarities between Bitcoin and gold lie in the fact that

both have market values far exceeding their intrinsic values, and both are derived from the scarcity of supply and the high cost of mining; neither has national attributes, and their supply is not controlled by the government. The fact is that Bitcoin is still very different from gold. Although the issuer defined bitcoin as a currency when it was created, due to the volatile nature of bitcoin, people who are interested in investing in it usually use it to preserve value to cope with tough economic situations. The most common example of this is when people buy gold, mainly because of its value preservation function, which is made difficult by the volatility of bitcoin prices [5]. Data shows that Bitcoin rose by more than 100% in 2021, but dropped significantly in 2022, and its investment attribute exceeded its monetary function [6]. However, due to its difficulty in fulfilling its payment and accounting functions, its monetary mechanism is closer to an asset rather than a stable currency [7]. Therefore, the question of whether cryptocurrencies can replace traditional currencies and become legal tender remains to be discussed.

3.2 Singapore's Crypto Regulation

Singapore has become one of the world's 'regulation-friendly' models in terms of its openness to cryptocurrency regulation while maintaining market health through precise enforcement. The measures it has taken include the following. First, tiered licenses, which are according to the risk of the scale of the business (e.g. MPIs need to meet higher capital requirements). Second, technology-neutral, no ban on privacy coins or DeFi, but requires compliance by access parties (e.g., exchanges). Third, Sandbox, allow companies to test innovative products (e.g. stable coins) in a 'fintech sandbox'. Fourth, global collaboration, following the FATF 'travel rules', which require exchanges to share information on both sides of a transfer [8]. Singapore is one of the few countries in the world that has been able to attract crypto innovation while controlling risk through a model of 'clear rules + strict enforcement'. Its experience shows that regulatory transparency and risk isolation (such as user funds custody) are important factors for balancing the development of the industry. The rules formulated by the Monetary Authority of Singapore (MAS) for cryptocurrency exchanges have clarified the requirements, thereby reducing the risks of fraud and money laundering using cryptocurrencies [9].

3.3 Discussion

The above discussion suggests that cryptocurrencies have the potential to develop without being subject to macroeconomic controls by Governments and financial institutions that could lead to a loss in their value, thereby affecting the standard of living and asset reserves of ordinary citizens. However, it is worth noting that they have the potential to replace fiat currencies and there is opacity in their transactions, thus affecting the effectiveness of the implementation of monetary policy regulation, reducing the amount of tax revenue and mint taxes that governments can levy, and even affecting the security of services and infrastructural resources for all citizens, so privatized and borderless cryptocurrencies may exacerbate global inequalities, but stablecoins will perhaps be a central focus of regulation [10]. Moreover, the core logic of regulation lies in regulating behavioral outcomes and indirectly regulating technology. Based on the discussion in the regulatory context of Singapore, the areas of regulations can be focused on in the

future: (1) AML/CFT, (2) securities and financial regulation, and (3) theft, misappropriation, and fraud [8]. For related follow-up research can be centered on DeFi risk assessment, CBDC implementation path, and on-chain governance design.

4 Conclusion

After the above discussion and the analysis of relevant cases, this study can draw the conclusion that it is difficult for cryptocurrencies to completely replace fiat currencies. Bitcoin is used as an example to illustrate this point. Because of its significant investment characteristics, bitcoin holders typically use bitcoin as a risk diversifier rather than a hedge against traditional risky assets (such as stocks, bonds, and related commodities with investment attributes), especially in the face of severe external economic shocks. However, the coexistence of fiat currencies and cryptocurrencies may impose constraints on central banks, thereby giving rise to innovations, such as the emergence of CBDCs, which help central banks retain their dominance over the monetary power in the face of the economic pressure brought by cryptocurrencies. Regarding the decentralized nature, concealment, cross-border nature, and volatility of cryptocurrencies, regulation should adopt a transparent and risk-isolated regulatory approach, and continuously adopt new regulatory models based on changes in the cryptocurrency market, to form a stable and powerful regulatory environment, gradually reducing the systemic risk of the cryptocurrency market in the economy. It is recommended to pay attention to the money laundering risks brought by cryptocurrencies and their transaction concealment characteristics and adopt relevant policies and measures to maintain a good economic environment, achieve and promote the development of new finance, and at the same time achieve the balance between traditional finance and emerging finance.

References

1. Yadav, S.P., Agrawal, K.K., Bhati, B.S., Al-Turjman, F., Mostarda, L.: Blockchain-based cryptocurrency regulation: an overview. Computational Economics **59**, (2020)
2. Kumar, R., Arunkumar, D.T., Sinha, R.K.: Analyzing regulations and standards for cryptocurrency algorithms. In: 2022 13th International Conference on Computing Communication and Networking Technologies (ICCCNT), pp. 1-6 (2024)
3. Cryptocurrency and traditional financial systems: exploring the impact of cryptocurrencies on traditional banking systems, financial regulations, and monetary policies. International Journal of Business and Management Sciences **6**(1), 587-609 (2025)
4. Masharsky, A., Skvortsov, I.: Problems and prospects of cryptocurrency development. In: Lecture Notes in Mechanical Engineering, pp. 435-444 (2021)
5. Wang, P., Liu, X., Wu, S.: Dynamic linkage between Bitcoin and traditional financial assets: a comparative analysis of different time frequencies. Entropy **24**(11), 1565 (2022)
6. White, R., Marinakis, Y., Islam, N., Walsh, S.: Is Bitcoin a currency, a technology-based product, or something else? Technological Forecasting and Social Change **151**(1), 119877 (2020)
7. Alfieri, E., Burlacu, R., Enjolras, G.: On the nature and financial performance of Bitcoin. The Journal of Risk Finance **20**(2), 114-137 (2019)

8. Alekseenko, A.P.: Legal regulation of the use of distributed ledger technologies in financial sector of Singapore. Revista de Investigaciones Universidad del Quindío **34**(S2), 381-391 (2022)
9. Handbook of Digital Currency: Bitcoin, Innovation, Financial. Elsevier Academic Press (2023)
10. Vaz, J., Brown, K.: Sustainable development and cryptocurrencies as private money. Journal of Industrial and Business Economics **47**(1), 163-184 (2019)