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Cryptocurrency under the Wave of Financial Technology: Development Trajectory, Impact Mechanisms and Trend Outlook

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Abstract

With the rapid development of financial technology (FinTech), cryptocurrency, as a critical component, has become a pivotal force in reshaping the global financial system. This paper systematically examines the developmental trajectory, impact mechanisms, and future trends of cryptocurrencies, focusing on the differentiated paths of mainstream cryptocurrencies and niche cryptocurrencies. The findings reveal that cryptocurrencies drive payment innovation, blockchain breakthroughs, and financial inclusion through decentralized architecture and smart contract technology. However, challenges such as high volatility, regulatory ambiguity, and energy consumption constrain their widespread adoption. This paper not only uncovers the bidirectional impacts of cryptocurrencies on monetary systems, technological innovation, and policy regulation but also highlights future directions for cryptocurrencies, including global regulatory harmonization, deep technology–market integration, and compliance-driven transformation of niche cryptocurrencies, by integrating cutting-edge cases and policy dynamics. The results provide multidimensional theoretical support for understanding the complexity of cryptocurrencies and balancing innovation with risk while offering practical insights for regulatory technology (RegTech) and the sustainable development of the financial ecosystem.

Keywords

fintech, cryptocurrency, development trajectory, decentralized finance, regulatory framework

1. Introduction

With the rapid advancements in big data, artificial intelligence, blockchain, and cloud computing, fintech has profoundly reshaped traditional financial systems. As a leading innovation in this field, cryptocurrency has attracted significant global attention because of its disruptive potential and technological sophistication. Since the introduction of Bitcoin in 2008, blockchain-based decentralized digital currencies have fundamentally altered the infrastructure of global finance. The decentralized nature of blockchain and the programmability of smart contracts challenge traditional monetary systems while opening new avenues for fintech innovation (Buterin, 2014; Nakamoto, 2008). By 2024, the global cryptocurrency market had surpassed a valuation of $3.91 trillion, driven by major geopolitical and regulatory events such as the approval of US spot ETFs, central bank policy shifts, and evolving political landscapes (CoinGecko, 2025).

However, the development of cryptocurrencies faces considerable challenges, including high market volatility, regulatory ambiguity across regions, and environmental concerns due to energy-intensive mining processes. These issues have hindered wider adoption and sustainable growth (Corbet et al., 2019). In this context, in-depth research on cryptocurrencies, especially representative cases such as Trumpcoin and Bitcoin, is highly practical. Analysing their development paths, impact mechanisms, and future trends can enhance the understanding of fintech evolution and the cryptocurrency nature, thereby supporting the formulation of strategies for maintaining financial stability. Such research not only enriches academic discussion but also offers insights for regulation, market practice, and risk management.

While existing studies have examined cryptocurrencies from isolated perspectives such as economics, technology, or regulation (Schueffel, 2016), there remains a lack of comprehensive analysis regarding their development trajectories within the financial system, the functional distinctions between mainstream and niche cryptocurrencies, and their systemic effects on traditional finance (Schär, 2021). Moreover, niche cryptocurrencies, such as privacy coins and algorithmic stablecoins, have received insufficient scholarly attention despite their unique roles and dynamic evolution (Zetzsche et al., 2020). This study integrates multidimensional perspectives to decipher the complex mechanisms of cryptocurrencies within the FinTech wave, providing a holistic reference for policymakers, market participants, and researchers to support sound innovation in finance.

This study addresses three core questions:

(1) How do the development paths of mainstream and niche cryptocurrencies shape the crypto ecosystem?

(2) What are the bidirectional impacts of cryptocurrencies on the monetary–financial system, technological innovation, and regulatory policies?

(3) What future trends will define the evolution of cryptocurrencies?

To address these questions, this paper employs an interdisciplinary framework incorporating economic, technological, and regulatory dimensions to reveal the multifaceted interactions underlying cryptocurrencies. It further examines the distinctive functions and compliance challenges of niche cryptocurrencies. By incorporating recent case studies and policy developments, this study offers a systematic analysis of technological progress, market behavior, and regulatory debates while proposing forward-looking trends such as compliance-driven transformation and deeper technology-market integration. These insights contribute to the theoretical and practical foundations for RegTech and risk mitigation.

Following this introduction, Section 2 reviews the differentiated development paths of mainstream and niche cryptocurrencies. Section 3 analyses the bidirectional influences of cryptocurrencies on the monetary–financial system, technological innovation, and policy controversies. Section 4 summarizes the findings and outlines future trends.

2. Development Trajectory of Digital Currency in the Crypto Ecosystem

This section systematically reviews the differentiated development paths of mainstream and niche cryptocurrencies. The technological breakthroughs of mainstream cryptocurrencies such as Bitcoin and Ethereum are analysed from three dimensions, namely, their technical architecture, market positioning, and functional evolution. Furthermore, it examines the dynamic balance between compliance and innovation in niche cryptocurrencies such as privacy coins and DeFi tokens, thereby revealing the diverse evolutionary logic of the crypto ecosystem.

2.1 Evolution of Mainstream Cryptocurrencies

The evolution of mainstream cryptocurrencies reflects a dynamic interplay among technology, market forces, and regulatory frameworks. Their development can be categorized into three overlapping phases: technology-driven experimentation, market validation, and functional differentiation. Initially, focused on creating decentralized monetary systems, cryptocurrencies later evolved to redefine asset attributes and financial utility, eventually diversifying into specialized use cases. Given their representative roles in the store of value, smart contract utility, and stability mechanisms, this section examines Bitcoin, Ethereum, and stablecoins as core cases, illustrating this evolutionary path.

2.1.1 Bitcoin—From Technological Experiments to Value Storage

Bitcoin originated as a decentralized digital currency introduced in the 2008 whitepaper by Satoshi Nakamoto. Its underlying technology, blockchain, utilizes a proof-of-work (PoW) consensus to enable peer-to-peer transactions without intermediaries. In its early years, Bitcoin was largely viewed as an experimental technology with high price volatility and limited real-world usage, restricting its mainstream adoption (Tschorsch & Scheuermann, 2016). Over time, increasing institutional participation and regulatory milestones, such as the approval of Bitcoin spot ETFs, facilitated its transition into a recognized inflation hedge and "digital gold" (Shahzad et al., 2019). By 2024, Bitcoin accounted for more than 40% of the entire cryptocurrency market capitalization, reflecting its entrenched role as a macroeconomic asset. This shift was driven by growing investor confidence, its finite supply, and its perceived safety during periods of monetary expansion.

2.1.2 Ethereum—Smart Contracts and the Evolution of the DeFi Ecosystem.

Ethereum significantly expanded the functionality of blockchain technology through the introduction of smart contracts, which allow for programmable and self-executing agreements. Launched in 2015, the Ethereum Virtual Machine (EVM) enabled developers to build decentralized applications (DApps), paving the way for decentralized finance (DeFi) ecosystems, including lending, trading, and derivative protocols such as Uniswap and Compound (Schär, 2021). The 2022 upgrade to Ethereum 2.0, transitioning from PoW to proof-of-stake (PoS), markedly improved network scalability, security, and energy efficiency. This technological increase further accelerated the growth of nonfungible tokens (NFTs) and metaverse applications. By 2024, the total value locked (TVL) within the Ethereum ecosystem exceeded $200 billion, cementing its status as the leading infrastructure for decentralized finance. These developments underscore how continuous technical innovation fuels ecosystem expansion and attracts sustained market participation.

2.1.3 Stablecoins—Algorithmic Innovation and the Balancing Act of Market Trust.

Stablecoins are blockchain-based digital currencies pegged to stable assets such as fiat currencies or commodities. They are designed to minimize volatility and serve as a bridge between traditional finance and crypto markets (Bellia & Schich, 2020). In 2024, the total market capitalization of stablecoins grew by 46%, reaching $192.56 billion. This growth was largely propelled by their utility in trading, remittances, and as safe havens during crypto market fluctuations. However, stability is not guaranteed. The collapse of TerraUSD (UST), an algorithmic stablecoin, demonstrated how designs reliant on market incentives and noncollateralized mechanisms can fail, triggering broad market contagion. In response, researchers have developed machine learning models that incorporate trading data, sentiment indicators, and volatility metrics to better predict depegging risk (Lee et al., 2025). Additionally, studies show that stablecoins are not entirely immune to traditional financial shocks, particularly U.S. monetary policy changes, which can propagate volatility across both traditional and crypto markets (Aldasoro et al., 2025). These insights emphasize that stability depends not only on technical design but also on external economic conditions and regulatory clarity.

2.2 Differentiated Paths of Other Cryptocurrencies

Niche cryptocurrencies are typically characterized by small market capitalization, limited liquidity, a targeted user base, and unique technical mechanisms (CoinGecko, 2025). The emergence and evolution of such niche currencies demonstrate a significant trend in the cryptocurrency economy, shifting from focusing on Bitcoin as a single value storage to the exploration of diverse functional applications.

2.2.1 Privacy Coins—Technical features and regulatory contradictions

Privacy coins enhance transactional anonymity through cryptographic methods such as ring signatures and stealth addresses. While appealing to privacy-conscious users, these features also facilitate illicit activities, drawing regulatory scrutiny (Scharnowski, 2024). For example, Monero's prevalence in dark web transactions led the European Union to include privacy coins under the Sixth Anti-Money Laundering Directive (AMLD6), mandating strict know-you-customer (KYC) checks. Consequently, several exchanges delisted Monero and similar assets, illustrating the persistent tension between privacy and compliance.

2.2.2 Meme Coins—Cultural Drive and Market Speculation

Meme coins originate from internet culture and social media trends, which often lack intrinsic value or utility. Dogecoin, created initially as a satire of cryptocurrency speculation, gained momentum through celebrity endorsements and online communities. Subsequent tokens such as SHIB amplified this trend. Their prices are predominantly influenced by social sentiment and speculative trading, resulting in high volatility. Although meme coins can achieve rapid market capitalization growth, they remain highly vulnerable to hype cycles and liquidity crises.

2.2.3 DeFi Tokens—Core Assets of Vertical Financial Protocols

DeFi tokens are native assets issued by decentralized finance protocols to enable governance, liquidity provision, and fee sharing (Harvey et al., 2020). Major milestones include MakerDAO's launch of the DAI stablecoin in 2017 and Compound's introduction of liquidity mining in 2020. However, the sector remains exposed to risks such as smart contract exploits and governance attacks, exemplified by the 2023 incident involving Curve Finance. To mitigate these risks, new tools such as DeFiTrust, which use machine learning to detect fraudulent activities and assess protocol safety on the basis of transaction patterns and social media sentiment, have emerged (Gunathilaka et al., 2024).

2.2.4 RWA Tokens - Exploration of Tokenization of Real Assets

Real-world asset (RWA) tokens represent tokenized versions of physical or financial assets such as real estate, bonds, or commodities (Chen et al., 2024). Since the early experiments in security tokenization in 2017, this segment has gradually attracted institutional players such as BlackRock and Goldman Sachs. RWA tokens aim to increase liquidity, transparency, and accessibility in traditional markets (Riabokin & Kotukh, 2024). Nevertheless, barriers to widespread adoption persist, including regulatory uncertainty, challenges in asset verification, and custody risks. Overcoming these hurdles is critical to fulfilling the promise of asset tokenization.

3. The Impact of Cryptocurrencies from the Perspective of Financial Technology

The rise of cryptocurrencies has had profound and complex bidirectional impacts on traditional financial systems, technological innovation, and policy regulation. This section systematically explores how cryptocurrencies reshape monetary functions, drive blockchain breakthroughs, and dynamically interact with existing regulatory frameworks through three dimensions: the monetary-financial system, technological paradigm shifts, and policy controversies. By analysing cryptocurrencies' dual roles in payment efficiency, asset attributes, and market volatility, this section reveals their paradoxical nature as both catalysts for financial innovation and sources of systemic risk, offering a multidimensional perspective to understand their positioning in the modern financial ecosystem.

3.1 The Impact of Cryptocurrencies on the Monetary and Financial System

From the perspective of monetary systems, the decentralized cryptocurrency framework introduced by Nakamoto challenged the traditional model of central banks' monopoly over currency issuance, thereby presenting a critical challenge to conventional monetary sovereignty concepts. The emergence of cryptocurrency has redefined traditional notions of money. The five fundamental functions of traditional money—measures of value, media of exchange, stores of value, means of payment, and units of account—are reflected to varying extents in the framework of cryptocurrency (Shahzad et al., 2019). However, Corbet et al. conducted research indicating that the high volatility of cryptocurrencies restricts their function as a reliable measure of value, which poses significant challenges to their adoption in routine economic transactions (Corbet et al., 2019). Nevertheless, the integration of cryptocurrencies into payment methods has experienced gradual expansion, particularly within the realm of DeFi. In this domain, implementing advanced technological tools, such as smart contracts and decentralized payment protocols (e.g., the Lightning Network), has notably enhanced the efficiency and scalability of cryptocurrency-based payment systems (Schär, 2021). In addition, Acikgoz (2025) provides empirical evidence that Bitcoin manifests safe-haven asset attributes comparable to those of gold under certain market conditions, especially during periods of elevated economic uncertainty. These findings underscore the distinct role of cryptocurrencies within the contemporary monetary framework.

From the perspective of financial markets, the impact of cryptocurrency can be analysed through three primary dimensions: asset allocation, market volatility, and financial innovation. These interconnected aspects collectively illustrate the transformative influence of cryptocurrency on traditional financial systems and its role in shaping the future of global finance. Dyhrberg (2016) utilized asymmetric GARCH and threshold GARCH models to analyse risk transmission and investment opportunities in the blockchain market (NFTs, DeFi tokens, and cryptocurrencies) under extreme volatility conditions. The findings highlight that, from an asset allocation perspective, risk-averse investors can utilize NFTs to hedge against the volatility risks associated with DeFi and cryptocurrencies. Moreover, risk-seeking investors can exploit the high volatility of Bitcoin to achieve short-term gains (Dyhrberg, 2016). Despite these findings, Hung et al. conducted further analysis using the DCC-RGARCH model combined with volatility analysis. Bitcoin is an effective diversification tool under loose monetary policy conditions, but it becomes extremely risky and unreliable under tight monetary policy environments, much like how it does not match the reliability of gold (Hung et al., 2024). In addition, Ozili (2023) posits that the integration of central bank digital currencies (CBDCs), cryptocurrencies, and fintech services can enhance financial inclusion by leveraging multifunctional user applications. This integration is particularly effective in delivering financial services to unbanked adults, thereby addressing a critical gap in access to financial resources. In addition to potential opportunities, digital financial innovation also faces significant challenges. Issues such as the absence of adequately humanized services, regulatory gaps, and disparities in digital literacy may pose risks to the stability of financial markets. Analysing the dual role of cryptocurrencies within the monetary system and financial markets, it is evident that they present both opportunities and challenges. Therefore, future research and regulatory innovations are imperative for comprehensively addressing the multifaceted impact of cryptocurrencies and enhancing the understanding of their position within the financial ecosystem.

In the future, the integration of cryptocurrencies into the broader financial system will likely depend on improving their stability and regulatory alignment. Future developments may include hybrid models that combine decentralized features with central bank oversight, such as officially issued stablecoins or CBDC-backed crypto assets. Additionally, advances in real-time settlement technology and cross-chain interoperability could further strengthen the role of digital assets in global finance, provided that issues around volatility, security, and regulatory fragmentation are systematically addressed.

3.2 Innovation of Cryptocurrency in Technology

Blockchain technology transforms the underlying technical paradigm of cryptocurrency by using distributed ledger systems, cryptographic algorithms, and consensus mechanisms. This innovative approach offers data immutability and transparency, providing a viable alternative to traditional centralized systems. During the early stages of technological evolution, cryptocurrency systems employing the proof-of-work (PoW) consensus mechanism were met with controversy because of their significant energy consumption. Research data indicate that the energy consumption intensity of mining data centers can be 100–200 times greater than that of traditional office areas. Scholars have proposed a green and energy-saving model for blockchain mining data centers in response to this issue. This innovative approach offers a practical technical reference for the sustainable development of the cryptocurrency mining industry (Mahmud et al., 2025).

With the paradigm shift introduced by blockchain technology, Melanie Swan defined the development stage of cryptocurrency systems incorporating smart contracts as the 2.0 era. The introduction of smart contracts not only broadens the functional scope of blockchain technology but also, supported by Layer 2 expansion solutions such as Optimistic Rollup, significantly enhances transaction processing speeds to thousands of transactions per second. This increase in speed effectively reduces transaction friction, thereby fostering the emergence of a DeFi ecosystem. However, the security of the DeFi ecosystem is vulnerable to multidimensional risks. On the basis of empirical research into the MarkerDao protocol, Xue et al. (2023) reported that these risks arise from three primary sources: the transmission of risks from traditional financial systems, inherent characteristics of blockchain technology (such as vulnerabilities in cross-chain interoperability protocols), and limitations within DeFi protocols themselves. Furthermore, Melnikov et al. (2025) analysed the Abracadabra lending protocol and highlighted that DeFi has not completely eliminated the necessity for individual trust in protocols. The incompleteness of smart contracts, such as the reliance on individual trust for the verification of zero-knowledge proofs in privacy-enhancing technologies, means that protocols still depend on assumptions about the reliability of preset algorithms. Therefore, despite continuous

technological innovations in cryptocurrency, it remains necessary to implement measures such as decentralized risk mitigation tools to address the risks associated with DeFi and prevent distorted valuations of cryptocurrency assets. These measures are essential for ensuring the stability and sustainable growth of the DeFi ecosystem.

Moving forward, the sustainability and scalability of cryptocurrency systems will require continued innovation in consensus mechanisms, such as broader adoption of proof-of-stake and energy-efficient alternatives. An increase in smart contract security through formal verification and decentralized auditing platforms could mitigate vulnerabilities in DeFi protocols. Furthermore, the integration of artificial intelligence and zero-knowledge proofs may offer new pathways to balance transparency with privacy, fostering more resilient and trustworthy blockchain infrastructures.

3.3 Controversy over Cryptocurrency in the Policy Field

The rapid development of cryptocurrencies and decentralized finance has posed significant challenges to the conventional financial regulatory framework. The existing regulatory system, such as securities law, lacks technological neutrality and cannot address emerging financial activities effectively on the basis of smart contracts and distributed ledger technology. To address this challenge, scholars such as Auer (2022) and Zetzsche et al. (2020) have proposed an innovative framework of "embedded supervision," which advocates leveraging the inherent data transparency of blockchain to construct a real-time, intelligent compliance monitoring system, thereby replacing the traditional compliance process that relies heavily on manual intervention. From the perspective of international practices, while regulatory standards, exemplified by the EU's "Markets in Crypto-Assets Act" (MiCA), are gradually converging, significant differences still exist among countries in terms of regulatory scales and implementation pathways. For example, Japan and Switzerland have already taken the lead in revising or establishing new legislative frameworks that encompass crypto assets and their service providers. In contrast, other jurisdictions, including the European Union, the United Arab Emirates, the United Kingdom, and the United States, remain in the legislative drafting phase (Crypto, 2022).

Although the aforementioned policies aim to strengthen the regulation of the cryptocurrency market, cryptocurrencies themselves exert a detrimental influence on the effectiveness of policy implementation. The two-way interactive effect between cryptocurrency and monetary policy has emerged as a prominent topic in contemporary monetary economics research. Empirical evidence indicates that cryptocurrencies continue challenging the efficacy of conventional monetary policy tools through mechanisms such as capital substitution, asymmetric reflection, cross-border flows, and speculative behavior. These dynamics exacerbate market complexity and diminish the transmission efficiency of central bank monetary policies (Nguyen et al., 2023). The BIS highlighted in a working paper that the utilization of Bitcoin in countries with capital controls may amplify the risk of capital flight. This observation has prompted many nations to accelerate their research and development into central bank digital currencies (CBDCs) (Carstens, 2021). For example, CBDCs can be categorized into two types on the basis of their service objects: wholesale CBDCs, which are designed for settlements between financial institutions, and retail CBDCs, which are intended for use by the general public (Carstens, 2021). However, the rapid advancement of CBDCs may introduce dual risks. First, the digital run risk may result in structural fragility within commercial banks' balance sheets. Second, the currency substitution effect may exacerbate the "digital dollarization" trend and give rise to a new competitive landscape in currency markets.

In addition, the rapid development of CBDC may have a suppressive effect on mainstream cryptocurrencies while simultaneously fostering the innovative growth of niche cryptocurrencies that prioritize privacy protection. Specifically, CBDCs, with their programmability and robust regulatory penetration capabilities, constrain the anonymity of mainstream encrypted digital currencies, thereby compressing their operational space. However, under the stringent regulatory framework imposed by CBDCs, cryptocurrency practitioners may gravitate toward niche encrypted digital currencies that emphasize privacy more considerably. In extreme cases, they may even seek technical breakthroughs, such as exploiting vulnerabilities in blockchain-based privacy protocols or DeFi. This regulatory pressure may not only facilitate the displacement of cryptocurrency-related criminal activities but also catalyze technological breakthroughs and innovative developments in niche cryptocurrencies within the realm of privacy protection (Dupuis et al., 2022).

To address ongoing regulatory challenges, future policy frameworks should strive for greater international coordination and technological adaptability. The development of regulatory sandboxes and real-time compliance tools based on blockchain analytics could help authorities keep pace with innovation while safeguarding financial stability. Moreover, as CBDCs evolve, policymakers must carefully design them to avoid stifling private-sector innovation or exacerbating financial exclusion. A balanced approach that encourages responsible experimentation within clear regulatory boundaries will be essential for harnessing the benefits of cryptocurrencies while minimizing systemic risk.

4. Conclusion

By integrating economic, technological, and regulatory perspectives within a coevolutionary framework, this study systematically examines the complex mechanisms of cryptocurrencies under the FinTech wave. The findings reveal that mainstream cryptocurrencies such as Bitcoin and Ethereum have evolved from a "digital gold" narrative into a foundational financial infrastructure driven by technological advances and market acceptance. In contrast, niche cryptocurrencies, including privacy coins and DeFi tokens, play specialized roles shaped by the tension between innovation and compliance.

Moreover, the redefinition of monetary functions, continuous innovation in blockchain technology, and ongoing regulatory adaptations collectively reflect the dual identity of cryptocurrencies as both drivers of innovation and sources of risk. This interplay underscores that cryptocurrency development is not only a technological process but also an economic and institutional process.

In terms of regulation, global efforts are increasingly shifting from fragmentation to coordination. Initiatives such as the EU's MiCA regulation and embedded supervision models demonstrate how technology-enabled compliance, such as smart contract automation, can improve market transparency. Nonetheless, disparities in regulatory approaches and the pace of technological change remain major challenges. Effective oversight must balance technological neutrality with risk management, using adaptive incentives to align innovation with financial stability.

Similarly, the development of niche cryptocurrencies highlights a trend toward functional specialization. Privacy coins employ advanced cryptography to ensure anonymity but face regulatory pressure, as seen in Monero's delisting from exchanges due to noncompliance with AML standards. Algorithmic stablecoins, exemplified by TerraUSD's collapse, reveal the risks of algorithmic mechanisms lacking collateral. These cases emphasize that sustainable niche markets must align technical innovation with regulatory and user expectations. Future innovations such as RWA tokens will need to enhance asset transparency and legal compatibility to bridge traditional and crypto finance.

In the future, cryptocurrencies are expected to evolve along three trajectories. First, regulatory harmonization makes compliance a central requirement. Second, blockchain is integrated more deeply with traditional finance through developments such as DeFi and CBDC interoperability. Third, niche domains such as green mining and regulated stablecoins are achieving functional specialization. To support sustainable growth, a collaborative governance model that integrates technology, market forces, and policy is essential. Such an approach should embed cryptocurrencies within macroprudential frameworks and promote RegTech solutions for improved risk monitoring and compliance.

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