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Bitcoin and Artificial Intelligence: Toward a Digital Economy Less Reliant on Bank Intermediation: A Critical Integrative Review and Foresight Study

Sakher Farea Ghaleb Al-Junaied^{1,*}

¹ Emirates International University, Sana'a, Yemen

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ABSTRACT

This study examines how the convergence of Bitcoin and artificial intelligence (AI) could reshape selected functions of the digital economy and reduce reliance on bank intermediation, while critically testing the limits and risks of that proposition. It distinguishes between eliminating intermediaries and redistributing intermediation functions. Bitcoin can enable direct settlement between parties in selected payment contexts, whereas AI can add a decision and coordination layer for payment routing, anomaly detection, liquidity prioritization, and user interaction. The convergence does not therefore imply an institution-free economy. Custodians, exchanges, liquidity providers, wallet operators, model providers, compliance institutions, and legal authorities may perform the functions previously associated with banks. The study uses a transparent critical integrative review of 31 sources identified through searches of Scopus, Web of Science, IEEE Xplore, ScienceDirect, Google Scholar, and official institutional repositories, covering January 2008 to August 2026. Searches combined terms relating to Bitcoin, crypto-assets, artificial intelligence, agentic payments, financial intermediation, decentralized finance, governance, and risk. Evidence was synthesized through a qualitative coding matrix and then used to construct three conditional scenarios through 2035: regulated integration, a fragmented hybrid economy, and institutional containment. The findings indicate that the most plausible trajectory is a reallocation of selected intermediation functions rather than the disappearance of banks. The study extends functional theories of financial intermediation by proposing the concept of programmable intermediation: cryptographic networks, software, AI agents, and service providers jointly perform monitoring, coordination, settlement, and accountability functions. It also derives scenario-specific regulatory and institutional recommendations.

1. Introduction

Digital finance has evolved from electronic banking services toward infrastructures that are increasingly programmable, data-driven, and distributed. Bitcoin represented a conceptual and

* Corresponding author.

E-mail address: sakherjonied@gmail.com

technical turning point because its foundational design proposed peer-to-peer electronic cash without requiring a central institution to maintain the payment ledger [1]. Its significance, however, is not that it abolishes institutions. It reopens the question of which functions financial institutions perform and whether those functions can be separated from their historical organizational form.

AI has developed from narrowly bounded analytical tools into systems capable of interpreting information, comparing alternatives, prioritizing tasks, and executing multistep actions. This development has given rise to agentic payments: transactions initiated or completed by AI-enabled agents within delegated limits and specified criteria [2]. Such agents could manage budgets, select payment routes, compare offers, and settle recurring obligations. The relevant issue is not whether AI is an independent legal actor. It is whether a delegated computational system can perform functions that have traditionally required a bank employee, payment intermediary, or other trusted organization.

This study asks whether Bitcoin, as an open settlement network, and AI, as a decision and coordination layer, could foster a digital economy less reliant on banks. The question is deliberately narrower than whether banks will disappear or Bitcoin will become a universal currency. It concerns the possible migration of selected functions—settlement, programmable custody, monitoring, coordination, and limited liquidity management—from traditional institutions to programmable and distributed infrastructures.

1.1 Research Problem and Questions

Existing scholarship at the intersection of AI and crypto-assets has concentrated on price forecasting, trading, anomaly detection, and machine-learning performance [3] [4]. These contributions are valuable but do not by themselves explain how decision authority, monitoring, credit, custody, consumer protection, and accountability might be redistributed. The research problem is therefore the absence of an integrated framework connecting three layers: the Bitcoin network, AI agents, and the functional architecture of bank intermediation.

The main research question is: How could the convergence of Bitcoin and AI affect the development of a digital economy less reliant on bank intermediation, and which technical, economic, regulatory, and ethical conditions determine whether this trajectory is feasible? The study addresses four subquestions: (1) which functions could be performed complementarily by Bitcoin and AI; (2) where could reliance on banks decline and where would new intermediaries remain necessary; (3) what risks arise concerning security, privacy, energy, governance, compliance, and inequality; and (4) which pathways are plausible through 2035?

1.2 Contribution and Scope

The study makes three contributions. First, it introduces programmable intermediation as a functional concept rather than treating decentralization as the absence of intermediation. Second, it uses a transparent integrative-review protocol to connect heterogeneous technical, financial, regulatory, and governance evidence. Third, it translates the evidence into three conditional scenarios and derives differentiated recommendations from each scenario. The paper does not provide investment advice, estimate Bitcoin returns, or claim that the scenarios are statistical forecasts.

2. Theoretical Framework

2.1 Bitcoin and the Redefinition of Settlement

Bitcoin was designed to reduce dependence on a trusted third party for the verification of electronic payments [1]. Its distributed ledger and proof-of-work mechanism enable settlement between addresses without a central bank administering the ledger. Settlement, however, is only one function of finance. Banks and other financial intermediaries also monitor borrowers, pool liquidity, transform maturities, provide credit, safeguard assets, perform compliance, protect consumers, and resolve disputes.

2.2 Financial Intermediation as a Bundle of Functions

Classic theories explain intermediation through information and transaction costs. Delegated-monitoring theory argues that an intermediary can reduce the cost of monitoring dispersed borrowers by monitoring on behalf of many investors [5]. A broader functional perspective holds that financial innovation changes the form of institutions while leaving the underlying functions—payments, risk management, liquidity, and information—economically necessary [6] [7]. The implication for Bitcoin and AI is precise: a technology can displace an organization in one function while creating a new organization or protocol for another.

In this study, the relevant functions are identity verification, custody, value transfer, liquidity aggregation, credit provision, risk management, compliance, consumer protection, and dispute resolution. Bitcoin may reduce the need for a bank-operated ledger in some settlements. AI may reduce search, monitoring, and coordination costs. Neither technology automatically supplies legal personality, lender-of-last-resort capacity, stable purchasing power, or enforceable redress.

2.3 Artificial Intelligence as a Decision Layer

AI denotes a computational layer capable of interpreting information, comparing alternatives, estimating risk, managing interactions, and recommending or executing actions within delegated authority. Unlike rigid automation, an adaptive agent can respond to changing data and competing objectives. Recent evidence suggests that AI agents can prioritize payments and manage liquidity in simulated environments, but this demonstrates task-level feasibility rather than readiness for autonomous macro-financial management [8].

An agent should therefore be treated as an auditable decision system, not as a substitute for law or human accountability. Its material properties include the data it can access, the permissions it receives, the model or models it uses, the limits placed on execution, and the party responsible for error.

2.4 Programmable Intermediation

This study defines programmable intermediation as the performance of selected intermediation functions through a combination of open networks, cryptographic rules, software contracts, AI agents, and specialized service providers. It extends functional theories of intermediation in two ways. First, it separates settlement from monitoring, credit, custody, and redress. Second, it treats algorithmic decision authority and audibility as explicit components of intermediation rather than as merely technical properties.

Table 1

Items used in the study

Dimension	Analytical question	Illustrative example
Programmable settlement	Can a transfer be executed without a central intermediary?	Direct or conditional payment between two parties.
Programmable decision-making	Can the system select an action in a changing context?	An agent balancing price, liquidity, timing, and fees.
Auditable trust	Can the decision and outcome be reconstructed?	Transaction records, authority limits, model/version logs.
Assignable accountability	Who bears responsibility for error or loss?	User, agent operator, model provider, wallet, or platform.

The concept does not mean that all functions become code. It means that the location of intermediation becomes modular and potentially distributed. A user may avoid a traditional bank for settlement but depend more heavily on an exchange, wallet provider, model operator, external data provider, liquidity protocol, or regulator.

2.5 Governance and Risk

AI governance frameworks emphasize validity, reliability, safety, security, accountability, transparency, explainability, privacy, and fairness [9]. Crypto-asset policy frameworks similarly emphasize functional regulation, governance, risk management, data reporting, disclosure, and monitoring of interconnections [10] [11]. These principles are especially relevant when an AI agent controls a wallet or can initiate irreversible payments. Greater autonomy increases, rather than decreases, the need for authority limits, audit trails, recovery procedures, human review, and redress.

3. Methodology

3.1 Research Design and Review Type

The study uses a qualitative critical integrative review combined with exploratory scenario planning. An integrative review is appropriate when evidence is heterogeneous and includes conceptual articles, empirical studies, technical papers, standards, and official reports [12] [13]. The review is not presented as a systematic review with meta-analysis because the research question concerns institutional configurations and future conditions rather than a pooled intervention effect. Nevertheless, reporting follows the transparency principles of PRISMA 2020 where applicable, especially for information sources, search strategy, eligibility, screening, and synthesis [14].

3.2 Information Sources and Search Strategy

The review protocol specified searches of Scopus, Web of Science Core Collection, IEEE Xplore, ScienceDirect, Google Scholar, and the repositories of the Bank for International Settlements (BIS), Financial Stability Board (FSB), International Monetary Fund (IMF), National Institute of Standards and Technology (NIST), Financial Action Task Force (FATF), and European Union institutions. The intended search period for scholarly and technical material was January 2008–August 2026, beginning with the publication of Bitcoin’s foundational paper. Arabic- and English-language sources were eligible.

The search combined four concept blocks. The principal query logic was: (Bitcoin OR crypto-asset* OR cryptocurrency OR decentralized finance) AND (artificial intelligence OR machine learning OR AI agent* OR agentic payment*) AND (financial intermediation OR bank* OR payment* OR settlement OR custody OR liquidity OR credit) AND (governance OR regulation OR risk OR accountability). Database syntax was to be adapted to each platform. Reference lists of key papers and official reports were also used to identify additional sources. Because the original submission did not preserve a database export or screening log, this revised manuscript reports the verified final analytical corpus rather than inventing record-level screening counts.

The final corpus used in this revised manuscript comprises 31 sources: peer-reviewed journal articles, official reports and standards, and foundational or technical sources. The corpus is intended to support conceptual integration and scenario construction; it does not imply statistical representativeness or a complete census of the literature.

3.3 Eligibility and Exclusion Criteria

Sources were included when they (a) addressed Bitcoin, crypto-assets, decentralized finance, AI systems, agentic payments, financial intermediation, or the governance of these systems; (b) contributed conceptual, empirical, technical, regulatory, or institutional evidence relevant to at least one research question; (c) provided enough methodological or institutional detail to support interpretation; and (d) were published in Arabic or English within the review period, except for seminal works necessary to define the theoretical framework. Official reports from recognized public or international institutions were eligible even when not peer reviewed.

Sources were excluded when they were duplicates; promotional or investment-oriented materials without analytical evidence; news items and unsourced commentary; papers concerned only with price prediction without implications for institutions, payments, risk, or governance; or documents whose full text could not be verified. Two passes were used for screening: title/abstract screening followed by full-text assessment. Borderline sources were retained only when they clarified a concept or policy issue central to the research question.

3.4 Data Extraction and Qualitative Synthesis

A structured extraction matrix recorded author and year, source type, geographic or institutional context, financial function, technology, degree of autonomy, intermediary displaced or redistributed, principal risks, governance requirements, and time horizon. The analysis proceeded in four stages. First, descriptive codes were assigned to each source. Second, related codes were grouped into functional themes: settlement, custody, liquidity, credit, compliance, risk management, consumer protection, and dispute resolution. Third, claims were classified as observed evidence, source-based interpretation, or authorial inference. Fourth, themes were compared across the three scenario conditions.

The synthesis was qualitative and configurational rather than statistical. Convergence across sources increased confidence in a claim; disagreement was retained as a boundary condition rather than averaged away. Scenario construction followed a two-axis logic: the degree of regulatory accommodation and the degree of institutional coordination. This produced three internally consistent futures rather than a single forecast. Scenario indicators were then specified so that future researchers and policymakers can assess whether a pathway is emerging.

3.5 Quality, Reflexivity, and Ethics

The study separates evidence from inference, treats technical feasibility as distinct from economic adoption, and integrates constraints into the analysis rather than adding them as a concluding caveat. The author reports no external funding from parties with a material interest in the conclusions. The study does not use personal data, does not provide investment advice, and does not recommend circumvention of anti-money-laundering or other legal obligations.

4. Analytical Results

4.1 Functions Open to Redistribution

The review indicates that settlement, coordination, monitoring, and selected forms of custody are more open to technological transformation than credit creation, legal protection, and crisis management.

Table 2

Results of the present study

Function	Bitcoin contribution	AI contribution	Potential outcome	Primary constraint
Settlement	Distributed ledger and address-to-address transfer	Timing, route, and fee selection	Less reliance on bank-operated settlement in bounded cases	Volatility, fees, confirmation time, scalability
Custody	Self-controlled keys and noncustodial wallets	Anomaly detection and assisted recovery workflows	AI-supported self-custody or hybrid custody	Key loss, fraud, irreversible error
Micropayments	Direct transfer infrastructure	Recurring or conditional payment execution	Programmable payment for selected use cases	Purchasing-power volatility and actual transaction cost
Liquidity management	Settlement separated from credit provision	Cash-needs estimation and prioritization	Automated balancing of selected flows	Model error, correlated decisions, incomplete data
Compliance	Partial ledger transparency	Pattern analysis and address linkage	Network-based monitoring	Privacy conflict and classification bias
Credit	No inherent credit-creation function	Risk assessment and collateral analysis	New lending models linked to digital assets	Credit risk, collateral volatility, leverage
Dispute resolution	Persistent transaction record	Evidence analysis and path tracing	Better reconstruction of transaction history	No substitute for legal adjudication

The main result is functional rather than institutional. Bitcoin can reduce dependence on a bank for specific settlement tasks. AI can reduce search and coordination costs. The same system can increase dependence on model providers, custodians, exchanges, data providers, and compliance platforms.

4.2 Integration Layers and Controls

Layer	Core question	Minimum controls
Sensing	Which data does the agent read?	Trusted-source requirements, data-quality tests, data minimization.
Decision	Under which criteria is an action selected?	Authority limits, explainability, model testing, conflict-of-interest controls.
Execution	When and with which permissions is a transaction executed?	Spending ceilings, staged confirmation, rate limits, emergency stop.
Governance	Who reviews the system and bears responsibility?	Complete logs, designated accountable entity, incident reporting, redress.

4.3 Future Scenarios Through 2035

Scenario 1: Regulated Integration

Authorities recognize Bitcoin as a conditional settlement option and regulate wallet, custody, exchange, and AI-agent providers through proportionate security, governance, disclosure, and compliance requirements. Banks shift from exclusive ledger operators toward providers of credit, trust, custody, interoperability, and regulated fiat conversion. Bitcoin becomes complementary rather than substitutive, while common standards govern agent identity, delegated authority, auditability, and liability. Validation indicators include interoperable agent standards, accepted secure-custody solutions, enforceable liability, and growth in genuine commercial use.

Scenario 2: Fragmented Hybrid Economy

Bitcoin-based agentic payments spread in specific sectors such as micropayments, digital services, and selected cross-border transfers, but infrastructures remain fragmented across countries and platforms. Large-value payments, credit, and systemically important settlement continue to depend on banks and conventional payment systems. Protection, privacy, and compliance vary by jurisdiction. Indicators include niche adoption, persistent volatility, regulatory divergence, and continuing dependence on centralized service providers.

Scenario 3: Institutional Containmentment

Major security incidents, operational failures, money-laundering concerns, or consumer losses lead to tighter restrictions on Bitcoin-based payments. Bitcoin persists as an investment asset and operating network, but agentic-payment innovation migrates toward regulated bank systems or official digital currencies. AI is used mainly within incumbent institutions. Indicators include major incidents, demonstrable protection gaps, rising compliance costs, limited international convergence, and concentration of innovation within regulated platforms.

4.4 Scenario Comparison and Central Finding

The central finding is that AI may make decentralized infrastructure easier to use, but it does not eliminate intermediation. It changes who performs it and how responsibility is allocated. The most plausible trajectory is a hybrid economy in which programmable networks and intelligent agents complement, rather than replace, banks and public authorities.

Dimension	Regulated integration	Fragmented hybrid economy	Institutional containmentment
Role of Bitcoin	Complementary regulated settlement option	Niche and sector-specific settlement	Primarily investment and network asset
Role of banks	Credit, custody, trust, interoperability	Remain central for large-value and fiat functions	Remain dominant across payments and finance
Role of AI agents	Standardized, auditable, bounded autonomy	Uneven autonomy and platform dependence	Internal institutional automation
Primary policy problem	Supervising new intermediaries without suppressing innovation	Managing unequal protection and regulatory arbitrage	Balancing financial stability with proportionate access
Primary institutional response	Interoperability, liability, resilience standards	Baseline protections and cross-border coordination	Containment, incident response, and regulated alternatives

5. Discussion

5.1 Theoretical Implications for Financial Intermediation

The findings modify functional theories of financial intermediation in three ways. First, they extend the unit of analysis from the institution to a modular configuration of network, code, model, platform, and public authority. A bank is no longer the only possible bundle of settlement, monitoring, custody, liquidity, and redress functions. Second, they show that disintermediation in settlement does not imply disintermediation in credit, risk absorption, or legal enforcement. Third, they add programmable decision authority and auditability to the theory of intermediation. In an AI-enabled payment system, the intermediary is partly an executable rule and partly an accountable service provider.

The findings therefore challenge a strong technological-displacement thesis. Bitcoin can lower the need for a trusted ledger operator, and AI can lower some coordination and monitoring costs, but neither removes the information, risk, liquidity, and accountability problems that motivate intermediation. The theory is consequently extended from “who is the intermediary?” to “which function is intermediated, by which technical or institutional component, and who bears the residual risk?”

5.2 Efficiency, Stability, Privacy, and Sustainability

Agents may reduce search, comparison, and execution costs, but efficiency is not equivalent to stability. If many agents rely on similar models and data, correlated decisions can amplify shocks. Bitcoin’s partial transparency can support network monitoring while enabling address linkage and surveillance. Proof-of-work energy use remains a scenario variable because estimates and energy mixes change over time. These trade-offs require evidence-based policy rather than technological enthusiasm or blanket rejection.

5.3 Implications for Developing Countries and Arab Markets

The technologies may reduce the cost of remittances and cross-border transfers where banking infrastructure is weak or expensive. Constraints include volatility, digital literacy, key recovery, consumer protection, and unclear accountability. Policy experimentation should therefore concentrate on bounded, measurable use cases—commercial transfers, supply-chain payments, and carefully limited micropayments—rather than treating Bitcoin as a wholesale substitute for national currencies or banking systems.

6. Conclusions and Scenario-Derived Recommendations

6.1 Conclusion

The convergence of Bitcoin and AI can reduce reliance on traditional bank intermediaries for selected settlement, custody, monitoring, coordination, and micropayment tasks. It does not eliminate the general need for intermediation. Instead, it redistributes intermediation across protocols, wallets, exchanges, custodians, model providers, liquidity providers, compliance systems, and public authorities. AI adds a decision and adaptation layer, but it cannot supply legal trust, lender-of-last-resort capacity, stable purchasing power, or enforceable redress.

The theoretical implication is that financial intermediation should be analyzed as a modular allocation of functions rather than as an all-or-nothing institutional condition. The findings extend

functional intermediation theory by adding programmable decision-making, auditable trust, and assignable accountability as core dimensions. They also challenge the claim that decentralization automatically produces a bankless economy: it may remove one intermediary from settlement while creating new forms of dependence elsewhere. The most defensible conclusion is therefore a conditional one: the convergence is capable of producing a less bank-dependent economy in selected functions, but only within an accountable institutional architecture.

6.2 Recommendations by Scenario

These recommendations are intentionally differentiated. Applying the same policy package to all three scenarios would ignore the conditions that make each pathway plausible. The appropriate response depends on the degree of adoption, regulatory coordination, institutional concentration, and observed harm.

Scenario	Regulatory recommendations	Institutional and firm recommendations	Rationale / trigger
Regulated integration	Adopt functional, technology-neutral licensing; require clear liability for agent actions; establish interoperable identity and delegated-authority standards; require model-risk management, audit logs, incident reporting, custody safeguards, and segregation of client assets.	Banks should offer interoperable custody, fiat conversion, credit, and recovery services. Wallets and agent providers should implement bounded permissions, independent security testing, human escalation, and explainable decision records.	Use when commercial adoption is genuine, standards are converging, and authorities can supervise new service providers.
Fragmented hybrid economy	Create a minimum cross-border baseline for disclosure, custody, complaints, privacy, AML/CFT, and consumer redress. Use regulatory sandboxes with caps on transaction size and user exposure. Monitor concentration in exchanges, model providers, and liquidity venues.	Firms should disclose jurisdictional limits, volatility, irreversibility, fees, data practices, and fallback routes. Institutions should support compliant interoperability while preserving bank rails for high-value and vulnerable-user transactions.	Use when adoption is niche, regulation diverges, and users depend on multiple centralized platforms.
Institutional containment	Apply proportionate restrictions to high-risk payment uses; mandate recovery and wind-down plans; preserve access to regulated payment alternatives; coordinate incident response and prevent regulatory gaps between banks, crypto providers, and AI firms.	Banks and public digital-payment operators should test AI internally under strict model governance. Bitcoin-facing firms should maintain transparent limits, emergency suspension procedures, and orderly customer exit mechanisms.	Use when systemic incidents, consumer losses, illicit-finance evidence, or persistent control failures exceed supervisory capacity.

6.3 Research Recommendations

Future research should compare settlement cost, execution time, error rates, recovery outcomes, privacy effects, energy use, and compliance costs between Bitcoin-based agentic payments and conventional methods. Researchers should develop standardized stress tests for agent behavior,

measure correlated decision-making across models, and construct a net-economic-value metric that deducts verification, risk, error, recovery, and energy costs. Cross-country research should examine regulation, digital literacy, remittance markets, and consumer protection, including Arab countries.

7. Limitations

The review is qualitative and does not estimate effect sizes or provide a statistically validated forecast. The corpus is limited to Arabic- and English-language sources accessible through the specified databases and institutional repositories through August 2026. The scenarios are logically plausible configurations, not predictions. Evidence on agentic payments remains recent and partly simulated. Political, regulatory, technical, and environmental factors interact in ways that cannot be isolated fully. These limitations make empirical testing essential.

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