

Blockchain as the Institutional Substitute for Central Banking in Cryptocurrency Systems A Systematic Review

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ABSTRACT: The emergence of cryptocurrencies has challenged traditional institution-based monetary systems governed by central banks. Unlike fiat currencies, cryptocurrencies operate without centralized authorities and instead rely on blockchain technology to manage transaction validation, record-keeping, and currency issuance. This study examines whether blockchain functions as an institutional substitute for central banking within cryptocurrency systems.

Using a qualitative systematic literature review methodology guided by the PRISMA framework, the study synthesizes evidence from peer-reviewed academic literature, working papers, international financial institution reports, World Economic Forum publications, and central bank documents. The findings reveal a clear functional convergence between traditional banking systems and blockchain-based cryptocurrencies. Blockchain replicates key central banking functions such as ledger maintenance, transaction verification, and monetary discipline through decentralized consensus mechanisms and algorithmic rules.

However, the absence of a centralized apex authority introduces risks related to monetary sovereignty, regulatory oversight, and financial stability. The study concludes that blockchain-based cryptocurrencies represent an alternative monetary infrastructure rather than merely a technological innovation, carrying significant implications for future monetary governance.

KEYWORDS: Blockchain, Central Banking, Cryptocurrency, Monetary Governance, Decentralization

INTRODUCTION

Money has evolved continuously to address the limitations of earlier exchange systems. Early economies relied on the barter system, or a commodity-to-commodity (C-C) economy, which was constrained by the problem of double coincidence of wants. To overcome this, societies adopted commodity money in the form of gold and silver, which functioned as full-bodied money with intrinsic value. However, the natural scarcity of these metals limited their ability to support expanding economic activity.

With the growth of trade, metallic coinage issued by ruling authorities emerged, standardizing value but remaining inconvenient for large-scale transactions due to weight and transport difficulties. This led to the adoption of paper currency, or fiat (fiduciary) money, whose value is derived from state authority and legal tender status. Fiat money enhanced transactional efficiency but introduced challenges related to security and centralized control.

Advancements in financial technology further shifted monetary systems toward plastic money (debit and credit cards) and later electronic money, enabling cashless and contactless transactions, particularly evident during periods such as the COVID-19 pandemic. Alongside these developments, cryptocurrencies emerged as a distinct form of money operating outside traditional banking structures. Unlike fiat currency, cryptocurrencies are not issued or regulated by central banks; instead, they rely on blockchain technology, a decentralized ledger that records, verifies, and limits currency supply through cryptographic and consensus mechanisms.

This evolution highlights a fundamental shift from institution-based monetary governance to algorithm-driven, decentralized systems, raising important questions about how blockchain substitutes the traditional functions of banking in cryptocurrency ecosystems.

Banking System in a Country: The banking system of any country broadly consists of two types of institutions: the Central Bank and Commercial Banks. The Central Bank functions as the apex monetary authority and is responsible for issuing currency, acting as the banker to the government and to commercial banks, and controlling credit to ensure monetary stability. It formulates and implements monetary policy to regulate money supply and inflation.

Commercial Banks, on the other hand, operate directly with the public. Their primary functions include accepting deposits, providing loans, creating credit, and offering agency services. While commercial banks facilitate day-to-day financial transactions for individuals and businesses, the Central Bank performs similar supervisory and regulatory functions for banks and the government. Together, these institutions form the core of a country's financial system, ensuring stability, liquidity, and efficient allocation of credit.

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Rise of crypto: Cryptocurrency began with Bitcoin, created in 2009 by an anonymous developer or group known as Satoshi Nakamoto. Bitcoin introduced a decentralized digital money system using blockchain technology, which records and verifies transactions without any central authority. Although Nakamoto's true identity remains unknown, Bitcoin's launch marked the beginning of the entire crypto world.

Blockchain Technology: Blockchain is a decentralized distributed ledger technology that securely records transactions across a network of participants without the need for a central authority. Transactions are grouped into blocks and linked using cryptographic hashes, creating an immutable and transparent record that cannot be altered once verified.

Blockchain relies on consensus mechanisms such as Proof of Work or Proof of Stake to validate transactions, ensuring trust and security through cryptography rather than institutional control. In cryptocurrency systems, blockchain maintains transaction records, regulates currency supply through predefined algorithms, and prevents double spending, thereby functioning as the core infrastructure of decentralized digital money.

LITERATURE REVIEW

The literature on blockchain and digital currencies converges around three key themes: blockchain as a technological infrastructure, cryptocurrencies as decentralized monetary systems, and institutional responses by central banks and global financial bodies. Collectively, this literature frames blockchain not merely as a technological innovation but as a potential alternative monetary architecture.

Peer-reviewed studies highlight the functional overlap between blockchain systems and traditional banking institutions. Zhang and Huang (2022) demonstrate how blockchain can support monetary functions typically performed by central banks, while emphasizing governance and scalability constraints, particularly when comparing permissioned and permissionless systems. Xu et al. (2019) provide foundational insights into blockchain's core characteristics decentralization, immutability, and transparency which underpin cryptocurrency systems, even though their focus remains broader than monetary governance. Empirical evidence from Guo et al. (2025) further suggests that rising cryptocurrency adoption pressures central banks to accelerate CBDC development in order to preserve monetary sovereignty, indicating that crypto-assets challenge institutional monetary authority rather than merely introducing technological change.

Complementing this literature, working papers emphasize blockchain's role in replacing centralized monetary authority with protocol-driven governance. Research on Nakamoto-inspired architectures explains how consensus mechanisms, cryptographic verification, and economic incentives collectively substitute institutional trust with algorithmic trust. Studies on decentralized finance extend this argument by demonstrating how blockchain-based systems replicate core financial functions such as payments, lending, and settlement without intermediaries, while embedding monetary rules directly into code through predefined issuance schedules and governance protocols.

Institutional reports from international financial organizations reinforce these findings from a policy perspective. The Bank for International Settlements highlights that cryptocurrencies and stablecoins increasingly perform banking functions, particularly in cross-border payments, thereby complicating capital controls and monetary supervision (BIS, 2023). Rey (2022) argues that global stablecoins may weaken national monetary sovereignty, especially in developing economies, a concern echoed in BIS–FSB regulatory frameworks. Similarly, World Economic Forum analyses recognize blockchain as a disruptive financial infrastructure while emphasizing the macroeconomic risks posed by decentralized currencies.

Central bank publications, particularly from the Reserve Bank of India, consistently frame cryptocurrencies as incompatible with hierarchical monetary governance. RBI documents stress risks to monetary stability, regulatory compliance, and policy transmission, while positioning CBDCs as sovereign, controlled alternatives to decentralized cryptocurrencies (RBI, 2019; RBI, 2022). Taken together, the literature supports the view that blockchain-enabled cryptocurrencies constitute an alternative monetary infrastructure, fundamentally distinct from institution-based banking systems, thereby justifying the comparative framework adopted in this study.

Research Gap: While existing literature extensively examines blockchain technology, cryptocurrency adoption, and central bank responses independently, there is limited systematic analysis that directly compares blockchain's functional role with the institutional functions of central banking.

Problem Statement: Traditional monetary systems rely on centralized institutions particularly central banks to manage currency issuance, regulate money supply, and maintain trust and stability. However, cryptocurrencies operate without such institutions, raising fundamental questions about how monetary order is achieved in decentralized systems. This study seeks to examine whether blockchain technology can function as an institutional substitute for central banking by replicating core banking functions through algorithmic and decentralized mechanisms.

Research Question

How does blockchain replicate and replace the core functions of a traditional banking system in managing, recording, and regulating cryptocurrency supply?

CONCEPTUAL FRAMEWORK

This study is grounded in a comparative conceptual framework that examines the traditional banking system architecture alongside the blockchain-based cryptocurrency architecture. The framework highlights how both systems perform similar economic functions such as record-keeping, value transfer, and trust creation while relying on fundamentally different governance structures.

Banking System Architecture: In a traditional financial system, the banking architecture is centralized and hierarchical. At the apex lies the Central Bank, such as the Reserve Bank of India (RBI), which acts as the supreme monetary authority of the country. The central bank is responsible for issuing currency, formulating monetary policy, controlling credit, maintaining price stability, and acting as the banker to both the government and commercial banks.

Below the central bank are commercial banks, which serve as intermediaries between the central bank and the public. Commercial banks accept deposits, extend credit, create money through the credit creation process, and provide various financial and agency services. They operate under the regulatory oversight of the central bank and must comply with statutory requirements such as reserve ratios and prudential norms.

At the base of this structure is the public, comprising households, firms, and governments, who use banking services for savings, borrowing, payments, and investments. Trust in this system is derived from institutional authority, regulation, and state backing, making the central bank the ultimate guarantor of monetary stability.

Blockchain Architecture: In contrast, the blockchain-based cryptocurrency system follows a decentralized and non-hierarchical architecture. Instead of a central authority, the system is maintained by a network of nodes, which are independent participants running blockchain software. Each node holds a copy of the distributed ledger and participates in transaction verification.

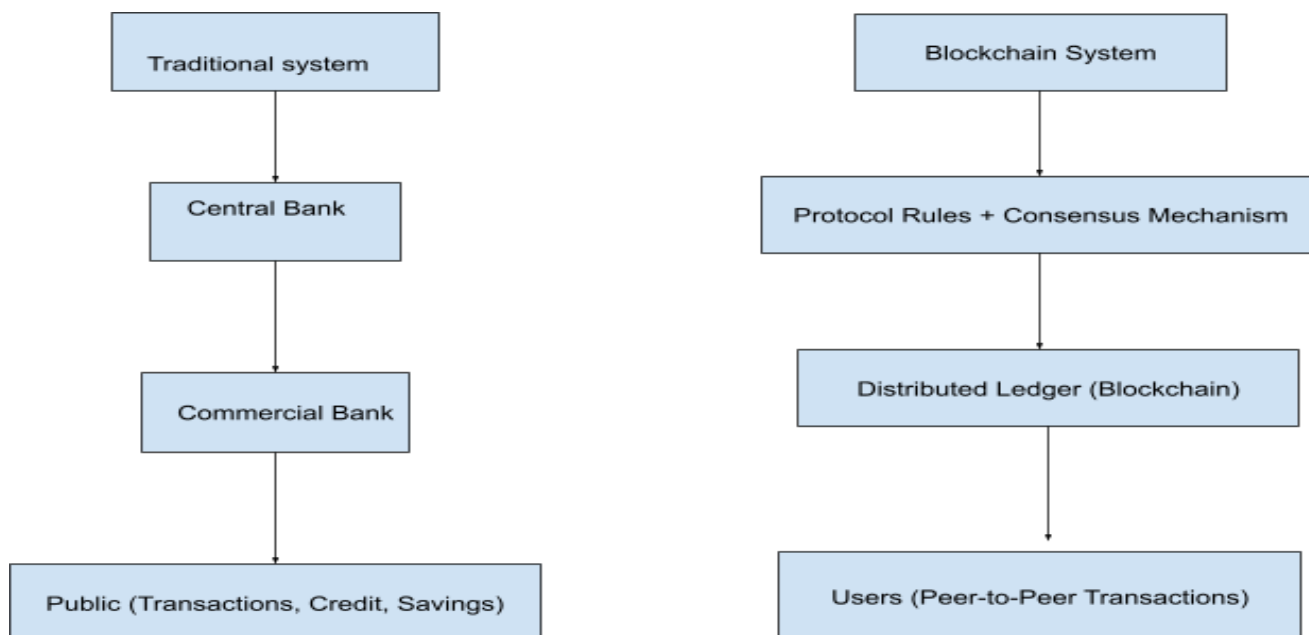
Transactions are validated through consensus mechanisms such as Proof of Work (PoW) or Proof of Stake (PoS). These mechanisms replace the role of a central bank by ensuring agreement among network participants regarding the validity of transactions. Consensus rules are embedded in code and enforced automatically, leaving minimal scope for discretionary intervention.

Once validated, transactions are recorded on a distributed ledger (blockchain), which is immutable and transparent. All participants can verify transactions, although identities remain pseudonymous. The ledger itself becomes the primary source of trust, maintained through cryptography and collective verification rather than institutional oversight.

Functional Comparison of the Two Systems: Although structurally different, both systems perform similar core financial functions:

- **Record-Keeping:** Banks maintain centralized ledgers, while blockchain maintains a distributed ledger.
- **Trust Creation:** Traditional systems rely on trust in institutions and regulation; blockchain relies on cryptographic verification and consensus.
- **Money Supply Management:** Central banks actively manage money supply through policy tools, whereas cryptocurrencies follow predefined algorithmic rules that determine issuance and supply.
- **Transaction Validation:** Banks validate transactions through centralized clearing mechanisms; blockchain validates transactions through decentralized consensus.

This comparison suggests that blockchain performs many functions analogous to a banking system, particularly those of record maintenance, transaction validation, and monetary discipline, but does so without a sovereign authority or centralized control.



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Relevance to the Study: This conceptual framework provides the foundation for analyzing blockchain as an institutional substitute rather than a technological extension of traditional banking. By mapping the functional equivalence between the two architectures, the study examines whether blockchain can be understood as a decentralized alternative to central banking functions in cryptocurrency ecosystems.

Review Objectives

- 1) Understanding blockchain as a monetary infrastructure
- 2) Comparing central banking functions vs blockchain mechanisms
- 3) Evaluating decentralization, trust, and monetary control

METHODOLOGY: SYSTEMATIC LITERATURE REVIEW (PRISMA FRAMEWORK)

Research Design: This study adopts a qualitative systematic literature review methodology following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The objective is to synthesize academic, policy, and institutional literature examining blockchain as a monetary and institutional framework for cryptocurrencies.

Data Sources: A comprehensive literature search was conducted across multiple data sources, including peer-reviewed academic journals, working papers and preprints, reports from international financial institutions, publications from the World Economic Forum, and official central bank documents. These sources were selected to capture scholarly, policy-oriented, and sovereign perspectives on blockchain technology, cryptocurrencies, and monetary governance.

Inclusion and Exclusion Criteria: Studies were included if they: (i) were published after 2010, (ii) were written in English, (iii) discussed blockchain, cryptocurrencies, central banking, monetary control, or decentralization, and (iv) were published in scholarly journals or by credible institutional bodies.

Table 1: Functional Comparison Between Traditional Banking Systems and Blockchain-Based Cryptocurrency Systems

Function	Traditional Banking System	Blockchain-Based Crypto System
Currency Issuance	Central Bank discretion	Algorithmic, pre-defined
Money Supply Control	Monetary policy tools	Fixed or rule-based supply
Record-Keeping	Centralized bank ledgers	Distributed ledger
Trust Mechanism	Institutional authority	Cryptography & consensus
Transaction Validation	Banks & clearing houses	Network consensus
Apex Authority	Central Bank	No central authority

Source: Created by the researcher

Peer Reviewed: This study adopted a Qualitative Systematic Literature Review following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. A comprehensive literature search was conducted across peer-reviewed journals, working papers, and institutional reports related to blockchain technology, cryptocurrencies, and monetary systems.

Studies were included if they: (i) were published after 2010, (ii) were written in English, (iii) discussed blockchain, cryptocurrencies, central banking, monetary control, or decentralization, and (iv) were published in scholarly journals or by credible institutions.

Studies were excluded if they primarily focused on technical or computer-science-specific aspects such as cryptographic algorithms or consensus security without direct relevance to monetary systems, banking architecture, or institutional analysis. Opinion blogs, promotional crypto content, and non-academic news articles were also excluded.

Based on these criteria, four articles were assessed for eligibility. One article was excluded due to its exclusive focus on technical security mechanisms, while three articles met the inclusion criteria and were retained for qualitative synthesis.

Working Papers: In addition to peer-reviewed journal literature, this study evaluated selected working papers and preprints from ArXiv to capture emerging concepts in decentralized monetary systems. Working papers were included if they examined blockchain governance, decentralized finance, or monetary system design without a central authority. Technical surveys focusing solely on consensus mechanisms were included as *background context* but not as primary evidence for monetary governance analysis. Two working papers were retained: one focusing on decentralized finance protocols and governance, and another offering insights into blockchain consensus mechanisms relevant to decentralization. Two additional papers could not be evaluated due to missing or incorrect identifiers, and are pending review upon receipt of accurate titles or PDFs.

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International financial institutions: In addition to academic literature and working papers, this study incorporated reports published by international financial institutions to capture policy-oriented and institutional perspectives on cryptocurrencies and blockchain-based systems. Reports issued by the Bank for International Settlements (BIS), the Financial Stability Board (FSB), and leading monetary economists were included where they addressed cryptocurrency functions, cross-border flows, monetary sovereignty, or regulatory responses. All identified institutional reports met the inclusion criteria and were retained for qualitative synthesis, with distinctions made between core analytical sources and contextual policy references.

World Economic Forum: Reports published by the World Economic Forum were included to capture policy-oriented and institutional perspectives on blockchain, cryptocurrencies, and central banking. WEF publications were included where they addressed distributed ledger technology, digital currencies, macroeconomic implications, or central bank policy responses. Reports that focused exclusively on technical implementation details without addressing monetary governance or institutional comparison were excluded. Based on these criteria, four WEF reports were retained for qualitative synthesis, while one was excluded due to its narrow technical scope.

Central Bank: Official publications issued by the Reserve Bank of India were included to capture sovereign and institutional perspectives on digital currencies, cryptocurrencies, and monetary governance. RBI documents were retained where they addressed central bank digital currencies, virtual currency regulation, payment system evolution, or monetary policy concerns. Documents focused on operational implementation or regulatory compliance were included as contextual evidence, while analytically substantive reports were treated as core sources. All identified RBI documents met the inclusion criteria and were retained for qualitative synthesis.

This study adopted a qualitative systematic literature review methodology in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The review aimed to synthesize academic, policy, and institutional literature examining blockchain as a monetary and institutional infrastructure for cryptocurrencies.

Literature was identified from five evidence streams: (i) peer-reviewed academic journals, (ii) working papers and preprints, (iii) international financial institution reports, (iv) World Economic Forum publications, and (v) central bank documents. Inclusion criteria required sources to be published after 2010, written in English, and to address blockchain, cryptocurrencies, monetary governance, decentralization, or central banking.

Key Findings

The PRISMA screening process resulted in the identification of multiple evidence streams, each evaluated separately to ensure methodological rigor.

From peer-reviewed academic literature, four studies were identified, of which three met the inclusion criteria and were retained for qualitative synthesis. One study was excluded due to its exclusive technical focus.

From working papers and preprints, four records were identified. Two papers were included for analysis one as core evidence on decentralized governance and one as background support while two papers remained pending due to incomplete identifiers.

All identified reports from international financial institutions, the World Economic Forum, and the Reserve Bank of India met the inclusion criteria and were retained, with distinctions made between core analytical sources and contextual or policy-oriented documents.

Key Outcomes

The PRISMA-based systematic review yielded a structured, multi-layered body of evidence demonstrating a clear functional convergence between blockchain-based cryptocurrency systems and traditional banking institutions. Across academic, institutional, and central bank sources, the literature consistently indicates that blockchain technology performs key monetary and financial functions such as record-keeping, transaction validation, supply discipline, and trust creation without reliance on centralized authorities.

At the same time, institutional and central bank documents emphasize the incompatibility of decentralized cryptocurrencies with hierarchical monetary governance, highlighting concerns related to monetary sovereignty, financial stability, and regulatory oversight. The coexistence of these perspectives confirms that blockchain-enabled cryptocurrencies represent not merely a technological innovation, but a structural alternative to institution-based monetary systems.

Consequently, the PRISMA methodology enabled the identification, filtering, and synthesis of high-quality evidence supporting the study's central argument: blockchain functions as the banking infrastructure of cryptocurrency systems, operating through algorithmic governance rather than sovereign authority.

LIMITATIONS OF THE STUDY

This study is limited by its reliance on secondary literature and does not include empirical data or quantitative analysis. Additionally, the rapidly evolving nature of cryptocurrency regulation and technology means that some institutional perspectives may change

over time. The study focuses primarily on major public blockchains and may not fully capture variations across all cryptocurrency systems.

CONCLUSION

This study addresses this gap by systematically mapping traditional central banking functions to blockchain mechanisms, thereby reframing cryptocurrencies as institution-like monetary systems rather than merely digital assets. This systematic review demonstrates that blockchain technology performs several core functions traditionally associated with central banking, including transaction validation, record-keeping, and monetary discipline. By embedding monetary rules directly into code and enforcing them through decentralized consensus mechanisms, blockchain replaces institutional trust with algorithmic governance. However, the absence of a central authority introduces risks related to monetary sovereignty, regulatory oversight, and systemic stability concerns consistently highlighted by central banks and international financial institutions. Therefore, blockchain-based cryptocurrencies should be understood not merely as technological innovations but as alternative monetary infrastructures that challenge the institutional foundations of modern banking. This reframing is essential for future research and policy discussions on digital money and monetary governance

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