Crypto Valley

www.cryptovalley.swiss

CVA RESEARCH JOURNAL 2024

THE FUTURE OF PAYMENTS & SETTLEMENTS NETWORKS

TABLE OF CONTENTS

1. Introduction

1.1. Foreword

It is with great pleasure to present the third edition of the Crypto Valley Association's Research Journal and Academic Symposium. This milestone not only marks the third consecutive year of this important initiative but also highlights the continued evolution and maturation of blockchain research, education, and application in both the academic and professional spheres.

The annual Call for Papers that underpins this Journal has, from its inception, been designed to encourage a dynamic exchange of ideas among scholars, researchers, and practitioners. Over the past two years, we have seen an impressive range of submissions that reflect the rapid growth and diversification of blockchain technology and its associated fields.

This year, the submissions have continued to reflect the urgency and relevance of blockchain technology in addressing real-world problems. The academic symposium has become a pivotal platform for knowledge exchange and collaboration, fostering interdisciplinary insights that are shaping the future of decentralized technologies.

The Crypto Valley Association's commitment to supporting high-quality, rigorous research has never been stronger. I extend my heartfelt thanks to the contributors, peer reviewers, and organizing committee members who have worked tirelessly to make this year's journal and symposium a success. Your efforts not only advance our understanding of blockchain and distributed ledger technologies but also inspire future research directions and practical applications.

As we look ahead to another year of development and innovation, I encourage all stakeholders — academics, practitioners, policymakers, and enthusiasts alike — to continue engaging with this research, sharing insights, and contributing to the broader blockchain ecosystem.

I am confident that the findings presented in this year's journal will continue to drive thought leadership and practical advancements, further solidifying Crypto Valley as a global hub for blockchain innovation.

Tilmar Wilhelm Goos
Crypto Valley Association
Chairman, Education Working Group

1.2. THE CRYPTO VALLEY ASSOCIATION

The Crypto Valley Association (CVA) is a prominent, independent organization headquartered in Zug, Switzerland, a region known globally as "Crypto Valley" for its concentration of blockchain and cryptocurrency activity. Established in 2017 with government support, the CVA has become a driving force in advancing the growth and adoption of blockchain and cryptographic technologies both in Switzerland and internationally. Its core mission is to foster innovation, support research, and create a collaborative environment for the development of decentralized technologies. At the heart of the CVA's mission is the promotion of blockchain innovation and the facilitation of meaningful connections among startups, established businesses, academic institutions, and policymakers. The association provides an influential platform for knowledge exchange, networking, and cooperation between diverse stakeholders in the blockchain ecosystem. By organizing industry-leading events, such as the annual Crypto Valley Conference, the CVA brings together global experts, entrepreneurs, investors, and regulators to discuss technological advancements, emerging trends, and regulatory challenges.

A key focus of the CVA Education Working Group is knowledge and research. Through its specialized working groups, such as the Education, Legal & Compliance, and Regulatory Working Groups, the association supports initiatives aimed at increasing the understanding and practical application of blockchain technologies. One of its hallmark programs is the annual call for papers, which culminates in the publication of a research journal and a symposium. This initiative has become an important platform for academic researchers and industry professionals to collaborate and contribute to the growing body of knowledge on blockchain technology.

1.3. THE EDUCATION WORKING GROUP

The Education Working Group within the Crypto Valley Association plays a pivotal role in advancing the understanding and dissemination of blockchain technology. Its primary mission is to foster high-quality education and research, equipping both industry professionals and the broader community with the knowledge needed to navigate and contribute to the rapidly evolving blockchain ecosystem. The group organizes educational programs, workshops, and academic events aimed at deepening expertise in blockchain technologies and their applications. A cornerstone of its efforts is the annual Call for Papers, which invites contributions from researchers around the world and culminates in the publication of the Crypto Valley Research Journal and an Academic Symposium.

Education Working Group & delegates from the SIAM Technology College, Bangkok, Thailand agree on joint collaboration at CVC24

This initiative not only promotes cutting-edge research but also bridges the gap between academia and industry, driving meaningful discussions on the future of decentralized technologies.

Transforming Transactions: Shaping The Frontiers of Payments and Settlement Networks at the CVC2024, Rotkreuz, Switzerland.

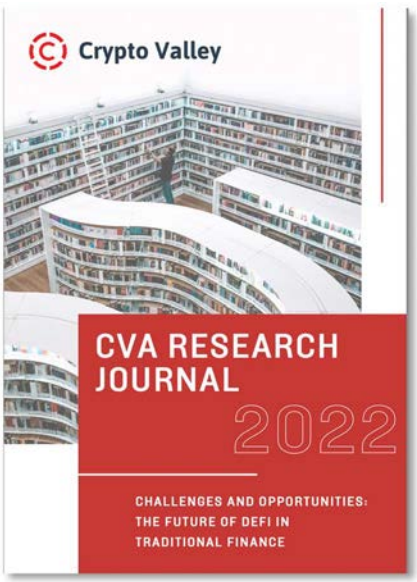
CVA's Education WG Official Announcement of the Call for Papers 2024 at iGB Amsterdam 2024.

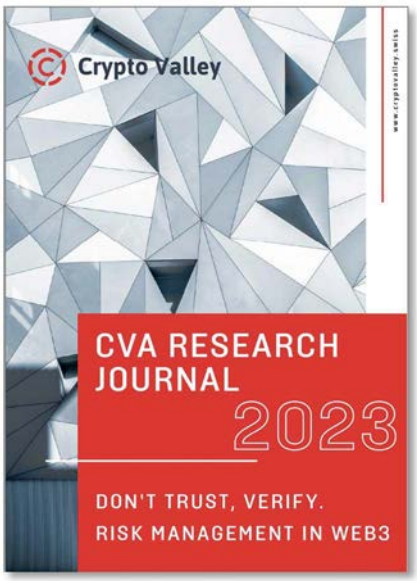
1.4 RESEARCH JOURNAL OF 2022 & 2023

The Crypto Valley Research Journal has now entered its third year, continuing its tradition of contributing cutting-edge research and fostering dialogue between academia and industry on critical blockchain topics. Each annual edition builds on the previous ones, offering insights into the most pressing challenges and opportunities facing the blockchain ecosystem.

In 2022, the journal focused on Challenges and Opportunities: The Future of DeFi in Traditional Finance. This theme addressed the integration of decentralized finance (DeFi) with traditional financial systems, highlighting the potential for DeFi to revolutionize banking while navigating significant regulatory and infrastructural hurdles. Researchers explored how DeFi could bring about a more transparent and efficient financial ecosystem, while also examining the risks and complexities that come with bridging the gap between decentralized systems and existing financial frameworks.

The 2023 edition shifted focus to Don't Trust, Verify: Risk Management in Web3. This theme underlines the importance of security and trust in decentralized environments, where traditional intermediaries are replaced by cryptographic protocols and verification methods. The research delved into the risks inherent in Web3 technologies, such as vulnerabilities in decentralized applications (dApps) and smart contracts, and explored strategies for ensuring the security and resilience of decentralized finance, NFTs, and DAOs. The 2023 edition emphasized the critical need for robust risk management frameworks in the Web3 space, particularly as these technologies scale and gain wider adoption.





Through these annual publications, the Crypto Valley Research Journal continues to play a crucial role in shaping the future of blockchain and decentralized technologies.

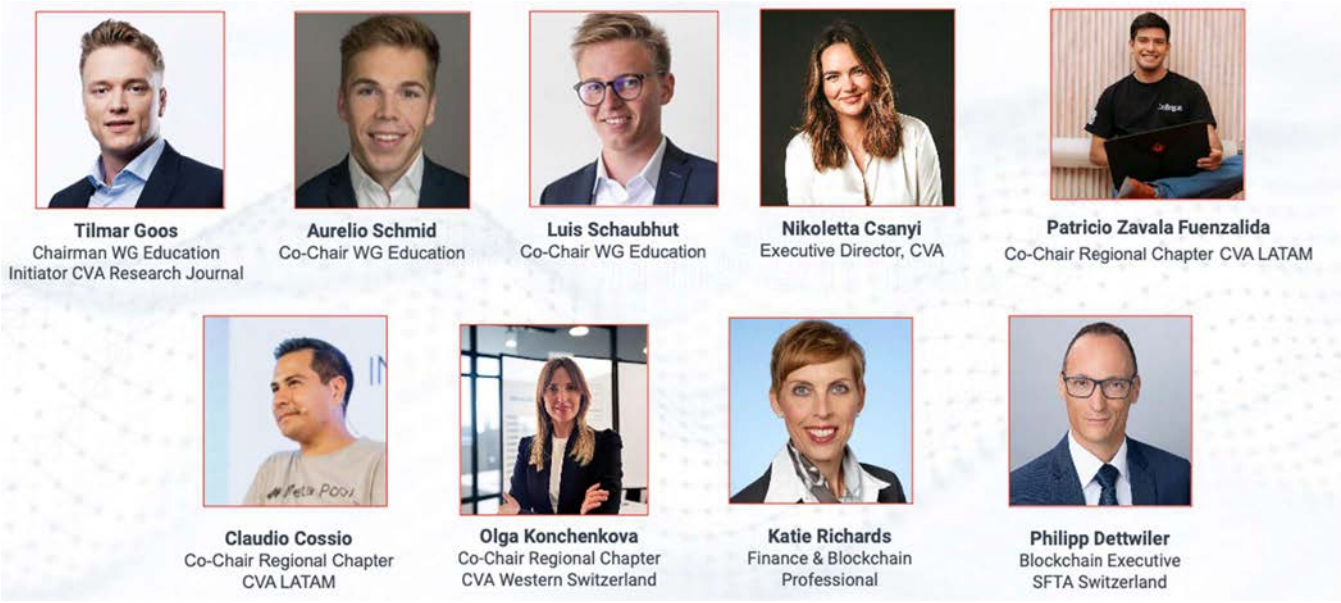
Download the
2022 CVA RESEARCH JOURNAL
2023 CVA RESEARCH JOURNAL

1.5 RESEARCH JOURNAL 2024 – THE FUTURE OF PAYMENTS AND SETTLEMENT NETWORKS

The theme for the 2024 edition of the Crypto Valley Research Journal is The Future of Payments and Settlement Networks. This edition will explore how blockchain and decentralized technologies are reshaping the landscape of payments and settlements, which are fundamental to global commerce. Researchers will examine the ongoing evolution of blockchain-based payment systems, highlighting how decentralized networks are offering faster, more secure, and transparent alternatives to traditional financial infrastructure.

Key topics include the potential for central bank digital currencies (CBDCs), stablecoins, and other digital assets to revolutionize cross-border payments by reducing costs and settlement times. Additionally, this edition will delve into the integration of blockchain with legacy financial systems, the regulatory challenges of adopting decentralized payment networks, and the role of tokenization in streamlining settlement processes across industries. As payment and settlement networks undergo this transformation, the 2024 journal will provide insights into the future of global financial transactions, highlighting both the opportunities and risks involved in this digital shift.

1.6 THE 2024 SCIENTIFIC COMMITTEE



1.7 SUB-THEMES OF 2024

The 2024 edition of the Crypto Valley Research Journal, themed The Future of Payments and Settlement Networks, will feature several sub-themes that provide a comprehensive exploration of the evolving blockchain payment ecosystem. These sub-themes will guide the research and discussions, focusing on key technological, regulatory, and practical aspects of blockchain in payment systems:

1. Scalability Solutions in Blockchain Payments
2. Interoperability Challenges in Cross-Border Payments
3. Smart Contracts in Payment Systems
4. Regulatory Frameworks for Blockchain Payments
5. Tokenization and Digital Assets in Payment Ecosystems
6. User Experience and Adoption in Blockchain Payments
7. Decentralized Finance (DeFi) and Payment Systems

1.8 SCORING DOMAIN

The *Crypto Valley Research Journal* employs a comprehensive scoring system to evaluate the submissions for its annual publication, ensuring that only the highest quality research is included. The scoring domains include **Relevance and Significance**, which assesses the importance of the research topic to the blockchain ecosystem. **Methodological Rigor** evaluates the soundness of the research design and execution, while **Innovative Propensity** looks for novel ideas and approaches that push the boundaries of current knowledge.

Clarity in Research Objectives ensures that the goals of the study are well-defined, contributing to a focused analysis. **Data Integrity and Analytical Precision** are critical for validating the findings, emphasizing the importance of accurate data handling and statistical analysis. Additionally, **Theoretical Framework Prowess** examines the robustness of the theoretical underpinnings guiding the research.

The **Practical Implications** domain considers how the findings can be applied in real-world scenarios, while **Consistency and Coherence** ensure that the research flows logically and is well-structured. **Ethical Contemplations** assess the ethical standards adhered to during the research process, and **Scholarly Contribution** highlights the study's contribution to the existing body of knowledge in blockchain and finance. Together, these scoring domains uphold the integrity and impact of the research published in the journal, fostering a rigorous academic environment that benefits both scholars and industry practitioners.

2024
RESEARCH PAPERS

2.1 Towards a New Era of Digital Payments: Blockchain, Global Standards and the Future of Finance - Monica Fior

THE AUTHOR

Monica Fior

FIDUCIARIA ORTELLI

CVA CFP 2024

Towards a New Era of Digital Payments: Blockchain, Global Standards and the Future of Finance

Monica Fior[1]

Abstract. This article focuses on exploring the future dynamics of cross-border payments and settlement networks, with particular attention to innovative solutions for blockchain scalability and interoperability challenges. The document analyzes how the adoption of standards such as ISO 20022 can facilitate the integration between global payment systems, improving efficiency and reducing transaction costs. Additionally, it examines the impact of asset tokenization and the use of smart contracts to automate and ensure security in payment processes. An analysis of existing regulatory frameworks highlights regulatory barriers and proposes solutions to harmonize laws globally, promoting broader adoption of blockchain technologies. Finally, the crucial role of user experience in adopting blockchain solutions is discussed, as well as the potential of the Metaverse in revolutionizing digital payments and financial ecosystems through integration with DeFi (Decentralized Finance). The article concludes that, despite progress, legal uncertainties remain, which may cause misunderstandings and delays, suggesting the need for further regulatory and judicial clarifications.

KEY WORDS

1. Cross-Border Payments 2. Regulatory Framework 3. ISO 20022
4. Blockchain Scalability 5. Metaverse

[1]Fior M.H.G., (fior@fiduciariaortelli.ch) Tax and Accounting Consultant at Fiduciaria Ortelli SA

1. Introduction

The growth of blockchain technologies in recent years has revealed the potential to transform payment systems worldwide, particularly with the advent of real-time settlement systems and the increased use of stablecoins. Traditional payment infrastructures, such as SWIFT and ACH, face limitations, including delays and fragmentation, primarily due to the involvement of intermediaries. Blockchain, with its ability to enhance efficiency and transparency, offers a promising alternative to overcome these constraints. However, the inherent challenges of blockchain technology, often encapsulated in the "blockchain trilemma," remain a significant hurdle. The trilemma, introduced by Ethereum creator Vitalik Buterin, highlights the difficulty in achieving an optimal balance between three key attributes: security, scalability, and decentralization.

Security is paramount to ensuring the integrity of blockchain networks: a secure blockchain must be resistant to attacks and manipulations, providing reliable data and verifying transactions accurately. On the other hand, scalability refers to a blockchain's ability to process an increasing number of transactions efficiently. The ability to handle more transactions per second without sacrificing speed or increasing costs is crucial for widespread adoption. Finally, decentralization ensures that control over the network is distributed across many participants, preventing any single entity from gaining disproportionate influence. Yet, according to the blockchain trilemma, optimizing all three properties simultaneously is challenging. Enhancing one aspect often results in compromising the others.

Bitcoin, for instance, prioritizes security and decentralization, but struggles with scalability, managing only a limited number of transactions per second. Similarly, Ethereum, while more scalable than Bitcoin, has faced challenges in optimizing all three attributes. To address scalability concerns, Ethereum has been working on innovations such as Layer 2 solutions and sharding. Layer 2 solutions, like Rollups, enable transactions to be processed off-chain, reducing congestion on the main blockchain and lowering costs. These advancements represent a potential breakthrough in solving the scalability issue while preserving security and decentralization.

The article also emphasizes the importance of ongoing research and technological innovation in addressing the blockchain trilemma. Sharding, for instance, is seen as a promising solution to enhance scalability without compromising security or decentralization. This technique involves dividing the blockchain into smaller parts, or shards, each capable of processing transactions independently. When combined with Layer 2 solutions, sharding could significantly increase a blockchain's capacity to handle more transactions, providing a pathway toward greater efficiency.

Another essential component of the blockchain ecosystem is interoperability, particularly between different blockchain networks and traditional financial systems. The lack of global standards for digital payments presents a major challenge to integrating blockchain solutions with existing infrastructures. Stablecoins and cross-chain platforms have been proposed as potential solutions to improve connectivity between different financial networks. The success of these technologies could facilitate the widespread adoption of blockchain for cross-border payments, where efficiency, speed, and cost-effectiveness are crucial.

The article provides a compelling case study in the Spunta Banca DLT project, which demonstrates the transformative potential of blockchain in the banking sector. Launched by the Italian Banking Association (ABI), this initiative leverages Distributed Ledger Technology (DLT) to optimize the interbank reconciliation process. By automating reconciliation through standardized algorithms, the project has shown how blockchain can modernize traditional banking

operations, offering greater transparency and efficiency. Furthermore, the adoption of the ISO 20022 standard in the Spunta project highlights the importance of harmonizing messaging formats in enhancing interoperability within the financial sector.

In parallel, the emergence of the metaverse—a digital, immersive world where users can interact, create, and trade using virtual currencies—has introduced new dimensions to blockchain technology. Blockchain is at the core of the metaverse's financial infrastructure, enabling secure ownership and transfer of digital assets, such as non-fungible tokens (NFTs) and cryptocurrencies. Within the metaverse, NFTs represent unique ownership of virtual goods, from digital art to virtual real estate, while cryptocurrencies facilitate transactions and provide users with economic agency in these virtual environments. The fusion of blockchain with the metaverse is expanding the scope of digital economies, allowing users to engage in decentralized financial activities in entirely virtual worlds.

2. Blockchain Trilemma

In recent years, the growth of blockchain technologies has demonstrated the potential to radically transform payment infrastructure, with the introduction of real-time settlement systems and the widespread use of stablecoins. Blockchain is considered a key solution to overcoming the limitations of traditional payment systems, such as SWIFT and ACH, which suffer from fragmentation and delays due to the presence of intermediaries.

The blockchain trilemma is a concept that describes the inherent challenges in achieving an optimal balance among three fundamental characteristics of a blockchain: scalability, security, and decentralization. This concept was formulated by Vitalik Buterin, the creator of Ethereum, to explain the difficulties blockchain designers face when attempting to optimize these three aspects simultaneously.

Briefly, the three elements of the trilemma can be illustrated as follows:

- Security: A blockchain must be resistant to attacks and tampering. Security ensures that the data on the blockchain is reliable and that transactions are accurately verified.
- Scalability: This refers to the blockchain’s ability to handle an increasing number of transactions efficiently while maintaining high speed and low costs. Scaling a blockchain means increasing its capacity to process more transactions per second without compromising the other two characteristics.
- Decentralization: Decentralization concerns the distribution of control over the network among many participants, rather than being concentrated in the hands of a central entity or a few individuals. A decentralized blockchain ensures that no single participant has disproportionate influence or control over the network’s decision-making processes.

The blockchain trilemma asserts that a blockchain network can optimize only two of these three properties at the same time. For instance, if a blockchain is secure and decentralized, it may struggle to scale, resulting in slower transaction times and higher costs. Alternatively, if a blockchain is scalable and secure, it may require a higher degree of centralization to maintain efficiency. On the other hand, if a blockchain is scalable and decentralized, security might be compromised, as faster consensus mechanisms may be less robust.

An example is Bitcoin, which is designed to be highly secure and decentralized, but its scalability is limited, with a relatively low number of transactions per second and high costs during periods of congestion. Ethereum faces a similar issue, but is implementing solutions like Layer 2 and sharding to improve scalability without excessively compromising decentralization and security. Technologies such as Rollups on Ethereum enhance scalability by processing transactions

off-chain and finalizing them on the main blockchain, preserving security and decentralization to a significant extent.

Solutions to the trilemma could be achieved through the many ongoing innovations aimed at mitigating it. Some strategies include:

- Sharding: Dividing the blockchain into smaller parts to improve scalability while maintaining decentralization and security.
- Layer 2: Developing off-chain solutions that reduce the load on the main blockchain.
- Advanced consensus algorithms: Developing new consensus algorithms such as Proof of Stake (PoS) to better balance the three properties.

This ongoing research is promising, suggesting that we may see significant progress in overcoming the blockchain trilemma in the near future.

Recent developments, such as the Ethereum Dencun[2] upgrade and the adoption of Layer 2[3] solutions like Arbitrum and Optimism, are significantly reducing costs and increasing efficiency. These technologies enable near-instantaneous transactions with minimal costs, facilitating the adoption of blockchain for cross-border payments.

Arbitrum and Optimism are two of the main Layer 2 scalability solutions for Ethereum, both based on Optimistic Rollups, a technology that processes transactions off-chain to reduce costs and congestion on the Ethereum mainnet.

Arbitrum[4] utilizes a multi-round fraud proof system, which allows for more efficient and cost-effective resolution of disputes regarding off-chain transactions. With this mechanism, only a specific part of the disputed transaction is reprocessed on Ethereum, thereby reducing gas fees. Additionally, Arbitrum features the Arbitrum Virtual Machine (AVM), an execution environment that optimizes transaction batching and offers compatibility with all Ethereum programming languages, facilitating the migration of decentralized applications (dApps) from the mainnet.

Optimism[5], on the other hand, uses a simpler approach with a single-round fraud proof, which involves executing the entire transaction in case of a dispute, potentially increasing costs due to Ethereum fees. However, this solution provides faster transaction finality, making it ideal for applications that require speed. Optimism is also known for its OP Stack, a modular framework aimed at building a "Superchain" of interoperable Layer 2 blockchains.

Arbitrum is generally preferred for its cost-efficiency and widespread adoption in decentralized finance (DeFi), while Optimism offers a simpler development experience and greater flexibility thanks to its modular stack and vision for a "Superchain."

However, scalability remains a technical and logistical challenge, as it requires greater optimization of network resources and the expansion of decentralized infrastructure capacities.

Another fundamental challenge is the interoperability between different blockchain networks and between these and traditional financial systems. The absence of a global standard for digital payments hinders seamless integration, complicating the standardization of messaging and settlement protocols. In this context, innovative solutions such as stablecoins and cross-chain platforms are considered crucial for improving accessibility and connectivity between global financial networks.

---

[2] Ethereum Dencun, https://consensys.io/ethereum-dencun-upgrade
[3] LAYER 2, Ethereum for everyone, https://ethereum.org/en/layer-2/
[4] ARBITRIUM, https://arbitrum.io/
[5] Optimism, https://www.optimism.io/

A concrete and successful case of blockchain application in the banking sector, demonstrating the technology's potential to optimize existing processes and create new opportunities for collaboration and future innovation, is the Spunta Banca DLT project. This innovative initiative, promoted by the Italian Banking Association (ABI) and coordinated by ABI Lab (with technical partners NTT DATA, SIA and R3 through the Corda Enterprise platform), leverages blockchain/DLT (Distributed Ledger Technology) to modernize and optimize the interbank reconciliation process. It's "[..] the only project in the world involving an entire banking sector, with around 200 million processed transactions, equivalent to a year of work" (Monti A., Head of Banking, Senior Vice President, NTT Data Italia).

By 2020, around 100 banks were accessing their node daily to manage the interbank process, which had transformed from a traditional back-office method based on phone calls and messages into a blockchain-based system. The new approach relies on automatic reconciliation using shared, standardized and traceable algorithms between the parties involved.

In this context, the ISO 20022 standard plays a crucial role, ensuring the harmonization of messaging formats used within the platform. ISO 20022, internationally recognized for its flexibility and comprehensiveness, provides a structured framework for the communication of financial data, enhancing interoperability between global banking and financial systems. In the Spunta project, the adoption of ISO 20022 enables the standardization of information flows between banks, facilitating the transmission of complex data such as transaction and accounting movement details. This results in greater accuracy and timeliness in reconciliation operations, as well as improved regulatory compliance, as the standard facilitates alignment with European and global regulations. The ISO 20022 standard is particularly relevant in the context of the migration to SEPA credit transfer and direct debit schemes based on this standard. Notably, the document "Summary of the Activities of the Italian Banking Association in 2023-2024" mentions that the migration to the 2019 version of the ISO 20022 standard is expected to be completed by March 2024[6].

The skills acquired in creating a distributed governance infrastructure make Italian banks ready to participate in projects and experiments for a European Central Bank digital currency. The digital euro, a potential Central Bank Digital Currency (CBDC), may require pilot tests to accelerate the implementation of a Europe-wide initiative in an initial country, and Spunta banks have gained the experience to support feasibility testing for the banking and financial sectors. The next goal could be to extend these services not only to European and international banks, but also to other sectors such as insurance, telecommunications, and energy[7].

Following the success of the Spunta Banca DLT project, in July 2023, the LEONIDAS initiative (Liquidazione Efficace ONchaIn Dlt Asset on Spunta) was launched. This project involves the same key players, as well as some major Italian banks and the Bank of Italy (Milano Hub). The aim is to analyze the potential benefits of a wholesale central bank currency (wholesale CBDC, or wCBDC) implemented on distributed ledger technology (DLT) for interbank transactions, meeting the capacity, efficiency, and robustness requirements of central bank systems. In June 2024, the LEONIDAS project was admitted to the European Central Bank's exploratory work on new technologies applied to wholesale payment infrastructures[8].

---

[6] ABI, *Sintesi delle attività dell'ABI nel 2023-2024*, https://www.abi.it/wp-content/uploads/2024/07/Sintesi-delle-AttivitaABI2023-2024.pdf

[7] ABI, *Fintech, credito: Spunta, 100 banche sulla blockchain di settore*, https://www.abi.it/fintech-credito-spunta-100-banche-sulla-blockchain-di-settore/

[8] ABI, *Fintech, progetto ABI e ABI Lab selezionato da Bce,* https://www.abi.it/fintech-progetto-abi-e-abi-lab-selezionato-da-bce/

SWIFT, the world's leading financial messaging network, has established a co-existence period between ISO 20022 and SWIFT MT messages, which will end in November 2025. After this date, all SWIFT messages used for payments must be ISO 20022-compliant. It's anticipated that the global transition will be fully completed by 2027.

Table 1. Various platforms and initiatives are exploring or utilizing both ISO 20022 and blockchain technology

Project	Description	Research Status	Key Clients or Partners	Currencies Fiat Supported
Ripple and RippleNet	Global network for cross-border payments using XRP, fast and cost-effective	Active implementation, partnerships with banks	Santander, American Express, Standard Chartered	40+ currencies (including USD, EUR, GBP, JPY)
Stellar	Initiative focused on financial inclusion, with Lumens (XLM) as the currency	Active implementation, used in emerging markets	IBM, Grayscale, Mercy Corps	Multiple currencies, particularly for emerging markets
SWIFT GPI and Blockchain	Integration of blockchain with traditional payments to increase efficiency	Research and testing phase with DLT	HSBC, Bank of America, JPMorgan Chase	Supports all major global currencies through banking partners
Lightning Network	Second-layer protocol on Bitcoin for instant, low-cost transactions	Adoption phase, used for micropayments	Adopted by various Bitcoin exchanges and wallets	Bitcoin is paired with fiat via various wallets and exchanges
CBDC (Central Bank Digital Currency)	Digital currencies of central banks for cross-border payments	Pilot projects, ongoing experimentation	European Central Bank, People's Bank of China, Bank of Japan	Depends on the central bank issuing the digital currency (EUR, CNY, JPY)
DeFi Projects (Uniswap, Compound, Aave)	Decentralized platforms for international payments and loans without intermediaries	Active implementation, growing DeFi sector	Used by thousands of DeFi users, integrated into MetaMask, Trust Wallet	No direct fiat support, operates mainly with cryptocurrencies
International Collaboration Initiatives (Digital Euro, Digital Dollar)	International collaboration for blockchain-based payment systems between countries	Research phase, collaboration between countries	Collaboration with ECB, Federal Reserve, and other European and US central banks	Targeted at major global currencies (USD, EUR)

Diagram developed by the author

There are currently several international projects underway that use blockchain to improve cross-border payments, addressing the challenges related to speed, costs, and security of global transactions. One of the main initiatives is Project Agorá, launched by the Bank for International Settlements (BIS) in collaboration with seven central banks, including the Banque de France, the Bank of Japan, the Bank of Korea, and the Swiss National Bank. The project aims to modernize cross-border payments through the use of a unified ledger and tokenization of deposits, supported

by both central and commercial banks from various countries, including France, Switzerland, Mexico, and South Korea.

Agorá focuses on reducing settlement times by eliminating the need for repeated checks by each bank along the payment chain. By leveraging blockchain technology and distributed ledgers, the project seeks to streamline the process, improve transaction transparency, and enhance security, while simultaneously reducing the costs typically associated with international transfers.

This initiative reflects a broader trend toward using blockchain and digital assets to reform global payment systems, aligning with the goals of improving efficiency and interoperability across different financial infrastructures. Through collaboration among central banks and key financial institutions, projects like Agorá represent significant progress in the modernization of cross-border payments.

The project aims to address current issues in cross-border payments, such as high costs, slow operations, and lack of transparency. The unified ledger concept proposed by the BIS is at the core of this initiative, while tokenization enables the management of both money and messaging in a single operation, reducing delays caused by the separation between messaging systems and money movements.

Project Agorá is a public-private collaboration involving both central banks and private financial institutions, selected based on their relevance and involvement in cross-border payments. Institutions participating in the project include Santander, BBVA, CaixaBank, Visa and Mastercard. The participating banks will experiment with the integration of central and commercial bank money on blockchain platforms, aiming to create a more efficient global financial infrastructure.

Through the use of smart contracts and programmability, tokenization streamlines processes, reducing the complexities of cross-border transactions. For instance, tokenizing commercial bank deposits allows for the automation of complex payments, ensuring that transactions are fast, secure, and less costly. Additionally, integrating CBDCs enhances control by central authorities, making the system more secure and traceable.

The BIS Annual Economic Report 2023[9] addresses various aspects of the future monetary system, particularly focusing on tokenization and its potential applications in the financial sector, including CBDCs, tokenized deposits, and other financial assets. The report outlines how tokenization can improve the existing financial system by enabling more efficient transaction management through programmability and operational composition. The central concept proposed is that of a "unified ledger", a platform where CBDCs tokenized deposits, and other assets coexist to allow for instant transaction finalization, reducing settlement times and risks associated with cross-border transactions.

Tokenization allows the digital recording of asset ownership and their transfer across programmable platforms. This enables greater automation in financial transactions and reduces traditional steps such as messaging and reconciliation, which currently slow down processes. The unified ledger concept aims to simplify these processes, ensuring transparency and efficiency through the use of CBDCs as a final settlement tool.

The report discusses several examples, including the potential improvement of securities settlement and the management of settlement risk in the foreign exchange market. Through smart contracts, it is possible to execute payments and securities transfers simultaneously and efficiently. Moreover, applying tokenization to the supply chain sector offers innovative solutions to improve

[9] BIS Annual Economic Report 2023, *Blueprint for the future monetary system: improving the old, enabling the new,* https://www.bis.org/publ/arpdf/ar2023e3.pdf

trade finance, automating payments and reducing risks associated with non-compliance with obligations.

The BIS Annual Economic Report 2023 provides concrete examples of how tokenization could significantly enhance securities settlement processes, reducing complexity, time, and costs. These improvements are primarily based on the use of CBDCs and programmable platforms that allow the simultaneous exchange of assets. The report illustrates how tokenization, in conjunction with blockchain technology, has the potential to reshape financial infrastructures, making them more efficient, transparent, and secure in the global market.

Example 1: Securities Settlement

In the context of securities settlement, current processes involve numerous parties, such as brokers, custodians, central securities depositories, and clearinghouses. Each of these actors requires the sending and receiving of messages to confirm, settle, and reconcile transactions. This not only increases costs, but also operational risks related to potential errors or delays.

The use of a unified ledger, as proposed in the BIS report, could significantly streamline this process. By tokenizing both money and securities on a programmable platform, settlement can occur automatically via smart contracts, which execute both sides of the transaction (securities against money) simultaneously. This method is known as atomic settlement, where the transaction takes place only if both conditions are met at the same time. This concept is particularly relevant in the financial sector, where traditionally transactions can take up to two days to settle (T+2). Atomic settlement promises to reduce this time to T+0, meaning instantaneous settlement.

This reduces settlement risk, as neither party can withdraw or fail to deliver their side of the transaction. The instant execution of both parts of the trade ensures that securities and money are exchanged simultaneously, minimizing the risks associated with delays, errors, or defaults during the settlement process. By leveraging blockchain and tokenization, atomic settlement offers a more efficient and secure approach to managing securities transactions, potentially transforming how global financial markets operate.

Example 2: Foreign Exchange Risk in Cross-Border Payments

Another area where tokenization can bring significant benefits is in the management of foreign exchange risk in cross-border payments. Currently, international transactions require the involvement of several correspondent banks and international messaging systems such as SWIFT. In addition to high costs and slow execution times, this process introduces foreign exchange risk. If one party fails to deliver the agreed-upon currency, the other party is exposed to potential losses.

The solution proposed by the BIS is similar to the securities settlement approach: using tokenized CBDCs, the settlement can be completed simultaneously and securely via payment-versus-payment (PvP). This approach ensures that both sides of the transaction occur simultaneously, minimizing the risk of one party failing to fulfill their part of the deal.

Projects like Jura[10], a joint initiative of the Swiss National Bank (SNB), the Banque de France (BdF), and the BIS Innovation Hub, have already demonstrated that this model is applicable to cross-border payments, drastically reducing foreign exchange risk by using subnetworks that respect jurisdictional boundaries and local regulations.

[10] SNB BNS, *Project Jura*, https://www.snb.ch/it/the-snb/mandates-goals/international-cooperations/multilateral/bis-innovation#t34

Launched to explore the use of central bank digital currencies (CBDCs) in cross-border payment contexts, Project Jura focuses on payments and settlements between the Swiss franc (CHF) and the euro (EUR) using wholesale CBDCs (wCBDCs). The goal is to make cross-border transactions more secure, faster, and less costly, as well as to test the feasibility of using CBDCs to facilitate transfers and settlements between different jurisdictions in a safe, efficient, and automated manner.

The project involves a consortium of commercial banks and institutions, including Credit Suisse, Natixis, and UBS, which have direct access to intraday CBDCs. Transactions in both Swiss francs and euros were settled through payment-versus-payment (PvP) and delivery-versus-payment (DvP) mechanisms, meaning the simultaneous clearing of payments in different currencies. This significantly reduces the risk of settlement failure or non-delivery in cross-border transactions. The technical platform was developed on Corda DLT by R3, allowing for the secure exchange of tokens representing assets and currencies. The project also employed the Digital Asset Registry (DAR) to issue and record tokenized financial instruments.

The technologies used for Jura's development included:

- Dual-notary signing: This feature, developed specifically for Project Jura, enables the simultaneous exchange of two tokens between subnetworks governed by different central banks, thus reducing settlement risks.
- Tokenization of assets: Jura experimented with a new type of tokenized commercial paper in euros, issued by Natixis and exchanged between the participating banks alongside wCBDCs, making transactions more efficient and secure.

Project Jura’s implementation showcases the potential of tokenized assets and CBDCs to transform cross-border payments by reducing risks, improving transaction efficiency, and enhancing the overall security of international financial operations.

Main Use Cases:

1. Cross-Border Payments with CBDC: Jura demonstrated that the use of wCBDCs can drastically improve the speed and security of international payments. Transactions occur instantly, without the waiting times traditionally required for reconciliation processes. Blockchain programmability allows for fully automated settlement, reducing human intervention and the potential for errors.
2. Jurisdictional Subnetworks and Data Protection: Jura introduced the use of jurisdictional subnetworks that respect the legal boundaries and local regulations of each participating country. This approach allows for maintaining local control over data and transactions, ensuring that each country’s regulatory requirements are met while facilitating global interoperability.
3. Innovation through Smart Contracts: The blockchain technology used in Project Jura enables the use of smart contracts to program specific payment conditions, such as conditional payments that are triggered only when certain events occur. This has important applications in the commercial sector, where payments can be tied to the delivery of goods or the fulfillment of specific contractual terms.

Benefits of Project Jura:

- Reduction of Foreign Exchange Risk: One of the greatest risks in traditional cross-border payments is foreign exchange risk, where one party may fail to deliver the agreed currency. The use of PvP with CBDCs eliminates this risk, ensuring that both currencies are exchanged simultaneously and that settlement is final and irrevocable.

– Security and Transparency: The DLT-based infrastructure offers greater security compared to traditional systems, thanks to the immutability of the ledger and the transparency of transactions. Additionally, the separation of data in subnetworks ensures that only authorized parties can access sensitive information. The project demonstrated that wCBDC and tokenized assets can be exchanged on DLT platforms with the same security as traditional settlement infrastructures.

– Efficiency of Cross-Border Payments: PvP and DvP were conducted atomically and instantaneously, showing that DLT technology can improve the efficiency of international settlement.

– Finality of Payment: Jura also introduced the concept of payment finality, which ensures that once a payment is completed, it cannot be revoked or altered. This reduces the risk of disputes and improves the operational efficiency of the banks involved.

– Public-Private Collaboration: Jura highlighted the value of collaboration between central banks and private institutions to drive innovation in international financial markets.

The project highlighted several issues related to financial stability and monetary policy, suggesting that wider integration of wCBDCs could enhance stability and reduce the costs of international transactions. However, it also requires coordination among central banks for the management of liquidity and access to CBDCs by non-resident institutions.

Example 3: Automation and Transparency

Another key advantage of tokenization is automation. With the introduction of programmability, transactions can be executed automatically based on predefined conditions. For instance, in the case of a tokenized green bond, as seen in Project Genesis[11], payments can be programmed to occur only upon meeting specific conditions, such as achieving environmental goals or carbon emissions reduction targets. This approach not only enhances transparency, but also allows for greater traceability of transactions.

The adoption of tokenization and programmable platforms promises to revolutionize the cross-border payments and securities settlement sectors. By integrating tokenized assets and CBDCs, significant improvements can be made in terms of efficiency, cost reduction and risk management. These advancements represent a step toward a more secure and transparent financial system, well-suited to the needs of modern global commerce.

Another significant example is the work of J.P. Morgan through its Onyx division[12], which successfully tested the use of permissioned blockchain for CBDC payments between Singapore and France. This project aims to enable near-instantaneous cross-border transactions, overcoming the limitations of traditional systems that take days to complete a transaction. Thanks to blockchain, institutions can manage cash flows more dynamically, reducing complexities and enhancing transparency.

These projects are experimenting with blockchain technology to tackle existing challenges in cross-border payments, paving the way for a future where global transactions will be faster, more secure, and less costly. Blockchain's automation and transparency can significantly streamline financial operations, leading to greater innovation and improved international collaboration.

[11] Project Genesis 1.0: prototype digital platforms for green bond tokenisationhttps://www.bis.org/about/bisih/topics/green_finance/green_bonds.htm

[12] Onyx, https://www.jpmorgan.com/onyx/index

3. Automated Escrow through Smart Contracts

Automated escrow using smart contracts represents a significant innovation in the field of cross-border payments. With the introduction of blockchain and smart contracts, the automated escrow model has revolutionized the way transnational transactions are managed. A smart contract acts as a pre-programmed agreement between parties, where funds are held in escrow until all predefined conditions are met. This mechanism not only ensures greater security and transparency, but also eliminates the need for traditional intermediaries, thus reducing transaction costs and improving operational efficiency.

In an automated escrow system, the smart contract self-executes when conditions are satisfied, such as the delivery of goods or completion of services, making the payment process more reliable and less prone to disputes. The use of blockchain guarantees the immutability and traceability of these transactions, further enhancing trust between parties, especially in high-stakes international transactions.

By automating escrow, smart contracts streamline processes that would otherwise require extensive third-party oversight, significantly accelerating cross-border trade and financial operations while ensuring secure and transparent settlements. This innovation is poised to transform industries that rely heavily on trust and verification, such as real estate, global supply chains, and e-commerce.

How the Automated Escrow System Works

A classic example of automated escrow is its use in physical goods transactions. Imagine a scenario where a seller ships a product to a buyer in another country: traditionally, the buyer might send the money upfront, trusting that the seller will ship the product, or the seller could ship the product, hoping to receive payment afterward. Both cases involve significant risk.

Instead, using a smart contract, the parties can define specific conditions on the blockchain: the buyer deposits the funds into the smart contract, which holds them until the product is delivered and confirmed by the buyer. Once the product is confirmed as delivered, the smart contract automatically releases the funds to the seller. This process is managed without human intervention once the initial conditions are set, ensuring the transaction is secure and reliable.

Moreover, the smart contract helps resolve potential disputes, as each condition is already recorded and immutable on the blockchain. The transparent and verifiable recording of transactions builds trust between the parties, even when operating under different geographical jurisdictions or financial regulations. By automating the escrow process, blockchain technology significantly reduces the risks associated with international trade, ensuring that neither party has to rely solely on trust. Additionally, the elimination of intermediaries reduces transaction costs and speeds up the settlement process, making global commerce more efficient and secure.

This automated escrow system is particularly valuable for industries such as e-commerce, real estate and supply chain management, where transactions are frequently conducted across borders and involve substantial financial stakes.

Advantages in Cross-Border Payments

Automated escrow using blockchain offers several advantages in international payments. First, it significantly reduces the costs associated with using financial intermediaries. Traditional systems like SWIFT involve high fees for international wire transfers, while smart contracts require only a small gas fee on the blockchain network (such as Ethereum), which is far lower than conventional banking costs. Second, transaction execution times are drastically reduced. Traditional transactions

can take several days to process, especially when involving multiple financial institutions and spanning different time zones. With automated escrow, the transaction is executed in a matter of minutes or even seconds, once the conditions specified in the contract are met. This is particularly beneficial for businesses that need to handle large volumes of transactions quickly.

Practical Examples

In the real estate sector, automated escrow enables the secure and transparent management of property purchases. A real estate transaction could involve the buyer depositing funds into a smart contract. Once the seller completes the property transfer and its registration is confirmed on the blockchain, the contract automatically releases the funds. This model eliminates the need for notaries or third-party agencies to manually verify the transaction.

Another practical example involves international remittances. People sending money to family members abroad can use smart contracts to ensure that the funds are released only when the recipient confirms they have received the money. Moreover, these transactions are completed at lower costs and much faster than traditional money transfer services like Western Union.

Automated escrow through smart contracts represents a breakthrough in cross-border payments. Its ability to guarantee security, reduce costs and accelerate transaction execution makes it an increasingly adopted solution in various sectors, from e-commerce to real estate transactions. Its implementation enhances operational efficiency and opens new possibilities for global trade, transforming the way international payments are handled[13].

4. Application of Blockchain – Statistical Analysis

Analyzing the report *"Switzerland-EU in Figures: Statistics on Trade, Population and Transport - August 2024*"[14], which provides detailed data on direct investments and trade of goods and services between Switzerland and the European Union, the main extracted data are as follows:

Direct Investments

1. Foreign Direct Investments in Switzerland (2022):
   - The total capital of foreign direct investments in Switzerland was CHF 1,055.44 billion, with 70.21% of these coming from the European Union (CHF 741.00 billion).
   - The main contributing countries were the Netherlands (CHF 296.91 billion, 28.13% of the total), Luxembourg (CHF 194.33 billion, 18.41%) and France (CHF 33.73 billion, 3.20%).
2. Swiss Direct Investments Abroad (2022):
   - The total capital of Swiss direct investments abroad amounted to CHF 1,318.90 billion, of which 50.13% was directed towards the European Union (CHF 661.19 billion).
   - The main recipient countries included the Netherlands (CHF 170.15 billion), Germany (CHF 65.63 billion) and France (CHF 60.11 billion).

Trade of Goods

[13] SHAH N., *Blockchain and DLT: A comprehensive guide to getting started with blockchain and Web3,* BPB Publications, 2024

[14] Switzerland-EU in Figures: Statistics on Trade, Population and Transport, August 2024, https://www.eda.admin.ch/dam/europa/de/documents/faq/schweiz-eu-in-zahlen_de.pdf

1. Exports of Goods from Switzerland to the EU (2023):
   - Switzerland exported goods worth CHF 137.94 billion to the EU, representing 50.32% of Switzerland's total goods exports (CHF 274.11 billion).
   - Main partners: Germany (CHF 42.60 billion), Italy (CHF 21.10 billion) and France (CHF 14.30 billion).
2. Imports of Goods from the EU to Switzerland (2023):
   - Imports from the EU totaled CHF 158.11 billion, representing 70.01% of Switzerland's total goods imports (CHF 225.85 billion).
   - The major supplier countries were Germany (CHF 56.30 billion), Italy (CHF 23.13 billion) and France (CHF 17.98 billion).

Trade of Services

1. Exports of Services from Switzerland to the EU (2023):
   - Switzerland's exports of services to the EU amounted to CHF 59.04 billion, representing 39.29% of Switzerland's total service exports (CHF 150.26 billion).
   - Main recipients: Germany (CHF 18.05 billion), France (CHF 9.25 billion) and Italy (CHF 5.63 billion).
2. Imports of Services from the EU to Switzerland (2023):
   - Imports of services from the EU amounted to CHF 77.65 billion, representing 44.74% of Switzerland's total service imports (CHF 173.57 billion).
   - Main suppliers: Germany (CHF 24.48 billion), France (CHF 8.15 billion) and Italy (CHF 7.93 billion).

The preparation of a savings prospectus in monetary terms through the use of blockchain for cross-border payments is based on certain assumptions, comparing the costs and inefficiencies of traditional systems with the benefits of blockchain, such as speed, reduced fees and increased transparency. Below, I outline a model that considers the provided data on financial flows between Switzerland and the EU, using blockchain as a tool for cross-border payments.

Assumptions and hypotheses:

1. Total financial flows: We consider both investment flows and commercial flows (goods and services).
2. Fees in traditional systems: Fees for traditional cross-border payments are generally high, ranging from 1% to 5% and include intermediary costs, currency conversion, delays of several days, etc.
3. Cost reduction with blockchain: The use of blockchain (e.g., Lightning Network or systems based on stablecoins) can reduce fees to as low as 0.1% or less, in addition to offering near-instant transactions.
4. Areas of application: Commercial flows (goods and services) and direct investments.

Direct investments between Switzerland and the EU (2022):

- Swiss direct investments in the EU: CHF 661.19 billion
- EU direct investments in Switzerland: CHF 741.00 billion

Total direct investments: CHF 1,402.19 billion

Calculation of Financial Flows Goods and services flows between Switzerland and the EU (2023):

- Exports of goods: CHF 137.94 billion

- Imports of goods: CHF 158.11 billion
- Exports of services: CHF 59.04 billion
- Imports of services: CHF 77.65 billion

Total trade in goods and services: CHF 432.74 billion

Estimated Potential Savings

- Traditional systems: If we assume an average cost of 1.5% for traditional cross-border financial flows (fees, intermediaries, waiting times), cost with traditional systems = 1.5% of CHF 1,834.93 billion = CHF 27.52 billion.
- Blockchain-based systems: By reducing costs to 0.1% through blockchain, the total cost would be: Cost with blockchain = 0.1% of CHF 1,834.93 billion = CHF 1.83 billion.

Total Savings:

- Estimated savings = Cost with traditional systems - Cost with blockchain
  = CHF 27.52 billion - CHF 1.83 billion = CHF **25.69 billion.**

From the results, it is clear that by implementing blockchain for cross-border financial flows between Switzerland and the EU, the estimated savings could amount to around CHF 25.69 billion based on the two years under review. This significantly reduces costs and improves the efficiency of commercial transactions and direct investments, making the payment system more competitive and sustainable.

Table 2. Summary of Sectoral Benefits from Blockchain Application

Sector	Main Benefits	Estimated Impact
Financial sector (banks, fintech, insurance)	Reduction in fees (from 1.5% to 0.1%), Faster payments, Smart contracts for insurance	Estimated savings on cross-border financial flows: CHF 25.69 billion due to reduced fees
International trade and supply chain	Traceability and transparency along the supply chain, Reduction of payment delays	Reduced logistics costs and increased confidence in supply chain processes, especially for perishable goods and pharmaceuticals
Professional services and consulting	Reduction in international payment costs, Automation of payments through smart contracts	Improved competitiveness for global consultants and increased payment efficiency for international consulting firms
Technology sector (blockchain startups)	Creation of new payment and traceability platforms, Tokenization of assets	Growth of new market opportunities, particularly in fintech and asset tokenization
Healthcare	Traceability of pharmaceuticals, Secure sharing of medical records	Greater guarantees in secure data management and reduced counterfeit pharmaceuticals
Manufacturing	Automation of the supply chain and production processes, Efficiency in logistics management	Reduced operating costs and increased productivity through smart contracts and automated tracking
Retail and e-commerce	Reduction in transaction costs, Increased consumer trust through product traceability	Increased global sales and reduced payment times for international e-commerce platforms
Public administration	More efficient intergovernmental payments, Increased transparency in public payments	Reduced corruption and increased public trust due to traceability and automation

Diagram developed by the author

5. Regulatory Framework

The existing regulatory framework for blockchain and Distributed Ledger Technology (DLT) faces several regulatory challenges and proposes solutions to harmonize laws globally, with the goal of promoting broader and safer adoption of these technologies.

One of the most advanced examples of blockchain and crypto asset regulation is Switzerland, which has adapted its federal law to accommodate technological developments through various laws and ordinances. Switzerland's approach is outlined in the Federal Act on the Adaptation of Federal Law to Developments in Distributed Ledger Technology, which came into force in 2021

(RU-2021-400-IT, RU-2021-33-IT) [15][16]. This regulatory framework provides clear, innovation-friendly guidelines, establishing rules for investor protection and anti-money laundering (AML) measures, which also apply to cryptocurrencies and investment tokens. In doing so, Switzerland aims to reduce risks associated with crypto assets and promote trust in digital transactions.

However, significant regulatory barriers remain globally: many countries have yet to adopt specific blockchain and crypto asset regulations, or they have incomplete or inconsistent legislation. This situation creates uncertainty for businesses operating transnationally, as they must navigate different and sometimes conflicting legal frameworks. Additionally, the lack of uniform international standards makes cooperation between regulatory authorities difficult and increases the risk of regulatory arbitrage, where companies choose to operate in jurisdictions with more permissive regulations.

To address these challenges, international organizations such as the Financial Action Task Force (FATF - intergovernmental organization that sets global standards for combating money laundering and terrorist financing) and the Financial Stability Board (FSB) have initiated efforts to develop global standards for the treatment of crypto assets and to harmonize regulations internationally. While some countries, like Switzerland, have established clear regulatory frameworks for blockchain and crypto assets, global coordination remains a work in progress.

In 2019, the FATF published a series of recommendations aimed at establishing global standards for regulating the use of virtual currencies and Virtual Asset Service Providers (VASPs). These recommendations include the application of Anti-Money Laundering (AML) and Know Your Customer (KYC) standards for all operators in the cryptocurrency sector. One of the most significant measures introduced by the FATF is the "Travel Rule", which requires VASPs to collect and share customer and transaction information when transferring cryptocurrencies between platforms. The adoption of FATF guidelines has led many countries to develop or adapt their regulations for the cryptocurrency sector. However, a major challenge lies in the uniform implementation of these recommendations worldwide. Different jurisdictions have varying standards, which can create opportunities for regulatory arbitrage, where operators choose to establish themselves in countries with less stringent regulations.

The FATF is working to enhance international cooperation to ensure that all countries adopt adequate measures to prevent the misuse of cryptocurrencies for illegal purposes. Despite these recommendations, there are still significant challenges in regulating cryptocurrencies. Emerging technologies such as Decentralized Finance (DeFi) and Non-Fungible Tokens (NFTs) further complicate the regulatory landscape, and the FATF continues to work on how to adapt its guidelines to these new developments.

One of the primary goals of these international initiatives is to ensure that security and transparency are maintained in all transactions involving blockchain technologies, without stifling innovation or hindering the growth of the cryptocurrency sector.

Financial stability remains a primary concern for regulatory authorities in the context of cryptocurrency markets. The volatility of cryptocurrencies, such as Bitcoin and Ethereum, along with the growing adoption of stablecoins, has drawn the attention of central authorities, who are closely monitoring the potential impact of these instruments on global financial market stability.

---

[15] Swiss Confederation, *Federal Act on the Adaptation of Federal Law to Developments in Distributed Ledger Technology*, 2020

[16] Swiss Confederation, *Ordinance on the Adaptation of Federal Law to Developments in Distributed Ledger Technology*, 2021

While the Financial Stability Board (FSB) has not yet identified material risks from crypto assets, it has warned that the widespread adoption of such assets could introduce new financial risks in the future.

To promote a broader and safer global adoption of blockchain technologies, there is a growing call for enhanced international cooperation among jurisdictions. The aim is to develop a consistent regulatory framework that can effectively address current challenges. In this context, tax transparency has become another critical issue. The Organisation for Economic Co-operation and Development (OECD) is working to include crypto assets in the international standards for the automatic exchange of financial account information.

The OECD has addressed blockchain in various reports and conferences, examining its impact on areas such as international trade, taxation, supply chain management, and financial services. The organization acknowledges blockchain as a key tool for enhancing transparency and reducing operational costs, thanks to its ability to record transactions in a secure and immutable manner.

A key area where the OECD is focusing its efforts is the fiscal impact of cryptocurrencies and digital assets. Specifically, the OECD is working on standards for tax transparency regarding cryptocurrencies, similar to the current Common Reporting Standard (CRS), which is used for the automatic exchange of financial account information. The unregulated use of cryptocurrencies can facilitate tax evasion, and the OECD is addressing this issue by developing tools to improve information sharing between countries and harmonize regulations at the international level.

These efforts by the OECD aim to ensure that crypto assets are subject to the same level of fiscal oversight as traditional financial assets, reducing the risk of tax evasion and improving transparency in the global financial system. By doing so, both the OECD and regulatory bodies are working toward creating a sustainable regulatory environment that supports innovation while maintaining the integrity and stability of global financial markets.

The OECD is also exploring the role of blockchain in environmental sustainability. The traceability and transparency offered by blockchain can improve supply chain management, enabling companies to monitor and certify the sustainable origin of their products. Additionally, the OECD has recognized the potential of the technology to track carbon emissions and facilitate the development of more transparent carbon markets.

Despite its potential, the OECD highlights several regulatory challenges related to blockchain adoption. One of the key concerns is the lack of unified global standards for regulating cryptocurrencies and DLTs (Distributed Ledger Technologies), that can lead to regulatory fragmentation, creating uncertainties for businesses operating across different jurisdictions. While the OECD considers blockchain a technology with high transformative potential, it emphasizes the need for clearer and more standardized global regulations to fully harness the benefits it can offer.

The global regulatory framework for blockchain is still evolving, but pioneering initiatives, such as those adopted by Switzerland, and increasing international cooperation represent important steps toward creating a regulated and secure environment for the use of these innovative technologies.

The Markets in Crypto-Assets Regulation (or MiCAR)[17] represents one of the first and most comprehensive global frameworks for the regulation of cryptocurrencies and digital assets within

[17] European crypto-assets regulation (MiCA), https://eur-lex.europa.eu/EN/legal-content/summary/european-crypto-assets-regulation-mica.html

the European Union. Approved in 2023, MiCA aims to create a harmonized framework for all member states, ensuring greater security for investors and transparency for crypto-asset issuers.

The primary goal of MiCA is to provide legal and regulatory clarity for all cryptocurrency-related activities that are not currently covered by other EU financial regulations. It seeks to fill existing gaps while promoting innovation. The regulation applies to all Crypto-Asset Service Providers (CASPs) and crypto-asset issuers, including reference tokens (stablecoins), e-money tokens, and other types of digital tokens. MiCA establishes specific rules for these actors, addressing both operational and transparency requirements to enhance investor protection and market integrity.

Key Innovations Introduced by MiCA

- Single Authorization for All Crypto Service Providers: Under MiCA, crypto-asset service providers will be able to operate throughout the European Union with a single authorization granted by one member state, eliminating the need to apply for separate licenses in each country. This simplifies market access for Web3 companies within the EU single market.
- Mandatory Whitepapers: Cryptocurrency issuers must publish a whitepaper containing detailed information about the risks, technological infrastructure, and environmental impact of the token. This document, similar to a financial securities prospectus, will be subject to oversight by national authorities.
- Regulated Stablecoins: MiCA introduces strict regulations for stablecoins, including the requirement for sufficient reserves to ensure their stability. Stablecoin issuers must maintain a reserve of highly liquid assets, managed separately from the company's other assets, to ensure the ability to redeem the tokens at face value at any time.

These measures aim to increase transparency, protect investors, and ensure financial stability in the rapidly evolving crypto-asset market within the EU.

Additionally, algorithmic stablecoins will be banned in the EU due to the inherent risks associated with their volatility.

- Investor Protection: The regulation requires crypto service providers to implement measures to protect customers, including the segregation of user funds, secure management of cryptographic keys, and transparency regarding costs and fees. Furthermore, clear and non-misleading communication standards will be required to prevent market abuse.
- Market Abuse Prevention: MiCA introduces strict rules to prevent market manipulation, insider trading, and other forms of abuse. Regulators will have the authority to monitor crypto markets more effectively, similar to the oversight applied to traditional financial markets.

These provisions aim to enhance investor safety and ensure greater integrity within the crypto-asset markets in the EU.

The MiCA regulation will come fully into force by December 2024, with some provisions related to e-money tokens and asset-referenced tokens that became effective as early as June 2024. This transition period will allow businesses to comply with the new regulations and provide regulators with time to develop the necessary guidelines and implementation measures.

MiCA is seen as a significant step forward in the global regulation of crypto-assets. As one of the first comprehensive regulatory frameworks, many countries are closely watching its implementation to assess whether to adopt similar approaches. Furthermore, the harmonization of rules within the EU could reduce regulatory arbitrage, where crypto companies relocate to jurisdictions with more lenient regulations.

Here are the main weaknesses of the proposal:

1. Exclusion of Decentralized Finance (DeFi): One of MiCA's major shortcomings is its lack of regulation for decentralized applications (DeFi) and other innovations such as Decentralized Autonomous Organizations (DAOs). This leaves a large portion of the crypto market without clear regulation, despite its growing impact. DeFi, being devoid of intermediaries, falls outside MiCA's regulatory scope, creating potential gray areas and risks for investors.
2. NFTs and Non-Fungible Assets: Non-fungible tokens (NFTs) are also ambiguously regulated. MiCA stipulates that NFTs will be subject to regulation only if they resemble an investment or financial asset, but it does not provide clear guidelines on how to classify them. This could lead to legal uncertainty for innovative projects based on NFTs and fractionalized tokens, leaving room for varying interpretations by national authorities.
3. Risks Associated with Stablecoins and Non-Euro Denominated Currencies: MiCA imposes strict restrictions on non-euro denominated stablecoins, stating that if they exceed certain daily usage thresholds (€ 200 million or 1 million transactions), they must halt issuance. While this measure is intended to protect the monetary stability of the euro, it could limit innovation and competition in the crypto sector, especially for global projects operating with currencies other than the euro.
4. Bureaucratic Burden for Small Projects: Although MiCA aims to create a uniform regulatory framework, it may pose a significant barrier for small startups and innovative crypto projects. Compliance requirements, including the publication of whitepapers and adherence to Anti-Money Laundering (AML) regulations, could result in excessive costs for new businesses, favoring only large, established platforms.
5. Long Implementation Timeline: The full implementation of MiCA is not expected until the end of 2024. This delay could create market uncertainties and slow the transition to a stable regulatory framework. In the meantime, many crypto service providers are already limiting or modifying their offerings to comply with the upcoming regulations.

While MiCA represents a crucial step toward clearer and safer regulation for the crypto sector, several weaknesses remain that could negatively impact innovation and competitiveness, particularly for small market players and emerging areas like DeFi and NFTs.

6. Blockchain and the Metaverse

The concept of the metaverse, although recently gaining widespread attention, has existed for decades. It represents an immersive digital environment, a shared three-dimensional virtual space powered by virtual reality (VR) and augmented reality (AR), where users from around the world can interact in real time with each other and their surroundings simply by connecting to the internet. Initially associated mainly with online gaming, with limited rights for users, the applications of the metaverse are progressively evolving thanks to the involvement of cryptocurrencies and the new digital economy, providing the financial infrastructure necessary for the *metaverse economy*[18] to emerge. Through this platform, companies interact with their customers and generate new revenue streams, while users gain ownership of their digital assets, with the ability to monetize and transfer

[18] The European House - Ambrosetti, *Metaverso e sistema finanziario: una nuova opportunità per la business community?,* 2022 https://www.astrid-online.it/static/upload/2022/20220902-ambrosetti-2022-metaverso-def-2022111715.pdf

value outside the platform (for example, a user could own virtual land and rent it out for virtual concerts or sell the rights in exchange for digital assets or fiat currency).

In the metaverse, transactions can take place via cryptocurrencies and NFTs; the latter are a fundamental component, representing unique digital ownership of virtual items such as digital art, virtual land, avatars, accessories, and even securities (potentially profitable ownership or investment categories). NFTs have solved the issue of digital ownership, making it possible to distinguish the owner of a digital artwork from someone who simply saves a copy, enabling the creation of markets around new types of transactions and products that previously could not be sold.

Fashion, e-commerce, and entertainment companies worldwide are already leveraging the metaverse to create virtual shopping experiences where users can interact with products in a 3D environment, increasing interest and engagement. Additionally, the use of NFTs enables the sale of unique digital goods, expanding market opportunities and customization for consumers.

The metaverse is becoming a vehicle for the creation of virtual economies where users can work, trade, and earn cryptocurrencies, often based on smart contracts that automate transactions and ensure transparency. For instance, in The Sandbox, users can create games and interactive experiences and sell their creations using the cryptocurrency SAND.

Cryptocurrencies serve as the official currency in most metaverse platforms, allowing users to buy, sell, and exchange virtual goods and services. Platforms like Decentraland and The Sandbox use MANA and SAND as native currencies, respectively, to build virtual shopping hubs where users can spend their funds[19].

In *Decentraland,* users can buy, sell, and manage virtual properties known as "parcels" (land). Each parcel is represented as an NFT on the Ethereum blockchain, ensuring ownership and authenticity. Users can develop these parcels with structures, games, and other interactive experiences. The economy of Decentraland is powered by MANA, a cryptocurrency used to purchase land, goods, and services within the metaverse. MANA can also be exchanged outside the platform like other cryptocurrencies. Users can create a wide variety of content and applications, including games, art galleries, and educational spaces.

Decentraland is governed by a Decentralized Autonomous Organization (DAO), allowing holders of MANA, LAND, and other tokens to vote on platform-related decisions, giving the community significant control over the development and management of the virtual world. Various companies and brands have partnered with Decentraland to create promotional experiences; for example, Sotheby's opened a virtual gallery to showcase and sell digital art[20].

The *Sandbox* has partnered with several prominent entities to create unique experiences within its metaverse. One of these collaborations was the launch of the *Gucci Vault Land* event, featuring an exhibition of collectible digital clothing items to be used within the metaverse[21]. Other brands, such as Nike, have made forward-thinking investments in companies like RTFKT, an innovative firm specializing in the creation of virtual sneakers, blurring the lines between physical and digital value.

---

[19] SARZANA F. DI IPPOLITO S., PIERRO M.G., EPICOLO I.O., *Il diritto del metaverso NFT, DeFi, GameFi e privacy*, Torino, G. Giappichelli Editore, 2022

[20] *Natively Digital: An Ordinals Curated Sale*, https://www.sothebys.com/en/buy/auction/2024/natively-digital-an-ordinals-curated-sale

[21] *Entra nel metaverso di Gucci,* https://www.gucci.com/it/it/st/capsule/vault-metaverse?utm_source=vault.gucci.com&utm_medium=vault.gucci.com

Christie's has also been at the forefront of integrating cryptocurrencies and blockchain technology into the traditional art market. In March 2021, Christie's sold Beeple's digital artwork, "Everydays: The First 5000 Days", for $69 million, marking the first sale of a non-fungible token (NFT) by a major auction house[22]. Since then, Christie's has continued to embrace digital art and NFTs, becoming the first auction house to host digital art sales in Asia, accept payments in cryptocurrency, and receive live bids in Ethereum.

In September 2022, Christie's launched Christie's 3.0, a fully on-chain auction platform dedicated to digital art[23]. This platform allows auctions to be conducted entirely on the Ethereum blockchain, with all transactions, including post-sale activities, automatically recorded on-chain.

The auction house has hosted various NFT-themed sales, including collaborations with brands like Gucci and charity initiatives supporting organizations such as UNICEF, through the Giga project, and the Multidisciplinary Association for Psychedelic Studies (MAPS). Christie's has also recently held an auction for Bitcoin Ordinals inscriptions, with the "Ordinal Maxi Biz (OMB)" collection of NFTs based on Ordinals technology on the Bitcoin blockchain, further expanding its involvement in blockchain-based art forms.

These developments reflect how leading brands and institutions are increasingly leveraging blockchain technology and NFTs to innovate and engage with their audiences in new and immersive ways within the digital economy.

NFTs will continue to represent unique ownership of virtual assets; digital artists and content creators can sell digital artworks, exclusive music, or videos as NFTs within the metaverse, ensuring authenticity and ownership through blockchain. The decentralization enabled by blockchain technology allows for the creation of new business models within the metaverse, where decentralized platforms enable users to actively participate in the digital economy, earning cryptocurrencies for their contributions and participation.

DAOs (Decentralized Autonomous Organizations) allow users to make collective decisions on projects and investments within the metaverse, such as deciding how to develop and improve the services offered. Digital professionals can also be compensated in cryptocurrencies for their services within the metaverse. For example, a virtual architect might be paid in cryptocurrencies to design digital buildings in a virtual world, with payments managed and guaranteed through smart contracts[24].

This new reality requires companies participating in the metaverse to determine the fair value of digital assets at the time of the transaction and recognize revenue in accordance with accounting standards. One of the key aspects involves revenue recognition from the sale of NFTs within the metaverse. According to ASC 606 guidelines, a contract involving the sale of an NFT is generally considered valid if it represents an agreement between the parties where the buyer receives an NFT in exchange for consideration, and if the NFT is an output of the company's ordinary activities.

The intersection of blockchain technology, NFTs, and the metaverse presents new opportunities and challenges for businesses, necessitating compliance with accounting standards while exploring innovative ways to engage in the digital economy.

NFTs can encompass multiple promised goods and services, complicating the identification of performance obligations. For example, an NFT might grant the holder various digital rights, such as free digital collectibles, loyalty rewards, enhanced gaming experiences, and VIP access to events

---

[22] *Digital Art & NFTs,* https://www.christies.com/en/events/digital-art-and-nfts/overview

[23] *Christie's 3.0: una piattaforma rivoluzionaria*, https://www.christies.com/about-us/press-archive/details?PressReleaseID=10648

[24] TORKY M., DARWISH A., HASSAINIEN A.E., *Blockchain Technology in Metaverse: Opportunities, Applications and Open Problems, Studies in Big Data, vol 123,* Cham, Springer, 2023

in the metaverse. Determining whether each promised good or service is distinct is critical, as it affects the timing and method of revenue recognition. If the promises are distinct, each performance obligation is recognized separately; otherwise, they may be bundled and recognized together.

Additionally, companies need to determine the appropriate accounting treatment for development costs, which may either be capitalized or expensed based on applicable accounting guidelines. If the costs are considered research and development (R&D) for software, they may be expensed until technological feasibility is established. However, if the costs are related to the development of software hosted on the company's platform, they may be capitalized during the application development phase.

This distinction is crucial for accounting purposes, as it influences the financial reporting of expenses and assets, especially for businesses engaging in digital assets and software development within the metaverse. Proper identification of performance obligations and cost treatment ensures compliance with accounting standards such as ASC 606 and aligns with the financial goals of companies operating in the virtual economy[25].

The report on the metaverse, commissioned by Meta and conducted using Deloitte methodology, highlighted significant projections regarding the potential economic impact of the metaverse in Europe. The document, titled "*The Metaverse and the Opportunity for the European Union*", provides a detailed analysis of how the metaverse promises to transform numerous industries and services. Estimates indicate that the annual economic contribution of the metaverse to the EU's GDP could reach between € 259 billion and € 489 billion by 2035, equivalent to 1.3% to 2.4% of the total GDP for that year.

Applications of the metaverse are already emerging in several key sectors, including services, manufacturing and agriculture. For example, while retail brands like Gucci and Adidas are exploring ways to connect with consumers, the agricultural sector is experimenting with technologies to improve operational efficiency.

Adoption of virtual reality (VR) and augmented reality (AR) technologies is higher in the EU (10%) compared to the US (9%), with market growth estimated at 37% annually, potentially reaching €34 billion by 2026. The creation of digital twins (detailed virtual representations of real-world objects, systems, or processes) in industrial processes, such as at BMW in Germany and TotalEnergies in France, showcases the metaverse's potential to improve productivity and safety in physical operations.

Significant opportunities are also anticipated in the realm of skills development and professional training. For example, Bosch in Germany is using VR training tools for technicians specializing in electric vehicle maintenance, enhancing the effectiveness and efficiency of the training process. This approach allows employees to be trained up to four times faster than with traditional methods.

The report underscores the potential of the metaverse to revolutionize industries across Europe, with far-reaching implications for economic growth, innovation and the future of work[26].

---

[25] DELOITTE & TOUCHE LLP, *The Metaverse — Accounting Considerations Related to Nonfungible Tokens,* https://dart.deloitte.com/USDART/home/publications/deloitte/accounting-spotlight/2022/metaverse-accounting-considerations

[26] META, *The metaverse and the opportunity for the European Union, Report*, 2023, https://research.facebook.com/quantifying-the-potential-economic-impact-of-the-metaverse/

7. Conclusion

In conclusion, the article synthesizes key findings related to various aspects of blockchain and payment networks. First and foremost, the adoption of blockchain technology is significantly reshaping the payments landscape, particularly through the introduction of real-time settlement systems and the use of stablecoins. These advancements offer a promising solution to overcome the limitations of traditional systems such as SWIFT and ACH.

A central theme that emerged is the "blockchain trilemma", which highlights the challenge of simultaneously optimizing security, scalability, and decentralization. Despite technological advancements, the trade-offs between these three attributes remain a crucial challenge for blockchain designers. Various technological solutions, such as sharding and Layer 2 protocols, were examined with the goal of improving scalability without compromising security and decentralization.

Studies show that solutions like the Lightning Network, a second-layer protocol for Bitcoin, can dramatically reduce transaction times and costs, enabling instant and low-cost payments. Off-chain solutions, such as Rollups and payment channels, offer significant potential for enhancing blockchain scalability, particularly in the context of cross-border payments.

The article analysed the statistical figures from the Swiss Confederation's August 2024 report, examining the potential economic savings from applying blockchain technology with neighbouring countries, particularly with Switzerland's most important trading partners.

Limitations of the study: Despite promising results, several limitations were identified. Many proposed solutions, such as sharding and Layer 2 protocols, are still in development or early stages of implementation, and large-scale empirical studies are lacking to confirm their long-term effectiveness. Additionally, open questions remain concerning the governance and regulation of decentralized networks, especially in international contexts.

New research questions: The analyses highlight new questions for future research. One important question is how to optimally balance the three elements of the blockchain trilemma, particularly in light of emerging scalability technologies. Moreover, the issue of global regulation of blockchain transactions remains a critical area for research, along with the topic of interoperability between different blockchains and payment systems.

While blockchain technology is demonstrating enormous potential, further studies and technological developments will be necessary to address the current challenges related to scalability, security, and decentralization of networks.

References

* ABI, *Fintech, credito: Spunta, 100 banche sulla blockchain di settore*, https://www.abi.it/fintech-credito-spunta-100-banche-sulla-blockchain-di-settore/
* ABI, *Fintech, progetto ABI e ABI Lab selezionato da Bce,* https://www.abi.it/fintech-progetto-abi-e-abi-lab-selezionato-da-bce/
* ABI, *Sintesi delle attività dell'ABI nel 2023-2024*, https://www.abi.it/wp-content/uploads/2024/07/Sintesi-delle-AttivitaABI2023-2024.pdf
* ARBITRIUM, https://arbitrum.io/
* BIS Annual Economic Report 2023, *Blueprint for the future monetary system: improving the old, enabling the new,* https://www.bis.org/publ/arpdf/ar2023e3.pdf
* *Christie's 3.0: una piattaforma rivoluzionaria*, https://www.christies.com/about-us/press-archive/details?PressReleaseID=10648
* DELOITTE & TOUCHE LLP, *The Metaverse — Accounting Considerations Related to Nonfungible Tokens,* https://dart.deloitte.com/USDART/home/publications/deloitte/accounting-spotlight/2022/metaverse-accounting-considerations
* *Digital Art & NFTs,* https://www.christies.com/en/events/digital-art-and-nfts/overview
* *Entra nel metaverso di Gucci,* https://www.gucci.com/it/it/st/capsule/vault-metaverse?utm_source=vault.gucci.com&utm_medium=vault.gucci.com
* Ethereum Dencun https://consensys.io/ethereum-dencun-upgrade
* European crypto-assets regulation (MiCA), https://eur-lex.europa.eu/EN/legal-content/summary/european-crypto-assets-regulation-mica.html
* LAYER 2, Ethereum for everyone, https://ethereum.org/en/layer-2/
* META, *The metaverse and the opportunity for the European Union, Report*, 2023, https://research.facebook.com/quantifying-the-potential-economic-impact-of-the-metaverse/
* *Natively Digital: An Ordinals Curated Sale*, https://www.sothebys.com/en/buy/auction/2024/natively-digital-an-ordinals-curated-sale
* Onyx, https://www.jpmorgan.com/onyx/index
* Optimism, https://www.optimism.io/
* Project Genesis 1.0: prototype digital platforms for green bond tokenization https://www.bis.org/about/bisih/topics/green_finance/green_bonds.htm
* SARZANA F. DI IPPOLITO S., PIERRO M.G., EPICOLO I.O., *Il diritto del metaverso NFT, DeFi, GameFi e privacy*, Torino, G. Giappichelli Editore, 2022
* SHAH N., *Blockchain and DLT: A comprehensive guide to getting started with blockchain and Web3,* BPB Publications, 2024
* SNB BNS, *Project Jura*, https://www.snb.ch/it/the-snb/mandates-goals/international-cooperations/multilateral/bis-innovation#t34
* Swiss Confederation, *Federal Act on the Adaptation of Federal Law to Developments in Distributed Ledger Technology*, 2020
* Swiss Confederation, *Ordinance on the Adaptation of Federal Law to Developments in Distributed Ledger Technology*, 2021
* Switzerland-EU in Figures: Statistics on Trade, Population and Transport, August 2024, https://www.eda.admin.ch/dam/europa/de/documents/faq/schweiz-eu-in-zahlen_de.pdf
* The European House - Ambrosetti, *Metaverso e sistema finanziario: una nuova opportunità per la business community?,* 2022 https://www.astrid-online.it/static/upload/2022/20220902-ambrosetti-2022-metaverso-def-2022111715.pdf

* TORKY M., DARWISH A., HASSAINIEN A.E., *Blockchain Technology in Metaverse: Opportunities, Applications and Open Problems, Studies in Big Data, vol 123,* Cham, Springer, 2023

2.2. The Role of Stablecoins in Cryptocurrency Adoption for Everyday Commerce: A Consumer PerspectiveStablecoins in shopping Cryptorefills - Massimo Silenzi & Umut C. Çabuk

THE AUTHORS

Massimo Silenzi

Cryptorefills

Umut C. Çabuk

Cryptorefills

CVA CFP 2024

The Role of Stablecoins in Cryptocurrency Adoption for Everyday Commerce: A Consumer Perspective

M. Silenzi[27†], U. C. Çabuk*[28†‡]

Abstract. This study examines the increasing preference for stablecoins as a means of payment among cryptocurrency users, particularly in the e-commerce sector. Utilizing data from Cryptorefills' annual consumer survey and transaction records, we demonstrate the growing dominance of stablecoins like Tether (USDT) and USD Coin (USDC) over volatile cryptocurrencies such as Bitcoin (BTC) and Ether (ETH) for everyday purchases. Our findings suggest that a key barrier to the use of Bitcoin and other volatile cryptocurrencies in commerce is the perception of these assets as long-term investments rather than viable currencies for daily transactions. Nearly 80% of crypto shoppers express a preference for stablecoins, driven by their price stability and reduced transaction costs when processed through Ethereum Layer 2 networks or highly scalable blockchains. The analysis also reveals a statistically significant, albeit modest, correlation between the preference for stablecoins and the frequency of crypto-based transactions, indicating stablecoins' potential to encourage repeat purchases and enhance customer loyalty. Additionally, this study highlights the current fragmentation among Layer 2 solutions and alternative blockchains for stablecoins, emphasizing the challenges and opportunities these technologies present in facilitating the practical adoption of stablecoins in consumer markets and shaping the future landscape of cryptocurrency-based commerce.

KEYWORDS

1. Blockchain. 2. Cryptocurrencies. 3. Cryptoshopping.
4. Consumer Research 5. Ethereum Layer-2 Networks 6. Stablecoins.

[27]M. Silenzi. is CEO of Cryptorefills and Ph.D. in Business and Finance, Sapienza University of Rome.
[28]U. C. Çabuk* (umut.can.cabuk@ege.edu.tr) is Head of Research at Cryptorefills Labs, Post-doctoral Researcher and Lecturer, San Diego State University and Ph.D. in Information Technology Engineering, Ege University.
† Cryptorefills (https://www.cryptorefills.com/en) by Big Dream Ventures BV, Keisersgracht 482, 1017 EG, Amsterdam, NL
‡ San Diego State University, 5500 Campanile Dr, San Diego, CA 92182, United States

1. Introduction

The conceptual foundation of cryptocurrencies was first introduced in 2008 by an anonymous individual or group operating under the pseudonym Satoshi Nakamoto. In a pioneering whitepaper titled "Bitcoin: A Peer-to-Peer Electronic Cash System," Nakamoto presented Bitcoin as a decentralized digital currency designed to facilitate direct transactions between individuals without the involvement of a trusted third party, such as a bank or financial institution. This innovative concept promised to revolutionize the financial landscape by enabling transactions that emphasized peer-to-peer interactions, privacy, low transaction costs, and the removal of traditional intermediaries (Nakamoto, 2008). The adoption of cryptocurrencies in everyday commerce has garnered significant attention in academic and industry research. Early studies, such as (Böhme et al., 2015), highlighted the transformative potential of cryptocurrencies like Bitcoin for payment systems due to their decentralized architecture and capability for peer-to-peer transactions without intermediaries.

While it was originally conceived as a medium of exchange, Bitcoin's inherent volatility, scalability limitations, and slow transaction processing times have contributed to its evolving reputation as more of a digital asset or commodity, similar to gold. This view has been reinforced by Bitcoin's deflationary nature, its capped supply, and its detachment from conventional financial and payment systems, making it particularly appealing to investors seeking a hedge against inflation. Over time, its role as a store of value has increasingly overshadowed its practicality as an everyday medium of exchange (Glaser et al., 2014). The high price volatility of Bitcoin, Ethereum, and many others has been identified as a major obstacle to their widespread adoption for daily transactions (Yermack, 2015). Price volatility introduces substantial risk for both consumers and merchants. Consumers may be reluctant to spend assets that could appreciate significantly, while merchants face the risk of accepting payments that might depreciate before they can convert them to fiat currency (Gandal & Halaburda, 2016).

Stablecoins, such as Tether (USDT) and USD Coin (USDC) have emerged as a potential solution to many of these problems. Unlike "standalone" cryptocurrencies like Bitcoin and Ether, whose values fluctuate widely, stablecoins are pegged to traditional fiat currencies or assets, allowing them to maintain a consistent value (Bullmann et al., 2019). For the purpose of this research, we will refer to stablecoins as those pegged to fiat currencies per the E-Money Token definition (ESMA, 2024), as these are the main focus of our study. Other types of stablecoins, such as those pegged to commodities, are comparatively insignificant in terms of market capitalization when contrasted with the current dominance of fiat-pegged stablecoins, and therefore, are not in the scope of our study.

As cryptocurrencies continue to evolve, it is essential to understand how they are being used by everyday consumers—not just investors, technologists, or early adopters—and the practical implications for businesses and payment processors accepting or intending to accept crypto payments. This study seeks to fill a gap in the current body of cryptocurrency knowledge by focusing specifically on the consumer use of stablecoins for everyday purchases. In contrast to volatile cryptocurrencies, stablecoins present a unique opportunity to bring the benefits of blockchain technology to the realm of consumer payments. By exploring why consumers prefer stablecoins over other forms of cryptocurrency and how this preference influences their shopping behavior, this research adds a new dimension to our understanding of cryptocurrency's role in the global economy.

Our study builds upon this existing body of knowledge by providing empirical evidence from consumer surveys and transaction records. We contribute to the literature by focusing on the

consumer perspective regarding the use of stablecoins in everyday commerce and examining the practical implications of network scalability solutions on stablecoin adoption. Additionally, this research contributes to the conversation around the scalability and usability of blockchain-based payment systems. With many stablecoin transactions occurring on Ethereum Layer 2 (L2) solutions, sidechains, or alternative Layer 1 (L1) networks, there is a growing need to understand how these technologies impact user experience. Finally, the paper examines the behavioral patterns of crypto-shoppers and their relationship with stablecoins.

Therefore, our research questions can be summed up as follows:

1. How does the merchant-side availability and support of stablecoins influence consumer motivation to use cryptocurrencies for everyday shopping?
2. How does the adoption of stablecoins contribute to the shopping experience compared to volatile cryptocurrencies and traditional payment methods?

2. Related Works

As stablecoins offer price stability while maintaining benefits like fast transaction speeds and low fees, they can bridge the gap between the cryptocurrency ecosystem and traditional financial systems, facilitating everyday transactions (Eichengreen, 2019). Yet, consumer perception is crucial in the adoption of new payment technologies. Studies have shown that consumers prefer payment methods that are convenient, cost-effective, and secure (Dahlberg et al., 2015). Stablecoins meet these criteria more effectively than volatile cryptocurrencies, particularly when utilized on networks that offer reduced transaction costs and faster processing times. The development of Ethereum Layer 2 solutions and scalable blockchains has further improved the practicality of using stablecoins for everyday transactions by addressing issues like scalability and high gas fees associated with the Ethereum mainnet (Buterin, 2021).

Furthermore, interoperability among different blockchain platforms enhances convenience for consumers. Cross-chain technologies and protocols enable stablecoins to be used seamlessly across various platforms and services, which is vital for widespread adoption (Zhou et al., 2020). This interoperability reduces friction in the user experience, making it more likely for consumers to adopt stablecoins as a preferred payment method.

It was identified well that stablecoins are advancing the field of payments in a different direction by utilizing the decentralized architecture that blockchain systems offer (Arner, 2020). The working paper discusses the potential of stablecoins, risks associated with their adoption and the regulations that may be helpful. Their emphasis on possibility of automated transfers through smart contracts is showing that it is already seen as a means for payments.

The usefulness and increasing popularity of stablecoins are remarkable, even from a government institution's perspective (Liao et al., 2022). The report from the Board of Governors of the Federal Reserve stated that stablecoins are used to facilitate fast peer-to-peer and cross-border payments. They also have the potential for new payment innovations, including programmable money. Their mention of huge growth of stablecoin usage and possibility of payments for purchases is a valuable observation, however, they do not investigate the rationale of consumers resorting to stablecoins.

Silenzi et al., in a quantitative survey, analyzed the usage of cryptocurrencies as a means of exchange in shopping (Silenzi et al., 2023). They identified different classes of consumers with varying motivations to use cryptocurrencies for purchases. While being knowledgeable about blockchain technologies was not a determining factor, the study claims different consumer classes have different knowledge levels about the technicalities under the hood. A more important factor

was the convenience of using cryptocurrencies. While the study mentions stablecoins, there was no analysis regarding the convenience they introduce to the shopping domain.

In general, existing studies have primarily focused on the technical aspects of blockchain payments or the macroeconomic implications of cryptocurrency, but this research looks at the micro-level: the individual consumers and their purchasing habits considering the stablecoin adoption.

3. Methods

To collect data and build our dataset in the most insightful way, we have prepared a large-scale consumer questionnaire with 141 questions (which includes questions related to stablecoin usage among many other topics) answered by 516 respondents, who have purchased something by paying in a cryptocurrency at least once. For the questionnaire, we adopted the second edition of Technology Acceptance Model (TAM) by Davis (Davis, 1989). It explains user acceptance of new technologies based on two factors: perceived usefulness (belief that the technology enhances performance) and perceived ease of use (belief that using it requires minimal effort). These factors determine an individual's intention to use a technology, leading to actual usage. To extend the model's explanatory power, Technology Acceptance Model 2 (TAM2) was introduced (Venkatesh & Davis, 2000). TAM2 adds theoretical constructs to better account for what influences perceived usefulness and usage intentions, particularly in organizational and consumer contexts. Another source of data was anonymized internal transaction data of the e-commerce platform Cryptorefills, involving purchase statistics.

Using the questionnaire data, we have run statistical analyses, including point-biserial correlations and rank-biserial correlations, to uncover the relation between stablecoin adoption and crypto-shopping tendency (or perception). Particularly, we investigated whether crypto-consumers who prefer stablecoins over other cryptocurrencies tend do more shopping through cryptocurrencies, in terms of frequency. For this purpose, from the TAM2-compliant questionnaire, we have evaluated the answers to two questions: (*i*) “I purchase products and/or services paying with bitcoin or other crypto” with the answer range “at least once a day”, “at least once a week”, “at least once a month”, “at least once a year”, “almost never” (frequencies are later log-transformed); and (*ii*) “When I buy something I prefer to pay with stablecoins instead of other crypto (BTC, ETH, etc.)” with the answer range “yes”, “no” (preference treated as binary). Thus, we derive the following hypothesis testing:

- Null Hypothesis (H_0): There is no correlation between preference for stablecoins and spending frequency.
- Alternative Hypothesis (H_1): There is a significant correlation between preference for stablecoins and spending frequency.

Limitations— Despite the insights provided, several limitations must be acknowledged. First, the data used in this research is primarily sourced from Cryptorefills’ survey and internal data, which may not fully represent the broader cryptocurrency market or capture all consumer behaviors. Consumers who use other platforms or operate in different geographical regions may have distinct preferences or behaviors that are not reflected in this study’s findings. This may limit the generalizability of the results.

Furthermore, this research provides a cross-sectional snapshot of stablecoin and payment network usage in 2023. The cryptocurrency landscape, including consumer preferences and technological solutions, is rapidly evolving, which means that the findings may not fully capture how the ecosystem has evolved today and could change in the future. These include the growth of

new scalability networks like TON, SUI, and Base, as well as the growing adoption of stablecoins like PayPal USD. These developments may have significant implications for specific stablecoin adoption and network fragmentation, potentially altering the dynamics observed in this study. Future studies should take into account these emerging networks and currencies to provide a more comprehensive understanding of the evolving stablecoin landscape. Finally, the study is heavily data-driven but lacks qualitative insights, such as consumer interviews or focus groups, which could provide a deeper understanding of the motivations behind stablecoin preferences. Incorporating qualitative research could offer richer, more nuanced insights into consumer decision-making processes and the factors influencing their preferences.

4. Results and Analysis

The results of our quantitative study efforts are presented in this section with brief explanations without a discussion, which is provided in the next section.

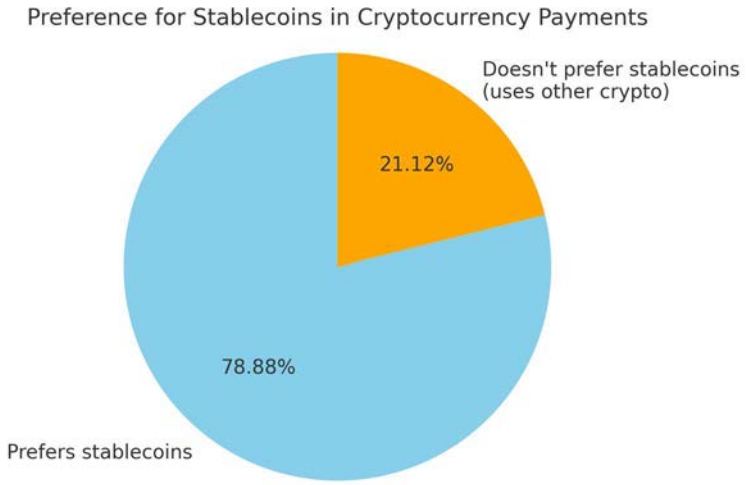


Fig. 1. Crypto-shoppers' preference for using stablecoins vs. other "non-stable" cryptocurrencies when making purchases.

Fig. 1 presents the share of crypto-consumers who prefer stablecoins for payments versus the ones who intentionally do not prefer stablecoins (for any reason) but use other, more volatile crypto-currencies, like Bitcoin, Ether, etc. The difference between the two groups is significantly large as almost 80% of crypto-consumers prefer stablecoins when available.

Fig. 2. Likelihood of customers making a purchase if the merchant offers stablecoin payments.

Fig. 2 provides a breakdown of the agreement to the statement, "I'd shop more if the merchants I like/prefer offered stablecoins as a means for payments. Two-thirds of crypto-shoppers agreed with this statement, while only a small minority disagreed. Fig. 3 illustrates the agreement with the statement, "I do not shop (or shop more) with cryptocurrencies as I see them as a means for investment". A third of the crypto-consumers agreed to this view.

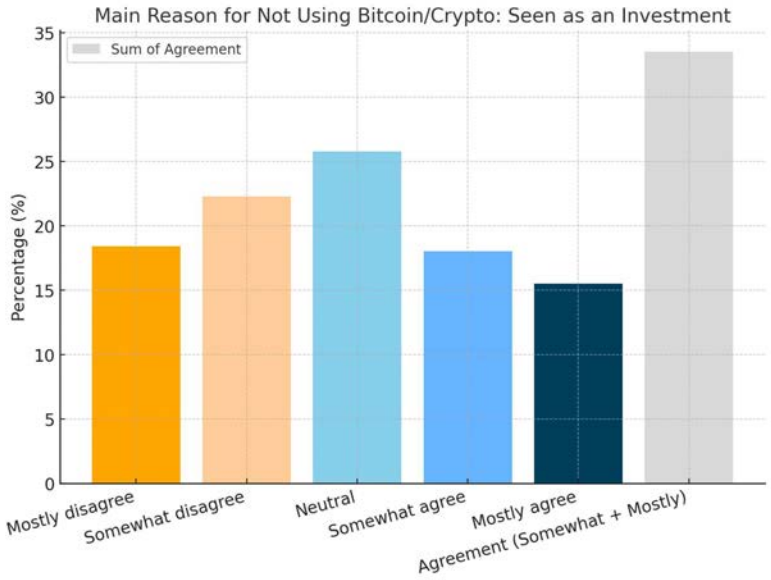


Fig. 3. Consumers' agreement to the idea that Bitcoin (and alike) are seen as investment tools, not as means for exchange.

Fig. 4 shows the stablecoin preferences of all crypto-shoppers compared to the subset of the ones who prefer stablecoins for purchases. USDT and USDC are the most popular by far. Consumers relying on stablecoins favor USDT and USDC more than the general set of crypto-consumers.

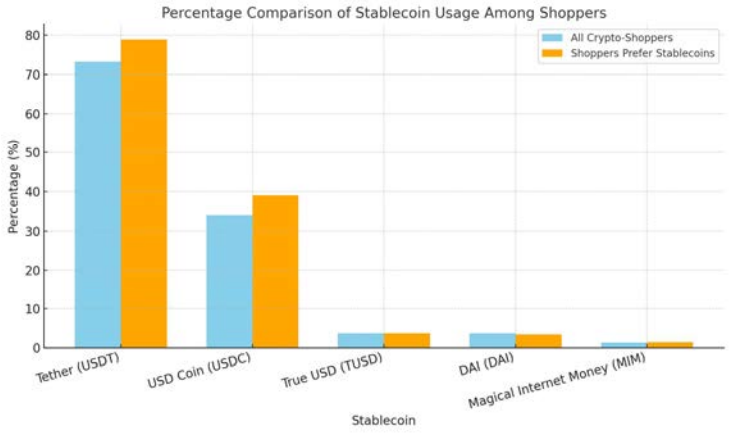


Fig. 4. Stablecoin preferences among all crypto-consumers vs. the ones preferring stablecoins for shopping.

Cryptorefills' internal transaction data from the last quarter of 2023 shows that the vast majority of stablecoin transactions occur outside of the Ethereum mainnet. This is depicted in Fig. 5.

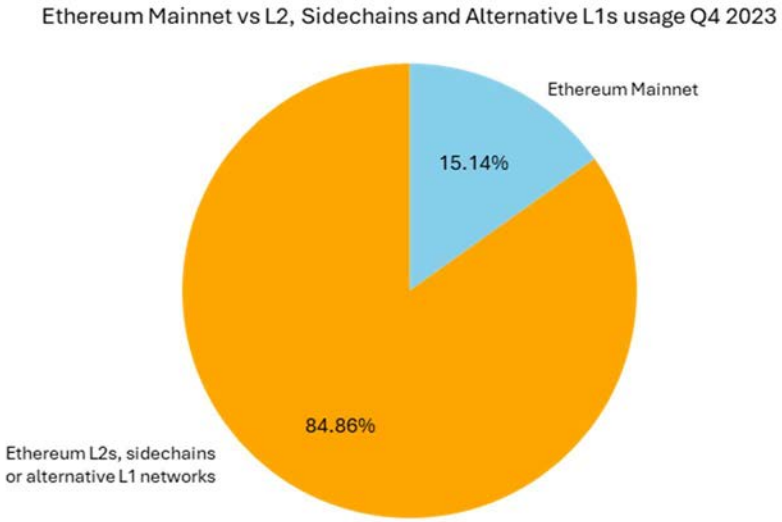


Fig. 5. Share of transaction volume of Ethereum mainnet vs. Ethereum Layer 2 or alternative blockchains, in 2023/Q4.

A more detailed breakdown, is presented in Fig. 6. with the distribution of stablecoin transactions by network on Cryptorefills for Q3 2023. The nearly 85% of transactions that occurred outside of the Ethereum Mainnet are highly fragmented across various Ethereum Layer 2 networks, sidechains, and alternative Layer 1s. While Cryptorefills maintains confidentiality regarding the specific transaction volumes per network, the networks included are Solana, Polygon, Binance Smart Chain, Tron, Avalanche, Arbitrum, and Optimism."

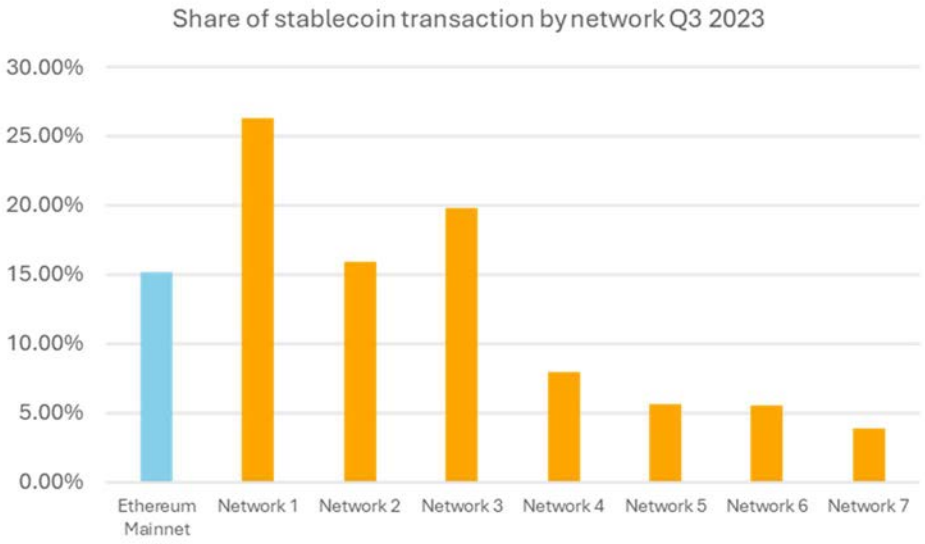


Fig. 6. Share of stablecoin transactions by Ethereum Mainnet, Ethereum L2 networks and sidechains, and Alternative L1s 2023/Q4.

Finally, we found the point-biserial correlation (r_{pb}) as 0.1850 with a p-value < 0.0001 and the rank-biserial correlation (r_{rb}) as 0.2268 with a p-value < 0.001 (from Mann-Whitney U test). As both tests are statistically significant, we can safely reject the null hypothesis and claim that there is an observable "weak-to-moderate" positive correlation between stablecoin preference and shopping frequency.

5. Discussion

The results of this study provide insights into the evolving landscape of cryptocurrency usage for everyday purchases, particularly the preference for stablecoins over more volatile cryptocurrencies such as Bitcoin and Ether. These findings hold significant implications for various stakeholders, including businesses, consumers, technology developers, stablecoin issuers and regulators. In this section, we explore the practical consequences of these insights, focusing on the opportunities and challenges that stablecoins present.

Consumers—This study reveals that when it comes to using cryptocurrencies for shopping, there is a clear and strong preference for stablecoins among consumers. Four out of five crypto-shoppers (80%) prefer to use stablecoins, such as Tether (USDT) and USD Coin (USDC), over more volatile cryptocurrencies like Bitcoin or Ethereum (see Fig. 1). This preference highlights a significant trend: consumers are prioritizing stability and predictability in their transactions, especially for everyday purchases.

Additionally, 38% of crypto-shoppers state that it is better not to use Bitcoin, Ethereum, or other "unstable" cryptocurrencies for spending, likely viewing them as investments rather than means of exchange. These consumers believe that spending these volatile assets could mean a potential loss of future value, as they expect prices of Bitcoin and Ethereum to appreciate over time. This aligns with existing research that suggests a growing consensus around Bitcoin's role as a "store of value," much like gold, rather than as a currency for daily transactions.

Our previous research also supports this shift in perception where we observed a slight but statistically significant negative correlation (-0.11, $p < 0.001$) between expertise in Bitcoin and the

frequency of using cryptocurrencies for shopping (Silenzi, 2023). Those with more knowledge or experience with Bitcoin are less likely to spend it, perhaps because they are more aware of its potential future value and are therefore more cautious about using it for everyday purchases. The preference for stablecoins, therefore, seems to be influenced by this perceived opportunity cost. Consumers may fear missing out on the potential upside of holding Bitcoin or Ethereum if they spend these assets now.

While the fear of missing out on future upside is likely a significant factor driving the preference for stablecoins, as well as the increased purchase frequency observed among stablecoin users, there are likely other contributing factors at play. Although we are unable to provide a consistent or exhaustive list of these factors, we will explore some potential ones below.

One likely factor is the unit of account and price transparency. It is challenging for consumers to easily compare prices or understand the value of goods if they are priced in a volatile cryptocurrency like Bitcoin. Stablecoins, by maintaining a 1:1 peg with fiat currencies, eliminate this problem, allowing for more transparent and straightforward pricing.

The two most preferred stablecoins for shopping, USDT and USDC, stand out significantly, with usage percentages far exceeding those of other stablecoins. This dominance is generally in line with their respective market capitalizations during the second half of 2023. It also highlights that USDT and USDC are not only the most widely adopted stablecoins overall but are also particularly dominant in terms of usage for shopping, reinforcing their strong role in consumer transactions. As new issuers enter the market, and if their stablecoins—such as PayPal USD—were to erode the significant market share of existing leaders, we may also see an increase in the use of these new stablecoins for shopping.

This popularity of USDT and USDC, consistent with their high market capitalizations, is further validated by consumer preferences even in regions with stablecoins pegged to local currencies. For example, in the Eurozone, where EURC—a euro-pegged stablecoin issued by the same entity behind USDC but with significantly lower market capitalization—is available, consumer preference and transaction volumes for EURC on Cryptorefills remain negligible in comparison to USDT and USDC. This trend highlights the strong global appeal and trust in these dollar-pegged stablecoins, even in markets where consumers have access to stablecoins tied to their local fiat currency.

Availability of stablecoins is another key factor. Our previous research showed that 42.5% of crypto-shoppers obtain their crypto through minor freelancer tasks or online gigs, while 19.8% are paid a salary in crypto (Silenzi et al., 2023). It is reasonable to assume that many of these payments are pre-agreed in fiat terms and then paid out in stablecoins to avoid exposure to volatility. As a result, stablecoins are more readily available for consumers to spend compared to other cryptocurrencies that may be held for long-term investment.

Technology, fees, and transaction speed are additional considerations. Stablecoins processed on Layer 2 networks or alternative Layer-1 blockchains tend to have lower fees and faster transaction times, which are important for consumers looking for convenience and cost-efficiency. Ease of use is likely another contributing factor to the rising popularity of stablecoins for everyday purchases.

The fragmentation in the use of different Layer 2s, sidechains, or alternative Layer 1s for processing stablecoin transactions points to another potential factor: technological preferences within the crypto community. Consumers may choose specific networks based on transaction speed, fees, or even community loyalty. This fragmentation could also be driven by a form of "tribalism" within the cryptocurrency space, where users align themselves with particular technologies or networks.

Another factor that may influence consumer preference for stablecoins is taxation. In some jurisdictions, the disposal of cryptocurrencies through transactions, such as when making a purchase, triggers a capital gains tax. This creates an additional financial or administrative burden when using volatile cryptocurrencies like Bitcoin or Ethereum. In contrast, stablecoin transactions often do not involve gains or losses due to price stability, meaning there may be little to no tax implications. For example, in the United States, stablecoin transactions generally only require reporting without triggering capital gains taxes. This potential tax advantage could further drive consumers toward using stablecoins for everyday purchases, making them a more practical choice in countries with stringent crypto tax laws.

The point-biserial correlation observed in this study ($r_{pb} = 0.1850$, $p < 0.0001$) aligns with consumers' preference for stablecoins by showing a slight yet statistically significant increase in shopping frequency among those who choose stablecoins over other cryptocurrencies. This trend suggests that the stability, predictability and practicality of stablecoins encourage consumers to use them more confidently for everyday purchases.

While we discussed above some factors that could influence consumer preference for stablecoins, future research could benefit from a more structured approach to understanding the full range and impact of influences. Future studies might use methods such as focus groups and case studies to explore possible factors, Factor Analysis to group these factors, and Regression Analysis to quantify their impact on stablecoin preference, offering a deeper understanding of the consumer decision-making process.

Businesses and Payment Processors—Our findings offer several critical insights for businesses that currently accept crypto payments or plan to implement them in the future as well as for third party payments processors offering crypto payments processing services. First and foremost, stablecoins, particularly Tether (USDT) and USD Coin (USDC), are essential components of any cryptocurrency payment strategy. With 80% of crypto-shoppers preferring to use stablecoins over volatile cryptocurrencies like Bitcoin or Ethereum, limiting payment options to only Bitcoin may exclude a significant portion of potential customers. This highlights the importance of integrating stablecoin payment methods to cater to the growing consumer demand for price stability and predictability in crypto transactions.

While the correlation between stablecoin preference and purchase frequency was relatively weak ($r_{pb} = 0.1850$), the significance of this trend suggests an observable pattern worth considering especially for businesses considering implementing stablecoin payments. The data on purchase frequency in this study was encoded non-linearly to capture varying levels of shopping behavior, with values set as 0 for “never,” 1 for “at least once a year”, 12 for “at least once a month,” 52 for “at least once a week,” and 365 for “daily.” This approach allowed us to approximate meaningful intervals in consumer behavior, where moving from monthly to weekly or weekly to daily shopping represents substantial increases in engagement and transaction volume. While correlation does not imply causation; a weak correlation points to a tendency among stablecoin-preferring consumers to engage in shopping with cryptocurrency more frequently. Even small positive trends in correlation can be impactful within this non-linear frequency framework. For businesses, this correlation could indicate that customers who prefer stablecoins may also be more active or loyal shoppers. Consequently, implementing stablecoin payment options could facilitate higher transaction volumes, improve customer retention, and potentially increase average sales per user. As such, catering to stablecoin users may represent a strategic advantage for businesses seeking to grow their crypto-based consumer base.

Given the market dominance of USDT and USDC, it is likely crucial for businesses offering or considering crypto payments to support both stablecoins. Accepting only one could limit the

potential customer base, as these two stablecoins together dominate the crypto-shopping space. The absence of either could lead to lost sales, especially when considering that USDT and USDC likely cater to different users and communities. Our research underscores the importance of providing a range of stablecoin options to ensure broader customer coverage. Future research could investigate whether the adoption of these two stablecoins, especially in the context of shopping payments, is linked to specific demographic factors, such as region, age, or income. Understanding these demographic characteristics could allow businesses to select their stablecoin payments option in relation to their target customers, optimizing their payment systems to better meet the preferences of their primary consumer base.

Transaction fees and processing speed are key considerations in implementing stablecoin payments. Both USDT and USDC transactions on the Ethereum mainnet can be costly and slow due to network congestion and high gas fees. For businesses dealing in high-ticket items with low purchase frequency (e.g., luxury goods), these fees may be less of an issue. However, for low- or medium-ticket items, where the transaction amount is small relative to the fee, Ethereum's mainnet may not be the ideal solution. For example, in high-volume retail or physical store environments where speed and efficiency are crucial (such as point-of-sale payments), businesses must seek scalable alternatives that minimize fees and improve transaction speed.

Interestingly, the data from Cryptorefills shows that only 15% of stablecoin transactions occur on the Ethereum mainnet. The vast majority of transactions (roughly 85%) are processed using Layer 2 solutions, sidechains, or alternative Layer 1 networks, underscoring the critical need for scalable options outside Ethereum (see Fig. 6). This finding indicates that businesses must consider these scalable solutions when developing their stablecoin payment strategies and third-party crypto processors, as relying solely on Ethereum could alienate a very large portion of customers.

While scalability solutions are clearly essential, the data also highlights a significant challenge for businesses: network fragmentation. Our findings show that the use of alternative networks for stablecoin payments is highly fragmented. The study examined seven networks in addition to Ethereum—Binance Smart Chain, Avalanche, Tron, Solana, Polygon, Arbitrum, and Optimism—with transaction volumes ranging from 3.81% to 26.33%. The median transaction share across these networks is 7.97%, with a standard deviation of 0.086. This fragmentation poses a challenge for businesses because there is no single dominant network that can be implemented across all customers. The fragmentation makes it difficult for businesses to identify a preferred network that offers both scalability and wide customer acceptance. This suggests that businesses may need to support multiple networks to accommodate their customers' preferences, though this comes with added complexity and cost.

Although we argue that the widespread use of Layer-2 and alternative networks—covering around 85% of transactions—highlights the need to offer scalable solutions, the specific choice of networks remains an open question. One area that requires further exploration is the switching costs for consumers. For instance, how much friction is introduced when a customer is required to use a network they are unfamiliar with or do not prefer? What impact does this have on conversion rates and customer satisfaction?

Furthermore, businesses and processors must carefully weigh the marginal utility and cost of supporting additional networks. While adding more scalability solutions might increase the likelihood of meeting customer preferences, it could also introduce operational complexity. The constantly evolving nature of blockchain technology adds another layer of uncertainty. Scalability solutions which are rising in popularity, such as Base, Sui, and TON, were not included in the dataset as they were not offered at the time of the analysis. Emerging scalability solutions may shift consumer preferences over time.

Because the blockchain ecosystem is highly dynamic, with new scalability solutions emerging over time, future research should focus on identifying whether network fragmentation decreases over time. It will be critical for businesses and processors implementing or operating cryptocurrency payments to understand whether certain networks consolidate and dominate stablecoin payments (and if so in which direction) or whether fragmentation persists. Businesses must also consider the marginal costs and benefits of adding new networks to their payment systems and determine how to adapt to shifting consumer behaviors and technological advancements.

Other Players in the Ecosystem—We have primarily focused on the implications of our findings for consumers, this was the main scope of our study as well as on the implications of this study on businesses and processors as this study has important, practical implications for merchants accepting or intending to accept crypto payments and for third party crypto payment processors supporting them. However, the results of our study are also valuable for other players within the cryptocurrency ecosystem.

Without being exhaustive, several other implications are worth considering. On the technical and service providers' side, wallet providers may need to take consumer preferences into account when choosing which networks and stablecoins to support, as well as ensuring ease of use during shopping transactions. Providers of AML, KYC, and KYT services may also find the data on stablecoin preferences and network fragmentation relevant when designing and adapting their offerings to ensure compliance across a fragmented network landscape.

For institutions and regulators, the insights gained from our study regarding the preferences for specific stablecoins and the diverse usage of different networks could inform future decisions on regulation, taxation, and policy-making. Understanding the stablecoin landscape, particularly the dominance of USDT and USDC and the fragmented use of networks, can help shape policies that foster innovation while ensuring consumer protection and market stability.

6. Conclusion

This study has provided insights into the increasing preference for stablecoins among cryptocurrency users for everyday purchases. With 80% of crypto-shoppers favoring stablecoins like USDT and USDC over volatile cryptocurrencies such as Bitcoin and Ethereum, it is clear that consumers prioritize stability and predictability in their transactions. This preference is driven by several factors, including the perceived opportunity cost of holding volatile assets and concerns about price fluctuations. Additionally, 38% of crypto-shoppers view Bitcoin and other volatile cryptocurrencies as long-term investments rather than practical means of payment, further reinforcing the role of stablecoins as the preferred medium of exchange for daily transactions.

For businesses, the adoption of stablecoins presents opportunities to enhance customer loyalty and increase transaction frequency, with stablecoin users demonstrating higher purchase frequency. However, the data also revealed that network fragmentation poses a challenge, with 85% of stablecoin transactions occurring on alternative networks like Layer 2 solutions and sidechains, as only 15% of transactions occur on Ethereum’s mainnet. This fragmentation shows the need for businesses to support multiple networks to meet the diverse preferences of their customers, though this may come at the cost of increased operational complexity.

There are several areas for future exploration as well. The evolving cryptocurrency landscape, including the emergence and/or growing adoption of new scalability solutions, and the rise of new stablecoins such as PayPal USD, warrants further investigation. Additionally, expanding research

into B2B stablecoin adoption could reveal the unique advantages stablecoins offer businesses, such as lower fees, immediate settlements, and reduced foreign exchange risks.

As stablecoins continue to gain traction, understanding their impact on both consumer behavior and the broader financial ecosystem will be essential. While future research is needed, this study provides important practical insights and data, particularly for businesses and payment processors implementing crypto payments. It addresses key questions such as the importance of offering stablecoins, which stablecoins to prioritize, whether to rely solely on Ethereum's mainnet or adopt scalability solutions, and whether there is a dominant solution or continued fragmentation. Additionally, the insights gained about purchase frequency and network usage can prove valuable for other players in the ecosystem, including wallet developers, KYC/AML service providers, regulators, and institutions.

Acknowledgment

The authors acknowledge the use of AI-powered tools to improve the English language used throughout the paper.

Author Contributions

MS collected and scraped data, and defined the methodology; UCC analyzed the data and studied the statistics. They both contributed equally to manuscript preparation.

References

Arner, D., Auer, R., & Frost, J. (2020). Stablecoins: Risks, potential and regulation (BIS Working Papers No. 905). Monetary and Economic Department. Bank for International Settlements. https://www.bis.org/publ/work905.pdf (Accessed: 10.10.2024)

Böhme, R., Christin, N., Edelman, B., & Moore, T. (2015). Bitcoin: Economics, technology, and governance. *Journal of Economic Perspectives*, 29(2), 213–238. https://doi.org/10.1257/jep.29.2.213

Bullmann, D., Klemm, J., & Pinna, A. (2019). In Search for Stability in Crypto-assets: Are Stablecoins the Solution? European Central Bank Occasional Paper Series, No. 230.

Buterin, V. (2021). An incomplete guide to rollups. Retrieved from https://vitalik.ca/general/2021/01/05/rollup.html

Cabuk, U. C., & Silenzi, M. (2023). Cryptocurrencies in commerce: Consumer adoption report 2023. Cryptorefills Labs.

Dahlberg, T., Guo, J., & Ondrus, J. (2015). A critical review of mobile payment research. In Electronic Commerce Research and Applications (Vol. 14, Issue 5, pp. 265–284). Elsevier BV. https://doi.org/10.1016/j.elerap.2015.07.006

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340. https://doi.org/10.2307/249008

European Securities and Markets Authority (ESMA). (2024). MiCA Consultation Paper: Guidelines on the Qualification of Crypto-assets as Financial Instruments. Retrieved from https://www.esma.europa.eu/sites/default/files/2024-01/ESMA75-453128700-52_MiCA_Consultation_Paper_-_Guidelines_on_the_qualification_of_crypto-assets_as_financial_instruments.pdf

Eichengreen, B. (2019). From Commodity to Fiat and Now to Crypto: What Does History Tell Us? *NBER Working Paper*, No. 25426. National Bureau of Economic Research.

Gandal, N., & Halaburda, H. (2016). Can we predict the winner in a market with network effects? Competition in cryptocurrency market. Games, 7(3), 1-21. https://doi.org/10.3390/g7030016

Glaser, F., Zimmermann, K., Haferkorn, M., Weber, M. C., & Siering, M. (2014). Bitcoin-asset or currency? Revealing users' hidden intentions. *ECIS 2014 Proceedings*. https://doi.org/10.18151/7217326

Liao, Gordon Y. and John Caramichael (2022). "Stablecoins: Growth Potential and Impact on Banking," International Finance Discussion Papers 1334. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/IFDP.2022.1334.

Nakamoto, S. (2008). "Bitcoin: A Peer-to-Peer Electronic Cash System." No Publisher. https://bitcoin.org/bitcoin.pdf (Accessed: 10.10.2024)

Silenzi, M., Cabuk, U. C., Karaarslan, E., & Aydin, O. (2023). Deciphering the Crypto-shopper: Knowledge and Preferences of Consumers Using Cryptocurrencies for Purchases. arXiv. https://doi.org/10.48550/ARXIV.2310.02911

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. In Management Science (Vol. 46, Issue 2, pp. 186–204). Institute for Operations Research and the Management Sciences (INFORMS). https://doi.org/10.1287/mnsc.46.2.186.11926

Yermack, D. (2015). Is Bitcoin a real currency? An economic appraisal. *Handbook of Digital Currency*, 31-43. https://doi.org/10.1016/B978-0-12-802117-0.00002-3

Zhou, Q., Huang, H., Zheng, Z., & Bian, J. (2020). Solutions to scalability of blockchain: A survey. *IEEE Access*, 8, 16440–16455. https://doi.org/10.1109/ACCESS.2020.2967218

2.3. Analyzing Blockchain Networks: A Framework for Evaluating Digital Payment Efficiency and Security - Paul Meeusen & Yvonne-Anne Pignolet

THE AUTHORS

Paul Meeusen

DFINITY

Yvonne-Anne Pignolet

DFINITY

CVA CFP 2024

Analyzing Blockchain Networks: A Framework for Evaluating Digital Payment Efficiency and Security

Paul Meeusen[29*], Yvonne-Anne Pignolet[30]

Abstract. A store of value and means of payment are essential functions of a currency. Combining both while optimizing yield and liquidity is a challenge. Digital assets, stablecoins in particular, benefit from being continuously accessible and tradable. New capabilities, enabled by modern cryptography and optimized distributed systems, pave the way for digital payments to meet requirements of state of the art remittances and trade settlements. In this article, we identify key factors and metrics for assessing and benchmarking blockchain networks' suitability for digital payment systems. Our evaluation framework considers both operational risks and performance criteria to determine a network's readiness for current and future payment requirements at scale. This includes the capacity for high-frequency, low-cost transactions essential for streaming, gaming, and social media applications.
By establishing this comprehensive assessment framework, we aim to guide the development of digital payment rails that will shape the future of financial transactions. It provides the foundation for creating blockchain-based payment systems that are secure, efficient, and scalable enough to meet the demands of an increasingly digital economy.

KEY WORDS

1. Digital assets. 2. Blockchain payments. 3. Operational risk. 4. Stablecoins.

[29] * Paul Meeusen (paul.meeusen@dfinity.org) is VP of Partnerships at DFINITY Foundation, Switzerland (corresponding author)
[30] Yvonne-Anne Pignolet (yvonneanne@dfinity.org) is Director of Research at DFINITY Foundation, Switzerland

1. Introduction

Digital assets or crypto currencies have increased in usage and value but their combined market valuation still represents less than 3 percent of the value of the entire equity and bond market, with a large dominance by BTC, ETH and the two US dollar stablecoins. However, in the diffusion cycle of innovation, we might soon reach the tipping point moving from early adopters, to majority large scale adoption. Hence, we need to examine the factors that can both accelerate such adoption, as well define performance criteria to monitor how blockchain based payments progress towards being able to securely and effectively operate at large scale.

We derive these criteria from the generally accepted three functions that any currency must fulfill: unit of account, means of payment and store of value. The most scalable solution for blockchain payments is one that combines those three functions best. We examine how the stability of stablecoins relates to its proof of reserves and whether those are truly an inflation resistant store of purchasing power. We distinguish between payments for remittances and the cash settlement of crypto trading. Across both categories, we apply the recently introduced Target Capital Adequacy Framework (TCAF) that applies risk sensitive criteria to set capital requirements to mitigate risk when operating and scaling stablecoins.

Finally we establish a set of best practices and metrics to monitor the ability of blockchains to operate stablecoins and payments in particular at a large scale. We recommend that adherence to practices and metrics results are transparently published and where applicable subject to independent third party reviews.

2. Intrinsic value of a currency

We have long abandoned the gold standard or an equivalent requirement for central banks to hold hard reserves, such as gold, with a value equal to that of the money issued. Since the 1970s, currency rates have been permitted to "float" in the global foreign exchange markets relative to other fiat currencies. Trust in scarcity of an asset backing up the currency was replaced by trust in the economic stewardship of national monetary authorities. Trust in such "fiat" currency relies on the government that issues it and the risk and strength of the underlying economy. Fiat-backed stablecoins have an additional counterparty risk, as the issuance of stablecoins is controlled by a centralized institution. There is a possibility that the issuer may mint excessive stablecoins or abscond with the underlying bank deposit.

The market definition of strength of a currency is a combination of utility and store of value. We can illustrate this by taking two examples of currencies of very different economies. The US dollar is strong by utility but weak as a store of value. A large share of global trade, from commodities, to energy, to financial instruments is settled in the US dollar which creates high demand. Traders and enterprises prefer the convenience of having a common unit of account being US dollars. The utility of the US dollar is high.

This is not necessarily an indication of the strength of the US economy. Over the past four years, the total US nominal GDP growth of USD 7 trillion has largely resulted from increased public debt, with only a small share stemming from demographic or productivity growth[31]. The US government annual deficit (USD 1.7 trillion in 2023) has almost doubled since the pre-

[31] Statista, Surplus or deficit of the U.S. government's budget in fiscal years 2000 to 2029, https://www.statista.com/statistics/200410/surplus-or-deficit-of-the-us-governments-budget-since-2000/
For all footnotes with references to website (URL) addresses, we accessed the links and verified their content on Nov 15, 2024

pandemic period (USD 0.9 trillion in 2019)[32]. Government spending can add significant value, if it structurally improves the country's productivity and efficiency, rather than just inflating its currency in circulation. Of the non-mandatory spending by the US government, the defense and interest payments take up the largest share, about 64%, leaving only smaller shares for education, transportation, infrastructure and health, which are the areas where the government can make discretionary choices.[33] The steadily increasing government debt and US dollar reserves in foreign hands have led to large shares of US real estate, infrastructure and government debt being owned by foreign investors, further ceding control over the local economy. All combined, the vast majority of US government spending is locked up expenditures driven by demographics, large debt and military expenditures, leaving little room to invest in areas that can structurally improve productivity, such as infrastructure, innovation, research and development. The debt to GDP ratio is exceeding 120%. Such government spending and overindebtedness fuels inflation, which Milton Friedman already in 1974 described as a hidden taxation, by way of pushing inflation while not indexing tax brackets. It therefore is a form of taxation without representation[34].

The Swiss franc, CHF, has moderate utility and strong value. The size of Switzerland's economy and share in global trade is much smaller than the USA and accordingly the CHF has a much lower utility. Reversely it is highly demanded as a store of value, especially in times of uncertainty. Over the past decade, government spending in Switzerland is estimated to have 35% dedicated to social welfare, 20% to research, infrastructure and transport and 13% to security and international relations. Over the past 5 years, government spending was on average 12% of GDP and debt was less than 20% of GDP.

Table 1. Debt to GDP ratio and GDP per capita, 2023 by country/region, USD[35]

Country	GDP per capita	Debt/GDP %
China	12'614	77.1
Switzerland	99'994	17.9
United Kingdom	48'866	101.4
USA	81'995	121.4

The market dominance of the USD utility is clear. The USD is the currency for trade and CHF a reserve currency. The USD dominance is even more extreme in the crypto market. The number of holders of USD denominated stablecoins is more than 120 million, with less than 20 thousand in EUR and less than 100 in CHF[36]. The "safe haven" reputation of a currency like CHF, comes from the country's debt free and sustainable economy, making CHF a currency that continues to appreciate in real value over recent years, hence its store of value, with little need for high frequency transfers and hence less needing a digital or stablecoin equivalent. The usage as a means of payment does not seem to strongly correlate to a currency's strength or intrinsic value.

[32] Bureau of Economics Analysis, Bureau of the Fiscal Service, US Department of Commerce, https://www.bea.gov/
[33] United States federal budget, https://en.wikipedia.org/wiki/United_States_federal_budget
[34] Friedman, M. "Inflation, Taxation, Indexation." Institute of Economic Affairs (1974); https://miltonfriedman.hoover.org/internal/media/dispatcher/214978/full
[35] Statista, General Government Debt; IMF for Debt/GDP, https://www.imf.org/external/datamapper/GG_DEBT_GDP@GDD/CAN/FRA/DEU/ITA/JPN/GBR/USA; Swiss Government Reports on https://www.efv.admin.ch/efv/en/home/finanzberichterstattung/bundeshaushalt_ueb/ausgaben.html
[36] https://app.rwa.xyz/stablecoins,

The strength of a fiat currency relies on the trust in the government that issues it and the power of its underlying economy. High government spending and money printing without evidence of utilizing that money for structural improvements are signs of weakness. In contrast, the strength of digital currencies, bitcoin at its purest, does not come from a country's economy, but rather from scarcity - similar to gold - and utility, through the advantages of digital programmability, governance and distribution. The mechanism on which it operates, drives its intrinsic value, provided it has strong governance and utility. The architecture of a well designed crypto currency includes token economics - also known as "tokenomics" -, typically described in a white paper, making clear what drives supply and demand, and explaining factors and computation of the currency's inflation and deflation and therefore making the currency's intrinsic value transparent to the market. A stablecoin which is simply pegged to a fiat currency does not have that characteristic, mainly adding value through a more efficient functioning as a programmable, "always on", digital currency.

3. The stable characteristic of stablecoins

The use of blockchain for payments is largely dominated by stablecoins. The main reason is that most crypto currencies are considered as too volatile to serve as a means of payment and therefore stablecoins pegged to non-volatile fiat currencies are preferred. For crypto trading, stablecoins form the dominant trading pairs and provide the liquidity required by financial markets to move between different positions. For merchant payments and remittances, they remain the preferred unit of account to set prices and settle accounts.

The "stable" characteristic needs some precision. Stablecoins and stable value tokens are often used interchangeably but there is a difference: stable value tokens include stablecoins, deposit tokens and tokenized cash. The difference between these terms depends on the asset-backing, regulatory treatment, and legal structure of the issuer. They share a common characteristic of providing stable values that can be transferred on distributed ledgers and therefore represent an explicit promise of at par issuance and redemption. Hence the primary risk associated with stablecoins is represented by the event of being unable to fulfill that promise.

The focus of this paper is on stablecoins, which aim to maintain at least a one-to-one value between the value of the reserve assets and the quantity of circulating tokens. They are digital currencies that combine the innovation of blockchain technology with the stability, guarantee, and simplicity of traditional currencies and are a subset of crypto assets, which, under MiCA regulation, are defined as "a digital representation of value or rights which may be transferred and stored electronically, using distributed ledger technology or similar technology"[37]. Therefore when scaling the use of stablecoins, the primary risk exposure is the occurrence of losing the stable 1-to-1 pegging to the underlying reserves that might get redeemed. Extreme redemption is typically referred to as "run risk". This represents a quite particular risk, so called idiosyncratic for stablecoins and is different from normal "bank run" risk, as it relates to the centralization of

[37] Markets in Crypto-Assets Regulation (MiCA), published by European Securities and Markets Authority. 2023. Available from: https://www.esma.europa.eu/esmas-activities/digital-finance-and-innovation/markets-crypto-assets -regulation-mica [Accessed: October 11, 2024]

deposits with banks who hold the reserves of the stablecoin issuer and hence represent a counterparty risk, as illustrated by Silicon Valley Bank for Circle's USDC .[38]

Whether stablecoins provide a stable store of value in terms of real purchasing power is a systematic risk for all fiat-backed stablecoins and depends on the reference currency measuring to. In high inflation countries with unstable economies and governments, a US dollar stablecoin can be a safe haven protecting against loss of purchasing power. However, taking gold as a reference point, the US dollar has lost significant value. As a simplified illustration, 20 years ago, 10 kg of gold bought you a nice house and still does today. By contrast, USD 150'000, the price of 10kg of gold 20 years ago, would only buy you a small apartment today.

By that standard, the most dominant global currencies have steadily lost real purchasing power with EUR and USD losing most, CHF least and CNY somewhere in between.[39]Stablecoins focus primarily on the use as a means of payment including short term inflation protection in high-inflation countries and therefore USD, and somewhat less EUR, are the leading stablecoins, despite their history of losing purchasing power. USD and EUR pegged stablecoins also seem the main priorities of banks and governments. However, it is worth differentiating between fiat pegging and fiat backing characteristic of stablecoins.

4. The difference between fiat pegged and fiat backed currencies

Pegging refers to the unit of account that the stablecoin is 1:1 pegged to, hence to which it aims to establish full parity. This limits the choice to a commonly used fiat currency, like USD. The stablecoin issuer promises a 1:1 coverage of the stablecoin, which ensures that assets are available for redemption by customers at all times.

Backing refers to the reserves that back up the reserves held, meaning the assets purchased with the receipts of those who purchased the stablecoin. The reserves are not necessarily in the same currency as the pegged currency. For example, approximately 15% of Tether's USDT reserves are held in precious metals, bitcoins and other investments.[12]

These reserves can be quite material and are likely to grow if stablecoins further scale. To provide some context, the reserves of USDT are approximately USD 120 billion, issued by Tether, employing less than 100 people, and are approximately equal to the total assets of Swiss Re, the second largest reinsurance company in the world, employing more than 10'000 people, supervised by financial market authorities, applying IFRS accounting standards, and publishing audited financial statements. For further comparison, the world's largest asset manager Blackrock has 20'000 employees.

The backing of leading stablecoins is typically assured by monthly reporting of audited proof of reserves. A closer look at the two leading stablecoin issuers shows:

- for Tether, USDT, monthly transparency reporting audited by BDO, who describe their audit as a reasonable assurance engagement carried out in accordance with International Standards on Assurance Engagements issued by the International Auditing and Assurance

[38] Circle, paper on proposing a Token Capital Adequacy Framework (TCAF) for stablecoins; https://www.circle.com/blog/beyond-basel-a-new-capital-risk-framework-for-stablecoins, p. 24

[39] Chat Gpt, "change in purchasing power between 2004 and 2024 ", https://chatgpt.com/ [12]

Tether, Monthly Transparency Report, https://tether.to/en/transparency

Standards Board (IAAS), as well as recognition and measurement principles of IFRS (issued by the IASB)[40];

- for Circle, USDC, monthly transparency reporting audited by Deloitte, who base their audit on attestation standards established by the American Institute of Certified Public Accountants.[41]

A detailed analysis of such reserves is beyond the scope of this paper and our main focus is to assert stablecoin's operational effectiveness and reliability of the proof of reserves. Generally USD stablecoin reserves are invested in USD denominated money market products, predominantly US government bonds. Over the recent years, these have benefited from a high interest regime, in particular for USD. The proceeds of such interest income are not returned to the stablecoin holders. Stablecoin issuers can generate material profits. In Tether's case, it operates at an annualized profit of more than USD 5 billion, which can be seen as generation of equity, or excess reserves, therefore a proof of strength. Stablecoin holders in turn can generate yield by using their stablecoin assets on decentralized finance platforms, for example in liquidity pools or collateralized lending protocols.

As with any investments, the stablecoin issuer reserves are exposed to market and counterparty risk. The market risk is mainly interest rate risk, which is limited given the fairly short duration of the assets. The counterparty risk is moderate, as the majority of assets are US government bonds with a quasi zero chance of default. A different counterparty risk however is linked to the banks with whom stablecoin issuers have deposited their reserves. This exposure became clear in 2023 with the downfall of Silicon Valley Bank (SVB) which held a small share (approximately 8%) of USDC reserves on deposit[42]. Although Circle eventually did not incur any loss, the unrest and reputational damage was significant and USDC lost about half of its market capitalization in the months after the event and till today its market capitalization, of USD 35 billion[43], is 10% lower than its pre-SVB level. Over the same period, the market capitalization of USDT grew by 70% to USD 120 billion. While not the only factor, this counterparty risk event lead to a much higher concentration in the stablecoin market, from one with two issuers - Tether and Circle - of somewhat similar size - Tether's market cap was only 1.75 times larger - , to a materially different one. Tether's current market cap is 3.3 times larger[44].

All together, despite risks embedded in its reserves (the "backing") and the continued loss of purchasing power, the market seems to rather focus on the general acceptance of the USD as a means of payment and unit of account (the "pegging"), resulting in the USD denominated stablecoins being the dominating ones with material capitalization.

It does raise the question, whether, even when USD pegged, a USD stablecoin could not be backed in reserves other than US dollar, such as gold, an alternative we have described in a previous paper.[45] Such alternative stablecoin uses reserves that are more inflation resistant by

[40] Tether, Monthly Transparency Report, https://tethansparency
[41] Circle, Monthly Transparency Report, https://www.circle.com/en/transparency
[42] Circle, paper on proposing a Token Capital Adequacy Framework (TCAF) for stablecoins; p. 24; https://www.circle.com/blog/beyond-basel-a-new-capital-risk-framework-for-stablecoins
[43] USDC market capitalization per 14 October, 2024, reported on, https://coinmarketcap.com/currencies/usd-coin/
[44] Coinmarketcap.com, https://coinmarketcap.com/currencies/tether/, and https://coinmarketcap.com/currencies/usd-coin/
[45] Meeusen, P., Liu Y., " Stable Coins Backed by Real-World Assets – The Best of both Worlds", IntechOpen, 2024, https://www.intechopen.com/online-first/1182384

retaining purchasing power. By tokenizing such strong reserve assets, they offer a more sustainable store of value, mainly derived from its scarcity.

5. The meaning of scarcity and utility

As described in its whitepaper[46], Bitcoin derives its key value from its scarcity characterics guaranteeing a limited amount in circulation, never more than 21 million, which is mathematically proven. In a similar way, the total amount of gold, valued at approximately USD 17 trillion, is known, geologically proven. Both Bitcoin and gold have a known unmined part and require (proof of) work to mine it. Like for other precious assets, this scarcity largely drives its value and is different from fiat money which governments can keep printing and its value relies on the trust in the governments issuing it. The value of these scarce assets has been steadily increasing over the last ten years, with the share of Bitcoin rapidly rising over the last 4 years.

Table 2. Market Capitalization of Gold and Bitcoin, in USD bn[47]

	Aug 2016	%	Aug 2020	%	Aug 2024	%
Gold	7'214	99.9%	8'696	97.9%	16'812	92.9%
Bitcoin	8	0.1%	185	2.1%	1'290	7.1%
Total	7'222	100.0%	8'881	100.0%	18'102	100.0%
Percentage increase			23.0%		103.8%	

While scarcity is a strength, these assets have limited economic utility. That gold is seen as precious and has artistic value, in jewelry, has historically been established and remains somewhat subjective. It stems from the notion that something that takes much effort to mine is by nature scarce and deemed valuable. In a digital form, Bitcoin shares the scarcity characteristic but neither produces much economic utility. Its superior characteristic is that, unlike gold, it can efficiently and digitally be transferred peer to peer with limited effort and without reliance on intermediaries.

Blockchain, the technology on which Bitcoin relies, has the potential for a much wider utility, which led to the genesis of Ethereum and layer 2 (L2) networks developed on it, applying smart contracts functionality. In the context of scalable payment solutions, the functionality that matters is one that enables efficient, solvent and secure functioning as a means of payment and a continuous smart contract based proof of reserves.

Such functionality or utility relies on decentralization, which reduces the central point of vulnerability and hence the operational risk involved in issuing and operating a payment currency. We define the components of operational risk as defined in the Token Capital Adequacy Framework, a research paper published by Circle in 2024.[48] This proposes a capital level that is risk sensitive and subject to stress testing rather than fixed-ratio methods, such as

[46] Nakamoto, S. "Bitcoin: A Peer-to-Peer Electronic Cash System." No Publisher (2008) https://bitcoin.org/bitcoin.pdf
[47] https://ingoldwetrust.report/chart-gold-bitcoin-marketcap
[48] Circle, paper proposing a Token Capital Adequacy Framework (TCAF) for stablecoins; p. 5; https://www.circle.com/blog/beyond-basel-a-new-capital-risk-framework-for-stablecoins

those adopted in the European Union's landmark Markets in Crypto-Assets (MiCA) regulatory framework.

In the following sections, we describe a more precise definition of payments and how the TCAF framework can be applied to assess operational risk to stablecoins and their scalability in particular. We believe this risk assessment is essential in the attempt to move to scalable blockchain enabled payments. To assess this accurately, it is important to differentiate between the meaning of payments as trade settlements versus remittances.

6. The definition of payments, distinguishing remittances from trade settlements

Scaling blockchain payments requires distinguishing remittances from trade settlements.

Remittances are money transfers between individuals, merchants and corporations, settling a commercial trade, paying for delivery of goods and services. The payment balances to an invoice, bill or some statement of account.

Trade settlement refers to the cash leg of a financial trade and therefore provides the liquidity to exchange assets, including digital crypto assets, and move assets across exchanges or liquidity pools.

Whether blockchain payments perform at scale might therefore be evaluated slightly differently among these categories of payments.

Table 3. Characteristics of Remittances and Trade Settlement.

Characteristics	Remittances	Trade Settlements
Performance Considerations	Speed, throughput, commissions, fx rates	Speed, throughput, spreads, impermanent loss, volume, market depth
Examples of standards	MT-100, SEPA, ACH	T+1 settlement, same day settlement
Incumbents	SWIFT, Western Union, Credit card operators	Regular (non-crypto) markets and exchanges

In the following sections, we assess the risks and performance of blockchain payments in a way that is agnostic of the above two categories. The principles are applicable to stablecoins but also to other crypto currencies being used for payments.

7. Managing operational risk of operating stablecoins and blockchain payments at scale

We define operational risk of a stablecoin as the risk associated with the technology, infrastructure, and operations of running a stablecoin on a blockchain. In a financial system, the net risk, after the mitigating effect of controls, typically determines capital requirements. This is also applied in the European Union's landmark Markets in Crypto-Assets (MiCA) regulatory framework. The objective is to ensure having adequate loss-absorbing capital to continue operations ("going concern"). However such capital frameworks to date have largely applied a risk-insensitive fixed ratio approach, such as a 2% capital requirement in MiCa. In contrast, in a risk sensitive approach, which we recommend, we reflect the specific technical and operational risk of the networks running the crypto assets.

Technically, a stablecoin runs as a smart contract on a blockchain network. The smart contract code defines the conditions for token issuance and redemption and stores the necessary information on the blockchain network. The blockchain network defines what the smart contract code can achieve, both from a functional and non-functional perspective. As a consequence, the risks have to be considered for a stablecoin smart contract and the blockchain network it runs on. To mitigate scalability limitations of Ethereum, several so-called Layer 2 (L2) solutions have been proposed. While they benefit from Ethereum's security and decentralization, they add operational complexity which has to be considered.

Both the smart contract and the network may function as Decentralized Autonomous Organizations, therefore it might be challenging or impossible to determine a central operator or issuer onto whom requirements and responsibilities can be imposed. For stablecoins specific operational risk factors to consider relate to technology, infrastructure and operations and include[49]

- Unauthorized token issuance and distribution
- Disruption in token issuance or redemption services
- Inaccuracy in transactions
- Failure or security breach of the blockchain
- Failure or error from external service providers
- Loss or compromise of digital assets

The actual calculation of the value at risk depends on various event types, assigning event likelihoods and severity. In order to assess these risks, we distinguish smart contract and network related aspects.

Smart contract related factors:

1. Issuance and redemption mechanism
    a. Code reviews and formal verification
    b. Minimize dependency on external services (oracles, bridges) and data

[49] Circle, paper proposing a Token Capital Adequacy Framework (TCAF) for stablecoins; Table A1, p. 37

2. Governance and control
    a. Code reviews and formal verification
    b. Process and conditions for smart contract upgrades
    c. Key management for issuers and users
3. Auditability and privacy
    a. Verifiability of transactions
    b. Confidentiality and information security

Network related factors:

1. Decentralization and trust
    a. Topology and number of nodes (validators) and node operators (providers)
    b. Geographic distribution, characteristics and number of countries, jurisdictions
    c. Entities involved and trust assumptions
2. Governance and control
    a. Code reviews and formal verification
    b. Process and conditions for network upgrades
    c. Process and conditions for smart contract upgrades
    d. Key management for node providers and users
3. Availability and failure resolution
    a. Up-time guarantees and history
    b. Network upgrade speed
4. Tokenomics
    a. Distribution
    b. Ratio of circulation to fully diluted market app
    c. Future development of supply
5. Auditability and privacy
    a. Verifiability of smart contract and network changes
    b. Confidentiality and information security
    c. Restrictions on data storage and processing
6. Interaction with external data and chain
    a. Ability for smart contracts to interact with external data directly without oracle and bridge services

The number of entities involved in these decision processes and how their keys are being managed affects overall security of the network and the smart contract enormously. Note that it is not sufficient to have a high number of nodes or validators. If they are all controlled by a small number of entities or don't exhibit a satisfactory diversity with respect to geography, controlling entities, countries and jurisdictions, then it is not possible to tolerate natural catastrophes, collusion, conflicts, or nation state actors with adverse intentions. In particular, a high concentration of nodes or validators running on services controlled by a handful of centralized cloud providers is problematic.

To minimize risk due to bugs and imprudent key management, stablecoin smart contracts as well as network code should be reviewed by well-known organizations with specialized

knowledge. Many networks provide links to their review reports publicly, see e.g., Kudelski's Flow USDC report[50], Trail of Bits' Internet Computer Protocol (ICP)[51] report or Arbitrum's report[52] to name some examples. Moreover, in the best case, the key mechanisms have also been formally verified to achieve their goals, as exemplified by Kudelski's Flow USDC report[53], DFINITY for ICP[54] or a peer-reviewed article of an algorithmic stable coin[55] .

At a first glance, one might come to the conclusion that an immutable network with immutable smart contracts may offer the best security guarantees. However, since it is virtually impossible to write bug-free code in reality, a well-defined process and governance for smart contract and network upgrades is necessary for any but very simple projects. It is crucial to have well-defined and preferably automated governance processes that prescribe what vetting and approval protocols smart contract and network changes go through. On many networks, proxy patterns are used to circumvent smart contract immutability by having a smart contract forward user calls to another contract which implements the actual logic dynamically. While this enables code changes, this pattern introduces security risks, complexity, and potential centralization concerns. [56]

Ideally, the network provides a fine-granular mechanism and governance to review and vote on proposals for upgrades, which are then carried out automatically upon a (weighted) quorum decision of the stakeholders. Moreover, the time frame of such smart contract and network changes matters. For security-sensitive changes a reaction time in the order of hours is desirable.

It is crucial to take the availability of a network into account, as repeated lengthy downtimes are highly undesirable. This aspect will be discussed in more detail in the next section.

The tokenomics of a blockchain network play a crucial role in determining the stability of its token price and its long-term evolution. An ideal tokenomics model achieves a balance between supply and demand, with sufficient trading volume to mitigate the impact of individual trades on price. A network's token distribution is crucial because it directly impacts decentralization, security, fairness, economic sustainability, and overall success by shaping incentives, community engagement, and governance structures. Key metrics used to assess a token's health include the ratio of circulating supply to fully diluted market cap and the projected future supply changes through minting or burning mechanisms. These factors help to understand what drives the token's intrinsic value and therefore bring overall token value stability. Additionally, the utility of the

[50] Kudelski, "Security Assessment for Flow USDC", 2021 https://kudelskisecurity.com/wp-content/uploads/Security-Assessment-forFlow-USDC.pdf
[51] Trail of Bits, "Security Review of Internet Computer Protocol", 2021 https://github.com/trailofbits/publications/blob/master/reviews/DFINITY.pdf
[52] Trail of Bits, "Security Review of Arbitrum", 2024, https://github.com/trailofbits/publications/blob/master/reviews/2024-01-offchainarbitrum-securityreview.pdf
[53] Kudelski, "Security Assessment for Flow USDC", 2021 https://kudelskisecurity.com/wp-content/uploads/Security-Assessment-forFlow-USDC.pdf
[54] O. Maric, "Eliminating Smart Contract Bugs with TLA+", 2023, Blog article https://medium.com/dfinity/eliminating-smart-contract-bugs-with-tla-e986aeb6da24
[55] J. Zahnentferner et al. "Djed: A A Formally Verified Crypto-Backed Autonomous Stablecoin Protocol," 2023 IEEE International Conference on Blockchain and Cryptocurrency (ICBC)
[56] C. Nightingale, "Upgradable Smart Contracts | What is a Smart Contract Proxy Pattern?", 2024, Blog article, https://www.cyfrin.io/blog/upgradeable-proxy-smart-contract-pattern

token within the network's ecosystem, governance rights, and staking incentives can significantly influence demand and long-term holder behavior.

Also, a good network makes it easy to verify that a transaction was processed by a certain version of a smart contract and what versions there were before. Ideally, the network enables users to get such information together with a cryptographic proof which the user can check without having to download gigabytes of data and replaying all transactions since genesis. However, for most networks, users are required to trust some third party service or run a node or validator themselves.

On networks which allow smart contracts to declare which parts of their data is publicly available and which require privileged roles, it is much more straightforward to build data protection into smart contracts and adhere to regulatory requirements, such as for data protection. Similarly, some networks offer guarantees with respect to the countries in which data is stored and computations are carried out and who has access to the machines.

To comply with regulatory requirements, it is also often necessary to take information from outside a network into account, e.g., OFAC sanctions lists. To minimize the number of services a user and issuer has to trust, networks which enable smart contracts to access such information directly are to be preferred over relying on oracles services which may be compromised.

In the table below, we illustrate the practical application of above risk assessment criteria on a selection of blockchain networks.

To apply all this in practice, we recommend that stablecoin issuers periodically include a description and assessment of above described risk factors, as well as network and smart contract governance features. As done for proof of reserves, this could include an assessment by an independent third party.

Table 4. Comparative Overview of Key Factors for a Selection of Blockchain Networks

Network / Factors	Ethereum (ETH)	Layer 2 (e.g., Arbitrum, Optimism, Polygon)	Binance Smart Chain (BSC)	Internet Computer Protocol (ICP)	Solana (SOL)	Tron (TRON)
Basic trust assumptions	More than two thirds of total staked ETH must be controlled by honest validators, incentivized by fees, staking rewards and slashing	Assumptions of L1 (typically Ethereum) and at least one honest L2 validator, incentivized by fees, staking rewards of slashing	21 out of 45 validators with most BNB staked are responsible for block production and validating transactions, more than two thirds of them adhere to protocol, incentivized by fees, block and staking rewards and slashing	More than two thirds of the nodes adhere to the protocol, incentivized by node provider and voting rewards	More than two thirds of the validator nodes adhere to the protocol, incentivized by fees, block and staking reward	Delegated Proof-of-Stake where token holders vote for 27 super representatives (SRs) to validate transactions and secure the network, at least half of them must adhere to the protocol, incentivized by fees, block and staking rewards and slashing
Network governance	Primarily off-chain, informal, and community-driven, node providers decide what they run. Validators decide on which nodes they stake.	Typically voting-based L2 governance, either for token holders (e.g., Arbitrum, Optimism), or stakers, validators and active community members or contributors (Polygon), or variants thereof.	Staking and delegation for voting rights, decisions are not executed automatically	Staking for weighted voting rights on node assignment and network upgrades; automatic execution of decision	Staking and delegation for voting rights, most decisions are not executed automatically	SRs can propose network changes, which require approval from at least 18 other SRs to be implemented (not executed automatically)
NodeAssignment	Node providers decide what and where they run, majority of nodes on cloud providers offering node as a service solutions[30]	Node providers decide what and where they run, cloud providers offer node as a service solutions.	Node / validator providers decide what and where they run. Users delegate stake to them.	Node providers and the location of nodes in independent data centers are known, voting-based assignment to subnets (shards)	Node / validator providers decide what and where they run. Users delegate stake to them.	Node providers decide what and where they run, cloud providers offer node as a service solutions. Users delegate stake to them.

[30] L. Heimbach, "Deanonymizing Ethereum Validators: The P2P Network Has a Privacy Issue", 2024 TUM Blockchain Conference, https://arxiv.org/pdf/2409.04366, p10

Network / Factors	Ethereum (ETH)	Layer 2 (e.g., Arbitrum, Optimism, Polygon)	Binance Smart Chain (BSC)	Internet Computer Protocol (ICP)	Solana (SOL)	Tron (TRON)
Network upgrades	Node/v providers decide which protocol version they run, 1-3 upgrades a year	Protocol upgrades approved by voting are applied manually after a delay period (exceptions for security upgrades)	Voted on by validators, not executed automatically, about 1 upgrade per year	Voting-based upgrades to new versions, roughly weekly cadence, upgrade complete in a few minutes	Voted on by validators, not executed automatically, about 1 upgrade per year	Voted on by SRs, not executed automatically, last significant upgrade in 2023
Smart contract upgrades	While generally immutable, smart contract functionality can be changed after deployment with a proxy pattern. Version history can be made publicly accessible	As on Ethereum	As on Ethereum	Controller (can be another smart contract, e.g., a DAO) of smart contract can trigger automatic upgrade to a new version. Version history is always publicly accessible	Upgradeable contracts have an upgrade authority, original contract account remains immutable.	As on Ethereum
Verifiability	Users must trust third party providers (block explorers, API providers) or run a node themselves, including replaying all transactions since genesis	In addition to the concerns for Ethereum, users should wait for the full fraud proof period to elapse (optimistic rollups) of the full verification process(zero knowledge rollups) to complete	As on Ethereum	Responses from ICP are signed and can be verified with the root public key	As on Ethereum	As on Ethereum
Restrictions on data storage and processing	Unknown, not restricted	As on Ethereum	As on Ethereum	Where applications run is publicly visible, restrictions to certain jurisdictions are possible (e.g., nodes exclusively in Europe)	As on Ethereum	As on Ethereum

Network / Factors	Ethereum (ETH)	Layer 2 (e.g., Arbitrum, Optimism, Polygon)	Binance Smart Chain (BSC)	Internet Computer Protocol (ICP)	Solana (SOL)	Tron (TRON)
Access external data	Oracle services are needed to access external information	As on Ethereum	As on Ethereum	Smart contracts can interact with servers outside ICP directly	As on Ethereum	As on Ethereum

8. Defining operating payments at scale and measuring ability to do so

Having established a risk and governance framework, we also evaluate whether current leading blockchains are able to meet operating requirements to function at large scale. While today's stablecoin transaction count and volume are moderate, an accelerated adoption phase could start at some point in time. To assess readiness for scaling, we define operating performance and cost requirements for a reliable blockchain based payment system at scale and assess the ability of today's blockchain landscape to meet these requirements.

To understand the context of the current stablecoin landscape, the daily volume of stablecoin transactions analyzed on https://app.rwa.xyz/stablecoins varies between USD 20 and 150 billion. As an example, on October 11, 2024, USD 55.978 billion were transferred in a total of 9.993 million transactions, implying an average transaction size of USD 5'601, at an average throughput of 115 transactions per second.

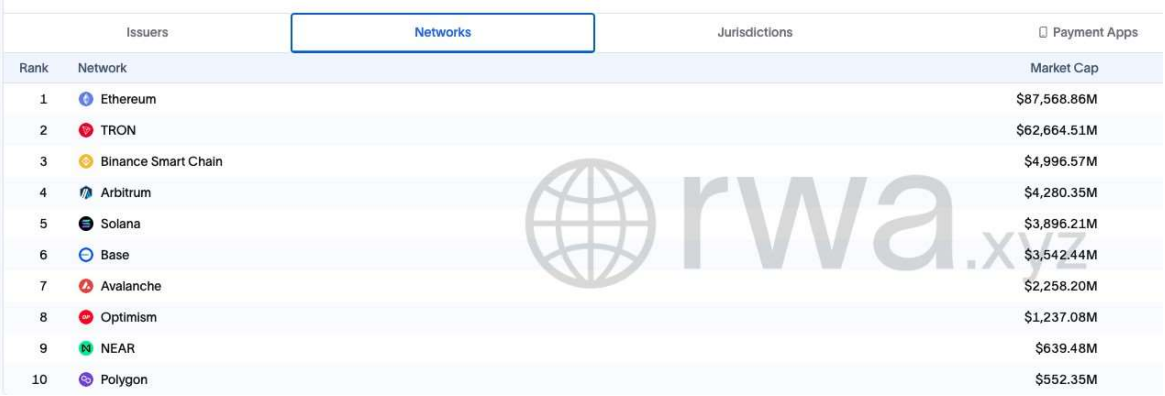
Table 5. Snapshot of top 20 stable coin transfer volumes and counts[57]

10/11/24	$55,978,328,228
USDT	$24,859,940,939
USDC	$23,419,123,975
DAI	$3,905,137,345
BSC-USD	$2,222,039,475
FDUSD	$868,265,488
PYUSD	$301,755,764
USDe	$141,809,147
GHO	$67,305,325
AUSD	$41,778,573
USD0	$30,936,674
USDD	$22,946,538
EURC	$21,040,242
BSC-BUSD	$16,050,634
FRAX	$14,598,077
deUSD	$13,278,099
AUDF	$12,096,898
TRYB	$10,972,470
LUSD	$2,306,922
sUSD	$1,440,013
XSGD	$1,384,818

10/11/24	9,993,816
USDC	4,410,049
USDT	3,353,832
BSC-USD	2,103,423
BSC-BUSD	68,737
PYUSD	35,147
USDe	6,438
FDUSD	4,812
DAI	4,181
AUSD	3,604
USDD	924
FRAX	509
EURC	451
GHO	421
USD0	324
USDM	300
deUSD	145
USDP	105
GUSD	91
LUSD	52
XSGD	51

[57] Real World Asset data collection, https://app.rwa.xyz/stablecoins

Table 6. Market cap snapshot of top 10 blockchains for stablecoins on October 13, 2024[32]



Issuers | Networks | Jurisdictions | Payment Apps

Rank	Network	Market Cap
1	Ethereum	$87,568.86M
2	TRON	$62,664.51M
3	Binance Smart Chain	$4,996.57M
4	Arbitrum	$4,280.35M
5	Solana	$3,896.21M
6	Base	$3,542.44M
7	Avalanche	$2,258.20M
8	Optimism	$1,237.08M
9	NEAR	$639.48M
10	Polygon	$552.35M

Within this landscape, we define the most relevant metrics for customers and issuers alike as follows:

- Latency: Time interval elapsing between the submission of a transaction until it is final and cannot be reverted;
- Throughput: Number of transactions executed per second;
- Availability: Percentage of time the system is up and running as expected; ● Cost: Fees for holding and transferring tokens.

Furthermore, with the impact of climate change becoming increasingly visible, the amount of energy consumed per transaction executed is also a factor of growing importance.

For remittances and trade settlements, desirable values for these metrics are depicted in the following table.

Table 7. Operational Performance Metrics For Remittances and Trade Settlements

Category / Metric	Remittances		Trade Settlements
	Customer - Merchant	P2P money transfer	
Latency	Seconds	Seconds to minutes	As fast as crypto trades
Throughput	10k-100k[33]		
Availability	24/7, every minute of downtime is very costly	24/7, occasional downtime in the order of hours is acceptable	24/7, occasional downtime in the order of minutes is acceptable
Cost	Stable, <1% of transfer		<1% of transfer

32Real World Asset data collection, https://app.rwa.xyz/stablecoins

33 Visa reports a capacity of 65k TPS
https://www.visa.co.uk/dam/VCOM/download/corporate/media/visanet-technologfactsheet.pdf

Note that it is important to distinguish between the throughput capacity of a network and the typical experienced throughput as well as peak throughput. Depending on the use case at hand, there can be a large difference between typical and peak throughput.

When comparing blockchain networks, ideally consistent definitions or experiments are used. However, in practice many blockchain networks use the same term to refer to concepts with subtle differences, e.g., with respect to the meaning of a transaction, finality, etc. Moreover, many reported throughput capacity as well as latency numbers can only be achieved under (theoretical) conditions which are not relevant in practice. Since the reported capacity numbers are therefore impossible to compare in a fair manner, average and peak throughput numbers offer more reliable performance indicators. Similarly, it is difficult to find reliable end-to-end latency evaluations over large sets of different networks. Finality and block time are not sufficient to evaluate performance, it also matters how long a transaction waits in a system's queue before being added to a block and executed. A number of articles benchmark different blockchain networks under various loads, most of them are not easy to repeat or check in real time[58,35,59]. A rare exception can be found on the following real time dashboard, which helps to assess user experience[60].

In reliability engineering, availability is often expressed as a ratio of uptime to total time (uptime plus downtime). However, from a user's perspective a very slow behavior is indistinguishable from the system being fully broken, therefore the definition of uptime needs to comprise acceptable conditions to declare a system to be "accessible and ready for use".

[58] Touloupou, Marios, et al. "A systematic literature review toward a blockchain benchmarking framework." IEEE Access 10 (2022): 70630-70644. 35

Saingre, Dimitri, et al. "BCTMark: a framework for benchmarking blockchain technologies." 2020 IEEE/ACS 17th International Conference on Computer Systems and Applications (AICCSA)

[59] Gramoli, Vincent, et al. "Diablo: A benchmark suite for blockchains." Proceedings of the Eighteenth European Conference on Computer Systems. 2023.

[60] Aptos Real Time E2E Latency Benchmark https://grafana.aptoslabs.com/publds/f32a07a7ef01456cbb9f79ac97

Even when ignoring this intricacy, comparisons for the availability across several chains are rare. Some blockchains release more or less detailed information about their incidents, e.g., https://status.solana.com, or https://status.internetcomputer.org/. Due to the lack of clear availability definitions, one cannot directly compute a widely understood metric from these reports. Availability comparisons found online are more than 1 year old. They either rely on status page information or derive up-time percentages from block time differences, reporting values between 97.67% for Solana to a full 100% for Ethereum in their methodology[61].

The fact that transactions can refer to different concepts on different networks, makes fair comparisons hard. For example, the number of instructions executed by an average Ethereum transaction compared to an average transaction on the Internet Computer differs by a factor of more than 130.[62] Moreover, different networks have different costs, which may either be fixed or dependent on the network's token price and/or the congestion currently experienced. There are examples, where the peak fee is 20 times the average fee in 2024.[63] On some blockchain networks, like ICP and Hedera, processing costs are charged at a rate fixed to fiat currencies, while most other fees vary, often based on the price of the network's native token(s) and on network congestion. For stablecoin issuers and users, it is preferable to have fixed costs without the volatility that cryptocurrency prices have been experiencing.

Table 8 lists numbers for key metrics from a variety of sources. The observed latencies vary between sub-second and minutes, indicating that several blockchain networks are able to meet the latency requirements of customer-merchant transfers and all networks listed here can be used for peer-to-person transactions and trade settlements. With the exception of ICP, no blockchain network has processed more than 20 thousand transactions per second (measured over a window of 100 consecutive blocks). Thus, it remains for them to prove that their mainnet deployments offer the capacity for a scalable payment system. With respect to the availability, precise definitions for acceptable service quality, mean time to repair and uptime percentages need to be developed, so blockchain networks can report their behavior accordingly. While several blockchain networks feature low average transaction costs, the fact that most of them suffer from high volatility still creates operational challenges. The energy consumption varies significantly (by a factor of more than 3000 between the lowest (ICP) to the highest (ETH) wh/tx), thus environmentally concerned users may have a clear preference for more sustainable blockchain networks.

[61] Blog articles https://bitquery.io/blog/analysis-of-blockchain-availabilitybased-on-block-lag and https://jp12.medium.com/l1-outage-list-c89a1d167d0a

[62] Wiki article on comparing transactions https://wiki.internetcomputer.org/wiki/Not_all_transactions_are_equal

[63] R.Pacheco, "Crypto Transaction Fees: A Beginner Guide (2024)", 2024, blog article, https://swissmoney.com/cryptocurrency-transaction-fees

Table 8. Operational Performance Metrics For Major Blockchains

Characteristic	E2E Latency[6465]	Real-time tps 42	Max recorded tps[66]	Avg tx fee[6768]	Watt hour per tx 45,[69]
Aptos	0.9s	30	10734	0.002 $	~0.0347
Arbitrum (L2)	2.5s	19	896	0.007 $	~0.7
Avalanche	4.1s	1.9	92	0.128 $	2.395
Binance Smart Chain	>7.5s[47]	50.4	1731	0.094 $	0.059
Base (L2)	4.1s	62	293	0.003 $[70]	~0.3
Ethereum	>10s	13	62	3.996 $	9.956
ICP	1.3-2s[71]	4201	25621	0.001 $[72]	0.003
Near	4.8s	82	342	0.003 $[73]	0.602
Optimism (L2)	4.4s	10	67	0.017 $	~1.7
Polygon (L2)	6.3s	35	429	0.004 $	~0.04
Solana	4-20s	774	7229	0.005$	0.517
Sui	0.7s	521[74]	988[75]	0.002 $[76]	~0.2
Tron	>57s[77]	108	272	0.821 $	1.202

[64] Aptos Real Time E2E Latency Benchmark, https://grafana.aptoslabs.com/public-dashboards/f32a07a7ef01456cbb9f79ac975fb00e?orgId=1&refresh=15m
[65] Chainspect, blockchain analytics platform, https://chainspect.app/dashboard, Nov 15 2024
[66] Chainspect, blockchain analytics platform, https://chainspect.app/dashboard, Nov 15 2024
[67] TokenTerminal, blockchain analytics platform, https://tokenterminanal/metrics/transaction-fee-average, Nov 15 2024
[68] CarbonCrowd, ICP Sustainability Report 2023, https://assets.carboncrowd.io/reports/ICF2023.pdf page 12
[69] C. Ibanez, "The Energy Consumption of Proof-of-Stake Blockchains" 2023, blog article, https://www.dltscience.org/news/energy-consumption-proof-of-stake-blockchains [47] E2E latency is at least as high as the finality reported on https://chainspect.app
[70] Dune, analytics platform, https://dune.com/Marcov/layer-2-transaction-cost
[71] R. Rumenov and D. Sharifim, "Tokamak: A Significant Improvement in End-to-End Latency", blog article https://medium.com/dfinity/tokamak-accelerating-the-internet-computer-update-call-lifecycle-f82517472709
[72] Wiki article on L1 comparison, https://wiki.internetcomputer.org/wiki/L1_comparison
[73] Artemis, blockchain analytics platform, https://app.artemisanalytics.com/project/near?from=chains
[74] Sui dashboard, https://suivision.xyz/
[75] Sui dashboard, https://suivision.xyz/
[76] Sui website, https://learn/the-sui-network-explained/
[77] E2E latency is at least as high as the finality reported on https://chainspect.app

9. Conclusion

The framework and metrics presented in this analysis provide a solid foundation for assessing the readiness of blockchain networks to support large-scale payment operations. It provides a more systematic approach to evaluating blockchain networks, moving away from subjective claims and towards data-driven assessments of performance, security, governance, cost, sustainability, and energy efficiency.

To overcome the challenges and limitations outlined in this paper, industry-wide standardization of performance metrics and verifiable ways to access them are necessary. This will increase transparency and make reliable data available to stakeholders, including regulators, users, and regulated institutions. In other words, this is a pre-requisite for informed decision-making based on the desired security and service levels and can facilitate the development and adoption of suitable networks.

Furthermore, we advocate for risk-sensitive regulatory frameworks that are both practical to implement and align with the specific risks of blockchain technology. Such regulations include licensing and capital adequacy and can encourage innovation while ensuring the protection of user interests.

Acknowledgement

The authors wish to thank the DFINITY Foundation and its various team members that provided valuable input and feedback in the completion of the manuscript.

Author Contributions

PM focussed on economic analysis and YAP on computer science and technical research. They both contributed equally to manuscript preparation.

Conflict of Interest

The authors are working for the DFINITY Foundation, a major contributor to the Internet Computer Protocol (ICP). ICP is one of the blockchain networks assessed in this article.

2.4. Smart Contracts in Financial Security: A Legal Analysis in the Context of Traditional Finance and DeFi - Przemysław Kępczyński and Aneta Napieralska

THE AUTHORS

Przemysław Kępczyński

LegalTeq

Aneta Napieralska

LegalTeq

CVA CFP 2024

"Smart Contracts in Financial Security: A Legal Analysis in the Context of Traditional Finance and DeFi"

Przemysław Kępczyński, Aneta Napieralska

Abstract.

The application of smart contracts in cross-border finance introduces new opportunities for automating and enhancing the efficiency of security mechanisms, both within traditional financial models and the growing decentralized finance (DeFi) sector. This article offers a legal analysis of smart contracts as instruments for securing financial transactions, exploring their potential to replace conventional tools such as letters of credit or escrow agreements while addressing the regulatory challenges arising from their cross-border implementation.

In traditional finance, smart contracts are seen as innovative solutions that could automate and simplify security processes, but their adoption raises legal concerns regarding enforceability, choice of law, and the adequacy of existing regulatory frameworks. The article assesses the extent to which these challenges can be mitigated to enable the broader integration of smart contracts into established financial systems.

The analysis then shifts to the DeFi context, where smart contracts are fundamental to the operation of decentralized protocols for lending, liquidation, and liquidity management. However, the decentralized nature of DeFi introduces significant legal and regulatory risks, including issues related to AML/KYC compliance, jurisdictional uncertainty, and the systemic risks associated with automated, algorithm-driven financial models.

By contrasting the use of smart contracts in traditional finance with their role in DeFi, the article identifies the boundaries of their effectiveness as security mechanisms in cross-border transactions. The conclusion offers recommendations for harmonizing legal frameworks to accommodate the evolving landscape of blockchain-based financial systems while ensuring regulatory compliance and market stability.

KEY WORDS

1. cross border transaction. 2. smart contract. 3. settlement.
4. financial security 5. agreement 6. settlement automation 7. payment security mechanism.

1. Introduction

In the era of globalization and intensified integration processes, cross-border transactions have become an integral part of contemporary economic activity. The dynamic growth of international trade, confirmed by data from the World Trade Organization (WTO), generates significant economic benefits for participating parties while simultaneously creating challenges in the areas of security and financial settlements.

Cross-border transactions, unlike domestic operations, are characterized by an increased level of complexity resulting from the heterogeneity of legal, monetary, and cultural systems. In this context, effective security and settlement mechanisms that minimize risk and guarantee the safety of the parties involved become particularly important.

Traditional security instruments, such as documentary letters of credit, escrow agreements, and bank guarantees, despite their utilitarian function, are often burdened with limitations like high costs, lengthy procedures, and insufficient transparency. Therefore, alternative solutions are sought to optimize the processes of securing and settling cross-border transactions.

In recent years, blockchain technology and smart contracts have been gaining increasing interest. Blockchain, as a decentralized and cryptographically secured data ledger, creates opportunities for innovative solutions in the area of international finance. Smart contracts, defined as self-executing agreements written in computer code on the blockchain, enable process automation and the elimination of intermediaries, which translates into cost reduction and increased transaction efficiency (Altay & Motawa, 2020; Chainlink, 2022; Ethereum Blog, 2022).

The implementation of smart contracts in cross-border transactions offers potential benefits such as reduced transaction costs, accelerated settlements, enhanced security and transparency, and the elimination of intermediaries. At the same time, it generates a number of legal challenges, the analysis of which is the subject of this article.

This article focuses on a legal analysis from the perspectives of the law of obligations, contract law, and banking law, while avoiding excessive delving into the technical aspects of blockchain technology. According to the authors, this study serves merely as an introduction to more detailed considerations on the potential applications of smart contracts. Despite the growing number of publications concentrating on technological and financial aspects, there remains a lack of in-depth legal analyses that consider the specifics of contract, financial, and banking law in the context of these new solutions. Security mechanisms are based on agreements that are directly subject to legal regulations, making their analysis from a legal standpoint indispensable to fully understand the challenges and opportunities associated with the implementation of smart contracts.

2. Traditional Cross-Border Security Mechanisms

To gain a fuller understanding of the legal issues related to the use of smart contracts in international transactions, the authors decided first to present the existing security instruments that serve to protect the interests of the parties involved. Before discussing the details of how these instruments work, it is necessary to identify the context of their use, the purposes they serve, and how they function in practice. International transactions, involving the flow of goods, services, and capital between entities from different jurisdictions, form the basis of modern international trade. Their execution requires the involvement of many parties, including exporters, importers, banks, transport companies, customs agents, and other intermediaries. This process can be divided into several stages:

1. **Negotiation and Contract Conclusion**: The parties agree on the terms of the transaction, including the type and quantity of goods or services, price, payment terms and methods, and delivery method.
2. **Preparation and Shipment of Goods**: The exporter prepares the goods for shipment and organizes international transport.
3. **Customs Clearance**: The goods undergo customs clearance in both the exporting and importing countries.
4. **Payment and Settlement**: The importer makes payment for the goods in accordance with the terms of the contract. The settlement process includes the transaction settlement between the banks of the parties and the transfer of ownership of the goods to the importer.

In this section, the authors focus on the first and fourth stages of the transaction—negotiation and contract conclusion, and the payment and settlement process. It should be emphasized that it is during the negotiation stage that the payment terms and transaction security mechanisms are agreed upon, which are crucial for the proper performance of contractual obligations.

Proper contract security is achieved through the application of additional legal mechanisms. These may include stipulating performance rules and sanctions for non-performance or improper performance within the main contract, as well as the obligation to enter into additional security agreements. These security agreements, dependent on the main contract, play a key role in risk mitigation and protecting the interests of the transaction parties. Therefore, security mechanisms should be analyzed within the legal context, particularly under contract law.

However, the freedom to shape these rules is limited by mandatory norms, such as financial law regulations, anti-money laundering provisions, banking law, and sometimes regulations related to data protection. These requirements affect how the parties can establish security conditions, further complicating the negotiation process and requiring strict compliance with applicable regulations. Designing a security mechanism that does not comply with market regulations may expose entities to not only contractual liability but also significant penalties from supervisory and regulatory authorities, potentially leading to heavy fines or even restrictions or loss of licenses.

Unlike domestic transactions, cross-border transactions require consideration of factors such as currency exchange rate fluctuations, the risk of counterparty insolvency, political instability in the counterparty's country, differences in legal systems, and potential barriers in cross-cultural communication. These factors generate an increased level of risk compared to operations conducted within a single jurisdiction.

To minimize these risks and ensure the security of parties involved in international transactions, specialized security instruments are used. These instruments perform guarantee and settlement functions, ensuring the fulfillment of contractual obligations and protecting the financial interests of the parties.

The following categories of risk are distinguished in cross-border transactions:

- **Currency Risk**: Arises from potential fluctuations in exchange rates between the date of contract conclusion and the date of payment, potentially causing financial losses.
- **Credit (Counterparty) Risk**: Related to the possibility of insolvency or failure to meet contractual terms by one of the transaction parties.
- **Political Risk**: Results from political instability, legislative changes, or governmental actions in the countries where the transaction is executed.
- **Legal Risk**: Associated with differences in legal systems and international regulations, which may hinder claim enforcement and dispute resolution.
- **Operational Risk**: Includes potential problems with logistics, transportation, customs clearance, or other operational difficulties that may affect the execution of the transaction.

To mitigate these risks and ensure the security of parties in international transactions, specialized security mechanisms have been developed, including documentary letters of credit, escrow agreements, and bank guarantees.

The following sections of this paper will present a detailed characterization of these instruments, considering their operating principles, legal frameworks, and advantages and disadvantages in the context of cross-border transactions.

Documentary Letter of Credit

The documentary letter of credit, as one of the foundations of international trade financing, is an abstract and formal instrument aimed at minimizing the risk associated with the importer's failure to fulfill payment obligations. In commercial law doctrine, it is defined as an obligation of the issuing bank, undertaken at the request of the importer (applicant), to pay a specified amount to the exporter (beneficiary) upon the fulfillment of strictly defined conditions by the latter (Oelofse,1997).

A fundamental feature of the letter of credit is its detachment from the underlying contract between the importer and the exporter. This means that the issuing bank is obliged to make payment regardless of any disputes or claims arising from that contract. In this way, the letter of credit provides the exporter

with certainty of receiving payment, while the importer gains assurance that payment will only occur if the goods delivered conform to the contract terms.

In the operation of a letter of credit, the following roles are distinguished:

- **Applicant (Importer)**: Initiates the transaction and instructs the issuing bank to open a letter of credit.
- **Beneficiary (Exporter)**: The recipient of the payment under the letter of credit.
- **Issuing Bank**: Commits to paying the beneficiary upon fulfillment of the letter of credit conditions.
- **Advising Bank** (optional): Acts as an intermediary in transmitting the letter of credit to the beneficiary.
- **Negotiating Bank** (optional): Verifies the documents presented by the beneficiary and negotiates payment.

Crucial to the proper functioning of the letter of credit are the documents the beneficiary is obliged to present to the issuing bank. These documents must strictly comply with the conditions specified in the letter of credit; otherwise, the bank may refuse payment. The most commonly required documents include:

- **Bill of Lading**: A document confirming the receipt of goods by the carrier.
- **Commercial Invoice**: A document specifying the value of the goods and the terms of sale.
- **Certificate of Origin**: A document confirming the country of origin of the goods.
- **Insurance Policy**: A document confirming the insurance of the goods against damage or loss.

The rules for issuing, confirming, amending, and executing documentary letters of credit in international transactions are governed by the UCP 600 (Uniform Customs and Practice for Documentary Credits), published by the International Chamber of Commerce (ICC) [8]. Although these standards are customary in nature, they become binding for the parties through incorporation into the letter of credit's terms. In the absence of reference to UCP 600, the provisions of the law applicable to the letter of credit are used, which may vary depending on the jurisdiction.

American doctrine (Kozolchyk, 1994,) emphasizes the fundamental principle of "strict compliance," according to which the documents presented by the beneficiary must fully comply with the letter of credit's conditions. Even minor discrepancies, such as spelling errors, dates, or numbers, can result in the issuing bank refusing payment. This principle aims to ensure transaction security and predictability and to protect the importer's interests.

The documentary letter of credit serves a dual security function: on one hand, it guarantees the exporter will receive payment upon fulfilling strictly defined conditions; on the other hand, it protects the importer from the risk of paying for improperly delivered or non-conforming goods (del Busto, 2002).

The abstract nature of the letter of credit is manifested in that its validity and effectiveness are not dependent on the fate of the underlying contract between the importer and the exporter. In cases of non-

performance or improper performance of the underlying contract, the parties must pursue their claims through legal channels, independent of the letter of credit operation.

Despite numerous advantages, the documentary letter of credit also has certain limitations. The most significant include high costs associated with its issuance and handling, procedural formalism and rigidity, and the necessity of involving financial institutions. Consequently, alternative solutions are sought that could provide a similar level of security while reducing costs and increasing flexibility. In this context, smart contracts are attracting increasing attention.

Escrow Agreement

The escrow agreement, although lacking a uniform legal definition in international law, is a security instrument based on the universal idea of fiduciary trust, guaranteeing neutrality and safety in settlements between transaction parties. In most jurisdictions, it is founded on a fiduciary relationship whereby two parties (principals) entrust a third party (escrow agent) with funds, documents, or other assets until certain conditions are met (Jankowski, 2020). Upon fulfillment of these conditions, the escrow agent is obligated to transfer the entrusted assets to the entitled party.

Legal Nature and Application of the Escrow Agreement

The legal nature of the escrow agreement varies depending on the jurisdiction. In some legal systems, such as the United States, it is a named contract, specifically regulated by state laws (e.g., California Escrow Law). U.S. law provides for numerous types of escrow agreements, including those in real estate sales, mergers and acquisitions, and e-commerce transactions. In each case, detailed regulations specify the requirements for contract formation, the duties and liabilities of the escrow agent, and the dispute resolution process.

In other jurisdictions, including Poland, the escrow agreement is an unnamed contract shaped based on the principle of freedom of contract (Article 353^1 of the Civil Code). This means that parties have considerable freedom in shaping the contract's content, provided it complies with general principles of civil and commercial law. Nevertheless, regardless of the regulatory approach, the escrow agreement is always a contract whose validity and effectiveness depend on meeting certain legal requirements (Coffey, 2015).

Despite differences in legal interpretation, the escrow agreement possesses certain common elements that give it a universal character. These include:

- **Existence of Three Parties**: Principals (usually buyer or seller), beneficiary (the other transaction party), and escrow agent (an independent intermediary).
- **Entrusting Assets to the Escrow Agent**: Funds, documents (e.g., shares, bonds, contracts), software, data, and even passwords or access codes are handed over to the escrow agent for safekeeping until specified conditions are met.
- **Conditional Release of Assets**: The escrow agent is obliged to transfer the entrusted assets to the entitled party only after all conditions specified in the agreement are fulfilled. These conditions may include, for example, delivery of goods, performance of services, or obtaining a permit or other document.
- **Neutrality of the Escrow Agent**: The escrow agent is an independent and impartial intermediary between the transaction parties. They cannot represent the interests of any party or take actions that could harm either of them.

In international transactions, the choice of jurisdiction is crucial for determining the law applicable to the escrow agreement and resolving potential disputes. In the absence of explicit designation by the parties, conflict-of-law rules apply, such as the Rome I Regulation. An appropriate choice of jurisdiction ensures predictability and legal security for the transaction parties and facilitates the enforcement of obligations in case of non-performance.

The escrow agreement is widely used in various types of international transactions, including:

- **Mergers and Acquisitions**: Used to secure payment for the shares or interests of the acquired company.
- **Real Estate Transactions**: Secures payment for property and holds ownership documents until all transaction conditions are met.
- **E-commerce Transactions**: Secures online payments and protects the interests of buyers and sellers.
- **Settlements Between Parties Lacking Mutual Trust**: Applicable in any situation where parties wish to ensure security and neutrality in settlements.

Main Advantages of the Escrow Agreement

The escrow agreement offers several significant benefits that make it a popular solution in international transactions requiring the protection of both parties' interests. Primarily, it guarantees neutrality and security in settlements. The escrow agent, as an impartial intermediary, ensures that the funds or other assets entrusted will be released only upon fulfillment of the conditions specified in the agreement, significantly reducing the risk of non-performance. The agent's neutrality is a key element in building trust between the transaction parties, especially when there are no prior business relationships.

Another advantage is the flexibility in shaping the agreement's terms. Parties can freely tailor the contract provisions to the specifics of a given transaction, allowing for the consideration of particular needs and expectations, such as specific delivery conditions, document requirements, or timelines for fulfilling obligations. The escrow agreement can thus be used in both high-value transactions, like mergers and acquisitions, and more standard transactions, such as real estate purchases or e-commerce settlements.

This flexibility is complemented by the agreement's adaptability to various types of transactions, making it an exceptionally universal tool. The escrow agent can hold not only funds but also documents, data, and even passwords or access codes, allowing the agreement to be utilized across many different economic sectors.

Disadvantages of the Escrow Agreement

Despite its numerous advantages, the escrow agreement is not without drawbacks that may affect its efficiency and attractiveness. Primarily, it involves costs, including the escrow agent's fees for their

services. The magnitude of these costs can be significant, especially in lower-value transactions, potentially discouraging parties from choosing this form of security. These costs include both fixed fees and any additional expenses arising from the need to engage experts or specialists, impacting the total value of the transaction.

Another limitation is the potential for delays in transaction execution, which may occur in the event of disputes regarding the fulfillment of contractual conditions. If one party disputes the fulfillment of conditions, the escrow agent is obliged to withhold the release of entrusted assets until the dispute is resolved. This can lead to significant delays, which is particularly problematic in transactions requiring swift completion. Additionally, in some jurisdictions, the lack of clear regulations concerning escrow agreements can further complicate matters, causing difficulties in dispute resolution and increasing legal uncertainty for the transaction parties.

Bank Guarantee

A bank guarantee is a security instrument that plays a significant role in international trade by minimizing the risk of non-performance by one of the parties. Essentially, it is an abstract and unilateral obligation of a bank (guarantor) to pay a specified sum of money to the beneficiary of the guarantee if the guarantee applicant (usually the importer or contractor) fails to fulfill their obligation to the beneficiary (usually the exporter or principal) (Górski, 2018, p. 345) [10].

Unlike a documentary letter of credit, which is linked to a specific trade transaction, a bank guarantee can secure various types of obligations, such as payment of the price, performance of a work contract, or rectification of physical defects in goods. A bank guarantee is accessory to the main obligation, meaning its existence and validity depend on the existence and validity of the principal obligation.

Legal Framework of Bank Guarantees in International Transactions

In international transactions, the "Uniform Rules for Demand Guarantees" (URDG) published by the International Chamber of Commerce (ICC) hold particular importance. The currently applicable rules are URDG 758, which replaced the earlier URDG 458. URDG 758 constitute a set of customary rules that regulate the issuance, interpretation, and execution of bank guarantees in international transactions. They are binding on the parties if they are explicitly incorporated into the guarantee's terms. In the absence of reference to URDG, the provisions of the law applicable to the guarantee, which may vary depending on the jurisdiction, apply.

URDG 758 Standards

The URDG 758 standards play a crucial role in international bank guarantees, outlining seven key stages of a guarantee's lifecycle: drafting the guarantee, issuance, amendment of terms, presentation, examination of documentation, payment, and termination of the guarantee or counter-guarantee. Each

of these stages is regulated in detail by the respective articles of URDG 758, ensuring predictability and uniformity in international bank guarantee practices.

URDG 758 also introduce the principle of the guarantee's independence, meaning that the guarantee is an obligation independent of the underlying contract between the applicant and the beneficiary. The guarantee is executed based on the documents presented, regardless of any disputes concerning the performance of the underlying contract. This structure aims to ensure the speed and security of guarantee execution, which is particularly important in international trade, where the risk associated with contract non-performance is significantly elevated.

Common Elements and Differences in the Use of Bank Guarantees

Like an escrow agreement, a bank guarantee relies on cooperation between several parties, including the guarantor (bank), the applicant, and the beneficiary. Bank guarantees can be used for various purposes, including securing payments, executing construction projects, export or import transactions, and ensuring proper performance of contractual obligations. However, a key difference between a bank guarantee and other forms of security, such as a letter of credit, is that a bank guarantee does not require a strict connection to a specific trade transaction, making it more flexible in securing diverse obligations.

Advantages and Disadvantages of Bank Guarantees

The advantages of bank guarantees include their universality and flexibility. They can be used in various types of transactions, both commercial and investment, making them a widely used tool in international trade. Additionally, bank guarantees, as independent instruments, provide the beneficiary with security, as the bank, acting as the guarantor, is obliged to pay based on the presented documents, regardless of any claims or disputes between the parties to the underlying contract.

However, the disadvantages of bank guarantees are also significant. Primarily, these guarantees involve costs for both the applicant and the beneficiary. Banks charge fees for issuing the guarantee and for any potential confirmations, which can significantly increase transaction costs, especially in long-term projects. Moreover, the documentation requirements and the need to adhere to the stringent rules specified in URDG 758 can lead to delays and complications, especially when parties are not fully familiar with international standards concerning bank guarantees.

Other Methods

In addition to the extensively discussed letters of credit, escrow agreements, and bank guarantees, other security instruments are also used in international trade, such as standby letters of credit, insurance policies, and bills of exchange. Although they will not be analyzed in depth in this study due to space limitations, it is worth briefly mentioning them. These instruments play an important role in minimizing

risk and ensuring the security of parties in international transactions, enabling efficient and safe trade between entities from different jurisdictions.

3. Exploring the Potential of Smart Contracts in Securing International Transactions

In the previous chapters of this study, we attempted a comprehensive analysis of traditional mechanisms for securing international transactions, with particular emphasis on their legal construction and functionality under existing norms. In this chapter, we move on to explore the potential of innovative distributed ledger technology (blockchain) and smart contracts in the context of optimizing and modernizing these mechanisms. The aim is to verify the research hypothesis that the implementation of smart contracts can lead to increased efficiency, transparency, and security in international transactions, as well as contribute to cost reduction.

After an in-depth analysis of traditional mechanisms—based on obligations and shaped within contractual frameworks—we proceed to examine the potential of smart contracts in this area. This chapter is dedicated to analyzing the possibilities of implementing distributed ledger technology, particularly algorithmic contracts, into the system of international payment securities.

Initially, it's essential to refer to the previously presented common features and assumptions of security contracts and the purposes for which they are concluded. The fundamental goal of these legal instruments is to guarantee the proper performance of obligations. In international transactions, securities aim to protect the interests of both parties—the exporter, who is assured of receiving payment for delivered goods, and the importer, who is guaranteed that payment will occur only upon proper execution of the contract.

Common Features of Traditional Security Instruments

An analysis of letters of credit, escrow agreements, and bank guarantees reveals several common features significant for designing smart contracts to secure international payments:

- **Conditional Release of Payment**: In all three instruments, payment is contingent upon fulfilling specific conditions. For letters of credit, the condition is presenting documents compliant with its terms; in escrow agreements, it's fulfilling conditions specified in the contract; and in bank guarantees, it's the non-performance of the obligation by the applicant. Smart contracts can be programmed to automatically verify the fulfillment of these conditions and release payment at the appropriate moment.
- **Clearly Defined Entities Responsible for Payment**: In a letter of credit, this is the issuing bank; in an escrow agreement, the escrow agent; and in a bank guarantee, the guarantor bank. With smart contracts, it's possible to program automatic payment from the appropriate entity's account once the contract conditions are met.

- **Possibility of Recourse Against the Secured Party**: If payment from the security instrument is made and it later transpires that the secured party was not entitled to it (e.g., in the case of a bank guarantee where the applicant fulfilled their obligation), the entity that made the payment can demand its return. In a smart contract, a mechanism can be programmed to automatically generate a recourse claim in such situations.

In this context, the question arises whether smart contracts, as a modern form of contracting, can fulfill these assumptions and provide effective protection for parties in international transactions. Can the automation and algorithmization of verification and enforcement processes contribute to increased efficiency and security in international transactions?

To answer these questions, we will analyze the characteristic features of smart contracts and their potential in automating security processes. We will focus on the role of oracles in verifying the prerequisites for contract execution and address issues related to the form and content of the securing smart contract. We will also discuss the advantages and disadvantages of smart contracts compared to traditional security instruments, as well as the legal aspects related to their application in international transactions.

Due to space constraints, we will omit an exhaustive analysis of the nature and taxonomy of smart contracts. For the purposes of this study, we assume that a smart contract can function as a declaration of intent, generating an obligation and implying automatic execution upon fulfillment of all conditions defined within it.

After extensive discussions and research on the civil law essence of smart contracts, we lean toward the concept that considers a smart contract as a form of expressing the parties' mutual declarations of intent, combined with the acceptance of automatic obligation execution.

Smart contracts represent the next stage in the evolution of declaring intent and concluding contracts, offering possibilities in terms of transparency, immutability, and automation. However, they also generate interpretative challenges, such as the identification of parties, the scope of obligations, and contractual liability.

The authors believe that two approaches can be applied to the interpretation of smart contracts: the **theory of dual obligation** and the **principle of smart contract autonomy**. The first assumes that the smart contract encompasses two elements: the obligation to create it and the smart contract itself as the instrument executing that obligation. The second theory views the smart contract as an autonomous legal instrument containing all the elements of a contract.

The choice of the appropriate theory has implications for determining the scope of contractual liability. Under the dual obligation theory, liability for code defects or irregularities in the functioning of the smart contract may rest with the party responsible for its implementation. In contrast, under the principle of autonomy, liability may be more distributed.

Having analyzed the characteristic features of smart contracts, we proceed to discuss the possibilities and challenges associated with their implementation in the cross-border payment system. It is necessary

to consider the form of concluding a smart contract, establish the rules and conditions for its execution, and determine how data that dictate its functioning will be collected and interpreted. In this part of the study, we analyze key aspects of implementing smart contracts in securing international transactions, highlighting both potential benefits and challenges associated with this innovative technology.

When attempting to implement a smart contract as a security mechanism intended to replace the traditional contracts discussed in previous chapters, it is first necessary to consider the form of concluding the smart contract, establish all the rules and conditions enabling its automatic execution, and determine how data will be collected and interpreted (Hacker, 2018).

To this end, this part of the study is divided into four key thematic areas:

1. **Conclusion of the Smart Contract**: We will focus on analyzing the form of concluding a smart contract, the method of interpreting the parties' declarations of intent, and issues of contractual liability in the event of errors or irregularities in the functioning of the smart contract.
2. **Creation of the Smart Contract**: This section discusses challenges associated with properly programming the smart contract, including issues of code interpretation and its compliance with the parties' intent and the assumptions of standards concerning guarantees and other security instruments.
3. **Data Interpretation and Collection**: This part is devoted to the role of oracles in verifying the prerequisites for contract execution, as well as issues related to the security and reliability of oracles and their impact on the proper functioning of the smart contract.
4. **Dispute Resolution**: In the final section, we focus on procedures for resolving disputes related to the execution of smart contracts, including the possibility of using arbitration courts or other alternative dispute resolution methods, and the issue of establishing jurisdiction in smart contract agreements.

In each of these areas, we attempt to identify potential problems and challenges associated with implementing smart contracts in securing international transactions, as well as propose solutions to enable their effective and safe application.

In the previous section, we began the discussion on the possibilities and challenges associated with implementing smart contracts in the cross-border payment system. We now proceed to a more in-depth analysis of the form of concluding a smart contract, with particular emphasis on issues concerning the contracting parties and the mechanism for holding financial assets.

The Parties to a Smart Contract in the Context of Securing International Payments

In traditional international transactions, payment security instruments like letters of credit, escrow agreements, or bank guarantees always involve a "third party"—a financial institution or specialized intermediary (escrow agent). Their role is to ensure neutrality, the safety of funds, and expertise in handling international transactions.

In the case of smart contracts, the concept of eliminating the "third party" and directly involving the transaction parties—namely the exporter and importer—in the payment security process may arise. However, this raises questions about how funds are held and secured, as well as the potential impact on the impartiality and neutrality of the process for verifying the fulfillment of obligations.

Eliminating third parties in smart contracts securing international payments is possible but requires considering the specifics of each security instrument. For a bank guarantee, a smart contract can automate the verification and payment process, but the bank still remains a party to the contract and the guarantor of payment. In an escrow agreement, a smart contract can serve as a "digital escrow agent," holding funds and releasing them upon fulfillment of the contract conditions.

In both cases, ensuring the security of funds and transparency of the smart contract's operation is crucial. To achieve this, the following solutions can be considered:

- **Multisignature (Multisig)**: Requires the agreement of multiple parties to authorize a transaction, increasing the security of funds.
- **Smart Contract Code Audit**: An independent audit of the code can identify potential security vulnerabilities and ensure compliance with legal requirements (Harz, 2020). Balance: Dynamic Adjustment of Cryptocurrency Deposits. Workshop on Trusted Smart Contracts.
- **Smart Contract Insurance**: Insurance can protect parties from financial losses in case of improper execution of the smart contract.

When the smart contract acts as a "digital escrow agent," it is important to consider responsibility for holding the funds. In a traditional escrow agreement, this responsibility lies with the escrow agent. In the case of a smart contract, it should be clearly defined who bears responsibility for the funds held in the blockchain escrow account.

In the following section, we will focus on summarizing the potential of smart contracts in securing international payments.

Mechanism for Holding Funds in Securing Smart Contracts

In the context of eliminating the "third party" and directly involving transaction parties in securing payments via smart contracts, developing a mechanism for holding financial assets is a significant issue. The authors consider the following possibilities (Knottenbelt, 2019):

- **Deposits in Cryptocurrencies**: Parties can place funds in cryptocurrencies in a special escrow account on the blockchain network, which will be administered by the smart contract. Upon fulfillment of the contract conditions, the smart contract automatically transfers the funds to the entitled party.
- **Use of Stablecoins**: Stablecoins, i.e., cryptocurrencies with a stable value pegged to fiat currency or other assets, can minimize the risk of financial losses resulting from cryptocurrency exchange rate fluctuations.

- **Asset Tokenization**: Converting rights to assets (e.g., real estate, securities) into digital tokens allows their use as collateral in smart contracts.
- **Hybrid Solutions**: Combining smart contracts with traditional security instruments, such as bank guarantees or insurance policies, can provide greater flexibility and transaction security.

The optimal choice of a fund-holding mechanism will depend on the specifics of the transaction, the type of obligation being secured, and the preferences of the parties. In the further analysis, we will focus on the form of concluding the smart contract and the interpretation of the parties' declarations of intent.

Discussion on the Optimal Form of Concluding a Smart Contract in International Transactions

In this study, the authors lean towards the concept of **dual obligation**, which assumes a two-stage contracting process:

1. **Conclusion of the Main Contract in Traditional Form**: The parties to the international transaction (e.g., exporter and importer) conclude a main contract in which they specify the essential terms of the transaction and the rules for securing payment via a smart contract. This contract can be concluded in any form permissible for commercial agreements, such as written or electronic form, in accordance with the principle of freedom of form.
2. **Creation and Implementation of the Smart Contract**: Based on the provisions of the main contract, the smart contract is implemented. The source code of the

smartcontract, representing the digital expression of the parties' intent, defines the conditions for automatic execution of the payment.

Dual obligation in this context implies that the parties' obligations arise on two levels: initially in the traditional contract, and subsequently in the smart contract. This solution mitigates interpretative ambiguities concerning the code and ensures the primacy of the parties' intent as expressed in the main contract.

An alternative model is the direct engagement of the parties in the smart contract, bypassing the stage of concluding a traditional contract. In such a case, the parties' declarations of intent are expressed solely in the smart contract code, which may generate interpretative difficulties and potentially undermine the validity of such an obligation under Article 58 of the Polish Civil Code, which requires that a declaration of intent be understandable and unambiguous.

In the dual obligation model, it is important to ensure the smart contract's compliance with existing standards for securing international payments, such as UCP 600, URDG, or civil law principles concerning escrow agreements. In practice, the smart contract serves as an instrument for fulfilling the obligation and can be seen as the digital equivalent of traditional security instruments.

The main contract or the metadata of the smart contract should also include provisions regarding the methods for resolving any disputes related to its execution. For example, an arbitration clause can be applied, or a competent court can be designated to resolve disputes.

It should be emphasized that in the case of smart contracts, oracles play a significant role in providing the data necessary to verify the conditions for contract execution. In the next part of the article, we will discuss in detail the importance of oracles for the functioning of smart contracts.

The Essence and Functionality of Oracles in Smart Contracts Securing International Payments

Oracles, as defined in the literature, are external information sources that enable smart contracts to interact with the real world. They are an essential component of smart contract infrastructure since smart contracts themselves lack the ability to obtain data from outside the blockchain. In the context of securing international payments, oracles play a key role in verifying the conditions for contract execution by providing smart contracts with information about the occurrence of events that trigger payment execution (Buterin, 2014).

In their functionality, oracles perform the following tasks:

- **Verification of Goods Delivery**: Oracles can confirm the delivery of goods to the destination based on data from shipment tracking systems or verification of the recipient's electronic signature.
- **Confirmation of Goods Compliance with the Contract**: Oracles verify that the delivered goods meet the contract conditions, e.g., by analyzing data from sensors monitoring the shipment's condition.
- **Verification of Service Performance**: Oracles confirm the performance of services in accordance with the contract, e.g., through analysis of reports or customer feedback.
- **Determination of Exchange Rates**: In the case of payments in different currencies, oracles provide up-to-date exchange rate data from reliable sources.
- **Verification of Parties' Identities**: Oracles are used to verify the identities of transaction parties, e.g., by integrating with electronic identification systems.

The Importance of Precise Agreements Regarding Oracle Functioning

To ensure the proper functioning of a smart contract securing payments, it is necessary to precisely define the rules for oracle operation (Elliptic, 2020). The parties should agree on data sources, verification methods, and procedures for resolving any disputes related to oracle functioning. Lack of such agreements may lead to misunderstandings and conflicts between the parties, resulting in improper payment execution.

Black Boxes and Machine Learning in the Context of Oracles

To enhance the security and reliability of oracles, the use of so-called black boxes—information systems whose operation is opaque to the contract parties—is considered. Black boxes can function as data verifiers obtained from oracles and enable more advanced processing, e.g., using machine learning algorithms (Christidis, 2016).

Implementing black boxes and machine learning can bring the following benefits:

- **Increased Security**: Black boxes may be more resistant to manipulation and hacking attacks than traditional information systems.
- **Improved Data Quality**: Machine learning algorithms can help identify and eliminate erroneous or incomplete data.
- **Process Automation**: Black boxes can automatically verify and process data from oracles, speeding up transaction execution.

However, it should be noted that the use of black boxes and machine learning can also pose certain challenges:

- **Transparency Issues**: The operation of black boxes is opaque, which may make it difficult for parties to understand the data verification process.
- **Risk of Errors**: Despite their advanced nature, machine learning algorithms are not flawless and may generate errors, potentially leading to negative consequences for the transaction parties (Marx, 2018).
- **Ethical Concerns**: The use of machine learning algorithms may raise ethical issues, such as discrimination or privacy violations (Teutsch, 2021).

Autonomy and Automation of Data Processing by Oracles

Parties entering into a smart contract securing international payments must be aware that data will be processed autonomously and automatically (Tapscott & Tapscott, 2016). Once the smart contract is deployed on the blockchain network, interference in the data verification and processing by oracles becomes significantly more challenging (Szabo, 1996). Therefore, it is crucial that the parties precisely define the rules of oracle functioning before concluding the contract and implement mechanisms to safeguard against potential errors or manipulations (Raskin, 2017).

Contractual Liability in the Use of Securing Smart Contracts

In traditional security instruments like letters of credit, escrow agreements, or bank guarantees, the responsibility for proper fulfillment of obligations typically rests with a financial institution or specialized intermediary (escrow agent). In the case of smart contracts, this responsibility becomes decentralized and may be distributed among the contracting parties and, in certain situations, third parties such as code developers or blockchain platform operators.

In the context of smart contracts securing international payments, the contractual liability of the parties may encompass the following areas:

- **Providing Accurate Data**: Parties are responsible for supplying correct and complete data to the smart contract, necessary for verifying contract fulfillment. If false or incomplete information is provided, the party may be held liable for damages resulting from improper execution of the smart contract.

- **Ensuring Access to Funds**: Parties are obliged to ensure access to funds that are to be locked and unlocked by the smart contract. In the event of lack of access to funds or insufficient amounts, a party may be liable for non-performance of the obligation.
- **Proper Coding**: If one of the parties is responsible for creating the smart contract code, they bear the responsibility for its correct formulation and compliance with the parties' intent and applicable legal regulations. In case of coding errors, that party may be held liable for damages resulting from improper execution of the smart contract.
- **System Security**: The party responsible for the technical operation of the smart contract and oracles should ensure system security and protection against hacking or other threats. In the event of security breaches and resulting losses, that party may be liable for damages.

Distribution of Liability Depending on the Smart Contract Implementation Model

The allocation of responsibility among the parties to a smart contract depends closely on the chosen implementation model. In the dual obligation model, responsibility for proper coding rests with the party who created it. In the case of direct engagement in the smart contract, this responsibility may be more decentralized and distributed among the parties.

Jurisdiction and Applicable Law in the Context of Contractual Liability

In international transactions, it is fundamental to designate the governing law for the smart contract, which will determine issues of contractual liability. In the absence of an explicit choice of law by the parties, conflict-of-law rules such as the Rome I Regulation will apply.

In the previous sections, we have thoroughly discussed traditional instruments for securing international payments, such as letters of credit, escrow agreements, and bank guarantees, as well as the potential of smart contracts in this area. This fragment provides a brief introduction to the specifics of security in decentralized finance (DeFi), with particular emphasis on the elimination of intermediaries and direct payment execution.

Security in DeFi Transactions: A Study of Intermediary Elimination and Direct Payment Execution

Decentralized finance (DeFi) constitutes an alternative financial system based on distributed ledger technology (blockchain), whose essence is the elimination of intermediary institutions such as banks or financial institutions (Allen & Overy, 2021). Within the DeFi paradigm, transactions are conducted directly between users, bypassing central institutions. In this model, security is based on cryptographic and algorithmic mechanisms implemented in blockchain protocols.

The most commonly implemented security mechanisms in the DeFi ecosystem include:

- **Smart Contracts**: Self-executing agreements whose operation is based on automatic enforcement of obligations upon the fulfillment of predefined conditions (Buterin, 2014). In

DeFi, smart contracts are used to automate various processes such as lending, cryptocurrency exchange, portfolio management, or token issuance. Their main advantage is the elimination of counterparty risk and ensuring transaction transparency.

- **Consensus Protocols**: Algorithms that ensure data integrity and immutability in the blockchain network, eliminating the risk of manipulation and fraud (Nakamoto, 2008) . DeFi employs various consensus protocols, such as Proof-of-Work (PoW), Proof-of-Stake (PoS), or Delegated Proof-of-Stake (DPoS). The choice of consensus protocol affects the security, scalability, and energy efficiency of the blockchain network.
- **Voting Mechanisms**: Tools that enable network participants to partake in decision-making processes regarding protocol development and modifications (Brown & Szabó, 2020) [34]. In DeFi, voting mechanisms are often used to manage protocols and make decisions about introducing new functionalities or changes to existing ones. Voting can be conducted using governance tokens that grant holders the right to vote.
- **Security Audits**: Independent audits of smart contract source code aimed at identifying and eliminating potential security vulnerabilities (Conner et al., 2019). Security audits are an important component of DeFi security, as they help minimize the risk of hacking attacks and exploitation of code flaws.

Reputation Systems in DeFi: Perspective for Adaptation to International Transactions

In addition to the aforementioned mechanisms, DeFi also utilizes reputation systems to assess user credibility. These systems, based on blockchain technology, aggregate data on transaction history and user behavior, thereby creating a measure of their trustworthiness. This information can be used by other DeFi protocols and applications to make decisions about lending, setting credit limits, or identity verification. While we cannot delve deeply into reputation systems in DeFi due to space limitations, it is important to highlight their potential in the context of international transactions, where assessing counterparty credibility is crucial for risk minimization.

The elimination of intermediaries in DeFi has significant implications for transaction security. On one hand, it reduces the risk of abuse and manipulation by centralized institutions. On the other hand, it places greater responsibility on users for the security of their digital assets.

It should be noted that security mechanisms in DeFi are continuously evolving, with new mechanisms being implemented to enhance user security and trust. In the future, we can anticipate further development of DeFi security measures, including the implementation of advanced cryptographic methods and reputation systems. In this context, it is important to monitor the latest trends and innovations in cybersecurity and blockchain technology to provide an adequate level of protection for DeFi users.

In the previous sections of this study, we have attempted a holistic analysis of payment security instruments in international transactions, covering both traditional mechanisms like letters of credit,

escrow agreements, and bank guarantees, as well as innovative solutions based on smart contract technology. In this fragment, we will focus on summarizing the previous considerations and formulating conclusions regarding the potential of smart contracts in the context of securing international payments.

4. Conclusions: Smart Contracts as a Catalyst for the Development of International Payment Security Systems

In light of the conducted analysis, smart contracts emerge as an innovative instrument with significant potential in securing international payments. Their implementation can contribute to increased efficiency, transparency, and security of transactions, as well as reduce transaction costs. From a regulatory standpoint, there are no obstacles preventing the use of smart contracts as security mechanisms. However, it is essential to consider the specific nature of these instruments and ensure their compliance with existing legal norms, including contract law principles. In this context, it is crucial to properly formulate the main agreement, clearly specifying the parties' intent, the subject of the transaction, payment terms, and security provisions. Additionally, issues related to the interpretation and processing of data by the smart contract, as well as dispute resolution mechanisms, should be addressed.

For smart contracts, it is also important to define who will participate in the contract and how. Eliminating the "third party" (e.g., a bank) is possible but requires ensuring the security of funds and neutrality in the verification process of obligation fulfillment. In this context, mechanisms such as deposits in cryptocurrencies or stablecoins, as well as decentralized identity and reputation verification systems, should be considered.

An undeniable advantage of smart contracts is the automation of the payment security process, resulting in greater speed and efficiency compared to traditional instruments. Oracles play a key role in the functioning of smart contracts by providing the data necessary to verify the conditions for contract execution. The authors advocate for the creation of standards for developing oracles and black boxes, which would contribute to increased security and reliability of these tools. Smart contracts also offer a higher level of transparency compared to traditional security instruments. The smart contract code is publicly available, allowing anyone interested to verify its content and operating principles.

In summary, smart contracts represent a promising tool for securing international payments. Their implementation can bring numerous benefits, such as increased efficiency, speed, transparency, and transaction security. However, it is important to be mindful of the challenges associated with their implementation, including legal, technical, and ethical issues. In the future, we can expect further development of smart contracts and their increasingly widespread use in international transactions, potentially introducing significant changes in the field of international trade finance.

References

Allam, Z. (2018). On smart contracts and organisational performance: A review of smart contracts through the blockchain technology. *Review of Economic and Business Studies*

Beck, R., Czepluch, J. S., Lollike, N., & Malone, S. (2016). Blockchain-the gateway to trust-free cryptographic transactions. In ECIS

Buterin, V. (2014). *A Next-Generation Smart Contract and Decentralized Application Platform.* Retrivered from https://ethereum.org/en/whitepaper/

Christidis, K., & Devetsikiotis, M. (2016). Blockchains and Smart Contracts for the Internet of Things. IEEE Access, 4, 2292-2303

Elliptic. (2020). *The Oracle Problem: How Can Smart Contracts Reach Out to the Real World?* Retrieved from https://www.elliptic.co/blog/the-oracle-problem-how-can-smart-contracts-reach-out-to-the-real-worl

Hacker. (2018). Smart contracts: A smart way to automate performance. Georgia Law Review.

Harz, G. G. (2020). Balance: Dynamic Adjustment of Cryptocurrency Deposits. Workshop on Trusted Smart Contracts.

Knottenbelt, Z. &. (2019). XCLAIM: Trustless, Interoperable Cryptocurrency-Backed Assets. IEEE Symposium on Security and Privacy.

Marx, D., & Chli, M. (2018, June). On the Security of Oracles for Smart Contracts. In UK Workshop on Cyber Security (UKWCS) (p. 8)

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System

Oelofse, A. N. The Law of Documentary Letters of Credit in Comparative Perspective / A.N. Oelofse. Interlegal, 1997

Raskin, M. (2017). The Law and Legality of Smart Contracts. Georgetown Law Technology Review, 1(2)

Szabo, N. (1996). Smart contracts: building blocks for digital markets. *EXTROPY: The Journal of Transhumanist Thought* (16), 18-26.

Tapscott. (2020). Financial services: Building blockchain one block at a time. Financial Times.

Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: how the technology behind bitcoin is changing money, business, and the world. Penguin.

Teutsch, J., & Masmej, A. (2021). Oracles: The State of the Art and Future Directions. Chainlink. Retrieved from https://research.chain.link/whitepaper-v2.pdf.

2.5. The Analysis of Digital Payment System: the Use Cases of Blockchain, How it Influences the Financial Trends, and Future Trends - Krisada Khruachalee, Praveen Maiget and Kanyanut Suriyan

THE AUTHORS

Krisada Khruachalee

Praveen Maigate

Kanyanut Suriyan

The Analysis of Digital Payment System: the Use Cases of Blockchain, How It Influences the Financial Practices, and Future Trends

Krisada Khruachalee Praveen Maiget Kanyanut Suriyan

krisadak@siamtechno.ac.th praveenm@siamtechno.ac.th kunyanuts@siamtechno.ac.th

Siam Technology College, Bangkok, Thailand

Abstract

Digital payment systems have played a significant role among tech-savvy communities globally, including in Thailand, as they offer both convenience and secure transactions. Amidst the rise of digital payments, blockchain emerges as a solution that provides transparency, thereby reducing fraud in financial processes. Unfortunately, the general public in Thailand still has a limited understanding of blockchain technology. This lack of knowledge can slow down adoption and lead to resistance from traditional industries. To accelerate awareness, this research aims at analyzing the current digital payment trends and predicting the next wave of trends to come. To achieve this goal, we employed thematic analysis with in-depth interviews from three different groups – IT experts from the banking industry, daily end-users, and SMEs entrepreneurs. The results have shown that the current digital trends are expected to reach all regions across Thailand, not only in the city parts, but including the rural areas as well. The most popular applications integrated with blockchain technology are PromptPay, TrueMoney, and Project Inthanon. As businesses in Thailand increasingly implement digital payment methods, even in small establishments such as street food vendors, there is a growing likelihood that Thai society will become more aware of and embrace digital transaction practices with open arms. However, a significant challenge is the evolving regulatory environment around blockchain in Thailand. The legal system may not yet be fully equipped to handle disputes and issues arising from blockchain technology. Additionally, businesses and individuals may encounter difficulties in complying with anti-money laundering and know-your-customer regulations, potentially leading to legal complications.

Keyword: Digital Payment Systems, Blockchain, Transparency, Financial Practices

1. Introduction

The rapid expansion of digital payment systems has significantly transformed global transactions, including those in Thailand. The use of digital payment systems in Thailand has witnessed remarkable growth in recent years, driven by a combination of government-led initiatives and a growing consumer preference for cashless transactions [1]. The Thai government has been actively promoting a cashless economy as part of its national agenda, launching policies and campaigns to encourage the adoption of digital payments. Key initiatives, such as the National e-Payment Master Plan, have aimed to reduce reliance on cash, enhance financial inclusion, and improve economic efficiency by promoting the use of digital payment platforms. Launched in 2016, PromptPay has become one of the most widely used platforms in Thailand [2]. It allows individuals to transfer money using their citizen ID, mobile number, or bank account number, making financial transactions more accessible and user-friendly. PromptPay's key advantage lies

in its low transaction fees compared to traditional banking methods [2][3], which has made it particularly popular among users of all demographic groups. By December 2021, PromptPay had over 57 million users and had processed more than 9 billion transactions, highlighting its significant impact on the country's payment ecosystem [4]. The Thai QR code system, introduced in 2017, further revolutionized the digital payment landscape by enabling seamless, real-time domestic and cross-border transactions. The system is based on a standardized format that can be used across different banks and payment providers, making it easy for merchants to accept payments from a wide range of customers, both locally and internationally. This has significantly enhanced the convenience of digital payments for merchants, particularly small and medium-sized enterprises (SMEs), who now benefit from simplified payment processing and lower transaction costs. Consumers, on the other hand, enjoy the flexibility and ease of making payments by simply scanning a QR code with their mobile banking apps.

In addition to these government-backed systems, private sector e-wallets such as True Money, LINE Pay, and Shopee Pay have gained considerable traction. These platforms offer a range of services beyond simple money transfers, including mobile top-ups, bill payments, online shopping, and peer-to-peer transactions. Their rapid growth can be attributed to their convenience, user-friendly interfaces, and integration with popular retail and online platforms. Furthermore, these e-wallets often attract users through promotions, discounts, and cashback offers, making them particularly appealing to younger, tech-savvy consumers [5].

However, public awareness and acceptance of blockchain technology integrated in the digital payment system in Thailand remain relatively limited [6]. At the national level, the integration of blockchain technology into Thailand’s digital payment system is still in its early stages, but significant strides have been made in both the public and private sectors. The Thai government, through institutions like the Bank of Thailand (BOT), has been actively exploring blockchain applications, particularly in large-scale financial systems. One of the most notable projects is “Project Inthanon”, which aims to create a Central Bank Digital Currency (CBDC) using blockchain. This initiative seeks to enhance efficiency in interbank settlements and cross-border payments, reducing processing times and costs while ensuring greater transparency and security. The BOT has also partnered with the Hong Kong Monetary Authority (HKMA) to develop a blockchain-based cross-border payment platform, indicating a growing interest in using this technology for international financial transactions.

In the private sector, several Thai companies are experimenting with blockchain technology to improve payment processes. For instance, Siam Commercial Bank (SCB) has collaborated with Ripple, a global blockchain-based payment provider, to facilitate faster and more cost-efficient cross-border remittances. Other major corporations, such as The Siam Cement Group (SCG) and PTT, are using blockchain for procurement and energy trading, which indirectly integrates blockchain into payment systems by optimizing financial transactions between businesses.

While blockchain adoption is advancing in specific areas, it has yet to become mainstream in everyday retail and consumer payments, as platforms like PromptPay and e-wallets remain more widely used due to their simplicity and established infrastructure. The future potential for blockchain in Thailand’s payment ecosystem remains promising, but full integration will likely depend on addressing scalability, regulatory clarity, and public trust issues.

Given these challenges, this research aims to address the existing knowledge gap by analyzing current trends in digital payment systems and examining the potential impact of blockchain technology on financial practices in Thailand. The study adopts a mixed-method

approach, integrating thematic analysis with in-depth interviews conducted with three key stakeholder groups: IT experts from the banking sector, daily end-users, and SME entrepreneurs. By gathering insights from these diverse perspectives, the research seeks to offer a comprehensive understanding of the present state and future direction of digital payments and blockchain adoption in Thailand.

2. Literature Review

Blockchain technology has emerged as a groundbreaking solution in today's financial landscape. As global transactions increasingly shift towards digital platforms, concerns over fraud, inefficiency, and lack of accountability have grown. Blockchain addresses these issues by decentralizing the process and creating an immutable and transparent ledger. Each transaction is recorded on a block, validated by a network of computers, and linked to the previous block in a chain, ensuring that once a transaction is made, it cannot be altered. The decentralized nature of blockchain eliminates the need for intermediaries, reducing both transaction time and cost. Furthermore, its transparency allows all participants in the network to view the transaction history, making it nearly impossible to engage in fraudulent activities without detection. In the digital payment sector, this level of security and transparency offers immense benefits, including enhanced trust between parties and reduced risk of manipulation. This study highlights how blockchain can serve as a key driver in transforming financial systems, offering a future where trust is embedded into the infrastructure of transactions, paving the way for a more secure and efficient global financial system.

Table 1: Comparative Study of Blockchain for Financial Processes and Digital Payments.

Research	BC platform	Conceptual	Relevance of financial and digital payments
Javaid, M. et al. (2022).[7]	General Blockchain	Discusses blockchain use in financial services for security and transparency.	Enhances transaction security, reduces costs, and improves transparency in digital payments.
Haque, M. M. et al.(2022). [8]	*Ethereum*	Proposes a decentralized payment system for fuel stations.	Improves efficiency and security of fuel station payments, reducing fraud and costs.
Amponsah, A. A. et al. (2022).[9]	Cloud-based Blockchain	Improves financial security for National Health Insurance using blockchain.	Secures insurance payments and prevents fraud through smart contracts and decentralized systems.
Alenizi, A. et al. (2024).[10]	Integrated Blockchain with AI	Enhances secure financial transactions by integrating blockchain with AI.	Protects digital payment systems by improving data

Research	BC platform	Conceptual	Relevance of financial and digital payments
			security and detecting suspicious activity.
Dashkevich, N. et al. (2020).[11]	DLT (Distributed Ledger Technology)	Systematic mapping of blockchain applications in central banks, especially for Central Bank Digital Currencies (CBDC).	Emphasizes the role of CBDCs and regulatory compliance in improving financial operations in central banks
Fachrian, M. A. et al. (2024).[12]	Ethereum & IPFS	Decentralized storage of payment records using blockchain and IPFS for enhanced security.	Secures digital payments and prevents fraud through decentralized transaction record storage.
Sethaput, V. et al. (2021).[13]	Distributed Ledger Technology	Focuses on CBDCs and their use in wholesale payment systems and cross-border transactions.	Supports the development of secure digital currencies by central banks for improving financial stability .
Haque, M. M. et al. (2022).[14]	Ethereum	Proposes a decentralized payment system for vehicle fuel filling stations.	Enhances payment security and efficiency by using decentralized digital wallets without third-party involvement
Amponsah, A. A. et al. (2022).[15]	Cloud-based Blockchain	Applies blockchain to improve the financial security of National Health Insurance by preventing fraud.	Ensures secure financial transactions in health insurance through decentralized systems.
Alenizi, A. et al. (2024).[16]	Integrated Blockchain with AI	Proposes the integration of AI with blockchain to enhance secure financial transactions.	Detects suspicious activity in financial systems and enhances data protection for digital payments.

3. Research Methodology

This study consists of two main phases. The first phase involved data collection through in-depth interviews. This interview was designed to gather diverse attitudes and perspectives regarding the effective and appropriate attributes of blockchain technology in digital payment systems, its

impact on financial practices, and potential future trends of its adoption. The second phase focused on analyzing the collected data using thematic analysis to identify key influences on the integration of blockchain into financial systems and its implications for the broader financial landscape.

Phase 1: Data Collection Methods

Step 1: We purposively selected three groups of participants to provide a comprehensive understanding of blockchain technology in digital payment systems from different perspectives. The groups included:

1. IT experts from the banking industry, who have specialized knowledge and experience in the technical aspects and security concerns of blockchain implementation.
2. daily end-users, representing the general public's attitudes, behaviors, and expectations towards using blockchain in digital payments.
3. SME entrepreneurs, who provided insights on how blockchain could impact small and medium-sized businesses, particularly in terms of cost-efficiency, ease of use, and scalability for business transactions.

The number of key informants used for interviews is not predetermined by a fixed structure but is instead shaped by the nature of the study and the need to gather rich, in-depth data. In this research, we consider the saturation point—the stage at which additional interviews no longer provide new insights or themes [17], [18]. In this study, a smaller group of informants (including IT experts, end-users, and SME entrepreneurs) was purposefully selected to allow for more focused, detailed interviews that captured diverse perspectives relevant to blockchain and digital payments. This approach ensures that the data collected is both meaningful and nuanced, facilitating a deeper and more comprehensive analysis of the subject.

Step 2: We conducted in-depth interviews with each participant to gather detailed insights into their experiences, perspectives, and practical use cases of blockchain technology within the digital payment system. The interviews also explored how blockchain influences financial practices, focusing on security, transparency, and transaction efficiency. Additionally, participants were asked to provide their views on the future trends of blockchain adoption in the financial sector, including potential challenges and opportunities for further integration. Each interview was designed to capture both individual and group-specific insights to ensure a well-rounded analysis of blockchain's current and future impact on digital payments.

Phase 2: Data Analysis Methods

We applied thematic analysis [19] to identify and examine recurring patterns or themes within the data collected from the in-depth interviews. The process began with familiarization, where we transcribed the interviews and thoroughly reviewed the data to gain an in-depth understanding of the content. This initial phase helped us to immerse ourselves in the data and recognize potential areas of interest related to the research objectives. Next, we systematically coded the data by identifying key segments related to the influence of blockchain technology. This coding process enabled us to categorize and label important parts of the data for further analysis. Following the coding, we grouped similar codes into broader themes during the theme development phase. These themes captured the underlying patterns across participants' responses and reflected the most significant issues related to blockchain’s impact on digital payments. We then reviewed and refined the themes to ensure that they accurately represented the data and

provided a comprehensive view of the diverse perspectives shared by IT experts, end-users, and SME entrepreneurs. This step was crucial to ensure that the themes were coherent, distinct, and truly reflective of the participants' insights. Finally, we defined and named the themes, creating a coherent narrative that aligned with the objectives of the research. The final report presents the themes in a structured manner, offering practical insights and recommendations for the analysis of digital payment systems, the use cases of blockchain technology, its influence on financial practices, and future trends in adoption.

4. Research Findings

Phase 1: Data Collected

4.1 The Use of Blockchain Technology

Based on interviews with five key informants from the banking industry, Figure 1, we found that, from a technical perspective, the informants focused on the challenges of integrating blockchain with existing banking infrastructure. Blockchain is a decentralized technology, which contrasts with traditional banking systems that are centralized. This disparity requires careful consideration to ensure blockchain can be incorporated without disrupting current processes. Interoperability between blockchain and legacy systems is a critical challenge, as banks rely on highly secure and regulated systems for financial transactions. The IT experts from the banking industry also highlighted scalability issues, noting that blockchain—particularly public networks—can struggle with processing large volumes of transactions quickly. High transaction volumes, which are common in banking, can lead to slower processing times and increased costs if the blockchain network lacks the necessary capacity.

In terms of security concerns, the informants highlighted both the strengths and vulnerabilities of blockchain technology. Blockchain is often praised for its transparency, immutability, and cryptographic security, which can reduce fraud and enhance the integrity of financial data. However, they also pointed to the risks of smart contract vulnerabilities, where bugs in the contract code could be exploited, potentially leading to financial losses or data breaches. Additionally, the threat of 51% attacks—where a single entity gains majority control of the blockchain network—remains a concern, particularly for smaller blockchains. The experts emphasized the importance of secure consensus mechanisms, such as Proof of Work or Proof of Stake, to mitigate these risks. Moreover, data privacy is a significant concern when implementing blockchain in the banking sector. While blockchain offers transparency, financial institutions must ensure that sensitive customer data is protected and compliant with privacy regulations such as the GDPR or Thailand's Personal Data Protection Act (PDPA). The experts discussed the need for permissioned (private) blockchains, which provide controlled access to participants and balance the transparency of blockchain with the privacy requirements of financial data.

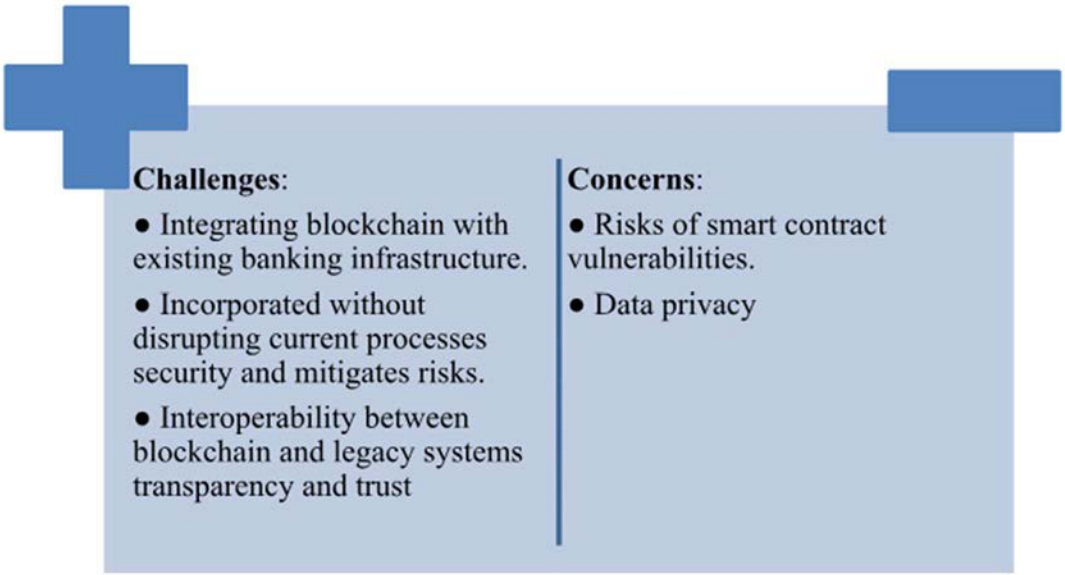


Figure 1: Challenges and Concern from Informants in Banking Industry

Based on interviews with eight key informants who are daily end-users, Figure 2, we found that many users express curiosity and interest in blockchain technology, particularly due to its association with increased security and transparency. They might appreciate the potential for blockchain to reduce fraud in digital payments by making transactions traceable and immutable. However, while the general public is aware of these benefits, there is often a significant knowledge gap regarding how blockchain actually works. This lack of understanding can lead to hesitation in adoption.

Daily end-users may also expect blockchain to improve the speed of cross-border transactions and reduce transaction fees, particularly for international transfers, a pain point that blockchain has the potential to address effectively. On the other hand, skepticism and concerns about blockchain's complexity, usability, and the perceived risks associated with cryptocurrencies—often closely linked to blockchain—are likely to be prevalent. Many end-users might worry about data privacy and how personal financial information is stored and shared on blockchain networks. Furthermore, due to the current unfamiliarity with blockchain-based payment platforms, users may prefer to stick with more traditional digital payment systems such as mobile banking, QR code payments, or e-wallets, which they find more user-friendly and accessible. Ultimately, while users see the potential advantages of blockchain in digital payments, broader education, simpler user interfaces, and clearer regulatory frameworks will be key to addressing their concerns and encouraging more widespread adoption.

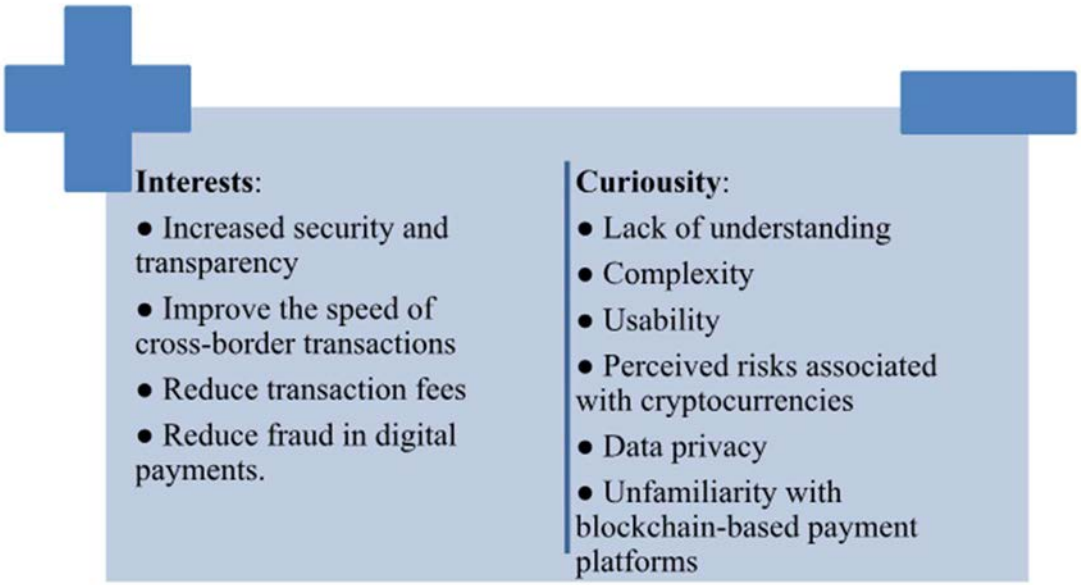


Figure 2: Interests and Curiosity of Informants as a Daily End-Users

Based on interviews with four key informants who are SME entrepreneurs, Figure 3, the informants recognized the potential cost-efficiency of blockchain, particularly in reducing transaction fees and eliminating the need for intermediaries in financial transactions. Blockchain can enable peer-to-peer payments, which could significantly lower costs for SMEs, especially for cross-border transactions that typically involve higher fees through traditional banking systems. Additionally, the use of smart contracts on blockchain platforms can automate processes like invoicing and payment settlements, reducing administrative overhead and improving cash flow management. Entrepreneurs also highlighted how blockchain could help cut costs related to fraud and security breaches, as the technology provides an immutable ledger that makes tampering with records more difficult.

However, in terms of ease of use, the informants expressed concerns about the technical complexity of blockchain systems. Many SMEs operate with limited IT infrastructure, and the need for specialized knowledge to implement and manage blockchain solutions could pose a barrier to adoption. Entrepreneurs might expect blockchain platforms tailored for SMEs to offer more user-friendly interfaces and simplified processes to make integration seamless. Additionally, SMEs would prefer blockchain solutions that can easily integrate with their existing systems without disrupting daily operations. Regarding scalability, SME entrepreneurs see blockchain as a promising technology that can grow with their businesses. As small businesses expand, blockchain's ability to handle increasing transaction volumes without compromising security could be a significant advantage. However, concerns about the scalability of public blockchains, which may suffer from slower transaction speeds as networks grow, were raised. The informants expressed a preference for private or consortium blockchains that offer faster processing times and greater control over transaction management while maintaining the core benefits of security and transparency.

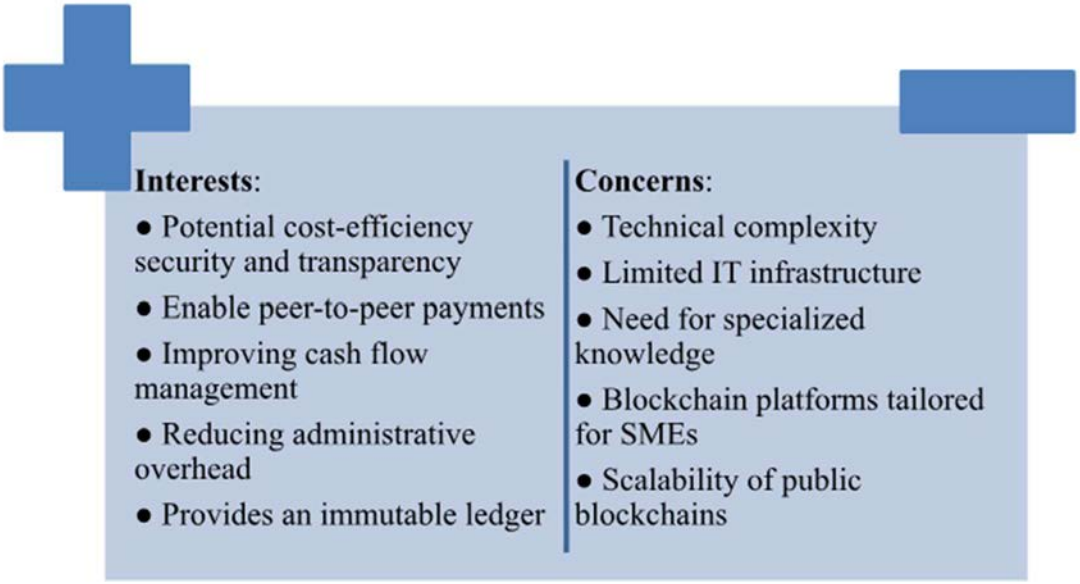


Figure 3: Challenges and Concern from Informants in Banking Industry

4.2 How it Influences the Financial Practices

Blockchain technology is gaining momentum in the financial industry due to several driving factors. The demand for greater efficiency, cost reduction, and enhanced transparency in transactions is one of the key motivators for adoption. Additionally, blockchain offers solutions for mitigating risks associated with fraud and money laundering, which are major concerns in the financial sector. Competition within the industry is another driving force, as financial institutions seek to differentiate themselves by leveraging innovative technologies. Furthermore, blockchain opens up opportunities to create new financial products and services, with increasing support from government bodies and regulatory frameworks. However, there are several hindrances to widespread blockchain adoption. Data security and privacy concerns remain significant, as blockchain's distributed ledger nature raises questions about the handling of sensitive information. Additionally, the lack of clear regulations creates uncertainty for companies looking to implement blockchain solutions. High costs associated with investing in infrastructure and developing blockchain-based systems also pose challenges, particularly for smaller institutions. Lastly, a shortage of skilled personnel and the knowledge required to effectively manage blockchain technology further complicates its adoption in the financial industry.

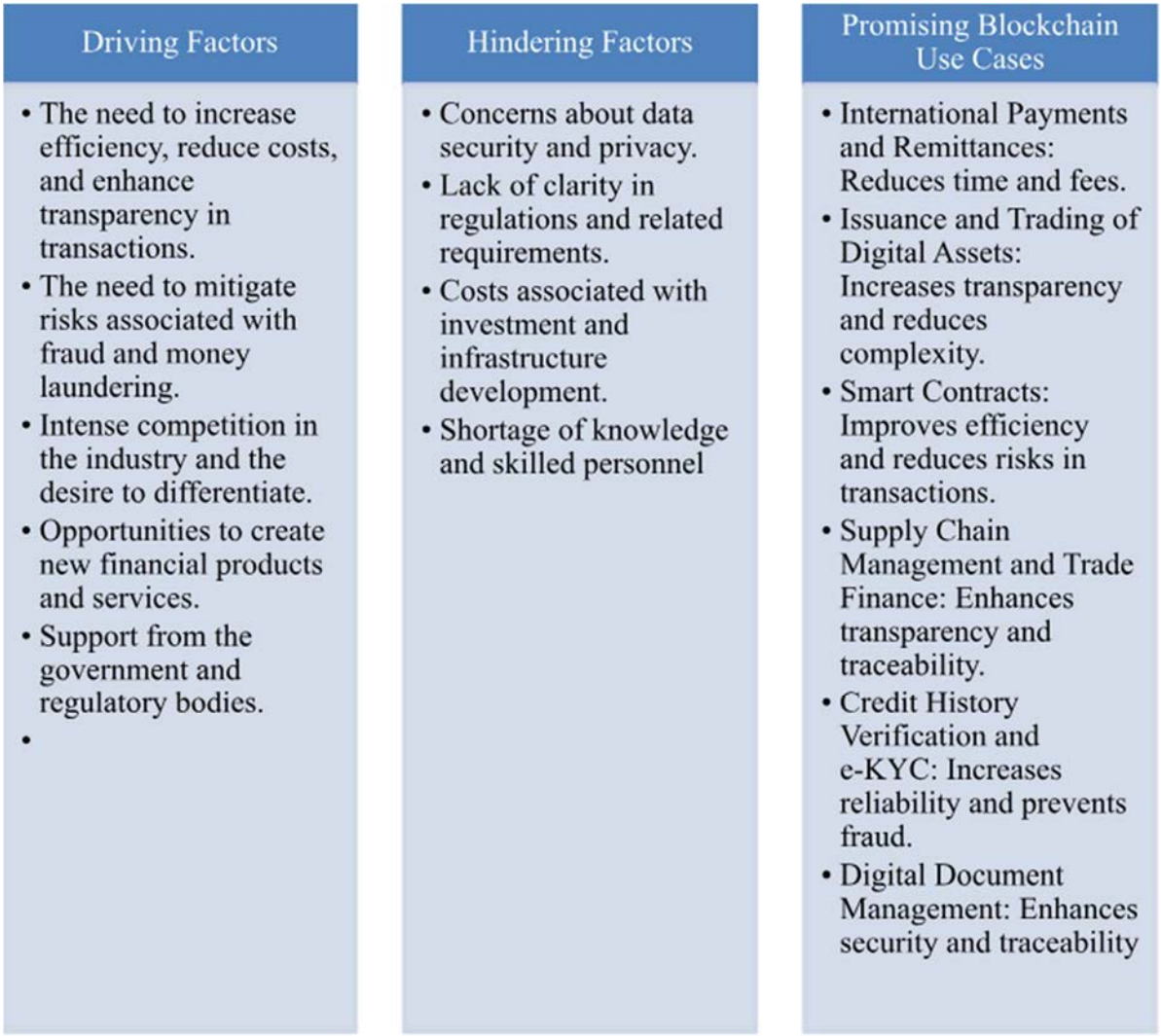


Figure 4: Factors Influencing Blockchain Adoption in the Financial Industry

Despite these challenges, blockchain presents several promising use cases within the financial sector. It can revolutionize international payments and remittances by reducing time and fees, while also simplifying the issuance and trading of digital assets. Blockchain enables the use of smart contracts, which increase efficiency and minimize risks in various transactions. It also enhances transparency and traceability in supply chain management and trade finance. In areas such as credit history verification and digital document management, blockchain can improve reliability and security, reducing fraud and ensuring better compliance with e-KYC standards. Blockchain's impact on traditional financial practices is substantial, particularly in reducing intermediaries' roles, automating processes, cutting costs, and creating new opportunities for innovation in financial services.

Considering the influence on traditional financial practices of the blockchain technology, Figure 5, we found that one of the most transformative aspects of blockchain is its ability to enable direct peer-to-peer transactions without the need for intermediaries, such as banks or payment processors. In traditional financial systems, intermediaries are necessary to validate transactions, which adds layers of cost, time, and potential points of failure. Blockchain

technology, through its decentralized ledger, removes this dependency. By allowing parties to transact directly, blockchain reduces the reliance on third parties, thus streamlining the process. This has significant implications for industries like banking, where the elimination of intermediaries can lead to faster transactions and lower fees, particularly for cross-border payments.

In addition, blockchain has the potential to automate many aspects of financial processes, which enhances efficiency and reduces costs. For instance, smart contracts—self-executing contracts with the terms of the agreement directly written into code—automate processes such as settlement and verification without the need for manual intervention. This eliminates unnecessary steps, reduces human error, and speeds up transaction times. In traditional systems, processes like clearing and settlement can take several days and involve numerous checks. Blockchain's ability to execute these steps in real-time minimizes both time and cost, which is especially beneficial in high-volume sectors like securities trading and remittances.

Additionally, blockchain's decentralized and immutable ledger creates a single source of truth that is accessible to all participants in the network. Every transaction is recorded in a block and linked to the previous one, creating a transparent chain of events that cannot be altered once it's been validated. This transparency enhances trust among participants, as all parties can verify the authenticity of transactions without relying on a central authority. This is especially critical in sectors where trust is paramount, such as auditing and regulatory compliance, as it reduces the potential for fraud and manipulation. The immutable nature of blockchain records ensures that financial transactions are transparent and traceable, making the system inherently more secure and reliable.

Moreover, blockchain is opening doors to the creation of innovative financial products and services that were not possible in traditional financial systems. For example, decentralized finance (DeFi) platforms are built on blockchain to offer financial services such as lending, borrowing, and trading without the need for traditional banks. These platforms operate using smart contracts, providing greater access to financial services for underserved populations who may not have access to traditional banking systems. Additionally, blockchain facilitates the creation of tokenized assets, where real-world assets like real estate or stocks can be represented on the blockchain and traded more efficiently. This democratizes access to investment opportunities and allows for fractional ownership, creating new financial models and increasing liquidity in markets.

Considering the benefits of integrating blockchain into banking systems, Figure 6, blockchain technology streamlines financial transactions by eliminating the need for intermediaries such as banks or payment processors. By enabling direct peer-to-peer transactions and automating processes through smart contracts, blockchain reduces the time and resources required for transaction processing. This leads to lower operational costs and increased efficiency for businesses and consumers alike. Automated verification and settlement processes minimize human error and accelerate transaction times, which is particularly beneficial for high-volume transactions and cross-border payments.

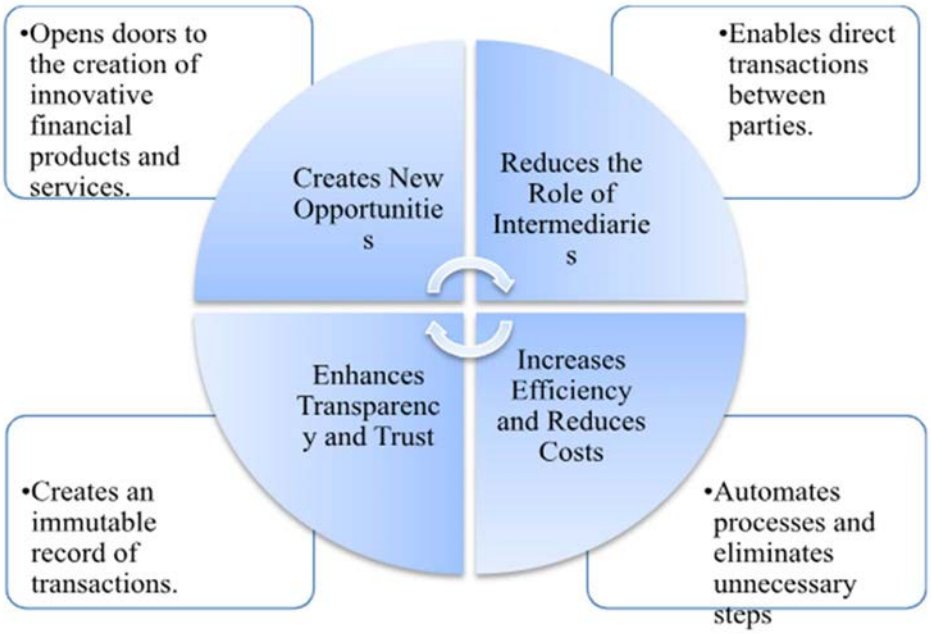


Figure 5: Blockchain's Influence on Traditional Financial Practices

In addition, the decentralized and cryptographic nature of blockchain provides robust security features that protect against fraud and unauthorized activities. Each transaction is encrypted and linked to the previous one, creating an immutable ledger that is nearly impossible to alter without consensus from the network. This reduces the risk of data tampering, double-spending, and other fraudulent activities. Additionally, blockchain's distributed network means there is no single point of failure, making it more resilient against cyberattacks compared to traditional centralized systems.

Additionally, blockchain's transparent ledger allows all authorized participants to view and verify transactions in real-time. This openness fosters trust among users, as it ensures that all transactions are recorded accurately and cannot be manipulated. In financial practices, this transparency enhances accountability and compliance, as regulators and stakeholders can audit transactions easily. The immutable nature of blockchain records builds confidence among parties, facilitating smoother business relationships and reducing the need for extensive due diligence.

Moreover, blockchain technology enables the development of innovative financial products and services that were not feasible with traditional systems. Examples include decentralized finance (DeFi) platforms, which offer services like lending, borrowing, and trading without intermediaries. Tokenization of assets allows for fractional ownership and easier transfer of real-world assets like real estate or commodities. These innovations can expand access to financial services, unlock new revenue streams, and cater to underserved markets by lowering barriers to entry.

Figure 6: Benefits and Challenges of Integrating Blockchain into Banking Systems

Furthermore, early adopters of blockchain technology can gain a significant edge over competitors by offering enhanced services that are more efficient, secure, and customer-centric. Implementing blockchain can lead to cost savings, faster transaction times, and improved customer trust—all of which contribute to a stronger market position. Businesses that leverage blockchain may also be perceived as innovators, attracting customers who value cutting-edge solutions and potentially opening up new market segments.

4.3 Challenges of Integrating Blockchain into Banking Systems

Considering the challenges of integrating blockchain into banking systems, integrating blockchain technology into existing financial infrastructures can be complex and costly. Legacy systems may not be compatible with blockchain platforms, requiring substantial overhauls or the development of new interfaces. This adaptation necessitates significant investment in technology and training, and may disrupt ongoing operations during the transition period. Organizations must carefully plan and execute integration strategies to minimize disruption and ensure seamless adoption.

In addition, while blockchain offers enhanced security features, it also introduces new vulnerabilities. Smart contracts, for instance, can contain coding errors that hackers might exploit. Additionally, the transparency of blockchain transactions may conflict with privacy requirements, as sensitive information could become accessible to unauthorized parties. Organizations must implement robust security protocols and consider using permissioned or private blockchains to protect confidential data and comply with regulations like GDPR or Thailand's Personal Data Protection Act (PDPA). Additionally, the complexity of blockchain technology can lead to a lack of understanding and skepticism among businesses, consumers, and regulators. Misconceptions about blockchain, often associated with cryptocurrencies and their volatility, may hinder trust and acceptance. Educating stakeholders about the practical benefits and addressing concerns through clear communication and demonstrations of successful use cases are essential steps toward building confidence in the technology.

Moreover, the regulatory environment surrounding blockchain is still evolving, with many jurisdictions lacking clear guidelines. Organizations may face uncertainty regarding legal obligations, compliance standards, and the potential for future regulatory changes. This ambiguity can deter investment and innovation, as businesses may be cautious about deploying resources without assurance of compliance. Engaging with regulators and participating in the development of policies can help organizations stay ahead of regulatory challenges. Furthermore, the absence of specific regulations for blockchain technology creates challenges in its adoption. Without regulatory clarity, businesses risk non-compliance with existing laws or future regulations that could impact their operations. Clear and supportive regulatory frameworks are needed to provide guidance on issues such as data privacy, security standards, and legal recognition of blockchain transactions. Advocacy and collaboration with policymakers can assist in shaping regulations that facilitate innovation while protecting stakeholders.

Lastly, scalability remains a significant hurdle for blockchain networks, especially public ones like Bitcoin or Ethereum. As the number of users and transactions increases, these networks can experience congestion, leading to slower transaction times and higher fees. Such limitations make it difficult for blockchain to handle the high transaction volumes typical in mainstream financial systems. Developing solutions such as layer-two protocols, sharding, or adopting more scalable blockchain platforms is crucial to overcome these challenges and enable widespread adoption.

4.4 The Future Trends of the Blockchain Technology with Digital Payment System

The future of blockchain technology in Thailand's digital payment system, as seen by IT experts from the banking industry, centers around its technical robustness and security. These experts emphasize that blockchain's decentralized nature provides enhanced security by reducing the risks of fraud and hacking. They also highlight its potential to improve transaction speed and reduce costs, though they caution that scalability and integration with existing banking systems remain technical challenges. They foresee blockchain playing a critical role in future banking infrastructure, but stress the need for stringent security protocols to protect sensitive financial data.

From the perspective of daily end-users, the general public views blockchain as a promising yet unfamiliar technology. Many are optimistic about its potential to simplify digital payments by offering faster transactions and lower fees. However, there are concerns about ease of use, as users expect intuitive platforms with minimal technical complexity. Meanwhile, SME entrepreneurs see blockchain as a valuable tool for increasing cost-efficiency and transparency in business transactions. They believe that blockchain could streamline payment processes, especially for cross-border transactions, reducing reliance on third-party intermediaries. However, they emphasize that for blockchain to be widely adopted among SMEs, it must be affordable, scalable, and easy to integrate with existing business operations.

Generally, all participants believe that digital payments and blockchain will play a crucial role in the future of the Thai financial industry. They will help increase efficiency, reduce costs, and create new opportunities. However, widespread adoption of these technologies requires addressing various challenges related to regulations, infrastructure, and building understanding. From the perspectives of these four experts, it is evident that blockchain technology and digital payment systems have the potential to significantly transform the financial landscape in Thailand. While there are challenges to overcome, the potential benefits are immense. Preparedness and

adaptation to these new technologies will be key factors for those who wish to survive and thrive in this digital era.

4.5 The thematic analysis of the multifaceted aspects of digital payment systems and blockchain adoption in Thailand

Based on the thematic analysis in the study, Figure 7, several key themes and subthemes emerged from the data collected through interviews with IT experts, daily end-users, and SME entrepreneurs. These themes reflect the current state and future potential of digital payment systems and blockchain adoption in Thailand.

Theme 1: Blockchain's Role in Enhancing Efficiency and Reducing Costs

Blockchain technology is recognized as a key enabler of cost efficiency and operational improvement in financial transactions. From the interviews with IT experts and SME entrepreneurs, blockchain's capability to reduce reliance on intermediaries (such as banks and payment processors) emerged as a pivotal factor. This not only cuts down transaction fees but also accelerates transaction times, making it a more attractive option for cross-border payments, where traditional banking systems often incur high fees and take several days to process.

Subtheme: Elimination of Intermediaries – Blockchain's decentralized nature allows for peer-to-peer transactions. This removes the need for third-party validation and the costs associated with it. For SMEs in particular, this means reducing the financial burden and friction in international trade, where currency exchanges and intermediary fees are often prohibitive. Entrepreneurs in your study noted that blockchain's peer-to-peer model could provide a lifeline for small businesses engaged in cross-border trade, reducing transaction fees and delays.

Subtheme: Automation of Processes – Smart contracts, a crucial blockchain feature, enable the automation of various financial processes, such as invoicing, payments, and settlement of agreements. The reduction in manual intervention not only decreases the administrative workload but also mitigates human error, resulting in greater accuracy and improved cash flow management. This is particularly beneficial for SMEs, which often operate with limited financial and human resources. IT experts interviewed underscored how automating repetitive tasks can speed up business processes, thereby reducing operational costs.

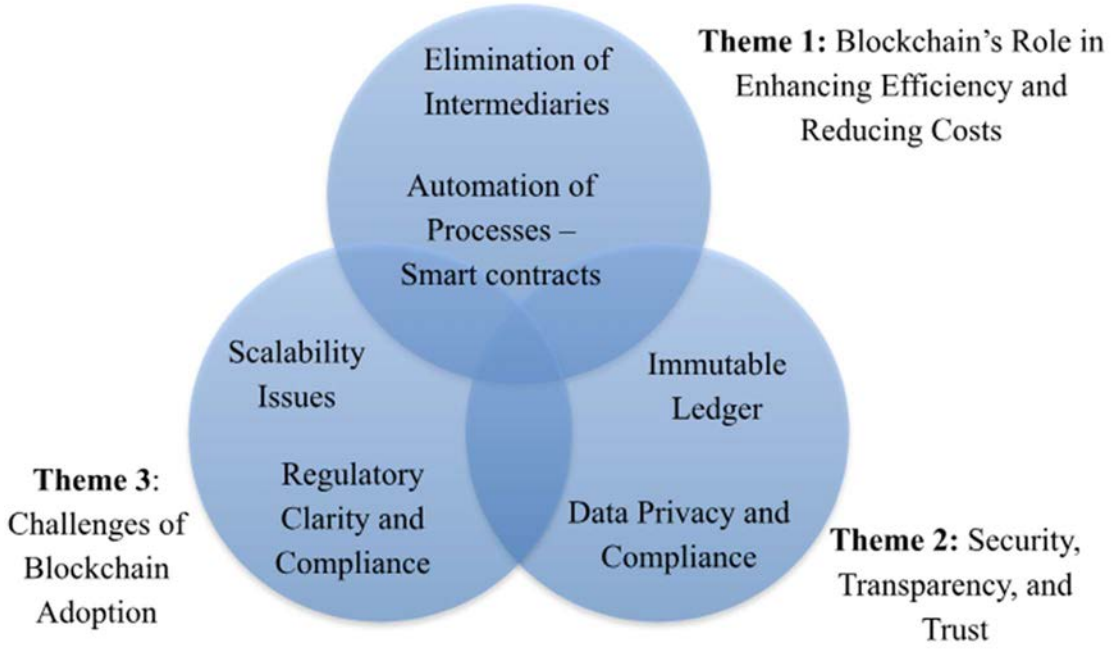


Figure 7: The thematic analysis of the multifaceted aspects of digital payment systems and blockchain adoption in Thailand

Theme 2: Security, Transparency, and Trust

Blockchain's ability to offer unparalleled transparency and security is another recurring theme. Trust is embedded within blockchain's infrastructure due to its cryptographic features and decentralized nature, which mitigates the risk of fraud, tampering, and unauthorized access.

Subtheme: Immutable Ledger – The blockchain ledger is tamper-proof and immutable, meaning once a transaction is recorded, it cannot be altered. This immutable feature was highlighted as a significant advantage in preventing fraud and building trust between transacting parties. Interviewees emphasized that in industries where trust is crucial—such as banking, supply chain management, and auditing—blockchain can ensure that records are secure, traceable, and free from manipulation. This is especially pertinent in the case of cross-border financial transactions where ensuring trust among disparate entities can be challenging.

Subtheme: Data Privacy and Compliance – While blockchain's transparency is seen as a benefit, it also raises concerns around data privacy and regulatory compliance. Interviewees expressed concerns over how sensitive data (such as financial information and personal identification) is managed on blockchain networks. IT experts, in particular, pointed out that public blockchains might expose sensitive transaction details to unauthorized parties. The need for permissioned or private blockchains was frequently mentioned as a way to balance transparency with privacy requirements, especially under data protection laws like Thailand's Personal Data Protection Act (PDPA) and the European General Data Protection Regulation (GDPR). These private blockchains allow for controlled access, ensuring that only authorized participants can view or manage sensitive data.

Theme 3: Challenges of Blockchain Adoption

Despite blockchain's potential, there are numerous barriers to its widespread adoption, particularly technical complexity, regulatory ambiguity, and scalability issues. These challenges are critical factors that need to be addressed to facilitate broader integration of blockchain into Thailand's digital payment ecosystem.

Subtheme: Scalability Issues – Blockchain's scalability remains a significant hurdle. IT experts highlighted that as transaction volumes grow, particularly on public blockchain networks like Bitcoin or Ethereum, the system may suffer from network congestion, resulting in slower transaction times and increased fees. This is a crucial issue for the financial industry, where high transaction volumes are standard, and speed is critical. To overcome this barrier, the experts suggested the adoption of layer-two scaling solutions such as sharding or off-chain processing, which would help increase transaction throughput without compromising security.

Subtheme: Regulatory Clarity and Compliance – The regulatory landscape in Thailand remains unclear when it comes to blockchain and digital assets, creating uncertainty for businesses looking to adopt the technology. Interviewees from SMEs and IT sectors expressed concerns about how to navigate compliance with laws such as Anti-Money Laundering (AML) regulations and data privacy requirements. In the absence of clear guidelines, many businesses are hesitant to fully integrate blockchain, fearing potential legal repercussions or future regulatory changes that could affect their operations. Furthermore, the government's current guidelines, while helpful, may be seen as overly restrictive for smaller enterprises, making it harder for them to innovate.

Recommendations for Overcoming Challenges

The study suggests several strategic actions to address these challenges and promote wider blockchain adoption in Thailand's digital payment landscape:

Education and Public Awareness Campaigns – There is a need to bridge the knowledge gap regarding blockchain's benefits and applications. Public awareness campaigns, workshops, and educational programs should be launched to familiarize users with blockchain's potential, especially its ability to enhance security and reduce transaction costs.

Simplifying User Interfaces – Simplifying the user experience of digital payment platforms integrated with blockchain technology will encourage greater adoption. Developing user-friendly interfaces that are intuitive, even for less tech-savvy individuals, will help overcome barriers to use. Features like one-click payments or automated transaction tracking could enhance ease of use.

Collaboration with Regulators – Businesses should work closely with regulators to develop clear and supportive regulatory frameworks. Regulatory sandboxes, which allow for testing of blockchain applications under relaxed regulatory scrutiny, should be expanded to foster innovation while ensuring compliance with essential laws. This will help clarify compliance requirements and reduce uncertainties.

In conclusion, blockchain has the potential to revolutionize the financial system in Thailand by improving efficiency, reducing costs, and increasing security. However, achieving widespread adoption requires addressing key challenges such as scalability, regulatory clarity, and public trust. The study highlights the importance of collaboration between businesses and regulators, as well as the need for public education, to fully unlock blockchain's potential in Thailand's digital payment ecosystem

5. Conclusion and Discussion

Based on interviews with seventeen key informants holding diverse positions and expertise, we gathered invaluable insights into their experiences, collective attitudes, and perspectives on the adoption of blockchain technology within digital payment systems. The informants widely agreed that digital payment systems in Thailand, particularly in the banking sector, are experiencing rapid growth. Consumers are increasingly adopting digital channels for financial transactions, such as mobile banking, QR codes, and e-wallets. The government's active involvement in promoting a cashless society has also played a crucial role in accelerating this trend. In terms of blockchain integration, many informants observed that while the adoption is still in its nascent stages, there is a growing interest in leveraging blockchain to enhance the security, transparency, and efficiency of payment systems. Blockchain technology has the potential to reduce fraud and improve transaction speeds by eliminating intermediaries. This has already been explored in pilot projects like the Bank of Thailand's Project Inthanon, which focuses on creating a blockchain-based Central Bank Digital Currency (CBDC) for interbank transfers and cross-border payments. The informants also highlighted the increasing role of blockchain in cross-border payments, where it can streamline and reduce the costs of international transactions. As Thailand becomes more integrated into the global economy, blockchain's ability to offer secure, real-time, and low-cost payment options is expected to play a crucial role in reshaping the financial landscape. Furthermore, private enterprises, such as Siam Commercial Bank and PTT, are exploring blockchain applications for procurement, cross-border remittances, and even supply chain finance, which could drive blockchain's integration into the broader digital payment ecosystem. However, several key informants noted that the general public's awareness and understanding of blockchain remain limited, posing a challenge to its widespread adoption. In summary, while blockchain is not yet fully integrated into everyday payment systems in Thailand, the rapid advancements in digital payments, coupled with pilot blockchain initiatives in sectors like banking and cross-border transactions, suggest a promising future for blockchain-based payment systems. The trends point toward increasing blockchain integration, but successful adoption will depend on addressing key challenges such as scalability, regulatory clarity, and public education. To enhance digital payment systems and encourage broader adoption of blockchain technology in Thailand, several recommendations emerge.

First, increasing blockchain awareness and education is crucial, as many users are only marginally familiar with its benefits. Educational initiatives, such as workshops and online tutorials, can help bridge this knowledge gap. Simplifying the user experience of digital payments and blockchain platforms will also promote broader usage, particularly for less tech-savvy individuals. Developing user-friendly interfaces with features like one-click payments can enhance the overall experience. Moreover, improving security and privacy measures will address concerns about data protection, while expanding digital payment options for underserved populations, including non-smartphone users, will promote financial inclusion. By focusing on blockchain's impact on reducing transaction fees and optimizing payment speeds, businesses can further motivate users to adopt these technologies. Finally, government and regulatory involvement is essential to build trust, create clear regulations, and incentivize secure digital payment solutions, fostering stability in the system. In summary, the adoption of blockchain in digital payments can be significantly improved through strategic efforts focused on education, simplifying the user experience, enhancing security, expanding accessibility, and encouraging

regulatory support. Several researches [20], [21], [22] shows similar findings, indicating that a user-centered approach to improving digital payment systems can lead to broader adoption and higher satisfaction levels

Reference

1. Derdour, J. (2024, August 20). Transforming Transactions: *The Rise of Digital Payments in Thailand*. Retrieved September 14, 2024, from https://www.finextra.com/blogposting /26643/ transforming-transactions-the-rise-of-digital-payments-in-thailand
2. Bank of Thailand. (n.d.). *PromptPay - Bank of Thailand*. Retrieved September 9, 2024, from https://www.bot.or.th/en/financial-innovation/digital-finance/digital-payment / promptpay.html
3. Statista. (2023, August 28). *Digital payments in Thailand - statistics & facts*. Retrieved September 9, 2024, from https://www.statista.com/topics/9825/digital-payments-in-thailand/
4. Storylab (2020, January 1). PromptPay: Transforming Thailand to a digital economy. Retrieved September 14, 2024, from https://b2b.mastercard.com/news-and-insights/archive/promptpay-podcast/
5. 2C2P. (2023, September 12). Popular payment methods in Thailand: What consumers want. Retrieved September 9, 2024, from https://2c2p.com/blog/thailand-payment-methods
6. Atato. (2023, November 22). Why Thailand is a hidden gem for blockchain. Atato. Retrieved from https://www.atato.com/why-thailand-is-a-hidden-gem-for-blockchain-2/
7. Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Khan, S. (2022). A review of blockchain technology applications for financial services. BenchCouncil Transactions on Benchmarks Standards and Evaluations, 2, 100073. https://doi.org/10.1016/j.tbench.2022.100073
8. Haque, M. M., Paul, S. K., Paul, R. R., Hasan, M. A. F. M. R., Fahim, S., & Islam, S. (2022). A blockchain-based secure payment system for vehicle fuel filling stations. In 2022 25th International Conference on Computer and Information Technology (ICCIT) (pp. 1-5). IEEE. https://doi.org/10.1109/ICCICT2022.01234
9. Amponsah, A. A., Adekoya, A. F., & Weyori, B. A. (2022). Improving the financial security of national health insurance using cloud-based blockchain technology applications. International Journal of Information Management Data Insights, 2, 100081. https://doi.org/10.1016/j.jjimei.2022.100081
10. Alenizi, A., Mishra, S., & Baihan, A. (2024). Enhancing secure financial transactions through the synergy of blockchain and artificial intelligence. Ain Shams Engineering Journal, 15, 102733. https://doi.org/10.1016/j.asej.2024.102733
11. Dashkevich, N., Counsell, S., & Destefanis, G. (2020). Blockchain application for central banks: A systematic mapping study. IEEE Access, 8, 3012295. https://doi.org/10.1109/ACCESS.2020.3012295
12. Fachrian, M. A., Sukarno, P., & Wardana, A. A. (2024). Decentralized transaction records of digital payment gateways using Ethereum blockchain and interplanetary file systems. Procedia Computer Science, 237, 269–276. https://doi.org/10.1016/j.procs.2024.05.105

13. Sethaput, V., & Innet, S. (2021). Blockchain application for central bank digital currencies (CBDC). In 2021 International Conference on Financial Technology (ICFT) (pp. 23-25). IEEE. https://doi.org/10.1109/ICFT2021.567890
14. Haque, M. M., Paul, S. K., Paul, R. R., Hasan, M. A. F. M. R., Fahim, S., & Islam, S. (2022). A blockchain-based secure payment system for vehicle fuel filling stations. 25th International Conference on Computer and Information Technology (ICCIT) (pp. 17-19). https://doi.org/10.1109/ICCICT2022.01234
15. Amponsah, A. A., Adekoya, A. F., & Weyori, B. A. (2022). Improving the financial security of national health insurance using cloud-based blockchain technology application. International Journal of Information Management Data Insights, 2, 100081. https://doi.org/10.1016/j.jjimei.2022.100081
16. Alenizi, A., Mishra, S., & Baihan, A. (2024). Enhancing secure financial transactions through the synergy of blockchain and artificial intelligence. Ain Shams Engineering Journal, 15, 102733. https://doi.org/10.1016/j.asej.2024.102733
17. Glaser, B., & Strauss, A. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. Mill Valley, CA: Sociology Press.
18. Guest, G., Bunce, A. & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. Field Methods, 18, 59-82. http://dx.doi.org/10.1177/1525822X05279903
19. Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. ISSN 1478-0887. Available from: http://eprints.uwe.ac.uk/11735
20. Norbu, T., Park, J. Y., Wong, K. W. & Cui, H. (2024). Factors Affecting Trust and Acceptance for Blockchain Adoption in Digital Payment Systems: A Systematic Review. Future Internet, 16(3), 1-21. https://doi.org/10.3390/fi16030106
21. Trivedi, S., Mehta, K. & Sharma, R. (2021). Systematic Literature Review on Application of Blockchain Technology in E-Finance and Financial Services. Journal of Technology Management & Innovation. 16(3), 89-102. ISSN: 0718-2724. (http://jotmi.org)
22. Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J. & Arami, M. (2020). How Blockchain can impact financial services – The overview, challenges and recommendations from expert interviewees. Technological Forecasting & Social Change. 158, 1-12. https://doi.org/10.1016/j.techfore.2020.120166

2.6. New Innovations in Cross-Border Payments and Settlement Networks - Josiah C. Odosu

THE AUTHOR

Josiah C. Odosu

New Innovations in Cross-Border Payments and Settlement Networks

Josiah C. Odosu

Abstract

This paper explores the future of cross-border payments and settlement networks, focusing on innovations powered by blockchain technology and smart contracts. It examines how these technologies enhance inclusion, democratisation, access, trust, and empowerment in the financial landscape of 2024. With an emphasis on underbanked populations in Africa, the paper discusses the transformative potential of decentralised payment solutions, including smart contract-powered transactions, cross-border capabilities, and POS exchanges for unbanked regions. Key innovations are highlighted, and the paper provides actionable recommendations for advancing global payment systems.

Keywords: Blockchain, Cross-border payments, Financial inclusion, Decentralised networks, Smart contracts, Decentralised Web Nodes (DWNs), Decentralised Identifiers (DIDs), DeFi.

1. Introduction

Cross-border payments and settlement networks are critical components of international commerce, facilitating the transfer of trillions of dollars annually. These systems enable businesses and individuals to engage in global trade, remittances, and financial transactions. However, traditional cross-border payment systems are often plagued by inefficiencies, high costs, and accessibility issues, particularly for underbanked populations. According to the World Bank, fees for cross-border transactions average 6.5%, with settlement times often extending to several days (World Bank, 2021). For the 1.7 billion unbanked individuals worldwide, accessing these payment systems is even more challenging, creating barriers to financial inclusion and limiting economic opportunities (IMF, 2020).

Blockchain technology presents a disruptive opportunity to enhance the current cross-border payment infrastructure. By leveraging decentralised networks, smart contracts, and innovations like DWNs and DIDs, blockchain-based systems can offer faster, cheaper, and more secure cross-border payment solutions. These systems also promote financial inclusion by providing underbanked populations with access to global markets and financial services.

This paper investigates the potential of blockchain technology to transform cross-border payments and settlement networks. It discusses the benefits of decentralised systems, examines case studies of existing blockchain-based payment platforms, and analyses the regulatory and technical challenges facing the widespread adoption of these technologies. The paper also highlights the transformative potential of decentralized payment solutions for unbanked populations, particularly in Africa, and provides recommendations for advancing the global payments ecosystem.

2. Problem Statement

“Traditional cross-border payment systems face inefficiencies such as high costs and settlement delays. Blockchain technology provides a transformative opportunity to enhance these systems by offering faster, cheaper, non-custodial and more secure solutions.”

3. Research Questions

1. How can blockchain technology improve the efficiency of cross-border payments?

2. What role do innovations like Decentralized Web Nodes (DWNs) and Decentralized Identifiers (DIDs) play in ensuring data security and privacy?

3. How do these innovations support financial inclusion, especially for underbanked populations?

4. Methodology

This research employs a mixed-methods approach, combining qualitative and quantitative analyses to provide a comprehensive understanding of innovations in cross-border payments and settlement networks. The methodology includes:

1. *Literature Review*—An extensive review of academic papers, industry reports, whitepapers, and case studies related to blockchain technology, smart contracts, DWNs, and DIDs in the context of cross-border payments.

2. *Case Studies* — Examination of blockchain-based payment platforms such as Stellar, Aave, Compound, and tbDEX to understand their mechanisms, benefits, and challenges.

3. *Statistical Data* — Collection of data from reputable sources like the World Bank, IMF, and industry reports to quantify inefficiencies and costs associated with traditional cross-border payment systems.

4. *Expert Interviews* — Insights from industry experts and blockchain developers to gain qualitative perspectives on future trends and potential obstacles in adopting decentralised payment systems.

The mixed-methods approach allows for a comprehensive analysis of both qualitative and quantitative aspects of blockchain technology in cross-border payments. By integrating various data sources, the research aims to provide a balanced and evidence-based assessment of the innovations and their implications for financial inclusion.

5. Financial Inclusion and Democratisation

Bridging the Gap for the Underbanked — One of the most significant benefits of blockchain technology in cross-border payments is its potential to promote financial inclusion, particularly for underbanked populations. In regions like Sub-Saharan Africa, where the majority of the population is unbanked, access to financial services is often limited to expensive and inefficient remittance services.

Blockchain technology can provide a solution to this problem by offering decentralised payment platforms that are accessible to anyone with an internet connection. These platforms allow users to send and receive payments, access loans, and participate in global trade without the need for a traditional bank account. This is particularly important for small businesses and individuals in developing regions, who often rely on remittances and cross-border payments for their livelihoods.

In addition to providing access to financial services, blockchain-based payment platforms also reduce the cost of cross-border payments. Traditional remittance services often charge high fees, with some providers charging as much as 10% of the transaction amount. In contrast, blockchain-based platforms can reduce transaction fees to less than 1%, making cross-border payments more affordable for low-income users.

One example of a blockchain-based platform that is promoting financial inclusion is Stellar, a decentralised payment network that allows users to send and receive payments in any currency, including fiat and cryptocurrencies. Stellar's platform is designed to facilitate low-cost, fast, and secure cross-border payments, making it an ideal solution for remittances and other financial transactions in underbanked regions.

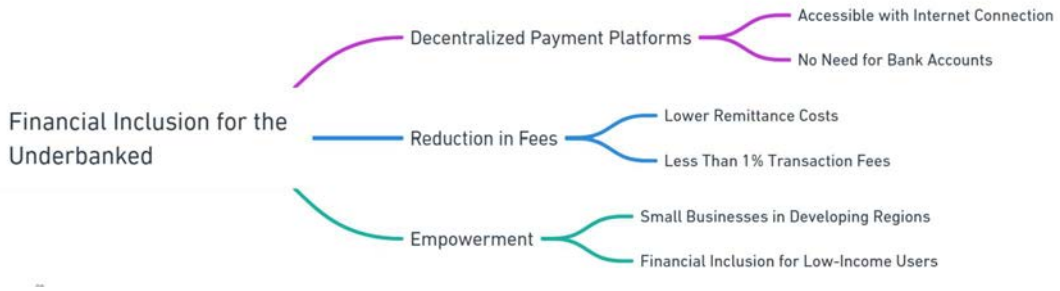


Fig 1: Sketch of financial inclusion for the underbanked.

6. Technological Innovations in Cross-Border Payments

Smart Contracts: Redefining Settlement Networks — Smart contracts are one of the most significant innovations in blockchain technology. A smart contract is a self-executing agreement where the terms of the contract are written directly into code. These contracts automatically enforce and execute the terms without the need for intermediaries. In the context of cross-border payments, smart contracts enable secure, transparent, and efficient transactions by removing correspondent banks and other third parties.

The cost reduction associated with smart contracts can be illustrated using the following equation:

$$C = C_t - C_b$$

Where:

C = Total cost of transaction

C_t = Cost of traditional transaction (including fees from intermediaries)

C_b = Cost of blockchain transaction (including smart contract execution fees)

For example, if the cost of a traditional transaction is $100 and the cost of a blockchain transaction is $5, the cost reduction would be:

$$C = 100 - 5 = 95$$

This indicates a significant cost saving of $95 per transaction, which is particularly important for remittances, where speed and cost are critical factors for users.

For instance, the tbDEX protocol developed by TBD provides a decentralised exchange protocol that leverages smart contracts to facilitate cross-border liquidity. By using decentralised liquidity pools, smart contracts enable peer-to-peer exchanges across different currencies, allowing users to bypass traditional fiat-dominated systems. This reduces reliance on correspondent banks and significantly lowers transaction fees.

Smart contracts also enhance security in cross-border payments by ensuring that transactions are immutable and transparent. Once a smart contract is deployed, it cannot be altered, reducing the risk of fraud and ensuring that all parties can trust the outcome of the transaction. Additionally, smart contracts provide greater transparency by recording all transactions on a public ledger, allowing users to verify the terms and execution of the contract.

7. Decentralised Web Nodes (DWNs) and Decentralised Identifiers (DIDs)

Decentralised Web Nodes (DWNs) and Decentralised Identifiers (DIDs) are emerging technologies that offer new levels of security, privacy, and control for users in cross-border payments. DWNs are decentralised data storage systems that allow users to store and manage their personal data in a secure, private, and decentralised manner. DIDs are unique, verifiable digital identities that allow users to authenticate themselves on a blockchain network without relying on centralised authorities.

In the context of cross-border payments, DWNs and DIDs provide users with greater control over their data and identity. Instead of relying on third-party intermediaries to store and manage their personal information, users can store their data on a DWN and use their DID to authenticate themselves when making transactions. This enhances privacy and security by ensuring that users retain control over their data and can choose who has access to it.

DWNs and DIDs also enable seamless cross-border transactions by allowing users to authenticate themselves and store their transaction history on a decentralised network. This eliminates the need for multiple intermediaries and reduces the complexity of cross-border payments. Additionally, by storing user data on a decentralised network, DWNs and DIDs reduce the risk of data breaches and identity theft, which are common in centralised systems.

The security level of DIDs in credit reporting can be represented by the following equation:

$$S = \frac{D}{R}$$

Where:

S = Security level of the DID

D = Data integrity score

R = Risk factor associated with centralized systems

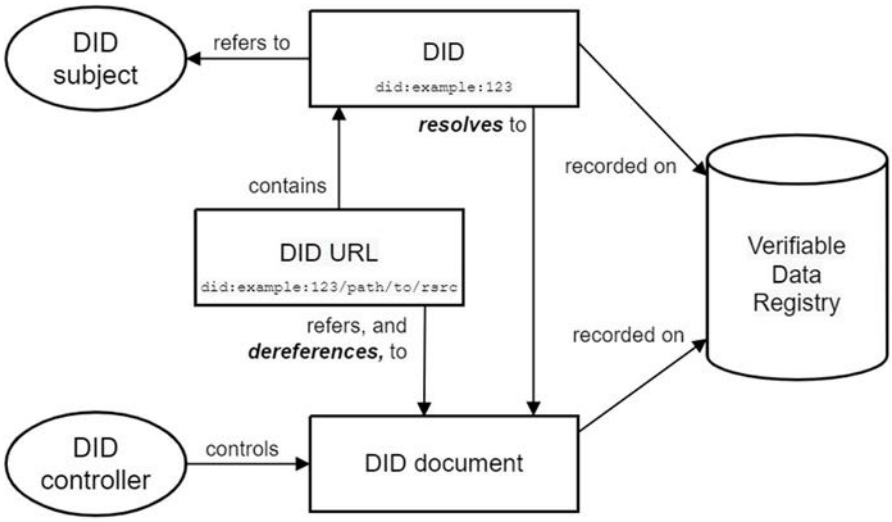


Fig 2: The Illustration of DID architecture, image credits; w3.org

8. On-Chain Credit Reporting and Financial Ecosystems

Leveraging DWNs for On-Chain Credit Reporting — Decentralised Web Nodes (DWNs) present a groundbreaking opportunity for on-chain credit reporting. In traditional financial systems, credit reporting is managed by centralised credit bureaus that collect and store users' financial information. This centralised model creates several problems, including privacy concerns, data breaches, and inaccuracies in credit reports.

By using DWNs, blockchain technology can offer a decentralised alternative to traditional credit reporting. Users can store their financial transactions, credit history, and other relevant data in a DWN, which is accessible only to the user and authorised parties. With the user's consent, financial institutions can access this data to generate real-time, privacy-preserving credit reports.

This decentralised approach to credit reporting has several advantages over traditional systems. First, it enhances privacy by ensuring that users retain control over their data and can choose who has access to it. Second, it reduces the risk of data breaches and inaccuracies by storing data on a decentralised network that is resistant to tampering. Finally, it provides users with greater access to credit by allowing them to carry their credit history across borders and access financial services in any jurisdiction.

The creditworthiness score can be calculated using the following equation:

$$C_w = \frac{T_r + A_s}{D_r}$$

Where:

C_w = Creditworthiness score: A measure of how creditworthy a user is, with higher scores indicating lower credit risk.

T_r = Total repayment history: This represents the individual's historical behaviour in repaying loans or obligations, which could include on-chain transaction history in a DeFi system.

A_s = Assets score: A numerical representation of the value and quality of the individual's or entity's assets. This could include tokenised assets or holdings within a DeFi ecosystem.

D_r = Debt ratio: A ratio representing how much debt the individual or entity has compared to their income or assets. It serves as an indicator of financial leverage and risk.

A. Incorporating Volatility — To reflect asset volatility, the asset score $A_s^{'}$ can be adjusted. For example, we could factor in an asset's volatility over a certain period to reduce the creditworthiness score for riskier assets:

$$A_s^{'} = A_S \; x \; (1 - Volatility \; Factor)$$

B. Time-weighted Repayment History — To give more weight to recent behaviour, a time-weighted component for the total repayment history T_r can be introduced, where more recent repayments are given higher importance than older repayments:

$$T_r^{'} = \sum_{i=1}^{n} (T_{ri} \; x \; W_i)$$

Where W_i is the weight applied to repayment, and more recent repayments have higher weights.

C. Risk Adjustment — Incorporating a risk premium based on external factors (e.g., market conditions, geopolitical risks) or user-specific behaviours (e.g., frequency of late payments) would reduce the score for higher-risk users.

D. Incorporating Income or Cash Flow — In addition to assets and debt, including an income or cash flow variable would further reflect the borrower's ability to repay loans. This could be modeled by introducing a variable *I*:

$$C_w = \frac{T_r + A_s + I}{D_r}$$

For blockchain-based systems, income could be represented by staking rewards, yields from DeFi protocols, or other on-chain revenue streams.

9. Use Cases in Decentralised Finance (DeFi)

A. Lending Platforms (e.g., Aave, Compound) — This formula can be integrated into decentralized lending platforms to assess borrowers' creditworthiness before allowing them to borrow funds. By tokenising repayment history and asset data, DeFi protocols could automate the credit scoring process using on-chain data, eliminating the need for traditional credit bureaus.

B. Cross-border Lending — Cross-border credit assessments could utilise this formula, where blockchain-based assets and repayment histories are global and verifiable across borders, providing seamless credit assessments for individuals and businesses in any jurisdiction.

C. P2P Lending — In peer-to-peer lending, this creditworthiness formula could help lenders assess borrower risk without needing intermediaries, providing a trustless way to evaluate decentralised credit data.

10. Tokenised Credit Reports in DeFi Ecosystems

The integration of tokenised credit reports within decentralised finance (DeFi) ecosystems could revolutionise access to credit and lending. Unlike traditional finance, where individuals must rely on centralised credit bureaus to assess their creditworthiness, decentralised systems could leverage tokenised assets that represent credit history and financial standing.

In a DeFi ecosystem, credit reports stored in DWNs can be tokenized and traded on blockchain networks. This concept introduces a new form of collateral, where users tokenise their credit scores or transaction histories to access loans. These tokenised reports could be utilised within DeFi lending platforms to assess credit risk and determine the interest rates of loans. Tokenised credit allows for cross-border portability, meaning users can apply for loans or services across jurisdictions without having to rebuild their credit histories from scratch.

For example, in a decentralised platform like Aave or Compound, users could pledge tokenised credit reports as collateral, providing a more flexible and inclusive model for borrowing. This could prove particularly valuable for the unbanked or underbanked populations, who often lack formal credit records but have demonstrated financial responsibility through informal economic activities. By tokenising their financial history, these individuals could gain access to global lending markets and financial services.

The value of tokenised credit reports can be calculated using the following equation:

$$V_t = \frac{C_w x\, L}{R}$$

Where:

V_t = Value of the tokenized credit report

C_w = Creditworthiness score

L = Loan amount

R = Risk factor

Imagine this scenario: You're part of a DeFi platform like Aave or Compound. Traditionally, you'd need a central credit bureau to validate your creditworthiness, but with DWNs, it's different.

10.1 User Data Control — First, you store your financial transactions and credit history within your DWN. This data is decentralised, tamper-proof, and accessible only to you and the authorised parties.

10. 2 Tokenisation —You subsequently tokenise this credit report. In other words, your credit history and financial standing become a digital asset, a token on the blockchain.

10.3 Collateral Pledge —You then use this tokenised credit report as collateral on a platform such as Aave or Compound. It is not some form of real estate or gold that becomes the security for your loan; rather, it is the credibility of your finances themselves.

10. 4 Cross-border Access — The beauty is that this tokenised report isn't tied to any single jurisdiction. So, if someone were to relocate from the UK to Japan, for example, credit history would smoothly move with them.

10. 5 Inclusive lending —This is particularly powerful for the unbanked or underbanked. Those who have been using informal ways of being financially responsible can now tokenise their histories and get access to loans, opening doors to financial markets all over the world. The integration of DWNs and tokenised credit within DeFi finally makes the financial ecosystem not just more private-secure but also increasingly inclusive and borderless.

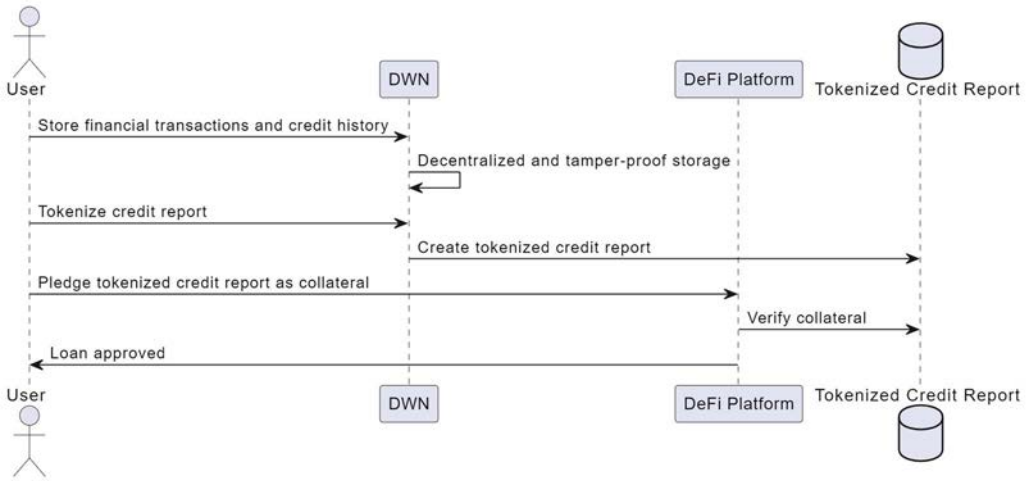


Fig 3: The diagram illustrates the process of integrating Decentralised Web Nodes (DWNs) within DeFi ecosystems for credit reporting and lending. It begins with users storing their financial transactions and credit history in DWNs, ensuring data decentralisation and security. This data is then tokenised, converting credit histories into digital assets. These tokenised credit reports are used as collateral on DeFi platforms like Aave or Compound. The process allows for cross-border portability of credit histories and provides unbanked and underbanked populations with access to global financial markets. This integration enhances privacy, security, and inclusivity in the financial ecosystem.

11. Challenges and Opportunities in Tokenisation

11.1 Challenges — While the concept of tokenising credit reports presents significant opportunities, it also faces several challenges. One of the key issues is establishing standardised protocols for representing and verifying tokenised credit data. Each decentralised platform may have its own standards, leading to fragmentation and inefficiency. Additionally, there are privacy concerns. Tokenised data, while secured by blockchain, could still be vulnerable to breaches if not managed properly, especially in a decentralised environment where data management practices vary.

Moreover, regulatory frameworks are not yet prepared to handle tokenised credit systems. Regulatory bodies will need to work closely with blockchain developers, product managers, and other stakeholders to create standards and safeguards that ensure fairness, security, cross-border acceptance, and legal compliance.

11.2 Opportunities — Despite these challenges, the opportunities for enhancing financial inclusion through tokenised credit systems are vast. Particularly, African countries with no elaborate credit system could leverage this innovation to build a unified African credit system. This creates an opportunity for the EU, which is slated to have the entire European Union countries using an identity wallet in 2026. DeFi and tokenisation ecosystems, if properly regulated and designed, could democratise access to credit and capital, empowering individuals across the globe.

12. Conclusion

Blockchain technology, smart contracts, decentralised Web nodes (DWNs), and Decentralised Identifiers (DIDs) present transformative opportunities for the future of cross-border payments and settlement networks. These technologies offer significant advantages in terms of efficiency, transparency, and financial inclusion, particularly for underbanked populations in developing regions. By reducing reliance on intermediaries and enabling greater user control over personal data, especially with the AI revolution, decentralised payment systems have the potential to revolutionise the global financial system.

However, significant challenges remain, particularly in the areas of regulation and compliance. Ensuring that decentralised systems can operate within the bounds of existing regulatory frameworks will require collaboration between regulators, blockchain developers, and financial institutions. Additionally, privacy and security concerns will need to be addressed to ensure that decentralised systems can be trusted by users and businesses alike.

Looking forward, the potential for decentralised payment systems to enhance financial inclusion and empower individuals is vast. By providing access to financial services for underbanked populations, decentralised systems can help drive economic growth and reduce poverty. Additionally, by tokenising credit reports and enabling cross-border liquidity through decentralised exchanges, these systems can provide new opportunities for individuals and businesses to participate in the global economy.

As blockchain technology continues to evolve, the future of cross-border payments and settlement networks looks increasingly decentralized. With innovations such as smart contracts, DWNs, and DIDs, the global financial system is on the verge of a major transformation, one that promises to be more inclusive, efficient, and empowering for individuals and businesses around the world.

13. Conflict of Interest

The author declares that there are no conflicts of interest regarding this study.

14. Funding Statement

No funding was received for this research.

15. Acknowledgements

I would like to express my appreciation to the CVA Education Work Group for initiating the program that inspired this research.
I am also grateful to the TBD team, W3, and the Identity Foundation for their pioneering work in advancing privacy and ownership in smart contract technologies. Your innovations have significantly influenced my understanding of these critical areas.
Finally, I extend my gratitude to my friends and team members for your encouragement and collaboration as we build together in this evolving landscape.

16. References

1. Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System.
2. IMF. (2020). Cross-border payments: Emerging opportunities in the digital age.
3. World Bank. (2021). Remittance Prices Worldwide.
4. Ripple. (2022). On-demand Liquidity Whitepaper.
5. Uniswap Labs. (2023). Unichain Whitepaper.
6. Stellar Development Foundation. (2020). Blockchain for Remittances in Africa.
7. Aave Protocol. (2023). DeFi Lending and Borrowing Whitepaper.
8. Web3 Foundation. (2021). Decentralised Identifiers (DIDs) and Web5 Technology.
9. Peters, G. W., & Panayi, E. (2016). Understanding Modern Banking Ledgers through Blockchain Technologies: Future of Transaction Processing and Smart Contracts. In Banking Beyond Banks and Money (pp. 239-278). Springer.
10. Zyskind, G., & Nathan, O. (2015). Decentralising Privacy: Using Blockchain to Protect Personal Data. In IEEE Security and Privacy Workshops.
11. Catalini, C., & Gans, J. S. (2016). Some Simple Economics of the Blockchain. MIT Sloan Research Paper.
12. European Union Blockchain Observatory and Forum. (2021). Blockchain and the EU: Opportunities and Challenges.
13. World Economic Forum. (2022). Remaking Financial Services: How Blockchain Can Enhance Transparency and Trust.
14. Mougayar, W. (2016). The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology.

2.7. Bitcoin and the Future of Blockchain in International Payment Systems – Prof. Mohamed Amine Issami

THE AUTHOR

Prof. Mohamed Amine Issami

Bitcoin and the Future of Blockchain in International Payment Systems

Professor Mohamed Amine ISSAMI
Groupe ISCAE, Morocco
aissami@groupeiscae.ma

Abstract

Blockchain technology, particularly exemplified by Bitcoin, has introduced transformative potential within the International Payment System (IPS), fundamentally altering the landscape of commercial transactions. By facilitating direct, decentralized transactions, blockchain challenges traditional systems reliant on intermediaries, offering the promise of faster, more cost-effective, and accessible global payments. This paper evaluates the prospects and challenges of cryptocurrency and blockchain adoption in the IPS, addressing regulatory, environmental, and economic dimensions. It explores the historical context of currency evolution, from precious metals to fiat money, emphasizing the role of intermediaries in fostering trust and confidence in monetary assets.

The European Union Agency for Cybersecurity defines blockchain as a decentralized data structure that enables participants in a peer-to-peer network to conduct transactions without a central authority, ensuring transactional integrity through cryptographic protocols while maintaining a degree of anonymity. Various sectors, including Supply Chain Management, Healthcare, and Real Estate, are increasingly integrating blockchain to enhance transparency and security. In the financial realm, the advent of Central Bank Digital Currencies (CBDCs) presents a regulated bridge between traditional finance and cryptocurrency, allowing for the retention of regulatory oversight and monetary policy control.

Despite its potential benefits, concerns regarding blockchain's decentralized and anonymized architecture persist, particularly regarding its potential facilitation of illicit transactions. This work aims to explore how decentralized finance protocols, CBDCs, and cross-border transactions via blockchain may reshape the IPS, while also examining the advisability of blockchain adoption for payment methods and proposing regulatory frameworks for effective control and oversight. Through case studies, this paper illustrates the potential impacts on financial inclusion, efficiency, and policy, contributing to the ongoing debate on the future of payment systems in a digital economy.

Keywords : Bitcoin, Blockchain, International Payment System (IPS), Central Bank Digital Currency (CBDC), Cryptocurrency, Financial Regulation, Cross-Border Transactions.

Introduction

Since its inception in 2009 by the enigmatic figure known as "Satoshi Nakamoto," through the seminal paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System," Bitcoin has fundamentally transformed the financial landscape and laid the groundwork for the emergence of numerous cryptocurrencies. The growth of this digital currency has extended beyond Bitcoin, encompassing a diverse array of digital currencies that collectively boast a market capitalization of approximately $2.65 trillion.

Initially, the innovative blockchain technology that underpins Bitcoin was primarily recognized by a niche group of investors who capitalized on the potential gains associated with Bitcoin. The inherent volatility of this digital asset attracted a broader spectrum of investors and users, leading to increased interest from larger entities. By 2014, notable companies such as Overstock began to accept Bitcoin as a legitimate payment method for online transactions, paving the way for major corporations like Mastercard, Pavilion Hotels, AXA Insurance, Starbucks, Visa, and PayPal to follow suit. In a significant development, Goldman Sachs classified cryptocurrency as a distinct asset class in March 2021, further legitimizing its role in the financial ecosystem.

The discourse surrounding the adoption of cryptocurrencies remains a vibrant topic of debate among governments and investors alike. Concerns regarding the high volatility and lack of transparency associated with cryptocurrencies contrast sharply with the potential profits and the decentralized solutions they offer. This dichotomy leaves regulators grappling with the challenge of determining the most effective framework to ensure that cryptocurrencies positively impact the economy. To assess this impact comprehensively, it is essential to explore the various dimensions through which cryptocurrencies influence economic dynamics.

Crypto: An Attractive Growing Solution

The surge in popularity of Bitcoin, in particular, underscores the significant impact and transformative potential that cryptocurrencies hold in the modern world. In response to this phenomenon, central banks across the globe are actively exploring the concept of Central Bank Digital Currencies (CBDCs). These digital currencies incorporate elements of cryptocurrencies into traditional monetary systems, establishing a 1:1 parity with real fiat currencies. This evolution suggests that cryptocurrencies may fundamentally alter the operational mechanisms of economies.

One of the primary drivers behind the increasing popularity of cryptocurrencies is their borderless nature, which simplifies transactions compared to conventional financial systems. This characteristic allows for seamless access to international payment methods, a stark contrast to traditional systems that often require intermediaries for cross-border transactions. The involvement of intermediaries introduces complexities, fees, and delays; however, digital currencies facilitate direct and instantaneous transactions between parties, effectively eliminating the need for intermediaries.

Moreover, cryptocurrencies serve as a hedge against inflation, particularly during periods of economic uncertainty. As inflation erodes the value of fiat currencies, investors often seek alternative assets, such as Bitcoin, to safeguard their purchasing power. The finite supply of Bitcoin, capped at 21 million BTC, further enhances its appeal, attracting investors in search of potential returns.

These trends collectively highlight the growing influence of cryptocurrencies on the global economy. They foster financial inclusion, reduce the costs associated with cross-border payments, and stimulate innovation within financial products and services. Key statistics underscore their significance, with a market capitalization exceeding $1.72 trillion, over 580 million active cryptocurrency users worldwide, and a daily trading volume surpassing $100 billion.

The Impact of Crypto on the World Economy Today

Over the past decade, cryptocurrency has transitioned from a nebulous concept to a legitimate payment and investment vehicle. As of January 2024, there are over 9,000 cryptocurrencies in existence, with approximately 580 million individuals globally owning some form of cryptocurrency. Its influence on both national and global economies is becoming increasingly apparent. While cryptocurrencies have yet to significantly impact larger economic sectors, such as the stock market, experts often refer to them as "digital gold," suggesting that they possess the potential to preserve value similarly to precious metals, thereby mitigating depreciation risks.

As cryptocurrencies gain legal recognition across various jurisdictions, they promise to catalyze increased global investments and job creation. In an era marked by declining trust in traditional banking systems, cryptocurrencies offer a decentralized alternative that empowers users and promotes financial inclusion. With an estimated 1.7 billion unbanked individuals worldwide, cryptocurrencies provide a pathway for these individuals to access financial services through mobile applications. The decentralized nature of cryptocurrencies fosters equality and facilitates cross-border transactions.

Potential Future Impact Depending on Regulations

The responses of central banks worldwide to cryptocurrencies have varied significantly, with some expressing strong support while others remain cautious due to the inherent volatility of these digital assets. The economic implications of cryptocurrencies are multifaceted and necessitate a thorough examination of various factors, including regulatory frameworks. Consequently, the impact of cryptocurrency usage on the global economy is closely aligned with the regulatory measures implemented. In the following section, we will explore four primary scenarios and their implications for the future of cryptocurrencies and their role in the economy.

Scenario 1: Allowing Current Cryptocurrencies to Operate Without Regulatory Intervention

The current trends in cryptocurrency usage indicate a significant increase in both everyday transactions and investment activities. There is a growing acceptance of cryptocurrency payments among businesses, alongside a rise in investments, suggesting a broader integration into traditional financial systems. This scenario presents several implications:

- **Monetary Stability:** The impact of cryptocurrency volatility on overall monetary stability is currently limited, as these assets are not widely utilized for everyday transactions due to the absence of regulatory frameworks. However, their volatility is notable, particularly in the context of investment.

- **Wealth Effect:** The increasing and unpredictable nature of cryptocurrencies, especially Bitcoin, has generated wealth for many investors. This phenomenon could potentially lead to a wealth effect in the broader economy, assuming that these investors will reinvest their gains into the real economy.

- **Financial System Stability:** The lack of regulatory oversight and a central authority can pose challenges to financial stability, particularly during economic crises.

- **Illegal Activities:** The decentralized and pseudonymous characteristics of cryptocurrencies may facilitate illicit activities and complicate efforts to combat them.

- **Innovation:** Current trends enable businesses to innovate and develop new cryptocurrency-based solutions. However, this innovation is often hampered by the uncertainty surrounding regulatory measures.

Overall, this scenario presents a highly ambiguous environment for cryptocurrency usage, leaving stakeholders uncertain about future regulations.

Scenario 2: Implementing a Ban on Cryptocurrency Use

In response to the rapid growth of cryptocurrencies, many countries have enacted laws to restrict or completely ban their use. This regulatory approach encompasses various mechanisms aimed at controlling the flow of cryptocurrencies, including partial bans on crypto payments, prohibitions on crypto mining, and restrictions on trading platforms. The implications of these regulations on the macroeconomic scale are significant, particularly concerning monetary and financial stability.

Such bans are primarily intended to safeguard the sovereignty of central banks and maintain control over monetary systems. This defensive strategy aims to preserve the effectiveness of central banks in managing inflation and ensuring financial stability.

Scenario 3: Regulating Cryptocurrency

The regulation of cryptocurrency is not without its consequences. Integrating cryptocurrencies into the economy necessitates the establishment of frameworks that ensure transparency. These frameworks may include transaction monitoring, sanctions, and the identification of transaction counterparts. The benefits of such regulation include:

- **Access to Financial Systems:** By facilitating access to digital assets, particularly for marginalized communities, cryptocurrency adoption can promote economic growth and empowerment.

- **Equity and Inclusion:** Ownership of cryptocurrencies can provide opportunities for financial independence from traditional banking systems. However, regulatory efforts must prioritize consumer protection to mitigate associated risks.

- **Innovation and Economic Growth:** Effective regulations can stimulate economic growth and foster innovation within cryptocurrency markets.

- **Environmental Sustainability:** Given the environmental impact of cryptocurrency mining, regulations should encourage the transition to more energy-efficient mechanisms, such as Proof of Stake, and promote renewable energy sources within the mining sector.

Scenario 4: Making Cryptocurrency Legal Tender – The Case of El Salvador

To understand the implications of designating Bitcoin as legal tender, it is essential to examine the case of El Salvador. On June 9, 2021, El Salvador made history by enacting legislation that recognized Bitcoin as legal tender, effective September 7, 2021. This landmark decision aimed to address three primary challenges facing the nation:

- **Enhancing International Remittances:** With remittances accounting for over 20% of El Salvador's GDP, the adoption of Bitcoin sought to improve the efficiency of these transactions by reducing costs and processing times.

- **Increasing Financial Inclusion:** The initiative aimed to boost the percentage of banked individuals, estimated at around 30% of the population, by providing easier access to financial services.

- **Reducing Reliance on the US Dollar:** By adopting Bitcoin as a neutral store of value, El Salvador aimed to decrease its dependence on the US Dollar and mitigate risks associated with exchange rate fluctuations.

However, the International Monetary Fund (IMF) raised concerns regarding the macroeconomic, financial, and legal implications of this move, particularly regarding potential price instability. The World Bank also initially declined to assist with the implementation of Bitcoin as legal tender due to environmental and transparency issues.

Finally, the objective of this analysis is to gain a comprehensive understanding of blockchain technology and Bitcoin, assess the advisability of adopting blockchain for payment methods, and explore how regulators can establish frameworks to protect users. Additionally, we will examine Central Bank Digital Currencies (CBDCs) as a revolutionary tool for governments transitioning to cryptocurrency-based systems.

Understanding Blockchain

Blockchain is defined as a distributed and shared database that maintains a continuously growing list of ordered records, known as blocks. These blocks are linked through cryptography, with each block containing a cryptographic hash of the preceding block. This decentralized, distributed, and

public digital ledger is utilized to record transactions across multiple computers, ensuring that the records cannot be altered.

The blockchain operates through a specific process dictated by its protocol. For instance, in Bitcoin's blockchain, transactions are initially stored in a memory pool before being added to a block by miners. The mining process involves solving complex mathematical puzzles to validate transactions and incorporate them into the blockchain.

One of the defining features of blockchain technology is its decentralization, meaning that no single entity has control over the network. Instead, data is distributed across multiple nodes, making it difficult for any one party to alter the information. This structure enhances security and transparency, as all transactions are visible to participants in the network. Blockchain technology has a wide range of applications beyond cryptocurrencies, including:

- **Payment Processing and Money Transfers:** Streamlining transactions and reducing costs associated with traditional banking systems.
- **Supply Chain Monitoring:** Enhancing traceability and accountability in supply chains.
- **Digital Identity Management:** Allowing individuals to control their digital identities, as seen in initiatives by companies like Microsoft.
- **Data Sharing:** Facilitating secure and efficient data exchange across various sectors.
- **Copyright and Royalties Protection:** Ensuring that creators receive fair compensation for their work.
- **Healthcare:** Improving the management and sharing of patient data.

The benefits of blockchain include improved accuracy, cost reductions, decentralization, efficient transactions, privacy, security, and transparency. However, challenges such as technology costs, speed and data inefficiencies, potential for illegal activity, and regulatory concerns also exist.

Understanding Bitcoin

Bitcoin is a digital currency, or cryptocurrency, that was introduced to the public in 2009 by an anonymous developer or group of developers under the pseudonym Satoshi Nakamoto. Bitcoin is created through a process known as mining, where miners are rewarded with newly generated bitcoins for their efforts.

The total supply of bitcoins is capped at 21 million coins, and new bitcoins are introduced into circulation at a decreasing rate through a process called halving, which occurs approximately every four years. This scarcity contributes to Bitcoin's value.

Once acquired, bitcoins can be stored in digital wallets and used for various purposes, including online purchases, investment, and speculation. However, investing in Bitcoin carries risks due to

its price volatility and regulatory uncertainty. Governments worldwide are still grappling with how to regulate cryptocurrencies like Bitcoin.

One of the primary challenges facing cryptocurrencies as a medium of exchange is their extreme price volatility. Unlike traditional currencies, which tend to maintain relatively stable values, cryptocurrencies can experience significant fluctuations in value over short periods. This volatility complicates the ability of businesses to set prices in cryptocurrencies, as they would need to constantly adjust them to reflect changes in value.

As a result, many investors view cryptocurrencies primarily as speculative assets rather than practical tools for everyday transactions. The volatile nature of the cryptocurrency market means that investing in cryptocurrencies carries inherent risks, and many investors may ultimately lose money in the long run. In light of these considerations, some policymakers and regulators have suggested treating cryptocurrencies more like gambling than traditional financial products, reflecting concerns about consumer protection and the need to manage expectations regarding the risks associated with investing in cryptocurrencies.

The Future of International Payment Systems Using Blockchain Technology

Cross-border transactions currently face significant inefficiencies, but there is potential for improvement through the adoption of blockchain technology. One promising avenue for innovation lies in enhancing the interoperability of Central Bank Digital Currencies (CBDCs), although only a limited number of central banks have ventured into CBDC issuance thus far.

The Bank of the Bahamas has pioneered the world's first CBDC, known as the Sand Dollar. Recognizing that the Bahamas has more smartphones than bank accounts, the Sand Dollar aims to promote financial inclusion by enabling consumers to conduct transactions with any merchant equipped with a digital wallet authorized by the Central Bank of the Bahamas.

Similarly, the National Bank of Cambodia introduced the Bakong system, which differs from the Sand Dollar in that it distributes digital currency through Cambodian partner companies rather than directly from the central bank. This system allows individuals with registered phone numbers in Cambodia to engage in transactions using Bakong, which is based on the Cambodian riel or US dollars.

The Bank for International Settlements (BIS) Innovation Hub is actively involved in the Multiple CBDC (mCBDC) Bridge Project, which includes authorities from several countries, such as Hong Kong, Thailand, China, and the UAE. This initiative seeks to leverage distributed ledger technology (DLT) and CBDCs to address challenges in cross-border fund distribution, including inefficiencies, high costs, and compliance issues. The BIS has proposed three theoretical models for effective CBDC systems:

Model 1: Compatible Standards - This model focuses on establishing common standards for CBDCs to facilitate interoperability.

Model 2: Interlinked Systems - This approach involves creating interconnected CBDC systems that can communicate with one another.

Model 3: Unified mCBDC System - This model allows users to execute cross-border payments using deposit receipts linked to CBDCs held in domestic systems, promoting policy discussions regarding CBDC issuance for financial and economic stability.

Research Findings

Research indicates that cryptocurrencies have both positive and negative effects on global payment systems. By upgrading IT systems, challenges related to the security and reliability of cryptocurrencies can be effectively addressed. Through a combination of quantitative and qualitative analysis, studies suggest that cryptocurrencies offer various benefits alongside several constraints within the realm of global payment systems.

Cryptocurrencies can enhance transaction speed and reduce costs compared to traditional financial systems. They enable quicker transactions with lower fees, which can be particularly advantageous for cross-border payments. However, the integration of cryptocurrencies into existing financial frameworks also presents challenges. Issues such as cybersecurity threats, regulatory compliance, and the potential for illicit activities remain significant concerns.

Many financial institutions and banks worldwide are beginning to embrace cryptocurrencies, providing specialized support services for customers interested in utilizing them. While cryptocurrencies facilitate faster transactions with lower tax burdens and reduced government intervention compared to traditional currencies, they also introduce specific challenges. Concerns about hacking, data breaches, and the absence of regulatory frameworks governing cryptocurrency transactions contribute to unease among users regarding potential fraudulent activities associated with cryptocurrency payment systems.

Central Bank Digital Currencies (CBDCs)

Central Bank Digital Currencies (CBDCs) are digital forms of currency issued by a nation's central bank, distinct from cryptocurrencies as they are backed by the central bank and maintain a fixed value equivalent to the country's fiat currency. As many countries actively explore and implement CBDCs, understanding their significance and impact on society is crucial.

Central banks worldwide are recognizing the increasing digitization of payments and the potential implications for their control over financial systems. With cash usage declining and the rise of cryptocurrencies, there is a growing awareness that central banks could lose some control over money supply, leading to greater financial exclusion among unbanked and underbanked populations. In response, many central banks, both large and small, are investigating the development of CBDCs, with some emerging economies already launching their own.

While widespread adoption of CBDCs in major economies may not be immediate, substantial planning is underway. This preparation involves detailed strategies to ensure readiness for launch when deemed appropriate by respective governments. Before implementation, central banks face

critical decisions regarding the design of CBDC systems, particularly those intended for retail use. Engaging with experts can help explore these options and understand their potential implications for financial inclusion and the role of private banks in the evolving payments landscape.

As of mid-2023, several countries and currency unions have fully launched digital currencies, with many others conducting pilot programs or in various stages of development. Some initiatives focus exclusively on retail CBDCs, while others target wholesale use, with several major economies considering both options. Notably, the countries that have already introduced CBDCs are primarily smaller economies in the Caribbean, driven in part by the goal of enhancing financial inclusion, especially among unbanked and underbanked populations.

For instance, Nigeria's motivations for adopting a CBDC include increasing the use of its own currency in domestic transactions to reduce reliance on the US dollar and improving the visibility and traceability of cash flows. In contrast, larger economies like Singapore exhibit less urgency due to the prevalence of digital payments and minimal perceived risks from cryptocurrency markets. Offline accessibility is a key feature of many retail CBDC projects, enabling transactions through basic mobile phones or stored-value cards, thereby reducing dependence on internet connectivity.

However, achieving financial inclusion through CBDCs requires deliberate design considerations. In addition to offline access, CBDC systems must integrate with existing payment infrastructures, facilitate merchant acceptance, and streamline Know Your Customer (KYC) and Anti-Money Laundering (AML) processes. Such designs not only promote inclusion but also foster a competitive environment among private sector entities, ultimately lowering service costs for consumers.

Potential Advantages of CBDCs

Proponents of digital finance argue that CBDCs and other digital instruments can deliver numerous benefits related to cost, efficiency, security, and financial inclusion. Key advantages include:

- **Cost Reduction:** By minimizing the need for physical infrastructure, digital financial service providers could save substantial amounts annually. However, these potential savings must be weighed against the significant investments required for technology and infrastructure to implement CBDCs.

- **Faster Transactions:** CBDCs could enhance the speed and efficiency of digital payment systems in various countries, particularly for cross-border payments and instant settlements, although this argument is less compelling in regions where rapid payment systems are already established.

- **Enhanced Financial Inclusion:** CBDCs could provide access to financial services for those without traditional bank accounts. With millions of adults globally lacking access to banking, CBDCs available via mobile phones could enable these individuals to participate in the financial system, potentially opening new markets for financial service providers. However, widespread adoption is not guaranteed, as some individuals may still prefer the anonymity of cash.

- **Improved Security:** A regulated digital currency accessible via smartphones could offer greater security for transactions. Utilizing private-key cryptography, users can electronically "sign" transactions, reducing the risk of fraud and ensuring that transactions are settled securely and irreversibly. This can also decrease transaction times and enhance confidence in the safety of digital payments.

Concerns Regarding CBDCs

While CBDCs present potential benefits, they also pose significant challenges and risks:

- **Traceability and Taxation:** Digital currencies can be tracked, which means transactions may be subject to taxation. This could deter voluntary adoption among individuals who prefer anonymous transactions or cash-based economies.

- **Technical Stability:** The reliability of digital currencies remains a concern. For instance, in January 2022, the Eastern Caribbean's digital currency, DCash, faced technical issues that rendered it offline for two months, highlighting the risks associated with technological instability.

- **Weak Business Case:** Developing and maintaining the infrastructure for CBDCs may require substantial effort and resources that may not be justified by the potential benefits. Some countries, such as Canada and Singapore, have determined that their existing financial systems already provide rapid payment solutions without the need for a digital currency, raising questions about the value proposition of CBDCs.

- **Limited Speed Improvements:** While CBDCs are often touted for their potential to facilitate faster transactions, many developed nations already have systems in place that allow for immediate payments without relying on blockchain technology. This raises concerns about whether CBDCs can genuinely offer significantly quicker settlement times compared to existing systems.

Case Study: The Bahamian Sand Dollar

The launch of the Sand Dollar, the Bahamas' CBDC, began with a pilot program in December 2019 on Exuma, a southern island that represents a microcosm of the nation. Prior to the pilot, a survey was conducted to assess the level of financial inclusion on the island and gauge residents' interest in digital payments. The results indicated that 93% of Exuma's residents had access to basic bank accounts, while 17% opted not to use a bank due to distrust in financial institutions or difficulties accessing physical banks. Notably, 96% of residents owned smartphones, with 40% using them for some form of payment or online banking. Despite a willingness among nearly two-thirds of participants to use their smartphones for payments, there was hesitance, particularly among older individuals, due to concerns about digital systems and cybersecurity.

The pilot was largely successful, despite challenges posed by the COVID-19 pandemic, which emerged shortly after the initial rollout. Following Hurricane Dorian in 2019, the pilot expanded to Abaco, one of the most affected islands, to help restore its financial system. All Supervised

Financial Institutions (SFIs) were given the opportunity to become Authorized Financial Institutions (AFIs) to facilitate the Sand Dollar. Payment Service Providers (PSPs) were the first to adopt the system, making up the majority of AFIs.

Launch Process of the Sand Dollar

To use the Sand Dollar, customers must download the application on their smart devices and be onboarded by an AFI, which verifies the necessary Know Your Customer (KYC) documents. Once the AFI confirms the account, users can fund their wallets through wire transfers or cash deposits with the AFI. Afterward, users can freely utilize their Sand Dollars for purchases, similar to other digital payment methods.

The Sand Dollar wallet features three tiers with varying requirements. The Tier 1 or basic wallet does not require KYC documentation, allowing users to hold up to 500 Sand Dollars and limiting transactions to no more than 1,500 Sand Dollars per month. The Tier 2 or premium wallet permits users to hold up to 8,000 Sand Dollars, with a monthly transaction limit of 10,000 Sand Dollars, requiring a valid government-issued ID and the option to link the wallet to a bank account. The Tier 3 wallet is designed for merchants, allowing users to hold between 8,000 and 1,000,000 Sand Dollars without transaction limits, but requiring a linked bank account and valid business registration.

Key Design Elements and Security Measures for the Sand Dollar's Success

For the Sand Dollar to achieve its objectives, several design elements were crucial. First, ensuring interoperability between the Sand Dollar and various e-wallets offered by AFIs was essential, allowing users to send and receive Sand Dollars regardless of the e-wallet provider. Second, transparency and accessibility were prioritized, along with real-time transaction processing and point-of-sale support for businesses accepting the Sand Dollar. A fully auditable transaction history was also implemented to enhance trust.

To address concerns about digital systems and cybersecurity risks, the Central Bank made significant efforts to ensure that every aspect of the Sand Dollar was secure, employing end-to-end encryption from the Central Bank's digital currency ecosystem to the functionality of e-wallets. Organizations wishing to become Sand Dollar agents underwent rigorous evaluation by a third-party entity to ensure their systems met necessary security standards before being approved as AFIs. At the user level, wallets required multi-factor authentication for access and transaction completion.

During the initial rollout of the Sand Dollar, adoption was slow, with average monthly transactions totaling around 15,000 Sand Dollars. However, as the impact of COVID-19 diminished and the Central Bank resumed its educational and promotional efforts, usage saw a significant increase. By 2021, monthly transactions surged by 119% to approximately 33,000 Sand Dollars. This upward trend continued into 2022, with average monthly transactions reaching 85,000 Sand Dollars by year-end, representing a 160% increase from the previous year. The growth in transactions indicated a rising acceptance of the Sand Dollar among the Bahamian population, reflecting a shift towards digital payments and financial inclusion.

Lessons Learned from the Sand Dollar Experience

The experience of the Sand Dollar provides valuable insights for other countries considering the implementation of CBDCs. Key lessons include:

- **User Education and Awareness:** A significant factor in the successful adoption of the Sand Dollar was the Central Bank's commitment to educating the public about the benefits and functionalities of the digital currency. Ongoing outreach efforts, including workshops and informational campaigns, helped demystify the technology and build trust among potential users.

- **Interoperability is Crucial:** Ensuring that the Sand Dollar could seamlessly interact with existing financial systems and various e-wallets was essential for user convenience. This interoperability facilitated broader acceptance and usage, as users could easily transact without being restricted to a single platform.

- **Security Measures are Paramount:** The implementation of robust security protocols, including multi-factor authentication and end-to-end encryption, was critical in addressing user concerns about cybersecurity. By prioritizing security, the Central Bank was able to foster trust in the digital currency, encouraging more individuals to participate in the system.

- **Gradual Rollout and Feedback Mechanisms:** The phased approach to launching the Sand Dollar allowed for adjustments based on user feedback and real-world testing. This iterative process enabled the Central Bank to refine the system and address any issues that arose during the pilot phase.

- **Collaboration with Financial Institutions:** Engaging with local banks and financial service providers was vital for the Sand Dollar's success. By partnering with these institutions, the Central Bank could leverage their existing customer bases and infrastructure, facilitating a smoother transition to digital currency.

Future Prospects for CBDCs

As more countries explore the potential of CBDCs, the lessons learned from the Sand Dollar and other initiatives will play a crucial role in shaping future implementations. The global landscape for digital currencies is rapidly evolving, with central banks recognizing the need to adapt to changing consumer preferences and technological advancements.

The potential benefits of CBDCs extend beyond mere convenience; they can enhance financial stability, promote economic growth, and improve the efficiency of payment systems. However, the successful implementation of CBDCs will require careful consideration of regulatory frameworks, technological infrastructure, and user engagement strategies.

Conclusion

The advent of blockchain technology and cryptocurrencies, particularly Bitcoin, has initiated a profound transformation in the global financial landscape. Bitcoin's introduction in 2009 marked the beginning of a new era in value transfer, challenging traditional financial systems and offering a decentralized alternative to conventional banking. This shift has not only led to the proliferation of thousands of digital assets but has also prompted a reevaluation of monetary systems worldwide. The implications of this transformation extend beyond mere currency; they encompass a broader rethinking of how value is stored, transferred, and regulated in an increasingly digital world.

The role of blockchain technology as the backbone of cryptocurrencies cannot be overstated. Its decentralized, secure, and transparent nature makes it an ideal candidate for enhancing international payment systems (IPS). By eliminating intermediaries, blockchain facilitates faster, more efficient cross-border transactions, reducing costs and improving accessibility. Furthermore, the exploration of Central Bank Digital Currencies (CBDCs) by national authorities signifies a willingness to embrace digital innovation while maintaining regulatory oversight. CBDCs present an opportunity to modernize traditional currency systems, offering a complementary solution to cash that enhances financial inclusion and streamlines payment processes.

However, the integration of cryptocurrencies and blockchain technology into IPS is not without challenges. Regulatory concerns surrounding volatility, security, and potential misuse necessitate a careful approach to governance. The scenarios outlined in this paper highlight the diverse paths that countries may take in response to the rise of digital currencies, ranging from unregulated growth to outright bans. A balanced regulatory framework that promotes innovation while safeguarding against risks is essential for fostering a stable and secure financial environment.

Looking ahead, the future prospects for blockchain in IPS are promising. The technology's inherent transparency and traceability can enhance various sectors beyond finance, including supply chain management and healthcare. As central banks and financial institutions continue to explore the potential of CBDCs, the integration of blockchain could lead to a more efficient global payment system, characterized by lower costs and faster processing times. The collaboration between public and private sectors will be crucial in harnessing the benefits of blockchain while addressing its associated risks.

All in all, the ongoing evolution of blockchain technology and cryptocurrencies represents a significant shift in the financial landscape, with the potential to reshape international payment systems. As stakeholders navigate the complexities of this new paradigm, the successful integration of digital currencies will depend on a delicate balance between innovation, security, and regulation. By embracing this transformative potential, the global financial ecosystem can move towards a more inclusive, efficient, and resilient future.

List of references

- Atlantic Council. CBDC tracker.
  https://www.atlanticcouncil.org/cbdctracker/

- Bank of International Settlements – BIS (2019), The Bahamian Payment System Modernisation: Advancing Financial Inclusion Initiatives, Central Bank of The Bahamas Blockchain Seminar.
  https://www.bis.org/review/r190321a.pdf

- Central Bank of the Bahamas. (2022). CBDC updated paper.
  https://www.centralbankbahamas.com/viewPDF/documents/2022-09-23-13-49-13-CBDCupdated-paper.pdf

- Deloitte. CBDC - Central bank digital currency.
  https://www.deloitte.com/global/en/Industries/financial-services/perspectives/cbdc-central-bank-digital-currency.html

- Di Filippi, P. Next generation internet.
  https://ec.europa.eu/futurium/en/system/files/ged/primavera_de_filippi_-_bitcoin_blockchain.pdf

- European Data Protection Supervisor. Techsonar: Central bank digital currency.
  https://edps.europa.eu/press-publications/publications/techsonar/central-bank-digital-currency_en

- Intereconomics. (2023). The evolution of the sand dollar.
  https://www.intereconomics.eu/contents/year/2023/number/4/article/the-evolution-of-sanddollar.html

- McKinsey (2023). What is central bank digital currency (CBDC)?
  https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-central-bank-digital-currency-cbdc

- 51 critical blockchain statistics: 2024 data analysis and market share.
  https://financesonline.com/blockchain-statistics/

- PwC. (2023). Global crypto regulation report.
  https://www.pwc.com/gx/en/new-ventures/cryptocurrency-assets/pwc-global-crypto-regulation-report-2023.pdf

- Nakamoto, S. (2009). Bitcoin: A peer-to-peer electronic cash system.
  https://bitcoin.org/bitcoin.pdf

SulPayments

15+ years of experience

Our solutions

Accept payments

- Accept local payment methods in Brazil, Mexico, Chile, Peru, Colombia.
- Multicurrency cross border settlement of your choice: USD, EUR, CHF, USDT.
  Local processing and settlements, send payouts in Brazil and Mexico.

Accept crypto payments

- Accept crypto payments and receive fiat worldwide.
- Multicurrency processing local currencies Brazil, Mexico, Chile, Peru, Argentina, Colombia settlement in USDT.
- OTC services for USDT liquidity.

Why SulPayments?

Cost Efficient

Our direct connections across Latam and Europe allow us to provide you with competitive pricing and a solid set up.

Seamless

Thanks to our unique set up we can make your cross border operations in Latam faster, transparent and efficient.

Compliant

We work with authorized entities only ensuring your operations runs smoothly and without interruptions with a unique set up.

authorized in Switzerland by:

VQF Association for Quality Assurance of Financial services

www.sulpayments.ch

EXPERT INTERVIEWS

1-1

3. EXPERT INTERVIEWS

This chapter aims to provide valuable insights from industry experts in the fields of payments, settlements, cross-border transactions, and stablecoins. Through interviews with seasoned professionals, we explore current trends, challenges, and the transformative potential of emerging technologies like blockchain and digital currencies. These conversations will illuminate how innovation can drive growth and enhance efficiency in the global financial landscape.

The following professionals provided their answers:

- Natascha Arrais - SulPayments Switzerland
- Ricardo Schlatter - Allegra Law (Switzerland)
- Arik Gabay - Amina Bank
- Sebastien Maraine - Gigadat
- Marinus Marinou - MariCorp Cyprus Consultancy
- Daniel van der Woude - Nuklai
- Borja Guadamuro & Pilar Gil - 4 Eyes Compliance Solutions
- Alyne Sousa - PG Advogados (Brazil)
- Benedikt Kukačka - Crystal Intelligence
- Hugo Castrejón González - SulPayments (Mexico)
- Michele Federici - Sig9.ch
- Alexander Ray - Albus Protocol
- Paolo Guarnerio - Berglinde

3.1. Natascha Arrais - SulPayments Switzerland

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

When it comes to digital payments, Brazil and Portugal provide highly efficient, user-friendly platforms like PIX and MBWAY, which have transformed the way consumers handle everyday transactions. PIX, launched by the Central Bank of Brazil, allows instant transfers between accounts 24/7, at no cost for individuals. This makes it ideal for daily payments, whether at supermarkets, gyms, or pharmacies, where transactions typically range from 5-10€. Similarly, in Portugal, MBWAY offers a mobile-based payment system that links your bank account to your phone number, making it incredibly easy to send and receive money in real time. Whether you're splitting a bill with friends or paying for groceries, these systems have made cashless, hassle-free payments the norm.

In terms of card payments, I initially relied on a credit card from ITAU Bank in Brazil for many transactions, including international ones. Surprisingly, using a Brazilian credit card abroad wasn't as expensive as I anticipated, with reasonable fees. Brazil also offers a wide array of payment options, including the "Buy Now, Pay Later" (BNPL) model, which has gained popularity in recent years. This option allows consumers to spread the cost of purchases over time, giving them more financial flexibility while still meeting their immediate needs.

When it comes to international transactions, I've had personal experience with transferring money from Europe to Brazil using WISE. Typically, I move EUR to my WISE account, convert it to BRL, and then send it manually to a Brazilian bank account. This method has proven to be both cost-effective and reliable. WISE offers very competitive exchange rates, low transfer fees, and a well-designed app that makes managing international transfers a breeze. It also caters to both individual users and businesses with corporate accounts, making it a versatile choice. However, WISE does have certain transaction limits depending on the account type and the level of user verification. Despite these limits, it's one of the best options available for international transfers, both in terms of cost and convenience.

Security in retail transactions has reached a high standard, particularly with the integration of advanced features like facial recognition for transaction approval. Much of this security is driven by the quality of the mobile device you're using; high-end smartphones typically come with more advanced security features, including biometric authentication, making

payments more secure than ever. As a result, the overall safety of retail payments is now closely tied to the capabilities of the user's device, ensuring that if you have a good smartphone, you can trust in the security of your transactions.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

One of the most prominent challenges in cross-border settlements within the fintech industry is the variation in regulatory requirements from country to country. For example, when processing a payment between the EU and Brazil, European regulators may require certain certified documents like proof of identity, tax compliance, or business registration. These documents often need to be translated into Portuguese for Brazilian authorities, adding layers of complexity. In some countries like China or India, fintech companies might need additional certifications or approvals, such as specific licensing, compliance with data protection laws, or additional due diligence on the source of funds. This creates a significant administrative burden that can slow down settlement processes.

For instance, if a company in the U.S. is settling payments with a partner in Japan, there may be requirements to submit documents in both English and Japanese, all of which must be legally certified and authenticated by respective local authorities. This results in additional time spent on paperwork, and any small discrepancy can result in further delays.

Another example is the challenge posed by time zone differences. If a fintech company based in London needs to settle a transaction with a partner in Australia, the time difference of around 10 hours can delay processes that require real-time coordination, such as document signing or approvals. Even simple tasks like getting signatures for compliance purposes can take at least an extra business day due to these time zone differences, resulting in a T+1 or even T+2 delay in the transaction.

This is particularly impactful when dealing with urgent international payments, such as cross-border payroll or vendor payments, where the delays caused by differing time zones or document processing can affect cash flow or business operations. These inefficiencies, combined with the regulatory and administrative hurdles, make cross-border settlements a more time-consuming and costly endeavor for fintech companies.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Fintech innovations such as blockchain, artificial intelligence (AI), and smart contracts are poised to significantly transform the future of cross-border payments, leading to greater automation, transparency, and efficiency. Blockchain technology, for example, enables decentralized, tamper-proof transactions that are immediate and secure. Unlike traditional banking systems that often involve multiple intermediaries and layers of verification, blockchain allows for direct peer-to-peer transfers. This not only speeds up the process but also ensures that all transaction details are recorded on a transparent ledger, making it far more reliable and accessible than conventional bank statements. The clarity and real-time nature of this data will streamline international payments, reducing the time and cost typically associated with cross-border settlements.

AI also plays a key role by automating many aspects of payment processing, including fraud detection, currency conversion, and compliance checks. AI algorithms can analyze vast amounts of transaction data instantaneously, identifying patterns that could indicate fraudulent activities or errors. This enhances security and ensures that payments are processed accurately, reducing the risk of delays or costly mistakes. For instance, AI could be used to automatically flag unusual transaction patterns in real-time, providing an extra layer of protection in cross-border payments.

Smart contracts, another innovation, have the potential to revolutionize international payments by enabling self-executing agreements between parties, with terms written directly into code. Once predefined conditions are met, payments are automatically triggered, eliminating the need for intermediaries and reducing the potential for human error. For example, a business in Europe could use a smart contract to settle an invoice with a supplier in Asia, where the contract would automatically release payment once the shipment is confirmed, ensuring a seamless transaction.

These technologies will likely lead to a future where cross-border payments are faster, more secure, and far more efficient than today's traditional methods. By eliminating the need for intermediaries, reducing manual intervention, and providing real-time data transparency, blockchain, AI, and smart contracts will help companies manage international transactions with minimal delays and lower fees, paving the way for more streamlined global commerce. Technology leads to more atomization. All transaction details are clean, listen, better than a bank statement, immediate, direct, secure, Will streamline payment especially international payments.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

To enhance the speed and reliability of cross-border transactions, several key improvements in fintech solutions are necessary, particularly around usability, infrastructure, and mass adoption of emerging technologies like cryptocurrency. Firstly, the user experience (UX) and user interface (UI) of fintech platforms must be optimized to ensure seamless and intuitive navigation. A clean, straightforward interface is crucial for users to easily access and complete transactions, especially when dealing with cross-border payments, which often involve multiple currencies and steps. Features like face recognition for identity verification can significantly streamline the process, making transactions faster, more secure, and reducing friction for users. This kind of biometric authentication not only improves security but also enhances the overall experience by eliminating the need for manual password entry or two-factor authentication methods, which can slow down transactions.

Secondly, infrastructure improvements are vital to support the growing demand for instant, reliable international payments. Current systems, even in fintech, are often limited by outdated banking rails or intermediary systems that introduce delays. Developing and adopting new infrastructure that leverages blockchain or decentralized networks can dramatically reduce settlement times by allowing peer-to-peer transactions without needing third-party validation. This shift would require global collaboration between financial institutions, governments, and fintech providers to standardize and build interoperable systems that enable faster cross-border payments.

Finally, mass adoption of cryptocurrencies could further revolutionize cross-border transactions. While cryptocurrencies have already proven to be effective for international payments—thanks to their decentralized nature and ability to bypass traditional banking fees—their full potential remains untapped due to limited mainstream usage. Increasing the general public's understanding of, and comfort with, using cryptocurrencies for everyday transactions is essential for achieving faster, more reliable cross-border payments. If cryptocurrencies become more widely accepted and integrated into everyday financial systems, they could offer near-instant settlement times, lower fees, and enhanced security compared to traditional fiat currencies.

In summary, improving the usability and design of fintech platforms, upgrading the underlying infrastructure, and encouraging the widespread use of cryptocurrencies are key steps to enhancing the speed and reliability of cross-border transactions. These changes will lead to a more efficient, user-friendly, and secure global financial ecosystem.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current international fintech regulations significantly impact the efficiency of cross-border payments and settlements. The process is often hampered by the extensive documentation requirements imposed by different countries. Each jurisdiction has its own set of regulatory standards, necessitating a diverse array of certified documents such as proof of identity, tax records, and business verifications. This paperwork must frequently be translated, notarized, and submitted for approval, which can be both time-consuming and administratively burdensome.

Moreover, despite advancements in automation, the need for manual oversight persists. A real person must typically review and validate these documents to ensure compliance with local regulations, introducing additional delays. This human element, coupled with varying regulatory turnaround times across different time zones, can further slow down the settlement process.

The challenge is compounded by the jurisdictional differences and the evolving nature of regulations in the fintech industry. Different countries have unique legal and regulatory frameworks for financial transactions, which can create inefficiencies when trying to establish a streamlined, uniform process for cross-border payments. What is considered compliant in one country may not meet the standards in another, leading to further complications. As fintech regulations continue to evolve globally, companies face increasing challenges in navigating these diverse requirements, adding to the complexity and cost of international transactions.

Overall, the current regulatory landscape introduces significant inefficiencies into the cross-border payment process. The administrative burden of documentation, coupled with jurisdictional discrepancies and the need for ongoing manual review, results in slower, more costly, and less seamless international transactions.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech companies are poised to play a pivotal role in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments. As the financial sector evolves, CBDCs represent a significant innovation, offering the potential to enhance the efficiency, speed, and security of international transactions. Fintech companies, with their technological expertise and innovative capabilities, are well-positioned to facilitate this transition and maximize the benefits of CBDCs.

One of the primary roles fintech companies will play is in the development and integration of CBDC infrastructure. They can leverage their advanced technological platforms to integrate CBDCs into existing payment systems, ensuring compatibility and smooth interoperability with traditional financial networks. By incorporating CBDCs into their platforms, fintech companies can offer seamless, real-time cross-border payment solutions that reduce transaction times and lower costs, addressing some of the current inefficiencies associated with international payments.

Additionally, fintech companies will be instrumental in educating businesses and consumers about CBDCs. They can provide insights into the benefits and functionalities of digital currencies, helping to drive adoption and build trust in these new systems. Through user-friendly applications and services, fintech firms can make it easier for users to access and utilize CBDCs, promoting widespread acceptance and integration.

Fintech companies can also contribute to the development of regulatory frameworks for CBDCs. Their experience in navigating complex financial regulations and their interaction with diverse markets make them valuable partners for central banks and regulators. They can offer practical insights into how CBDCs can be implemented effectively while addressing potential challenges and ensuring compliance with global standards.

Furthermore, fintechs are well-positioned to innovate around CBDCs, exploring new use cases and applications that can enhance the functionality of digital currencies. From advanced analytics to integrating CBDCs with blockchain technology, fintech companies can push the boundaries of what's possible with digital currencies, creating new opportunities for cross-border transactions and financial inclusion.

In summary, fintech companies will play a crucial role in the successful adoption and implementation of CBDCs for cross-border payments. By developing infrastructure, educating stakeholders, contributing to regulatory frameworks, and driving innovation, they will help to unlock the full potential of digital currencies, making international payments more efficient, secure, and accessible.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

In my view, the most promising technological advancement for improving cross-border payments in the next five years is the enhanced integration and innovation within payment systems. As technology progresses, we will see a more seamless connection between different payment networks and platforms. This increased interconnectivity is expected to

significantly streamline the cross-border payment process, making transactions faster and more efficient.

The impact of these advancements will also be reflected in lower transaction fees. As digital payments become more widespread and the infrastructure supporting them becomes more sophisticated, the cost of cross-border transactions is likely to decrease. The normalization of digital payments and the growing number of users will drive competition among service providers, further reducing fees and making digital transactions more accessible.

Additionally, the rise in digital financial services will play a crucial role in the success of cross-border payments. With more people adopting digital payment methods, the infrastructure will continue to evolve and improve, enhancing the reliability and efficiency of international transactions. Innovations such as blockchain technology will also contribute to this progress by providing secure, transparent, and tamper-proof transaction processing. Blockchain's ability to facilitate direct peer-to-peer transactions will reduce reliance on intermediaries, thereby speeding up processes and cutting costs.

Overall, the future of cross-border payments will be shaped by these technological advancements, leading to a more integrated, cost-effective, and user-friendly payment experience on a global scale.

3.2. Ricardo Schlatter - Allegra Law (Switzerland)

1. How do you evaluate the current state of cross-border payment systems for fintechs?

The payment market is still dominated by bigger players who are all happily taking their share of the pie. I am advising more and more fintechs who are breaking into this market dominance with innovative business models. The market is growing due to technological advancements and increasing global transactions. Client demand seems high, not only for retail but also for small and medium enterprises in different sectors.

2. Why would such fintech choose Switzerland as the place for their business?

Switzerland is perceived as a very stable and pragmatic country related to the applicable rules for payment providers. Many other jurisdictions only allow prudentially supervised companies to be active in this field, e.g. with a so-called EMI-license, which stands for electronic money institution. Compared to that, the Swiss concept of self-regulatory organisations works highly efficient. This is a key differentiator because depending on the business model, a Swiss institution may operate a payment system with a membership to a self-regulatory organisation. This is not a prudential supervision but requires a fully-fledged AML-framework. Whether such SRO-membership is sufficient mainly depends on how the custody of the client assets is handled and on the size of the payment system. In this case, clients have a short go to market time here in Switzerland combined with reasonable setup costs.

3. What are the primary challenges you encounter for fintechs who want to enter the market?

Fintechs have two options how to become an important player in the payments industry. They can challenge the existing players and try to replace them, or they can find a particular sweet spot or new role in the existing ecosystem. For a start, collaborating with existing players is probably easier, but requires an offering which is not only better for the end-client but also comes with an incentive for the existing players to work with the fintechs. Such incentive could be regulatory pressure like in the EU where PSD3 and FIDA are being implemented. In Switzerland, we have no such "Open Banking / Open Finance" regulation, which forces the bigger players to work with fintechs. However, and as so often, open finance projects will follow in Switzerland soon, not driven by a revision of the existing rules but through innovation in the market. Not only from fintechs but also from the very well-known players such as SIX who launched their bLink platform.

4. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Even though the crypto valley is very well established, only a small amount of crypto services provider is related to payments. How come? For payment providers, connectivity to TradFi legacy systems is crucial. Given that, APIs are probably more important than blockchain or other new technologies. On the other hand, many of our clients are bridging the gap between TradFi and NewFi systems. New business cases may not be one or the other but combine the advantages of both worlds.

5. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

There are various possible key improvements in fintech solutions. Using APIs for instance, can significantly improve the speed and transparency of cross-border payments, e.g. with real-time FX rates integrated into the existing systems of the clients. A big topic these days are also instant payments. Although, a few players such as SWIFT have a quasi-monopoly at the moment, new business cases emerge which allow clients to pay their out-of-country customers and vendors instantly, with little to no friction points. The use of stablecoins or other crypto-assets can further facilitate faster and more reliable transactions by by-passing traditional banking systems. However, such faster payments should go hand-in-hand with enhanced security measures, e.g. against cyber threats and with automated compliance checks.

6. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

There are various global “soft law initiatives”, e.g. from the G20, the Bank for International Settlements (BIS), the Financial Stability Board (FSB) and the International Monetary Fund (IMF). This gives us a pretty good idea of how the future cross-border payments regulation will look like. The focus of future regulation will be an interoperability of different payment system, access for non-bank players and very robust risk and compliance frameworks. Overall, the regulatory landscape is dynamic, and innovation, security and compliance need to be carefully balanced.

7. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

With the Swiss National Bank’s Project Helvetia, Switzerland is at the forefront of implementing wholesale CBDC. Unlike a retail CBDC, a wholesale CBDC can only be used

among financial institutions but will unlock new opportunities in streamlining cross-border payments, FX and cross-country securities transactions. The world's first issuance of wholesale CBDC on a regulated third-party platform happened within this project Helvetia. Fintechs are poised to play a crucial role in the adoption and implementation of such projects, for example by providing the technological backbone to central banks, by developing interoperability solutions and robust security and compliance frameworks, as well as by conducting pilot programs and real-world testing of CBDCs. Overall, fintech companies will be instrumental in bridging the gap between central banks and end-users, ensuring that CBDCs are not only technically sound but also widely adopted and trusted.

8. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Competing with existing infrastructure providers is challenging. A lot of our clients have accepted this challenge, by facilitating payments through a blockchain-based ledger significantly reducing costs and time for cross-border payments. For example, SulPayments is a very interesting company who is facilitating cross-border payments by exchanging FIAT received through merchants into stablecoins. Transactions that currently take days can be completed in minutes or even seconds, thanks to the decentralized nature of blockchain.

3.3. Arik Gabay - Amina Bank

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

I see cross-border payments as rather inefficient and cumbersome at the moment, as the high fragmentation in international regulation and different risk appetites of banks and payment providers make it virtually impossible to implement scalable automation and therefore have high STP rates. However, the positive aspect of stringent regulation is security, where I currently do not see many issues. This can differ though, if we speak about non-traditional and more anonymous payment routes such as crypto.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

As mentioned in the answer above, the task of implementing a compliant, scalable and highly automated AML engine to facilitate a high number of international payments through traditional as well as non-traditional routes (e.g. blockchain) with an STP rate close to 100%, is what I see as most challenging. With an increasing number of global payments, especially micro payments in emerging markets, I believe to be ready for this development will be key for organizations to scale without a linear increase in staff.

3. How do you perceive the impact of fintech innovations (e.g. Blockchain, AI, smart contracts) on the future of cross-border payments?

With blockchains and smart contracts being able to interact with another autonomously, the number of transactions (also considering IoT) will increase exponentially in the years to come. Given this trend, implementing rule-based engines enriched or fully run by AI is paramount, as the human element could become the limiting factor in this scenario. Pattern recognition, continuous learning and improvement of existing rulesets and autonomous decision making (where feasible) is where I see AI to be the most promising.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

The only thing that can increase speed is STP processing. And the only way to enable this is to create a very clear rule matrix, taking into account the country of origin, destination and the settlement routes that are in place for the combination. If such a ruleset is in place, not only does the speed increase, but so does the reliability, as possible grey zones are reduced or even eliminated. Of course there are other improvements that can be made on the customer touchpoints, i.e. reducing free text fields, validating user inputs before broadcasting (IBAN checker, address checks) etc., that increase the quality of the input into these payment engines, hence improving the quality of the output (speed / reliability).

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

International regulation is currently very stringent due to geopolitical and macro economical events in the past couple of years. Therefore, to be compliant and especially to be on top of changes and new regulations, a high number of specialized personnel is needed. This elevates the entry barriers for startups, significantly increasing the costs to build and maintain an operating business in this field. Therefore, the regulatory landscape skews the market in favour of big, existing players that have the resources at hand to cope with this complex and resource intensive task. The advantage that fintechs have, however, is that they are much more flexible and agile than large organizations with rigid structures and decision-making paths. They can therefore adapt and possibly change business models, if need be, to stay ahead of the pack.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

I believe fintechs will play a crucial role in adoption of CBDCs, as they dispose of the necessary knowledge but also the risk appetite and flexibility in structure to engage in such endeavours. As these projects will be of tremendous scope, I think we will see many joint ventures between these fintechs and larger institutions that provide resources, stability and existing structures that will be crucial for such projects to succeed. By engaging in such ventures, fintechs will be able to influence the outcome massively and therefore have the chance to shape the solutions to be as customer friendly as possible.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

I could see the combination of cryptocurrency payments and artificial intelligence to be a catalyst for more seamless and speedier cross-border payments, as it can leverage non-traditional routes and infrastructure. Being governed by the same regulatory framework, however, having AI solutions in place that help to become and to stay compliant, to me seems an obvious necessity.

3.4. Sebastien Maraine - Gigadat

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

In my view, cross-border payment systems in fintech have made significant strides, but there's still a long way to go, especially when it comes to moving away from legacy infrastructure. The emergence of blockchain has been a game changer, offering greater efficiency by cutting out intermediaries and lowering costs. However, many banks and governments are still tied to old networks, making the transition slow. Security has improved thanks to encryption and fraud detection technologies, but compliance with differing regulations adds complexity. Overall, fintech is on the right path, but broader blockchain adoption could really harmonize systems globally and drive further efficiency.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

The biggest challenge we face is the reliance on outdated banking networks, which are slow and expensive to use. Many banks and governments are hesitant to adopt new technologies like blockchain because of regulatory challenges and unfamiliarity with the technology. Another issue is the lack of interoperability between national payment systems, and this is compounded by inconsistent regulations across borders. While blockchain has the potential to address these problems, the resistance to change makes progress slower than it should be.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

I believe fintech innovations like blockchain, AI, and smart contracts will completely reshape the future of cross-border payments. Blockchain, in particular, has the ability to eliminate intermediaries, speeding up transactions and cutting costs. AI will play a key role in improving fraud detection and risk management, while smart contracts will automate payments, reducing delays and errors. That said, the full impact of these technologies will depend on how quickly traditional financial institutions and regulators adopt them. Once that happens, the transformation will be significant.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

For cross-border payments to be faster and more reliable, fintech solutions need to be more interoperable with traditional banking systems and regulatory frameworks. Blockchain has the potential to bridge these gaps, but its broader adoption is key. On top of that, governments and regulators need to work together to create a more consistent global regulatory environment. User-friendly platforms and more advanced fraud detection tools, powered by AI, would also enhance the reliability of transactions by reducing errors and mitigating risks.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current regulations are often a bottleneck for cross-border payments. Internationally, regulations are fragmented and outdated, which creates inefficiencies and adds complexity to compliance. This not only slows down payment flows but also increases costs for fintech companies trying to navigate different regulatory environments. Blockchain offers a way to harmonize these processes, but regulatory resistance to adopting new technology remains a significant hurdle. For fintech to reach its full potential, we need more alignment and cooperation between regulators on a global scale.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech companies will be key players in the development and implementation of CBDCs, particularly for cross-border payments. Their experience with blockchain and digital payments will help central banks create secure, efficient, and interoperable systems. I see fintechs as crucial partners in providing technical expertise to solve the challenges that come with CBDCs. However, collaboration between fintechs, governments, and international regulators will be essential to ensure that these digital currencies are integrated smoothly into the global financial system.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Without a doubt, blockchain is the most promising technology for improving cross-border payments in the coming years. It offers a decentralized, secure, and transparent infrastructure that can solve many of the inefficiencies present in traditional systems. Blockchain's ability to reduce intermediaries, lower transaction costs, and enable real-time settlements makes it a game-changer. However, the key to realizing this potential will be

overcoming the regulatory and institutional resistance that's slowing down its adoption. Once that happens, I believe we'll see a significant shift in how cross-border payments are processed.

In conclusion, while blockchain and fintech innovations have the potential to revolutionize cross-border payments by streamlining systems and boosting efficiency, the real challenge is in how quickly governments can understand and adopt these technologies. Historically, regulatory bodies tend to lag behind, often taking years or even decades to develop frameworks for emerging tech.

This delay could prevent the full benefits of blockchain from being realized. For blockchain adoption to succeed, governments need to better understand these innovations and act faster in creating supportive regulations.

Otherwise, we risk seeing a surge of users turning to unregulated platforms, which could lead to a regulatory overreaction and stifle the very innovation we're trying to promote. Until a balanced regulatory approach is in place, blockchain adoption for cross-border payments will likely continue to face delays in several geos.

3.5. Marinus Marinou - MariCorp Cyprus Consultancy

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

The current cross-border payment systems in fintech have improved in terms of speed and accessibility, thanks to digital innovations. However, lots of banks and specifically the traditional brick and mortar banks do not follow the SEPA INSTANT PAYMENT method where funds within the EU can be remitted instantly. Traditional systems like SWIFT are slow and expensive, but fintech companies have introduced faster, cheaper, and more transparent alternatives. Fintech Companies tend to take advantage of such EU functions as opposed to the traditional ones. An issue which remains at large in all the banking sector worldwide but within the EU specifically is the high bank charges starting from opening fees to maintenance and transactions fees. Some fintech Companies even charge an incoming fee of 1% and then a different one for payouts.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

Cross-border settlements in the fintech industry face several challenges that impact transaction efficiency, cost, and speed. One major issue is that instant payments are not universally adopted by banking institutions. While some countries have implemented real-time payment systems, others still rely on traditional methods, causing delays. Banks often resist adopting instant payments due to concerns over regulatory compliance, particularly anti-money laundering (AML) laws. Additionally, not all banks have the technology to support instant payments, complicating integration with fintech solutions.

High processing and maintenance fees are another significant challenge. Currency conversion costs can be substantial, and traditional banks typically impose high fees for international transactions, such as wire transfer charges. These costs often get passed on to customers, making cross-border payments expensive.

Processing delays also occur, especially when AML approvals are required. Many banks have strict policies necessitating manual approval for transactions, leading to delays for high-value transactions or those that trigger alerts. The complexity of compliance across

different jurisdictions can complicate this further, increasing the risk of legitimate transactions being rejected due to minor discrepancies.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Fintech innovations, particularly in areas like blockchain, decentralized finance (DeFi), and artificial intelligence (AI), are poised to significantly impact the future of cross-border payments.

Blockchain technology has revolutionized payment institutions by accelerating the speed of transactions. Its decentralized nature eliminates the need for intermediaries, which reduces delays and lowers fees to nearly zero. Because blockchain operates without a centralized authority, there is no requirement for manual checks on each transaction, allowing peers to transact freely and efficiently.

Decentralized finance (DeFi), a sub-sector of blockchain, further enhances this landscape by enabling lenders to earn returns on their assets while providing borrowers with easier access to funds that might otherwise be restricted. This opens up new avenues for financing and investing, making capital more accessible across borders.

Artificial intelligence (AI) plays a critical role in improving the overall security and efficiency of cross-border transactions. AI technologies can enhance fraud detection by analyzing transaction patterns and identifying anomalies. Furthermore, AI can automate compliance processes and improve risk management, ensuring that transactions adhere to regulatory requirements while minimizing the chances of delays due to compliance checks.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

To enhance the speed and reliability of cross-border transactions, several improvements are necessary in fintech solutions.

Incentives from governments are crucial for fostering innovation in the fintech sector. Currently, many governments primarily support traditional brick-and-mortar banks, which hampers the growth of fintech companies. By providing incentives, governments can encourage these companies to develop solutions that enhance cross-border payment efficiency.

Faster anti-money laundering (AML) reviews are also essential. Many fintech startups lack the robust AML teams that larger institutions have, resulting in slower issue resolution. Regulators should impose minimum requirements for AML departments within fintech

companies to ensure that these organizations can respond more quickly to compliance issues without compromising security.

Finally, addressing lower fees is important for improving cross-border transactions. By reducing intermediary costs and enhancing blockchain scalability, fintech companies can significantly lower transaction fees, making cross-border payments more accessible and efficient for users.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current regulations present a blend of efficiency and inefficiency for fintech companies, significantly affecting their operations and competitiveness. While some regulations foster innovation and secure transactions, others can be cumbersome, hindering agility. Fintech firms with a higher risk appetite tend to perform better in this environment, as they are more willing to embrace innovative business models and adapt quickly to market changes. In contrast, companies that prioritize exhaustive Know Your Customer (KYC) onboarding processes may struggle, as lengthy verification can frustrate potential customers and lead to higher drop-off rates during onboarding.

To improve the landscape for all fintech firms, regulators should adopt a more flexible approach to oversight. Instead of imposing rigid, one-size-fits-all regulations, they should consider the unique contexts of different fintech companies. By monitoring licenses quarterly, regulators can proactively identify compliance issues and offer guidance for corrective actions. This ongoing oversight will help fintech firms navigate regulatory challenges more effectively, promoting a dynamic ecosystem where both innovation and consumer protection can thrive.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech companies and central banks must collaborate closely to effectively promote Central Bank Digital Currencies (CBDCs). This partnership is vital because fintech firms serve as key gateways for CBDCs, providing the infrastructure and user-friendly applications that make digital currencies accessible to the public. As consumers increasingly rely on digital solutions for their financial needs, fintech companies excel at creating intuitive platforms that enhance user experience. By integrating CBDCs into these applications, fintech firms can facilitate seamless transactions and improve user engagement. Additionally, their insights into consumer behavior can help central banks design CBDCs that address specific user needs, such as security and compliance. Collaborating also allows central banks to tackle concerns about CBDCs, including privacy and financial inclusion. By leveraging fintech expertise, central banks can develop solutions

that mitigate these issues while educating the public about the benefits of CBDCs, such as faster transactions and reduced costs.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Blockchain technology, alongside artificial intelligence (AI), represents one of the most promising advancements in the digital landscape today. When these two powerful technologies are effectively combined, they have the potential to transform the way we produce, market, and sell goods and services, ultimately leading to a more productive and efficient global economy.

Blockchain offers a decentralized, transparent, and secure method for recording transactions, while AI enhances data analysis, decision-making, and automation. Together, they can streamline processes across various industries by enabling smarter supply chain management, improving data integrity, and enhancing customer experiences. For instance, blockchain can provide an immutable record of transactions, ensuring transparency and trust in the supply chain, while AI can analyze this data to optimize logistics, predict consumer behavior, and personalize marketing strategies.

As these technologies continue to evolve and integrate, we may reach a future where the production and distribution of goods and services rely entirely on blockchain and AI solutions. This shift could lead to unprecedented levels of efficiency, lower costs, and improved sustainability, as businesses can better track resources, minimize waste, and respond swiftly to market changes.

3.6. Daniel van der Woude - Web3 & Blockchain Product Leader

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

Traditionally, cross-border payment systems have been always inefficient due to high fees and long processing times often taking several days for funds to reach the recipient. This delay comes from the involvement of multiple intermediaries or correspondent banks, each adding complexity to the transaction. As the money passes through various banks in different countries, the origin of funds can become obscured, increasing the risk of fraud and money laundering.

Criminals can exploit these gaps, especially since countries often have different levels of anti-money laundering (AML) regulations and enforcement. The lack of consistent oversight across jurisdictions makes it easier for illicit activities to go unnoticed. While newer fintech solutions aim to address these issues by streamlining processes and improving transparency, these legacy systems still pose significant challenges in terms of both efficiency and security.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

There are two main challenges that are encountered with cross-border settlement, that are also challenging to really overcome.

The first one is the varying regulations across countries create a complex compliance landscape, particularly around anti-money laundering (AML) and know-your-customer (KYC) procedures. This inconsistency not only slows down transactions but also increases their costs and the risk of legal and financial penalties due to non-compliance.

Additionally, many payment systems are built on outdated infrastructure that increase technical complexities, preventing the deployment of new, scalable, real-time solutions that are urgently needed. Security risks further compound the problem, with cross-border payments being especially vulnerable to cyberattacks, fraud, and money laundering as sensitive data passes through multiple intermediaries.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Blockchain technology allows cross-border payments to take place in near real-time, with almost instant settlement. This significantly reduces transaction costs and eliminates the need for intermediaries. Individuals and businesses that engage in frequent cross border payments save both time and money thanks to blockchain technology.

Smart contracts further enhance efficiency by automating the settlement process, ensuring that payments are made only when specific pre-defined conditions are met, as set within the contract. This automation reduces the risk of disputes and streamlines operations.

On top of that artificial intelligence (AI) plays an important role in identifying anomalies within transactions, improving compliance with regulatory frameworks, and reducing errors and the risk of financial crimes. AI can also help automate many compliance tasks, which lowers the overall costs of adhering to complex regulations, making cross-border transactions safer and more cost-effective.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

To increase the speed and reliability of cross-border transactions, fintech solutions should focus on adopting new technologies, while outdated legacy payment systems must be overhauled. Legacy infrastructure, which often relies on slow and expensive intermediary banks, should be replaced by real-time payment rails capable of handling the complexities of global financial flows. Blockchain technology offers a promising solution, enabling faster, more secure settlements without the need for traditional intermediaries.

As regulatory frameworks evolve, fintech companies must be ready to navigate varying legal requirements across jurisdictions. AI can play a crucial role in this by monitoring and ensuring compliance with diverse regulations in real-time, minimizing errors and reducing the risk of financial crimes. With regulatory oversight increasing, the ability to efficiently manage compliance is essential for the survival of fintechs. Embracing novel technologies is the only viable way to improve efficiency while controlling operational costs.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current regulatory uncertainty hinders fintech innovation. In addition to regulatory differences across the U.S., Europe, and Asia, many countries are still adapting their laws to accommodate emerging technologies like blockchain and artificial intelligence. The absence of clear, harmonized regulations prevents companies from fully embracing these novel solutions.

However, there are positive initiatives aimed at streamlining regulations across borders, such as the Global Financial Innovation Network, which seeks to create a global regulatory sandbox where fintechs can test solutions in multiple jurisdictions with the cooperation of regulators.

Additionally, SWIFT is making efforts to modernize its payment protocols through initiatives like SWIFT Global Payments Innovation, demonstrating that both industry players and regulators are working together to improve the efficiency of cross-border payments.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintechs have a vital role to play in the adoption and implementation of central bank digital currencies (CBDCs). By actively engaging with governments and participating in the co-creation of CBDCs, fintechs can help shape their design to ensure they meet the needs of the market.

On the retail side, fintechs can create user-friendly solutions to encourage adoption, ensuring that merchants can accept CBDCs as a form of payment and consumers can easily integrate them in their daily financial activities.

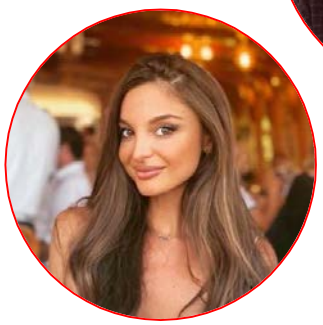
If CBDCs were built on blockchain technology, fintech firms, already experienced with this distributed ledger systems, can demonstrate how this infrastructure can enhance transactions speed, security, and transparency.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Blockchain technology represents the most promising solution for cross-border payments, particularly as a replacement for legacy infrastructure. The key debate lies in whether the ledger for settlement will be on a public or private network. While private ledgers may offer advantages in terms of control and compliance, public ledgers are generally more secure due to their decentralized nature.

In the next five years, as central banks and financial institutions become more familiar with open blockchain technology, I foresee a convergence where public networks will be used for settlement, enhanced by privacy solutions and regulatory compliance frameworks. For example, zero-knowledge proof could allow certain transaction details to remain private while maintaining transparency and security. This approach would balance the need for both privacy and trust in the evolving landscape of cross-border payments.

3.7. Borja Guadamuro & Pilar Gil - 4 Eyes Compliance Solutions



1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

Cross-border payment systems in fintech have made impressive progress in efficiency due to advancements like real-time payments and blockchain technology. These innovations have streamlined processes and drastically reduced transaction times, benefiting both businesses and consumers alike. The integration of advanced technologies has minimized delays and reduced costs, making international transactions smoother and more cost-effective. Blockchain and Distributed Ledger Technology (DLT), for instance, enhance transparency and traceability in cross-border transactions, ensuring secure and tamper-proof record-keeping.

However, while efficiency has improved, security remains a top concern. Ensuring robust security measures is essential to protect against financial crimes and safeguard customer data. Compliance with Know-Your-Customer (KYC) and Anti-Money Laundering (AML) regulations is fundamental to secure cross-border transactions. Fintech companies must implement stringent KYC processes to verify customer identities accurately and continuously monitor transactions for suspicious activities. Advanced AML technologies, such as Artificial Intelligence and machine learning, are being employed to detect and prevent illicit activities by analyzing transaction patterns and flagging anomalies.

Protecting customer data is also paramount. Compliance with international data protection regulations, such as the General Data Protection Regulation (GDPR), ensures that personal information is handled securely and legally. Implementing robust encryption methods and anonymization techniques further enhances data privacy and security, making it difficult for unauthorized parties to access sensitive information.

Considering all this, at 4 Eyes Compliance Solutions we believe that fintech companies that invest in cutting-edge technologies and robust compliance frameworks can differentiate themselves in the market, building trust and credibility with customers and regulators alike. By staying ahead of regulatory challenges and continuously improving their security measures, fintechs can position themselves as leaders in the cross-border payment space.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

In the rapidly evolving fintech industry, cross-border settlements present unique challenges, particularly from a compliance, KYC, and AML perspective. One of the primary challenges we encounter with cross-border settlements is regulatory complexity. Different jurisdictions have varying regulations governing international transactions and navigating this complex regulatory landscape can be daunting for fintech companies, requiring continuous review of international regulatory frameworks, constant vigilance, and adaptation to stay compliant.

Ensuring thorough KYC processes across multiple jurisdictions is also a complex and multi-layered challenge. Fintechs must verify the identity of their customers and accurately assess the risks associated with their transactions. This involves collecting and analyzing a vast amount of personal data, which can vary significantly between countries in terms of type and amount required. For example, one country might accept utility bills as proof of address, while another requires government issued documents. This lack of standardization complicates the process for international companies.

Another challenge we commonly encounter is the risk of financial crime, such as money laundering and terrorist financing. Companies must implement robust AML measures to detect and prevent illicit activities, which often involves sophisticated technology and continuous monitoring. It is essential that companies develop systems capable of monitoring these transactions effectively, and dedicate the right resources to identify unusual patterns that might indicate financial crime. Additionally, these systems need to understand that different jurisdictions have different AML requirements which can be especially challenging for smaller fintech firms with limited resources and budget. Finally, effective AML compliance requires close cooperation with regulatory authorities and other financial institutions, including sharing information and reporting suspicious activities promptly.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Fintech innovations such as blockchain, Artificial Intelligence, and smart contracts are revolutionizing the landscape of cross-border transactions. These advancements hold immense potential to enhance efficiency, security, and transparency, especially in the realm of compliance.

Blockchain offers a decentralized and immutable ledger that records transactions transparently and securely. This technology significantly reduces the risk of fraud and enhances the traceability of transactions, which is crucial for compliance. By providing a clear audit trail, blockchain simplifies the verification process for regulatory authorities and helps fintech companies meet their KYC and AML obligations more efficiently.

AI is transforming compliance in cross-border payments by automating complex cases and enhancing the accuracy of risk assessments. Machine learning algorithms analyze vast amounts of transaction data to identify patterns and flag suspicious activities in real-time. This enables fintech companies to detect and prevent money laundering and other financial crimes more effectively, while also streamlining the KYC process through automated identity verification.

Smart contracts automatically enforce compliance with contractual obligations, reducing the need for manual intervention and minimizing the risk of human error. In the context of cross-border payments, smart contracts can facilitate faster and more secure transactions, ensuring that all parties adhere to KYC and AML requirements seamlessly.

We see these opportunities as substantial. By leveraging blockchain technology, AI, and smart contracts, fintechs can not only enhance their compliance frameworks, but also build greater trust with customers and regulators. These technologies enable more efficient, secure, and transparent cross-border transactions, paving the way for a future where compliance is seamlessly integrated into the transaction process.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

At 4 Eyes Compliance Solutions we believe that to enhance the speed and reliability of cross-border transactions, several improvements in fintech are needed:

(1) Implementing standardized data formats and processes across different jurisdictions can reduce the complexity and time required for cross-border transactions and would facilitate smoother integration and interoperability between various payment systems.
(2) Leveraging technologies such as blockchain or Artificial Intelligence can significantly improve transaction speed and security. Blockchain, for instance, provides a transparent and immutable ledger, reducing the risk of fraud and errors and AI can automate KYC processes and detect suspicious activities in real-time.

(3) Developing interoperable payment systems that can seamlessly connect different financial networks is crucial. This would allow for faster and more efficient cross-border transactions by eliminating the need for multiple intermediaries.
(4) Simplifying and harmonizing international regulations can help reduce compliance burdens on fintech companies. Clear and consistent regulatory guidelines would enable faster implementation of new technologies and solutions.
(5) Implementing real-time payment systems can drastically reduce transaction times, ensuring that funds are transferred instantly, and therefore improving the overall efficiency of cross-border transactions.
(6) Strengthening security measures, such as encryption and multi-factor authentication, is essential to protect sensitive financial data. Robust security protocols can build trust among users and regulators, facilitating smoother cross-border transactions.
(7) Developing solutions that prioritize user experience, such as user-friendly interfaces and transparent fee structures, can enhance customer satisfaction and adoption of cross-border payment services.

We strongly believe that by focusing on these areas, fintech can significantly improve the speed and reliability of cross-border transactions, making international payments more efficient and secure for business and consumers alike.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current international fintech regulations have both positive and negative impacts on the efficiency of cross-border payments and settlements. On one hand, these regulations provide a necessary framework for ensuring security, reducing fraud, and maintaining compliance with anti-money laundering (AML) and counter-terrorism financing (CTF) standards, fostering trust and reliability in cross-border transactions, essential for a growing fintech ecosystem.

However, these regulations often vary between countries, creating fragmented compliance requirements. Navigating multiple jurisdictions can introduce delays and increase operational costs for companies, particularly when handling cross-border settlements. This is compounded by regulatory lag, where traditional rules don't always keep pace with fintech innovations like blockchain or decentralized finance (DeFi).

To increase the efficiency of cross-border transactions within the current regulatory environment, 4 Eyes Compliance Solutions strongly advises the application of several recommendations, aimed to streamline and harmonize fintech regulations:

- Companies need to encourage international collaboration between regulators to establish more unified standards. This could include AML/KYC protocols, tax reporting requirements, or digital identity frameworks that apply across borders. Harmonized regulations would reduce friction in compliance, lower costs, and simplify processes for fintech firms operating across multiple regions.
- Firms need to pressure countries to adopt or align with international regulatory frameworks, such as the Financial Action Task Force (FATF) guidelines for digital currencies or the G20´s recommendations on cross-border payments. International bodies like BIS (Bank for International Settlements) could play a larger role in setting best practices. Greater consistency in regulation would lead to faster onboarding of new financial technologies, reducing delays in cross-border settlements.
- Fintechs need to promote the use of centralized, globally accepted digital ID systems. Leveraging blockchain or other decentralized technologies could allow for seamless and secure verification of individuals and businesses across borders. Enhanced efficiency by reducing the duplication of KYC processes across countries, speeding up cross-border payments.
- Financial firms should embrace blockchain technology to enable real-time settlement of cross-border transactions, reducing delays associated with intermediaries. Clear guidance on the use of blockchain in payments can encourage broader adoption. Streamlining cross-border payments through blockchain can lower settlement times, reduce costs, and improve transparency.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech firms are poised to play a crucial role in the adoption and implementation of Central Bank Digital Currencies (CBDCs) for cross-border payments. By leveraging their technological expertise and commitment to compliance, fintech companies can enhance the efficiency, security, and transparency of international transactions, paving the way for a more inclusive and robust global financial system.

First, firms are at the forefront of technological innovation and can leverage their expertise to facilitate the seamless integration of CBDCs into existing financial systems. By developing APIs and other technologies, fintech companies can ensure that CBDCs are compatible with current payment infrastructures, enhancing the efficiency and speed of cross-border payments.

Secondly, with the implementation of CBDCs, companies can enhance compliance measures through advanced technologies. Blockchain, for instance, provides an immutable ledger that can streamline KYC and AML processes by offering real-time transaction

monitoring and a transparent audit trail. This ensures that all transactions are compliant with regulatory standards, reducing the risk of financial crimes. Fintech companies can also improve KYC processes by using AI and machine learning to automate identity verification and risk assessments, and analyze vast amounts of data. This level of scrutiny is essential for maintaining the integrity of the financial system in the context of CBDCs.

Lastly, effective collaboration with Central Banks for the successful implementation of CBDCs for cross-border payments can provide valuable insights and technological support to central banks, helping to shape the regulatory framework and ensure that CBDCs meet the highest standards of compliance. This partnership can drive innovation and create a more resilient financial ecosystem

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

The emergence of deep fakes poses significant risks when verifying individual identities, especially in the context of cross-border payments. As technology continues to advance, so do the capabilities of deep fake tools, which can create highly convincing audio and video representations of individuals. This poses serious challenges to the integrity of identity verification processes, which are crucial in preventing fraud and ensuring regulatory compliance.

One of the most immediate risks is the potential for criminals to use deep fakes to impersonate legitimate individuals. In cross-border payment scenarios, where transactions often rely on digital identity verification through video calls or biometric data, a convincing deep fake could allow a fraudster to bypass security measures which could lead to unauthorized transactions, financial losses for both individuals and institutions, and a wider impact on trust within financial systems.

Financial institutions are bound by strict Know Your Customer (KYC) and Anti-Money Laundering (AML) regulations that require them to verify the identities of their clients thoroughly. The presence of deep fakes could compromise these verification processes, making it challenging to establish a client's true identity. If organizations fail to adapt to these risks, they could find themselves in violation of regulatory requirements, facing hefty fines and significant reputational damage. This is particularly concerning in cross-border contexts, where regulatory standards may vary widely between jurisdictions.

The increasing prevalence of deep fakes can lead to an erosion of trust in digital identity verification systems as a whole. If individuals and businesses begin to doubt the reliability of these systems, they may become hesitant to engage in digital transactions, potentially

stalling the adoption of innovative payment technologies. This erosion of trust could have long-lasting effects on the financial industry, limiting the potential benefits of technological advancements in cross-border payments.

As the threat of deep fakes grows, businesses will need to invest in more sophisticated technologies and processes to differentiate between genuine identities and deep fakes. This could include the development of advanced biometric verification methods, machine learning algorithms, and other tools to enhance due diligence efforts. However, this increase in complexity may also lead to higher operational costs, requiring organizations to allocate more resources to compliance efforts at a time when many are trying to streamline operations.

The risk of deep fakes extends beyond impersonation in transactions. If an individual's likeness can be convincingly replicated, it raises concerns about identity theft on a broader scale. This could lead to unauthorized access to personal accounts, credit fraud, and other forms of identity theft that further complicate the compliance landscape for financial institutions.

To address these risks, organizations involved in cross-border payments must prioritize developing robust verification methods that can withstand the challenges posed by deep fakes. Some strategies may include:

Institutions can leverage artificial intelligence and machine learning to enhance their identity verification processes. These technologies can help detect anomalies and flag potential deep fakes during the verification process.

Employing multi-factor authentication methods is critical as we can add layers of security that make it more difficult for deep fakes to succeed. This might include combining biometric data with other forms of identity verification, such as secure access codes or document verification.

Lastly, compliance frameworks must be dynamic and adaptable to evolving threats. Regularly updating verification protocols and conducting risk assessments can help organizations stay ahead of potential fraud attempts.

In summary, while there are promising technological advancements on the horizon for improving cross-border payments, the implications of deep fakes on identity verification represent a critical area of concern. Organizations must prioritize enhancing their compliance frameworks and invest in sophisticated verification technologies to mitigate these emerging risks. By addressing these challenges proactively, financial institutions can

help ensure the integrity of cross-border transactions while fostering trust in digital payment systems.

3.8. Alyne Sousa - PG Advogados (Brazil)

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

In my opinion, Cross-border payment systems have made significant strides in efficiency, driven largely by fintech innovations like blockchain, digital wallets, and AI. However, they still face challenges related to security, especially with increasing cyber threats. While blockchain enhances transparency and security through decentralized ledgers, the integration of traditional banking with these new systems still lags in terms of global standardization.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

The main challenges in cross-border fintech settlements, for me, are: Fragmented regulatory environments: Different countries have different regulatory frameworks, making it hard to harmonize cross-border payments. High transaction costs: Traditional financial systems, including correspondent banks, often have high fees and intermediary costs. Slow settlement times: Despite improvements, some systems still take days to settle, compared to near-instantaneous domestic transfers.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Fintech innovations such as blockchain, AI, and smart contracts are set to revolutionize cross-border payments. Blockchain's distributed ledger technology can facilitate near-instant and cost-efficient transactions by removing intermediaries. As we now can see, AI can improve fraud detection, enhance compliance, and optimize currency conversion. Smart contracts can automate and enforce payment agreements, reducing the need for manual intervention and lowering errors.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?To enhance cross-border payments, I believe that fintech solutions need:

- Interoperability: Seamless integration between different payment networks globally.
- Lower transaction costs: Blockchain and other decentralized systems can reduce dependency on intermediaries and lower costs.
- Improved user experience: Simplified interfaces and more transparent exchange rates will enhance trust and reliability. UX is a must nowadays.
- Faster regulatory harmonization: Cross-border regulations need to be more standardized to facilitate quicker, compliant payments.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current international regulations often slow down cross-border payments due to discrepancies in compliance requirements (like KYC/AML). While initiatives such as PSD2 in the EU aim to standardize fintech regulations, other regions may still have complex frameworks that delay settlements and increase compliance costs.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech companies are expected to play a crucial role in the adoption and implementation of central bank digital currencies (CBDCs). These companies can provide the technical infrastructure and platforms for the distribution and transaction of CBDCs, potentially integrating them with existing payment rails to allow faster, more secure cross-border transactions.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

I strongly believe that the most promising technology for cross-border payments in the next five years is likely blockchain. Its decentralized nature can dramatically reduce the reliance on intermediaries, cut down costs, and increase transaction speed. Paired with advancements in AI for fraud detection and smart contracts for automating settlements, blockchain can reshape the landscape for cross-border payments.

3.9. Benedikt Kukačka - Crystal Intelligence

1.How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

Evaluation on Efficiency:

1. Speed: Fintech solutions in general have significantly reduced transaction times, often reaching almost real-time or near-instant payments. Together with the costs involved, this might be the single most important improvement.
2. Fintech firms - due to their non-legacy systems and smaller workforce, are often able to provide services at much lower transaction fees, compared to traditional banks and remittance services.
3. User Experience: Many of the new platforms provide very intuitive interfaces which greatly enhance the user experience.

Evaluation on Security:

1. Regulatory Compliance: Depending on the jurisdiction, many fintechs are now offering services based on regulations (e.g., AML, KYC), which should help to enhance security and build trust.

2. Blockchain Technology: While some fintechs are leveraging blockchain technology and stablecoins for remittances, this comparatively young technology still bears some risks that premature systems come with. Recent hacks like Coinspaid are proof of this.

3. Fraud Prevention: Although advanced algorithms and machine learning are increasingly used to detect and prevent fraudulent activities, the fintech industry sometimes falls victim of it's own success, when the due diligence in client onboarding falls short, due to the vastly increasing numbers of clients.

Conclusion:
While the advantages of using fintechs in cross border payments are clearly on the side of efficiency, the industry itself has yet to mature on the side of security.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

1. Lack of Standardization: While there is no universal standard for cross-border payments, it is difficult to navigate and compare the landscape of fintechs, making it hard to choose the best option.

2. Technical Barriers & Support: Clients may face difficulties navigating the technology or the app from the fintech when making payments. That is particularly hard for the non-tech savvy clients. However, the lack of support from service providers seems to be one of the biggest challenges.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

1. Blockchain
The technology in theory allows all parties to track transactions in real time, enhancing transparency and trust for those who are willing to learn the technology.
By eliminating intermediaries, blockchain can help to lower transaction fees, making cross-border payments itself and especially smaller volumes much more economical.
Blockchain can facilitate near-instant transactions, reducing the time it takes to settle cross-border payments.

2. Artificial Intelligence

- AI can be used to analyze transaction patterns and to identify and prevent fraudulent activities, which improves the overall security
- AI could also help in tailoring services and recommendations to individual users, which enhances the customer experience
- AI can be used in compliance to automate processes, which ultimately reduces onboarding or checks on transactions and improves the user experience.

3. Smart Contracts

- Smart contracts can be used to automatically execute payments which streamlines the process and ultimately eliminates the need for manual intervention.
- Since smart contracts can utilize atomic swaps, the potential of settlement issues is vastly reduced, ultimately making transactions more reliable.
- The automation and transparency that Smart Contracts are offering can enhance trust between parties in cross-border transactions.

Conclusion:
These - and other innovations - are likely to lead to a much more efficient, secure and user-friendly cross-border payment ecosystem. An ecosystem that one day hopefully will also include the unbanked population.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Regulation is - ad definitionem - not designed to accelerate innovation. Regulators must strike a fine balance between allowing the national ecosystem to develop and mature, but also allowing the existing incumbents to do their business. So, whether you see regulation as a blessing or a curse, one of its core principles is to protect the user which sometimes gets forgotten.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

In general, fintechs seem to move quicker and adopt new technologies faster than incumbents. It is therefore most likely that fintechs will also be quicker when it comes to the adoption CBDCs. If that alone will fuel a wider adoption is yet to be seen, as you can tell from the fierce discussions around the necessity of a CDBC (and with that "programmable money on a shared ledger", as Agustin Carstens calls it).

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

The most promising one - blockchain - is already here and being implemented. Being still in its infancy, the next 5 years will be all about adopting and making it not only "as secure" as the traditional payment rails, but also so convenient, that nobody really feels that they're using blockchain as underlying technology.

3.10. Hugo Castrejón González - SulPayments (Mexico)

1.How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

I think in today's landscape, there is a lot of noise in terms of brands and players occupying the space. And the problem is that many of them are bootstrapping themselves with poor local knowledge, inefficient setups and too many intermediaries on the value chain, which brings as consequence: interrupted and unscalable operations, penalties from authorities, extended money flow time and ultimately, high processing rates.

But don't get me wrong, there are a lot of serious players doing great things: processing according to local laws, complying with security and operational guidelines, using trusted and scalable infrastructure to operate, and beating the best costs due to their undeniable volume. But the main issue is that it is very difficult to tell one from another, as there are so many "players" in the industry. So my call on this would be: you can find top level efficiency and security, but you need a highly knowledgeable team or a hell of a partner to navigate securely in this landscape.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

I think the first one and most important for the merchants is TIME. Any money flow outside the company operations has costs, and someone in the value chain has to pay it. As I personally don't think this is the most relevant, when it comes to a financial decision, TIME is always MONEY. Enhancing time is always costly, so being fast and cheap is not easy and certainly a challenge that every payment system has in their radar.

The second and in my opinion the most valuable is CONTINUITY. Market conditions tend to change, regulations evolve and incidents happen, but being prepared in all senses to keep operations going through every new challenge is the most important capability. Continuity is a very extended subject and reflects a company's ability to adapt, and covers up from legal perspective, operational, technological, strategic & marketing. If any of the above does not mutate to adapt to the new conditions, business will be certainly at risk.

PRICE: related to the first one, but no less important, pricing will always be challenging, at least in open market conditions. As we know, TIME is MONEY, but money is not always time. There are some things that just can't be bought, and it could be because they are just abstract things, or more relevant to the subject, there is no technology, agreements or infrastructure to support a cheaper way to do it. As you can imagine: anything can be always more expensive, if there is someone willing to pay the price, in terms of expensive "the sky is the limit". But the other way around, there are limits, and a permanent challenge will be "how can we beat our competitors' prices?

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

My perception is that we are at the edge of the next technological revolution, as the Internet changed how we access information, these technologies are not just changing how we use money, they are changing how we perceive, transfer and enhance VALUE. Money is just one way of storing value, but these innovations are redefining finance as we know it.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

I think there are a lot of very interesting solutions out there, but most of them rely on traditional channels, just with better rates and agreements.

But for me, the real deal will come when DeFi becomes mainstream. There are so many applications to smart contracts that we are not far from a 100% decentralized bank. With decentralized technology, there are no borders anymore, so even the term "cross-border" will be kind of inaccurate in the near future.

New blockchain networks provide speed, low cost and high reliability nowadays, and most stable coins now have multi/cross chain capabilities, so there is a very bright future in terms of speed and reliability, not just from the C2C, but B2B, B2C and all the ways you can imagine.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

I think that regulation will always be a barrier, disregarding if traditional channels are in place, or cutting-edge innovations. It is a reality that regulation is always slower than innovation, so even if we create something revolutionary, regulation will come eventually.

That being said, I think our goal as payment innovators is to create simple, but groundbreaking things capable of adapting to the new regulation landscape. I know that regulation is hard to predict, but if entrepreneurs can understand that the main goal of regulation comes to prevent financial crimes, tax evasion and funding illegal activities, they can play around with a lot of advantages knowing that even if regulation comes, their business will be able to adapt and thrive.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

I see fintech companies as the last mile providers (and certainly the most important in terms of adoption), providing value to merchants and final users. On the merchant side, enabling comprehensive APIS, SDK's and great interfaces, and for the final user providing great user experience, easy to use capabilities and connections with their day-to-day applications.

Fintech companies opened their way in the industry by being where banks and big institutions couldn't, innovating fast and capturing the trust and confidence of the users, while enabling small businesses to scale quickly. They have a lot of experience, and I am pretty sure that for these CBDCs to have mass adoptions, they will require the fintech brands and infrastructure to get popular.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

For me, it will be that CBDCs enable smart contract capabilities, cross-chain compatibility, and offer true open-source platforms so creativity and talent of individuals can detonate adoption, that way, we would be on the verge of unlimited possibilities.

One simple but powerful result will be being able to send money directly from one person to another, from one company to another or any combination you like, just using blockchain rails, but enabling real time payments and settlements, potentially using smart contracts technology. Having multi-currency wallets, real time fx conversion and accessing international investment vehicles will be just the tip of the iceberg of the possibilities. No this is possible with coins and tokens, but imagine this as well with CBDCs.

Certainly, there is a bright future for world payments, in which the most accurate description will be **borderless payments** instead of cross-border payments :)

3.11. Michele Federici - Sig9.ch

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

It surely used to be more complicated and expensive. Luckily for us, blockchain networks are not affected by borders, so the pain points are more or less all about compliance when doing on- and off-ramps. Regulations are somewhat behind and always trying to catch up, but in practice, it's kind of working today, and the experience is not so bad anymore, most of the time.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

Unjustifiably high fees, especially transaction and conversion fees, are the most common pain points in my experience. On top of that, dealing with different regulatory systems can be a headache as well. Given the tech we have, I think most problems are purely artificial, often more complicated and less smooth than they could be.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Blockchain and cryptocurrencies have already made cross-border payments way more efficient by adding new global, open, and almost instant options to an oligopoly of closed middlemen, but there's still a lot of potential to be leveraged, especially when it comes to scaling, establishing reasonable regulatory frameworks, and encouraging more mainstream, real world adoption. The real impact of these technologies is going to depend heavily on what kind of regulations different countries put in place—those decisions could surely boost or slow innovation in this space.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

For real improvements, we need standards that are recognized and adopted widely, especially for interoperability. Systems across different networks, platforms, and countries being able to communicate seamlessly is something that would surely improve both accessibility and reliability. This will take collaboration within the ecosystem; fintechs, banks, institutions, and regulators all need to work together to make this happen.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Frankly, I feel like regulations in this space are always either practically impossible to comply with, or just vague, with huge gray areas and uncertainties. If regulators were more open towards public discussion and opinion, they could surely develop more meaningful guidelines and make life easier for businesses, especially startups and small companies without unlimited funds or an army of compliance officers.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

I'm personally not that excited about the CBDC concept. But if central banks ever decide to go for the route of open standards, other than being a fairer choice for everyone, it would also allow private businesses to potentially have roles in expanding, optimizing, and building on top of such standards. A voluntarily adopted standard will always be more successful and well received than a planned one imposed from top to bottom. The revolution Bitcoin started is hard proof of this.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Even though blocks of nations are becoming increasingly polarized due to political interests, I think people are, on the contrary, still getting more and more connected. I think interoperability layers and gateways are surely going to play a big role in this, and even in authoritative
situations, innovations like zero-knowledge cryptography could help verify truths in environments with a high level of mistrust.

3.12. Alexander Ray - Albus Protocol

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

In my opinion, we've come a long way with cross-border payments in fintech, especially with new technologies like blockchain and AI. These innovations have made transactions faster and more efficient than ever before. However, it's still a bit of a mixed bag. While some cutting-edge solutions are available, many businesses still rely on older, less efficient systems. Most banks still take 3-5 working days to process an international transaction, and it can get flagged by a security algorithm, leading to freezing your account. From there, months can go by before unfreezing it.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

The challenges are pretty clear. First, the cost of cross-border transactions is still too high. Traditional banking systems, which many companies still depend on, use a lot of intermediaries, which slows things down and adds to the expense. On top of that, you have the issue of different regulations in different countries—what works in one jurisdiction might not in another. And then there's currency volatility, plus the constant need to meet various KYC and AML requirements, which is time-consuming and can introduce delays. I think this is where fintech can really make a difference, but we're not there yet.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Personally, I think the impact of fintech innovations like blockchain, AI, and smart contracts on cross-border payments is massive and only growing. Blockchain is already helping to cut out the middlemen, making payments faster and cheaper. AI plays a huge role in identifying potential fraud and ensuring that companies stay compliant without adding too much manual work. And smart contracts? They're a game-changer for automating processes that would normally take days or weeks. Smart contracts are essentially removing the middle-man, making any operations faster and cheaper. These technologies, combined, are shaping a future where cross-border payments can be almost instantaneous, much cheaper, and far more secure.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

To be honest, there's still a lot that can be done to improve the speed and reliability of cross-border payments. We need to see better regulatory alignment between countries so that compliance isn't such a headache. Also, fintech platforms need to become more interoperable—too many systems don't talk to each other, which slows everything down. Blockchain can help here, but it needs to scale better and integrate more smoothly with traditional payment infrastructures. In short, we need faster blockchain protocols and better global regulation standards.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

International fintech regulations are kind of a double-edged sword. On one hand, they're absolutely necessary to maintain security and prevent fraud. On the other hand, they can slow down the whole process. Every country has its own set of rules, and it's tough for companies to navigate that maze efficiently. I think we need a more standardized global framework that prioritizes both security and speed, but that will only happen with more cooperation between regulators and fintech companies. Something similar is happening in the EU with the unified MiCA Rules.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

I truly believe fintech companies are going to be key players in the rollout of central bank digital currencies (CBDCs), especially when it comes to cross-border payments. CBDCs will definitely become a game changer when it comes to simplifying the transactions. However, CBDCs also mean that the government will have even more monetary control, since it will control the emission and will be able to monitor the transactions. They're already ahead in terms of developing the infrastructure that could allow different countries' CBDCs to interact seamlessly. These companies also have the experience to make these platforms secure and user-friendly. It's exciting to think about how fintech could bridge the gap between traditional financial systems and the CBDC-powered future we're headed toward.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

Looking ahead, I'd say the most exciting technological advancement for cross-border payments in the next five years will be blockchain. Decentralized KYC is another trend that I think will become even more important, since it helps to speed up the process of traditional KYC, simultaneously giving the people more control over their information. Tthe emergence of CBDCs will probably push this forward. Imagine real-time, secure, and cheap cross-border transactions—it's not too far off, and fintech will be at the heart of it all.

3.13. Paolo Guarnerio - Berglinde AG

1. How do you evaluate the current state of cross-border payment systems in fintech regarding efficiency and security?

The current state of cross-border payment systems in fintech is marked by varying degrees of efficiency and security. On one hand, advancements in digital payment infrastructure have significantly improved the speed and convenience of cross-border transactions. However, issues like high transaction fees, lengthy processing times, and regulatory complexities continue to hinder the efficiency of these systems. Furthermore, the security of cross-border payments is also a concern, with the rise of cyber threats and the need for more robust risk management systems.

The lack of standardization in payment systems is another significant challenge. Different countries have different payment systems, and the lack of interoperability between these systems can make cross-border transactions cumbersome and time-consuming. Moreover, the reliance on intermediaries such as banks and payment processors can increase the cost and complexity of cross-border transactions.

2. What are the primary challenges you encounter with cross-border settlements in the fintech industry?

The primary challenges encountered with cross-border settlements in the fintech industry include navigating diverse regulatory environments, managing foreign exchange risks, and mitigating the threat of financial crimes. Additionally, the lack of standardization in payment systems and the need for better interoperability between different fintech platforms also pose significant challenges.

Another challenge is the complexity of cross-border transactions. These transactions involve multiple parties, including the sender, the recipient, and the intermediaries, which can increase the risk of errors and delays. Furthermore, the lack of transparency in cross-border transactions can make it difficult to track the status of payments and identify potential issues.

Fintech companies are working to address these challenges by developing more robust and efficient payment systems. They are leveraging technologies such as blockchain and

artificial intelligence to improve the speed, security, and transparency of cross- border transactions.

3. How do you perceive the impact of fintech innovations (e.g., blockchain, AI, smart contracts) on the future of cross-border payments?

Fintech innovations such as blockchain, AI, and smart contracts have the potential to revolutionize the future of cross-border payments. Blockchain technology, in particular, offers a secure, transparent, and decentralized way to facilitate cross-border transactions, reducing the need for intermediaries and increasing the speed of settlement.

Blockchain technology can also help to reduce the risk of financial crimes such as money laundering and terrorist financing. By providing a transparent and tamper-proof record of transactions, blockchain technology can help to identify and prevent suspicious transactions.

Artificial intelligence and machine learning can also help to improve the efficiency and security of cross-border payments. These technologies can be used to automate payment processing, detect potential security threats, and optimize payment routes.

4. What improvements are needed in fintech solutions to enhance the speed and reliability of cross-border transactions?

To enhance the speed and reliability of cross-border transactions, fintech solutions need to prioritize improvements in areas such as real-time payment processing, better foreign exchange management, and more robust risk management systems. Additionally, the development of more standardized and interoperable payment systems would also help facilitate smoother cross-border transactions.

Fintech companies can also improve the user experience of cross-border payments by providing more transparent and user-friendly payment systems. This can include features such as real-time tracking, instant notifications, and simplified payment processing.

Moreover, fintech companies can leverage technologies such as blockchain and artificial intelligence to develop more efficient and secure payment systems. These technologies can help to reduce the risk of errors and delays, and provide a more seamless payment experience for users.

5. In your opinion, how do current international fintech regulations affect the efficiency of cross-border payments and settlements?

Current international fintech regulations can hinder the efficiency of cross-border payments and settlements. Overly complex or restrictive regulations can create barriers to entry for new fintech players, limit innovation, and increase the cost of compliance.

In many cases, regulations can also be contradictory, with different countries having different regulatory requirements. This can create confusion and uncertainty for fintech companies, making it difficult for them to navigate the regulatory landscape.

A more balanced and harmonized regulatory approach is needed to support the growth of cross-border payments. This can include more flexible and adaptable regulations that allow for innovation and experimentation, while also protecting the interests of consumers and the integrity of financial systems.

6. What role do you foresee for fintech companies in the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments?

Fintech companies are unlikely to benefit from the adoption and implementation of central bank digital currencies (CBDCs) for cross-border payments. CBDCs are likely to be managed directly by central banks, allowing little if not zero innovation and flexibility for fintech companies.

Moreover, CBDCs are likely to introduce several challenges and limitations for cross-border payments. These can include regulatory complexities, technological limitations, and the potential for government control and surveillance. Fintech companies may find it difficult to operate in this environment, and may be forced to adapt to a more restrictive and regulated payment landscape.

In contrast, decentralized and open payment systems such as Bitcoin and cryptocurrencies can provide more opportunities for innovation and growth for fintech companies. These systems can allow for more flexibility, transparency, and security, and can provide a more level playing field for fintech companies to compete and innovate.

7. What is your personal view on the most promising technological advancement for improving cross-border payments in the next five years?

The most promising technological advancement for improving cross-border payments is the Lightning Network, a second-layer protocol built on top of Bitcoin. The Lightning Network has emerged as a groundbreaking solution for instant and cost-effective cross- border payments, eliminating the need for intermediaries.

The Lightning Network offers several advantages over traditional cross-border payment systems. These include:

- Speed: Lightning-Fast Transactions: The Lightning Network processes transactions. in mere seconds, a dramatic improvement over the sluggish pace of traditional methods
- Cost: Affordable for Everyone: Lightning Network transactions are incredibly cost-effective, with fees typically a tiny fraction of a penny.
- Simplicity: Streamlined Payments: Enjoy a more user-friendly experience with the Lightning Network, bypassing the complexities of traditional cross-border payment systems. The Lightning Network has the potential to revolutionize the way we make cross-border payments. By providing a fast, secure, and cost-effective way to send and receive payments, the Lightning Network can help to bridge the gap between different countries and economies, and can provide more opportunities for economic growth and development.

COMPANY SPOTLIGHTS

4. Company Spotlight

This chapter aims to showcase a diverse range of innovative projects in the payments and stablecoin sectors. By highlighting various companies making significant contributions to the industry, we provide a snapshot of the dynamic landscape shaping the future of financial transactions. From established leaders to emerging startups, these projects exemplify how technology is transforming the way we transact, store value, and engage with the global economy. Through this exploration, readers will gain a deeper understanding of the trends and developments driving innovation in payments and stablecoins today.

4.1. SulPayments Switzerland

Sul Payments Switzerland is dedicated to revolutionizing the payments landscape, particularly for cross-border transactions in Latin America. The company offers a variety of innovative payment solutions, including stable coin settlements that facilitate efficient and cost-effective transactions, crypto payments that enable businesses to accept digital currencies seamlessly, and an over-the-counter (OTC) desk for large-scale cryptocurrency transactions. These services are designed to meet the diverse needs of businesses operating in this dynamic market.

Compliance is a core component of Sul Payments' operations. As a registered Virtual Asset Service Provider (VASP) under the Swiss SRO VQF, the company adheres to stringent regulations set by the Swiss Financial Market Supervisory Authority (FINMA), reinforcing its commitment to high industry standards.

To maintain robust compliance, the company implements comprehensive anti-money laundering (AML) and counter-terrorist financing (CFT) measures, aligning with both local and international regulations. They also follow frameworks like the General Data Protection Regulation (GDPR) to safeguard customer data and privacy.

By prioritizing compliance and offering innovative payment solutions, Sul Payments not only enhances its reputation as a trusted partner but also supports the broader acceptance and integration of blockchain-based payment systems across Latin America, ensuring that businesses can operate securely and legally within this evolving financial landscape.

For more information, you can visit their official website: https://sulpayments.ch

4.2. FinSoft - Stablecoin Payroll Provider

Finsoft, a Cyprus-based company, has made waves as the first stablecoin payroll provider, specifically designed to meet the needs of influencers, streamers, and affiliates. By leveraging stablecoins—cryptocurrency assets pegged to stable currencies like the US dollar—Finsoft allows businesses in these rapidly evolving sectors to pay their collaborators and content creators with speed and efficiency.

This innovative payroll solution addresses the unique challenges faced by digital creators who often operate globally, requiring prompt and flexible payment options. Traditional payment methods can involve lengthy processing times and high fees, which can be particularly burdensome for individuals who receive earnings from diverse international sources. Finsoft's stablecoin payroll system not only streamlines the transaction process but also provides a hedge against local currency volatility, giving content creators greater financial stability and control over their earnings.

In addition to supporting influencers and streamers, Finsoft's platform is also tailored for affiliates and other digital professionals, facilitating seamless integration of cryptocurrency payments into their business models. By adopting this forward-thinking approach, Finsoft is at the forefront of the shift towards cryptocurrency in payroll systems, offering an alternative that is increasingly appealing in the digital economy.

For those interested in learning more about Finsoft and its innovative offerings, additional details can be found on their official website at finsoft.com.cy.

4.3. Circle

Circle.com is the online platform for Circle Internet Financial, a key player in the fintech industry that is transforming the integration of digital currencies into the global financial system. Founded in 2013 by Jeremy Allaire and Sean Neville, Circle is committed to utilizing blockchain technology to enhance accessibility and efficiency in finance.

1. USDC (USD Coin): Central to Circle's operations is USDC, a stablecoin designed to maintain a 1:1 peg with the U.S. dollar. Each USDC token is fully backed by cash and short-term U.S. Treasury bonds, allowing users to redeem their tokens for actual dollars. This structure fosters confidence and positions USDC as a reliable medium for digital transactions, with rapid settlement times often completing in seconds compared to the delays of traditional banking systems.

2. Blockchain Integration and Developer Support: Circle has made significant advances in USDC's compatibility across various blockchain networks. Initially launched as an ERC-20 token on Ethereum, USDC has expanded to include networks such as Solana, Algorand, and Polygon. This interoperability enhances liquidity and usability, facilitating the development of applications that utilize USDC. Circle supports this ecosystem with robust developer tools and APIs, enabling businesses to integrate USDC into their services effectively.

3. Regulatory Compliance and Transparency: A strong emphasis on regulatory compliance and transparency is a cornerstone of Circle's operations. The company collaborates closely with regulators to ensure that USDC meets legal standards. Circle's reserves are held at regulated institutions, and the company undergoes regular third-party audits to verify that USDC is fully backed, distinguishing it from less transparent stablecoins.

4. Global Partnerships and Financial Inclusion: Circle has established partnerships with numerous financial institutions and technology platforms to broaden USDC's reach. These collaborations facilitate USDC's adoption in payments, remittances, and decentralized finance (DeFi) applications, promoting financial inclusion, especially in regions with limited access to stable currencies or banking infrastructure.

5. Future Aspirations: Looking forward, Circle envisions a future where digital currencies like USDC play a vital role in the global economy. The company is focused on driving innovation in digital payments, aiming to expand USDC's

adoption among consumers and businesses alike. Circle seeks to enhance the speed, cost-effectiveness, and accessibility of financial transactions, aligning with the ongoing trend toward digitization in finance.. For further details, you can explore their official site at Circle.com.

4.4. Ripple

Ripple is a leading technology company based in the United States that is transforming the global financial landscape through blockchain technology. Its primary objective is to facilitate seamless cross-border payments, making the transfer of value as efficient and instantaneous as the transfer of information over the internet. Ripple offers a suite of solutions aimed at enabling financial institutions, businesses, and governments to optimize their payment processes and enhance liquidity management.

1. RippleNet: This is Ripple's flagship product, designed to provide a secure and efficient network for real-time cross-border payments. RippleNet connects banks, payment providers, and digital asset exchanges, allowing for quick and cost-effective transactions across different currencies and countries. By leveraging its proprietary technology, RippleNet reduces the complexities and costs typically associated with international payments.

2. XRP: Ripple's native digital asset, XRP, is utilized within RippleNet to facilitate cross-border transactions. XRP acts as a bridge currency, enabling real-time liquidity for financial institutions and minimizing the need for pre-funded accounts in destination currencies. This capability significantly streamlines the payment process and lowers costs.

3. Digital Asset Custody: Ripple also offers secure custody solutions for digital assets, helping businesses manage and safeguard their tokenized assets within a regulatory framework. This service enhances security and compliance for organizations engaging with cryptocurrencies.

4. Sustainability Commitment: Ripple is dedicated to sustainability, emphasizing the energy efficiency of the XRP Ledger, which underpins its operations. The company has actively invested in renewable energy initiatives and sustainable practices to minimize its environmental impact.

Vision and Goals: Ripple's overarching goal is to create a more inclusive financial system by making cross-border payments accessible to everyone. By utilizing blockchain technology, Ripple aims to provide financial services that are faster, cheaper, and more transparent, ultimately enhancing global commerce and promoting economic growth. For more information about Ripple's offerings and initiatives, you can explore their official website.

4.5. Tether

Tether (USDT) is a widely recognized stablecoin launched in 2014 by co-founders Brock Pierce, Reeve Collins, and Craig Sellars. As one of the first stablecoins in the cryptocurrency market, Tether was designed to maintain a stable value by pegging its price to the U.S. dollar, thereby providing a reliable medium for transactions within the digital currency ecosystem. The company behind Tether is based in the British Virgin Islands.

1. Value Stability: Tether's primary function is to offer price stability, making it an attractive option for traders and investors in the volatile cryptocurrency market. Each USDT is intended to be backed 1:1 by reserves, which include traditional fiat currencies and cash equivalents. This structure aims to provide users with the confidence that they can redeem their USDT for U.S. dollars, enhancing its utility as a medium of exchange.

2. Multi-Blockchain Integration: Tether's ecosystem operates across multiple blockchain networks, including Ethereum, Tron, and Binance Smart Chain, which enhances its liquidity and accessibility. This interoperability allows users to transact with USDT seamlessly across different platforms, facilitating efficient trading and financial operations within the cryptocurrency market.

3. Regulatory Scrutiny and Transparency: Despite its widespread usage, Tether has faced scrutiny regarding its claims of full backing by reserves. Critics have raised concerns about transparency, leading Tether to adapt its reserve management strategies. In response to regulatory pressure, Tether has shifted towards holding a larger portion of its reserves in short-term U.S. Treasury securities, rather than commercial paper. This move aims to improve transparency and strengthen confidence in its backing.

4. Market Impact: Tether has emerged as one of the most significant stablecoins in the cryptocurrency ecosystem, often used as a trading pair on major exchanges. Its

liquidity and stability have made it a preferred choice for traders seeking to hedge against market volatility. Furthermore, Tether's influence extends beyond trading; it is also used in decentralized finance (DeFi) applications, enhancing its utility within the broader financial landscape.

5. Future Outlook: As Tether continues to evolve, its commitment to stability, transparency, and compliance with regulatory standards will be crucial for its ongoing relevance in the fast-changing cryptocurrency market. The company is poised to adapt to the growing regulatory landscape, aiming to maintain trust among users while fostering innovation in digital finance. For more information about Tether and its offerings, you can visit their official website at Tether.to.

4.6. DAI by MakerDAO

DAI is a decentralized stablecoin that operates on the Ethereum blockchain, designed to maintain a stable value relative to the U.S. dollar. Launched in 2017 by the MakerDAO community, DAI is notable for its unique governance structure and collateralization model. Unlike centralized stablecoins, DAI is not controlled by a single entity; instead, it relies on a network of smart contracts and community governance, enhancing transparency and decentralization.

1. Collateralization: DAI is primarily collateralized by various cryptocurrencies, predominantly Ethereum (ETH). Users can mint DAI by depositing ETH into a Collateralized Debt Position (CDP), where the deposited assets are locked in a smart contract. This process requires users to maintain a collateralization ratio above a certain threshold to mitigate the risk of liquidation. The over-collateralization mechanism ensures that DAI remains stable even in volatile market conditions.

2. Governance by the Maker Community: The governance of DAI is carried out by MKR token holders, who participate in the decision-making process regarding the DAI ecosystem. This includes setting parameters such as collateralization ratios, stability fees, and the introduction of new collateral types. This democratic approach fosters community involvement and aligns incentives among participants.

3. Transparency and Security: The issuance and collateralization of DAI are recorded on the Ethereum blockchain, ensuring complete transparency. Users can verify the amount of DAI in circulation and the corresponding collateral locked in smart contracts. The security of DAI is bolstered by the robust nature of the Ethereum

network, which has been extensively tested in various scenarios.

4. Integration in Decentralized Finance (DeFi): DAI has become a foundational component of the DeFi ecosystem, enabling a wide range of applications such as lending, borrowing, trading, and yield farming. It allows users to access decentralized financial services without relying on traditional banking systems, promoting financial inclusion and access to liquidity.

5. Market Adoption and Use Cases: DAI's decentralized nature and stability have made it a popular choice among users in regions with economic instability. It serves as a hedge against inflation and currency fluctuations, providing a reliable store of value. Furthermore, DAI is utilized in various DeFi platforms, making it a versatile tool for investors and traders alike.

6. Challenges and Future Outlook: While DAI has successfully carved out a niche within the cryptocurrency landscape, it faces challenges such as maintaining its peg to the U.S. dollar during extreme market conditions. Additionally, the reliance on Ethereum's network can lead to high gas fees, particularly during times of congestion. The MakerDAO community continues to innovate and adapt to these challenges, exploring new collateral types and governance mechanisms to enhance DAI's stability and usability. For further exploration of DAI and its functionalities, you can visit the official MakerDAO website.

4.7. Stellar

Stellar, founded in 2014 by Jed McCaleb, is an innovative blockchain platform designed to facilitate cross-border payments and promote financial inclusivity. Central to the Stellar ecosystem is its native cryptocurrency, Lumens (XLM), which serves multiple roles, including transaction fees and as a bridge currency for facilitating conversions between various fiat and digital currencies. Stellar's unique consensus mechanism, known as the Stellar Consensus Protocol (SCP), allows for rapid transaction processing, achieving speeds of up to 1,000 operations per second. This efficiency significantly reduces the time and costs associated with traditional cross-border transactions, which often involve multiple intermediaries and lengthy settlement periods.

Key Features of Stellar

1. Decentralized Exchange (DEX): Stellar's DEX allows users to trade a variety of assets, including cryptocurrencies and fiat currencies, without the need for centralized control. This feature empowers users to conduct transactions in a trustless manner, enhancing security and reducing counterparty risk.

2. Custom Token Creation: Stellar enables users and organizations to create and issue custom tokens, facilitating the representation of real-world assets on the blockchain. This functionality fosters a diverse ecosystem of digital assets, which can range from traditional currencies to innovative financial products.

3. Anchors and Fiat Integration: The platform incorporates “anchors,” trusted entities that act as intermediaries between the Stellar network and traditional financial systems. These anchors facilitate the conversion of fiat currencies into digital currencies on the Stellar network, promoting greater accessibility and usability.

4. Interoperability and Financial Inclusivity: Stellar is designed to connect disparate financial systems, thereby providing individuals and businesses, especially in underserved regions, with access to global financial networks. This mission aligns with Stellar’s broader goal of fostering financial inclusivity and empowering users with low-cost, efficient transaction options.

5. Partnerships and Collaborations: Stellar has established numerous partnerships with organizations, including tech companies and non-profits, to expand its reach and application across various industries. These collaborations enhance Stellar’s impact on financial services, remittances, and humanitarian aid.

6. Challenges and Future Aspirations: While Stellar has made significant strides in the cryptocurrency space, it faces challenges such as potential centralization risks and competition from other blockchain platforms. However, its ongoing commitment to innovation and community-driven development positions Stellar favorably for continued growth in the evolving landscape of decentralized finance (DeFi). For more detailed information, you can visit the official Stellar website.

4.8. Celo

Celo is an innovative blockchain platform that seeks to bridge the gap between traditional financial systems and the decentralized economy, with a focus on mobile accessibility. Launched in 2017, Celo emphasizes usability and inclusivity, making it especially suitable for users in developing regions where access to banking services is limited. Its mobile-first approach allows billions of smartphone users to engage with blockchain technology through simple and intuitive interfaces.

1. User-Friendly Interface: Celo's design prioritizes ease of use, enabling users to send and receive funds using their phone numbers. This feature lowers the barriers to entry for individuals who may not be familiar with cryptocurrency wallets or traditional banking.

2. Stablecoins: Celo supports a suite of stablecoins, including Celo Dollar (cUSD), Celo Euro (cEUR), and Celo Real (cREAL), each pegged to their respective fiat currencies. These stablecoins are designed to provide stability in transactions and are essential for everyday financial activities like remittances, online payments, and cross-border transactions. This multi-currency approach allows users to transact in their local currencies while benefiting from the advantages of blockchain technology.

3. Decentralized Governance: Celo employs a decentralized governance model where CELO token holders can participate in decision-making processes. This includes voting on proposals that affect the platform's development, ensuring that the community has a say in the direction and priorities of the ecosystem.

4. Environmental Sustainability: Celo is committed to environmental sustainability, utilizing a Proof-of-Stake consensus mechanism that is energy-efficient compared to traditional Proof-of-Work systems. Additionally, a portion of transaction fees is allocated to carbon offset projects, positioning Celo as a leader in sustainable blockchain practices.

5. Interoperability and Scalability: As Celo evolves into an Ethereum Layer 2 solution, it enhances its scalability and interoperability with other blockchain networks. This transition aims to reduce transaction costs further and support a broader range of decentralized applications (dApps) while maintaining high throughput and low

latency.

6. Community and Ecosystem Growth: Celo fosters an active global community of developers, users, and builders who collaborate to create and refine applications that serve real-world needs. This community-driven approach not only enhances the platform's usability but also encourages innovation and expansion within the Celo ecosystem. For more information, you can explore their official website at Celo.org.

4.9. Paxos

Paxos is at the forefront of integrating traditional finance with blockchain technology, emphasizing regulatory compliance and innovation. The company's flagship products, Paxos Standard (PAX) and Paxos Gold (PAXG), reflect its commitment to providing stable, reliable digital assets.

1. Paxos Standard (PAX): As a fully-collateralized stablecoin pegged to the U.S. dollar, PAX is designed to facilitate seamless transactions within the crypto ecosystem. With its transparent reserve management, users can redeem PAX for USD on a one-to-one basis, providing a trustworthy alternative to traditional banking systems.

2. Paxos Gold (PAXG): This unique offering allows users to trade and own digital gold, simplifying the process of investing in a historically stable asset. Each PAXG token is directly backed by one ounce of gold, securely stored in professional vaults. This digitization of gold not only reduces the logistical challenges associated with physical ownership—such as storage and transportation—but also enables instant trading and fractional ownership.

Paxos leverages blockchain technology to enhance the security and efficiency of financial transactions. Its infrastructure is designed to handle high transaction volumes while ensuring the integrity and speed of operations. The company employs advanced security protocols and is regulated by the New York State Department of Financial Services (NYDFS), which ensures that all operations meet stringent legal and compliance standards.

Paxos is actively seeking to broaden its influence by forming strategic partnerships with banks, exchanges, and other financial institutions. This collaboration not only enhances the liquidity of its products but also fosters the adoption of digital assets across various sectors. By making cryptocurrencies accessible to traditional financial players, Paxos aims

to bridge the gap between conventional and digital finance, paving the way for a more inclusive economic future.

Paxos also prioritizes community engagement and education about digital assets. By providing resources and insights, the company aims to empower users with knowledge about blockchain technology and its potential applications in everyday finance. This educational effort is vital in fostering trust and encouraging the adoption of digital currencies among broader audiences. For further details, you can explore their offerings at Paxos.com.

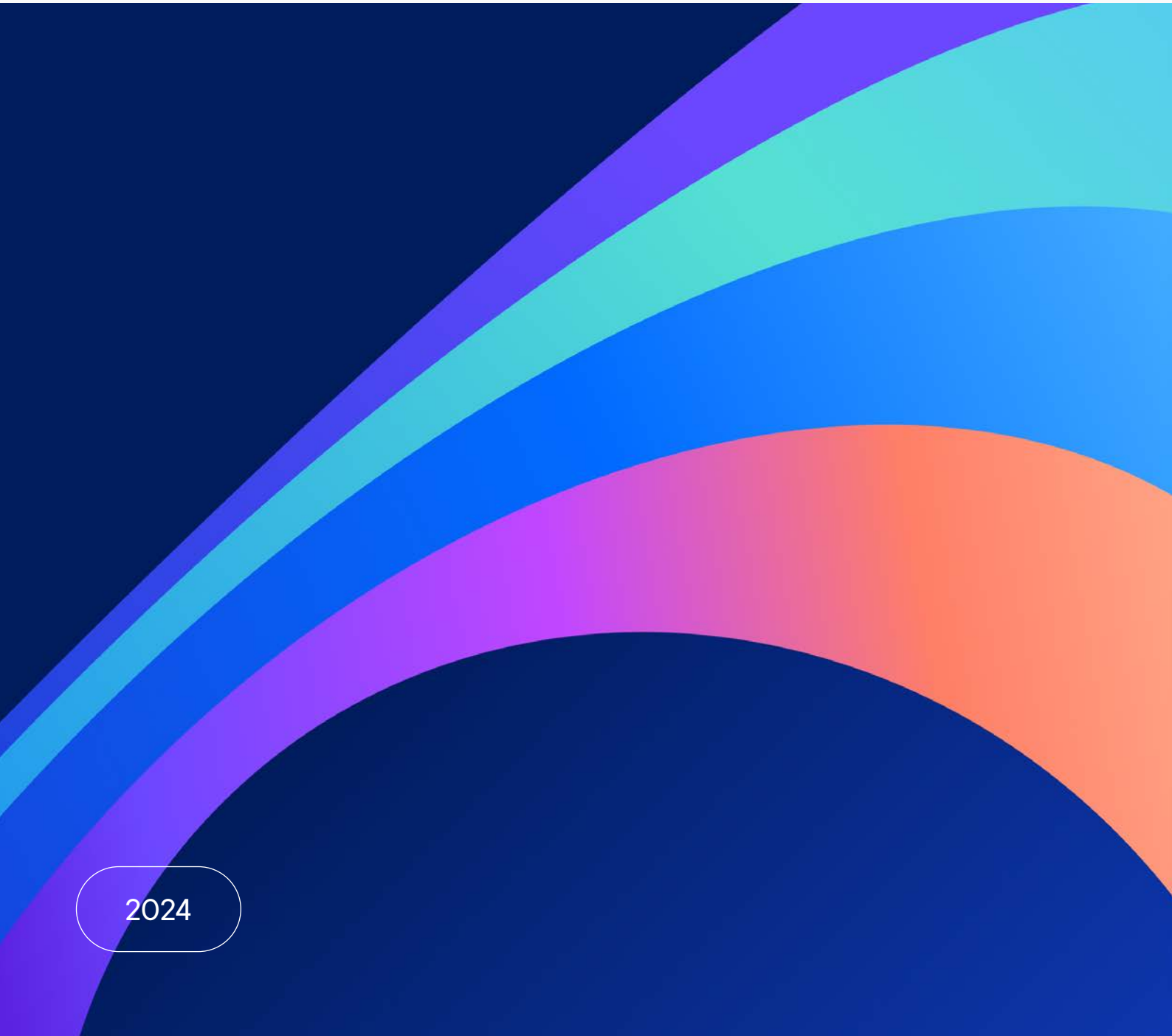
TRENDS IN REGIONAL PAYMENTS

ripple

EBOOK

Trends in Regional Payments

Inside the Evolving Global Payments Landscape



2024

Contents

About Ripple

Ripple is the leader in enterprise blockchain and crypto solutions, transforming how the world moves, manages, tokenizes and stores value. Ripple's business solutions are faster, more transparent, and more cost effective—solving inefficiencies that have long defined the status quo. And together with partners and the larger developer community, we identify use cases where crypto technology will inspire new business models and create opportunity for more people. With every solution, we're realizing a more sustainable global economy and planet - increasing access to inclusive and scalable financial systems while leveraging carbon neutral blockchain technology and a green digital asset, XRP. This is how we deliver on our mission to build crypto solutions for a world without economic borders.

Learn more about Ripple at ripple.com.

Introduction

Major shifts driven by consumer preferences, regulatory movements, and new technologies have upended payments experiences.

Across the modern arc of payments, McKinsey describes distinct eras marked by paper, plastic, and accounts. Now, a new era is emerging marked by a decoupling where a mix of banks, payment service providers, and fintechs institute new products and technologies to try and keep up with the ever-growing demand for cross-border payments.

While payments trends vary by region, some themes are more pronounced globally. Within each region, modernized payments solutions, including blockchain-enabled payments, are bringing faster, more inclusive, and transparent experiences. The acceleration of instant payments is paving the way for faster, more efficient payment rails. And the adoption of open banking is paving the way for greater transparency. Stakeholders from central banks and super app providers to rural consumers stand to gain.

This report explores principal payment trends throughout North America, Latin America, Europe, Asia, and Africa. We examine the genesis of these, and spotlight success barriers, opportunities, and potential impacts.

01

Open Banking on the Rise in North America

Modernized payment systems and financial services are gaining traction across North America as standardized messaging, secure data exchange, and interoperability take shape. Here, we examine how open banking, FedNow, and ISO 20022 have contributed to streamlining the financial landscape in this region.

Banks and fintechs across the region are leveraging alternatives to traditional payment experiences and adopting technologies for real-time payments use cases extending through B2B, B2C, A2A, P2P, G2C, and beyond.

Today, the dynamic of connecting various banking and payment card accounts is leading to more customized payments products, faster access to credit and financing, and greater financial control for individuals.[1]

Research suggests that the global open banking market will eclipse $130 billion by 2028, driven by rising consumer and institutional preferences for digital payments. In 2022, the market reached $15.21 billion, but is set to expand at a remarkable 24.6% estimated CAGR due to the growing use of digital payments and mobile wallets.

Additionally, open banking solutions have skyrocketed across myriad industries like financial services, healthcare, retail, and insurance.[2]

Open Banking 101

Open banking takes place when banks and financial institutions give customers and customer-approved third parties digital access to financial data.

These third parties are often able to initiate payments as well as download and easily share information on account balances, payments, transactions, investments and more.

There are a number of benefits to open banking, such as:

- Broadened revenue streams through new API-enabled products
- Improved customer personalization and satisfaction via increased touchpoints
- Strengthened relevance for financial institutions through diversification of client offerings
- Expanded data transfer capabilities in which competitive third-party providers can access bank account and transaction data through APIs
- Support for financial inclusion as a broader range of data points can be used to assess a customer's creditworthiness

Customers who consent to share information within an open banking system give providers a better understanding of their needs, enabling streamlined payments solutions, personalized products and offerings, and better user experiences.

$130B

The global open banking market will eclipse $130 billion by 2028, driven by rising consumer and institutional preferences for digital payments.

Early, but Eager: Open Banking Trends in North America

Europe and the United Kingdom have historically been the first-movers across open banking adoption, however, rising US-based support is underway. Account to account payments which represent 45% of all electronic payments are growing 280% year over year in the UK. In parallel, 71% of US consumers now say they'd like to make purchases or pay bills directly from their bank account.[3]

The past year has seen an uptick in newsworthy open banking initiatives. Coinbase announced a partnership with an account-to-account infrastructure company to improve deposit and withdrawal experiences in Canada, the world's third-most crypto-aware nation.[4]

Welcoming open banking opportunities can result in a rise in competition and a downward pressure on margins, which drive traditional financial institutions to either find new revenue streams or new cost-saving measures. Companies harnessing the benefits of open banking — particularly those incorporating blockchain innovations — have the opportunity to address both issues.

While the impact open banking has on banks, credit unions, payment service providers, and legacy institutions must be considered, there is ample economic opportunity for consumers and the markets to which these institutions contribute.

Leaders at the Financial Data Exchange (FDX) — a non-profit industry standards body dedicated to unifying the financial services ecosystem — report that open banking initiatives are thriving in the US. Last year, they estimated that over 30 million consumers had converted from credential-based access (ID and password) to the more secure, tokenized API access.[5] Likewise, FDX leaders suggest network effect-led growth from open banking use is imminent in the US.

Two additional forces have supported the growth of open banking in North America: US consumer demand and increased regulatory clarity. In terms of consumer use, Visa notes that 87% of US consumers are using open banking to link their financial accounts to third parties, however only 34% are aware that they are using the technology.[6]

280%

Account to account payments which represent 45% of all electronic payments are growing 280% year over year in the UK.

So while open banking advances are broadly considered market-driven, patchwork regulatory frameworks and educational initiatives may be slowing adoption. In Canada, the expected establishment of a country-wide open banking regime remains delayed. Should these forces reverse, more innovation could quickly emerge.

Still, activities from industry vanguards point to open banking momentum. Mastercard recently introduced small businesses to its open banking platform which provides advanced analytics. When business owners give permission to access their financial data via open banking, lenders can use Mastercard APIs to apply cash flow, balance, and payment history analytics to transactions. With improved insights on liquidity, revenue, cash flow, and default risk, lenders can tailor offerings and SMBs with more competitive growth financing.

Importantly, this signifies supply and demand momentum behind an expanding range of spending, financing, and payment tools.

In conjunction, banking-wide system improvements like FedNow©, the Federal Reserve's instant payment service, have allowed financial institutions of varying sizes to develop innovative solutions that can be personalized and data-driven to ultimately deepen customer relationships and strengthen brand loyalty.

FedNow® Launch and Impact

Towards the middle of 2023, the United States Federal Reserve launched the FedNow® Service to modernize the national payment system and enable faster, more efficient, and more secure domestic transactions.

The instant payment infrastructure is available to US-based depository institutions and allows individuals and businesses to send instant payments through institutional accounts.

While the RTP network was made available across the US prior to FedNow, the latter supports awareness efforts and helps grow adoption of real-time payment systems. As adoption and implementation expands, we anticipate a meaningful reshaping of the US financial landscape.

With this progress, financial institutions, fintech companies, and other stakeholders will have the opportunity to create new products and services that maximize the real-time capabilities offered through FedNow.

"In the next year, we are likely to see the networking effect — 'everyone's on it because everyone's on it' — begin to manifest itself in North America."

Don Cardinal, Managing Director, FDX

Examining the Benefits of Real-Time Payments with FedNow[7]

What are the core benefits?	How will financial institutions be impacted?	What are the potential macro effects?
Enhanced accessibility: Small businesses, corporates and consumers will be able to access instant payments across domestic institutions that are participants of FedNow.	Small banks and credit unions will be able to provide real-time payment services to their customers.	Enhanced accessibility improves financial service offerings for everyone involved which can have a lasting impact on financial inclusion.
Enhanced global competitiveness: Real-time domestic payments enable US-based businesses to operate on par with others in the global marketplace.	Customers will become accustomed to real-time domestic payments and likely expect the same from international transactions, putting pressure on financial institutions to offer more efficient cross-border payment services.	GDP is expected to increase by $173 billion with $184 billion in savings for consumers and businesses as real-time payments take shape.
Improved efficiency: Payment speed and settlement times will improve dramatically.	Institutions will need to invest in improved tech stacks to support the demand generated by real-time payments.	Financial agility will increase for businesses and consumers alike as barriers to streamlined cash flow are reduced.
Support for innovation: Real-time payments will increase end-user expectations and push the financial services industry to progress.	Financial service providers will need to develop or adopt solutions that leverage the real-time capabilities of FedNow.	New developments could include innovative payment apps, integrated payment solutions, expanded data and directory offerings—all to serve a superior payment experience.

As customer expectations continue to rise alongside technological advances, depository institutions and their service providers can build on this capability and introduce value-added services to their customers.[8]

Some 25% of financial institutions said they were waiting for FedNow to deploy before finalizing a real-time payments strategy, but major players in the payments space still haven't moved on adoption.[9] Taking a passive approach to innovation could be detrimental to an institution's competitive stance as fintechs fill the gaps with more advanced offerings and global markets leverage progressive solutions.

FedNow will also leverage the ISO 20022 messaging standard, which is designed to be compatible with future iterations of the instant payments infrastructure.

> **"The Federal Reserve built the FedNow Service to help make** everyday payments over the coming years faster and more convenient."
>
> **Jerome Powell, Chair, Board of Governors, Federal Reserve**

ISO 20022 Goes Live

ISO 20022 serves as a universal language to more efficiently share financial data across the globe. The messaging standard represents the need for modernization and plays a critical role in supporting instant payment capabilities and expanding payment process innovations. ISO 20022 is expected to bring significant changes to how financial services are conducted, improving data quality and reducing errors across cross-border payment flows, while making transactions more efficient and secure.[10]

Specifically, ISO 20022 offers a structured, data-rich common language for corporates and banking systems. This is necessary to move away from end-of-day batch file payments processing to real-time processing. The standard may also provide better analytics using more robust data elements, which could bolster financial institutions in generating new services and product offerings.

For corporates and financial institutions, ISO 20022 adoption will boost operational efficiencies, including the ability to exchange detailed remittance information with a customer payment. In addition, it adds support for straight-through processing and a reduction in errors and manual processing.[11]

Growing adoption of the ISO 20022 messaging standard and the opportunity for highly structured data has led the Federal Reserve to incorporate the framework into its FedNow® service. According to the Federal Reserve's bank services group, this standard will be able to support FedNow as it evolves and adds capabilities.[12]

Fast Facts: ISO 20022

- An international standard for exchanging electronic messages
- Offers structured, rich data using XML syntax
- This format is already in practice for real-time, low-value and high-value clearing systems around the world.
- Offers richer references and improved remittance information
- Requires planning ahead: multi-year project for financial institutions to implement value-added services to enhance experience

Source: JP Morgan

ISO 20022 offers a structured, data-rich common language for corporates and banking systems.

Going Cashless: Spotlight on Stablecoins for Payments

A stablecoin is a type of digital currency designed to make transacting with crypto more practical.

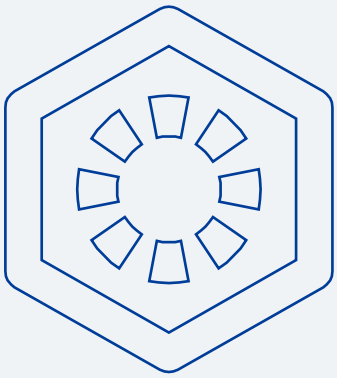
Most stablecoins are pegged to a fiat currency like USD or EUR. Because of this, stablecoins have acted as a gateway into using blockchain and digital assets for payments amongst users concerned with cryptocurrency price volatility.

Like many digital assets, stablecoins can provide broad, inclusive access to the financial system, and enable the fast and efficient movement of value. In 2022, fiat-backed stablecoins transacted $6.87T, eclipsing both Mastercard and PayPal in terms of moving value across networks.[13]

Using stablecoins for payments combines the benefits of blockchain technology — namely greater security, transparency, cost efficiency, and speed — with the trust and familiarity of traditional fiat.[14]

As demand for stablecoins grows, particularly as cash use is at a historic low, more individuals and businesses are considering these assets as payment alternatives. The number of Americans who say they did not use cash to make a purchase in a typical week is now 41%, up from 29% in 2018.[15] Business owners are increasingly finding the switch to stablecoins advantageous, noting rising consumer demand, faster checkouts, lower labor costs and increased security.[16]

The trend towards stablecoin use is driven by the benefits of blockchain technology that add improvement over credit-card and other traditional payment types.



Stablecoins reduce the role of middlemen in the current financial system and support direct transactions between merchants and consumers, reducing intermediary costs. Since stablecoins are cryptographically secure, users can settle transactions almost instantaneously without double-spending or other problematic settlement facilitation.

Because stablecoins are built on distributed ledger technology, they offer programmability to payments via smart contracts which can inspire useful product or service innovation and link the traditional Web2 economy with the future of finance—Web3.

Adoption of new digital payment methods offer significant benefits to customers and society: improved efficiency, greater competition, expanded financial inclusion, and innovation.

In 2023, PayPal jumped on the stablecoin trend and launched PayPal USD (PYUSD) a stablecoin backed by US dollar deposits, short-term US treasuries, and similar cash equivalents. PYUSD can be redeemed one-to-one for US dollars.

PayPal USD was designed to reduce payments friction in virtual environments, facilitate the fast transfer of value, send remittances or conduct international payments, enable direct flows to developers and creators, and foster the continued expansion of digital assets by the world's largest brands.

On-trend with the rest of the global crypto industry, regulation of this new asset class has already begun to take shape. According to Bernstein research, stablecoin regulation is quickly progressing across the US, EU, UK, and Asia, and tends to merit more political support than crypto regulation.

The US is witnessing regulatory progress with recent bipartisan support for the 'Clarity of Payments Stablecoin Act'. If passed, the legislation could unlock stablecoin innovation led by private players in the blockchain industry, allowing anyone with consumer distribution (social, commerce, finance) to partner with a regulated stablecoin issuer.[17]

$6.87T

In 2022, fiat-backed stablecoins transacted $6.87T, eclipsing both Mastercard and PayPal in terms of moving value across networks.

02

Asia Pacific: Leading the Way in Instant Payments

The combination of innovative technology, ubiquitous smartphone access, and friendly regulation cements the Asia Pacific region as the global leader in instant payments and enables wide-spread access to real-time settlement. With the vast majority of profitable digital banks based in the region, it's likely that this success will flourish as adoption of new fintech models increases.

Countries across the Asia Pacific region continue to pioneer instant payment delivery and digital banking innovations. In terms of established global financial systems, the region is relatively new to the banking industry but has grown adept at navigating digital-only financial services. Asia Pacific is home to 10 out of 13 of the most profitable digital-only banks worldwide.[18]

The region's appetite for experimentation with alternative payment rails has led to better cross-border and domestic payment capabilities, access to real-time settlement, opportunities for financial inclusion, and global leadership in financial innovation. By many measures, Asia Pacific operates as the epicenter of digital finance: The region is home to 20% of the world's digital banks, and its citizens are the most enthusiastic adopters of digital payments.[19]

The region's digital banking sector outperforms other markets in part because its culture and processes are rooted in a customer-first ethos. Companies tend to only leverage banking technologies, platforms, and architectures conducive to omni-channel customer experiences and differentiate offerings with proactive customer service.[20]

Sector participants also tend to aggressively evaluate and embrace robust use cases for blockchain, Web3, decentralized finance, and artificial intelligence, particularly around mobile wallets and social apps to facilitate better domestic and cross-border payments.

Digital wallets in Asia Pacific (excluding China) more than doubled their share of e-commerce transaction value in the last five years, and this share is projected to grow over the next three years. Similarly, digital wallets' share of payment transaction value at point-of-sale grew 6x in the last five years.[21]

Southeast Asia in particular has exemplified expansive regional payments progress. Within the market, real-time payments network volume is expected to reach $2.4 trillion by 2025—a 230% increase from 2020. In terms of technology adoption, consider that over 400 million people in Southeast Asia alone will use mobile wallets by 2026.[22]

APAC's 'Payments First' Playbook

Over the last year, APAC's digital banking participants made spirited attempts to capitalize on consumer interest in transacting abroad by supporting more affordable, real-time money transfers.

For example, Thunes' partnership with Tencent Financial Technology introduced wallet and account infrastructure for over one billion Chinese users across Weixin (internationally known as WeChat). The partnership aims to make sending money across borders and sending remittances as easy as sending a message.[23]

Asia Pacific is home to 10 out of 13 of the most profitable digital-only banks worldwide.

Elsewhere, Asia's banks and fintechs are recasting how billions of consumers engage with digital finance, including surrounding real-time payment offerings.

Singapore and Thailand, for example, both launched QR code-based real-time retail payment systems, PayNow and PromptPay. Malaysia, Indonesia, and Thailand now have connected networks. And in 2022, Malaysia, Singapore, Indonesia, Thailand, and the Philippines signed a deal to integrate their QR code payment systems. According to ACI Worldwide, growing cross-border QR-code payment linkages forming between Malaysia and Indonesia, Singapore and Thailand drive rapid RTP growth.[24]

India launched its own real-time payments platform, Unified Payments Interface (UPI), in 2016 and just recently eclipsed 10 billion processed transactions.[25] UPI allows instant peer-to-peer and person-to-merchant payments via mobile devices and is expanding internationally through partnerships in several countries including Singapore and the UAE. UPI is expected to support the US dollar to further enhance the mobile payments system. India's digital payments volume grew tenfold over the past five years and is projected to grow at roughly 35% annually over the next five years.[26]

Payments revenues across India have risen by an average of 12% over the past five years, reaching $64 billion in 2022 when they grew by 38%. India has pulled even with Japan as the fourth largest payments-revenue-generating country—behind only China, the United States, and Brazil.[27]

Between 2021-22, India received $89 billion in foreign remittances—the highest ever in a year by any nation. That number is projected to rise to $100 billion in 2024. Leaders across India suggest that the UPI-PayNow linkage (and others to come) will grow in utility and will contribute in facilitating trade.[28]

Even countries that have traditionally remained behind the innovation curve are reassessing payments progress. Cash stands out as the dominant medium of exchange in Japan, however, banking authorities recently announced a "Cashless Vision" to increase digital transactions to 40%, by 2027.[29] While the country lags behind regional, digital-first peers (and still operates the world's oldest payments infrastructure), the labor ministry is backstopping this system of e-money salary payments to encourage workers to use digital transactions for daily purchases.[30]

"Sustained growth in India, fueled by cash displacement, moved it into the top five countries for payments revenues."

McKinsey & Company

Spotlight on India: Payments Fueling E-commerce Ambitions

In January 2023, The National Payments Corporation of India — an umbrella organization operating payments and settlements systems — announced that it was making UPI available to Indian non-residents of ten countries including Australia, Canada, Singapore, the UK, and the US, paving the way for a global remittance network. Other countries including Bhutan and Nepal are adopting UPI, and the technology is integrating with payment architectures in Singapore and the UAE.

In addition to streamlined remittance networks, UPI and other real-time payment schemes are fueling cross-border commerce in India and providing online merchants with a significant growth opportunity.

For merchants, account-to-account (A2A) payments reduce the cost of payment acceptance while improving cash flow through immediate availability of funds. In India specifically, A2A payments as a percentage of e-commerce transaction value jumped from 12% in 2021 to 19% in 2022–and is projected to reach 24% by 2026.[31]

Given UPI's versatile architecture, the technology connects to a variety of payment sources. Today, nearly every bank in India supports UPI transactions through mobile applications. UPI is also displayed at the checkout page along with other common payment methods. When consumers click on UPI, they are offered several payment options, including using digital wallets (e.g., Paytm, Google Wallet, BHIM, PhonePe, WhatsApp), scanning a QR code, or linking a bank.[32]

Bain estimates that by 2027, there will be more online shoppers in India than there are in the United States. Analysts expect the number of online shoppers in the country to increase from 190 million to 450 million. From a market size perspective, e-commerce volumes are expected to grow by 82% by 2026, likely boosting digital payments activity.[33]

Wider and more robust global payment connections will be key to realizing new revenues and e-commerce volume. A recent study found that 75% of small to mid-sized businesses (SMBs) were dissatisfied with existing cross-border payment solutions, and 27% said the complexity of cross-border payments 'hindered their business growth'.[34]

Research also highlights how digital merchants across Asia Pacific that do not account for local payment capabilities experience underperformance and cart abandonment issues; those that did offer local payment methods saw cart abandonment drop by almost half. Enabling differentiated, local payment methods via payments orchestration — supporting digital avenues like e-wallets, online bank transfers, buy now, pay later (BNPL), crypto, direct debit — can all aid performance.

Although popular card networks, including VISA and Mastercard, hold substantial market share in India, a meaningful consumer segment still prefers local payment alternatives. Indian consumers only pay for 28% of all online purchases using a credit or debit card. The remaining 72% of purchases are made via bank transfers, e-wallets, and other types of payment methods.[35]

> **"India & Southeast Asia will see APAC's strongest e-commerce growth through 2026."**
>
> The Global Payments Report 2023

Obstacles to Digital Payments Transformation

Despite Asia Pacific's progressive take on digital technology, privacy and security concerns may hamper the adoption of new payment rails. Research suggests that more than 75% of the region's consumers would withdraw support of a brand in the case of a data breach, regardless of the products or services offered.[36]

The World Economic Forum dubs the Asia Pacific region "ground zero for cybercrime incidents." The pace at which the cyber threat landscape is evolving in conjunction with malicious software, the mobilization and organization of cybercriminal groups, geopolitical conflicts, and economic uncertainty have all combined to create the perfect environment for threat actors to flourish.[37] In the region, 60% of surveyed leaders acknowledged a substantial lack of cybersecurity staff in their organizations.[38]

According to CheckPoint Research, APAC witnessed the highest year-over-year increase in weekly cyberattacks during the first quarter of 2023.[39] Observers also express concerns over problems of macroeconomic volatility and uncertainty, and higher cost of funding.[40]

The flipside of the region's dynamism is the lack of predictable and homogenous consumer behavior. Payment behaviors and usage remain fragmented; consumers in Hong Kong and Singapore are historically more receptive to new digital payment methods (e.g. Apple Pay, Google Pay, Samsung Pay), in markets like China, the Philippines, and Vietnam, consumers tend to pay with local and regional wallets out of familiarity and convenience.[41]

As the use of crypto in payments continues to expand in APAC, harnessing that momentum will rely on close collaboration between national governments and private companies to achieve maximum impact and ensure the utmost security for consumers.

75%

More than 75% of the region's consumers would withdraw support of a brand in the case of a data breach, regardless of the products or services offered.

03

Africa: Crypto and Mobile Payments Fuel Financial Inclusion

Across African developing markets, the use of digital payments is expanding well beyond the global average. The mobile-first transformation is so far-reaching that the typically conservative banking sector is actually at the forefront of mobile money technology, and this initiative is reaching individuals who have been historically excluded from traditional financial systems. Consumer behaviors also suggest an optimism for crypto in payments as Africans respond to frustrations with limited banking system access and a need for better cross-border remittance options.

A few reasons for the aforementioned financial exclusion include cost barriers to opening an account, high remittance fees, a lack of identifying documentation, limited access to physical bank branches, and an economy that still largely operates on cash.

Today, the continent accounts for 70% of the world's $1 trillion mobile money value, and nearly half of registered mobile money accounts. The value of Africa's mobile money transactions edged up 39% to $701.4 billion in 2021 from $495 billion in 2020, reinforcing that the future of African financial services is both digital and mobile.[42]

Bottom Line on Mobile Money

Mobile money refers to electronic payment technology that allows money transfers between mobile devices using a SIM card. This allows users to freely transact without needing to connect to a bank or open a bank account.[43]

This technology has been touted as a tool for broadening access to financial services in areas where financial infrastructure is lacking. Across Africa, SIM cards can be used on both smartphones and non-smartphones, widening the number of mobile money users and improving accessibility. Nearly half of the world's mobile money users are in Africa, making up approximately two-thirds of global mobile money transactions.[44]

Research shows that by 2025, at least 70% of all online transactions will be made with alternative payment methods. In this paradigm, digital wallets, mobile money, and instant payments will hold sway, with card transactions representing only 30% of online volume.[45]

Even as mobile money adoption proliferates, broader financial services are still not reaching the majority of African citizens. Due to the constraints listed previously, consumers are forced to forfeit access to typical legacy banking perks including earning interest on banked savings and building up a credit history.

Interoperability on the continent also remains a major issue amongst banking and payment alternatives.[46] For this, a growing number of network providers are working on near-instantaneous payments technologies built on blockchain.

Reimaging Remittances

The past few years have seen a steady increase in the use of digital financial services across Africa. After COVID-19 initially disrupted remittance flows, activity surged—in large part, as family members abroad supported African communities. Migrants are actively responding to the needs of their families and taking advantage of improving connectivity as mobile money firms innovate, develop products, and compete to meet the growing demand for broader financial services.[47]

In addition to rising mobile money adoption, inbound remittance payments in Africa surged to over $100 billion last year reflecting a 12.1% CAGR over the past three years.[48] The World Bank estimates the Sub-Saharan region would receive an estimated $55 billion in remittances last year.[49] Still, traditional payment rails saddle users with high fees—up to 9% in the Sub-Saharan region.

70%

Africa accounts for 70% of the world's $1T mobile money value.

There is clearly a demand and market for faster, more affordable remittances in the region, and crypto-enabled payments are making this a reality.

Crypto Use is Catching On

Africa is one the fastest-growing crypto markets in the world, however, it remains one of the smallest. Tech-savvy consumers across Ghana, Nigeria, and South Africa are leading the crypto movement and adopting crypto-enabled payments in lieu of traditional banking services.[50]

Last year, despite the recent bear market environments in crypto, the number of retail transfers of $1,000 actually increased in Sub-Saharan Africa, bucking global trends.[51] One of the reasons: Africans don't tend to trade crypto speculatively, and instead use digital currencies to solve issues related to financial inclusion and to address limited access to the banking system, including for cross-border remittances.

These behaviors point to resurgent formal and informal dollarization activities. Across developing economies, consumers are showing a preference for digital assets pegged to the dollar (like USDC) to counter economic instability and high inflation.

In Nigeria, Korapay processes billions in cross-border payments via Bitcoin, USDC, and other digital assets while settling transactions in traditional fiat. Forbes highlights how global companies use the company's services to exchange Nigerian naira for US dollars without even knowing they're using cryptocurrencies and stablecoins, suggesting a retooling of traditional financial services.[52]

While mobile money can make domestic payment rails more efficient (and address fragmentation and cost issues associated with physical branches like Western Union and Moneygram), crypto-enabled services can reduce costs, increase security, and streamline international transactions for businesses and consumers alike.

Beyond consumers, across over a dozen African nations, interest in central bank digital currencies (CBDCs) is growing. African governments see CBDCs as tools to enhance monetary policy effectiveness and add greater payment system efficiency. In addition, based on central banker surveys, authorities also envision CBDCs as promoting superior payments systems compared to existing mobile money alternatives.[53]

Encountering Barriers to Sustained Success

Africa remains encumbered by a complex, competitive, and fragmented payments landscape resulting in low rates of interoperability. Paradoxically, while the region leads the world in the number of mobile money accounts, compatibility issues mean users must constantly move money in and out of various wallets to complete transactions.[54]

Further, poor interoperability hinders both electronic payments growth and limits enhanced cross-border payment experiences. African Business argues that interoperability also stifles the potential benefits of financial innovation and inclusion.[55] Extending crypto and blockchain technologies into existing mobile money infrastructures — of which there are nearly 150 serving Sub-Saharan Africa alone — is difficult given the prevalence of closed-loop systems. In these systems, available monies have limited use cases.[56, 57]

There is also a significant learning curve for the average person to familiarize themselves with crypto, including using crypto applications and digital wallets. While new technology like mobile money has garnered success, the high rate of adoption may be due to comfort levels with traditional fiat currency.

The growing popularity of mobile money services in Africa has also created a new threat vector for criminals to take advantage of. Increasingly, bad actors target victims in cyberattacks, exploit weaknesses in regulations and identification systems, and commit mobile money enabled crimes.[58]

Historically, illicit activity has been an early outcome of mobile payments adoption, and public hesitation may exist

around crypto and other digital payments types if criminality goes unchecked.

More recently, South Africa's financial regulator announced that all crypto exchanges operating in-country need to obtain licenses by the end of 2023. While broader fintech regulation may not be antithetical to digital asset use, it may add initial friction in terms of adoption and innovation.[59]

Elsewhere, Central African countries like Cameroon and Democratic Republic of Congo have been slow to adopt digital payments due to the lack of regulation and poor infrastructure. Even where infrastructure and consumer awareness are high, adoption can take time given the legacy presence of banking institutions.[60]

Last year's move by the Central African Republic's parliament to accept bitcoin as legal tender appeared a meaningful step towards improving the country's payment infrastructure. However, the move embroiled the country's economic and monetary community in controversy and the legislation was just recently reversed.[61]

Considering What's Next

There is opportunity for Africa's fintechs to piggyback on the success of mobile money to push the adoption of crypto-enabled tools. These tools can make payments even more accessible, approachable and affordable for everyday users. Today, brands like Kotani are pioneering how to use technology like blockchain to reimagine onerous international money transfer and payouts.

Building safeguards like Know Your Customer (KYC) and Anti-Money Laundering (AML) into mobile money transactions that utilize blockchain and crypto technology can grow safe, scalable adoption and address concerns around organized crime. Increasing awareness of these safeguards and educating end-users and institutions on both the benefits and ease of use of crypto is key to gaining trust and buy-in from the public and enabling the successful adoption of this technology.[62]

And as the world's workforce continues a remote or hybrid-first model, this opens up further possibilities for Africa to stimulate its economy with crypto-enabled payments. The African workforce now has the opportunity to go global, uplifting millions from poverty and enabling remote workers to be efficiently paid with crypto via digital wallets on their mobile devices.

Not only will use cases like these provide opportunities for both traditional banking providers and non-banking entities to serve untapped populations at scale, it will also broaden access to financial services for the massive unbanked population across Africa's developing economies.

04

Latin America: Ditching Cash and Finding Crypto

Throughout Latin America, funded fintechs and progressive governments are embracing digital payments. Continued post-COVID comfort with online experiences, plus unsettling inflationary issues in certain parts of the region are supporting interest in crypto. But enthusiastic consumers may not be enough to bring reimagined payments mainstream.

For the first time in history, cash no longer represents the majority of payment preferences in Latin America. Today, only 36% of consumer transactions are cash-based, and the shift toward digital payments is gaining momentum.[63]

According to a global survey, Latin American respondents were the biggest adopters of alternative payment methods, with research suggesting that they were more likely than their global peers to feel comfortable without physical wallets. They were also the most likely to believe mobile wallets would fully replace cash within the next 10 years.[64]

Going forward, cashless transactions are expected to grow 52% between now and 2025, and then 48% thereafter until 2030.[65]

Post-COVID, millions of consumers moved en masse toward internet-based shopping and banking. The heightened online connectivity led the shift from cash to digital wallets; this adaptability signifies promise for technologies like blockchain and digital currencies.[66]

Still, the region suffers from a fragmented payments landscape resulting in low interoperability and high fees for both payment senders and receivers.

Regulators in the region are working to enable real-time payment options — with varying progress and approaches — that improve interoperability, increase financial inclusion, generate revenue for banks and businesses, and help protect economies from global market volatility. Use cases like inbound remittance flows are still seen as a critical component of GDP for numerous countries across Latin America, so reducing costs associated with those remittances is a key driver of regional growth.

Interoperability: Insist or Encourage?

Payment apps and services depend on interoperability to maximize their potential. Many providers are encountering regulatory pressure to open their networks, including Yape and Plin in Peru and various P2P apps in Colombia. Brazil has opted for a proactive approach, including launching PIX — the central bank's real-time payment system — that serves over 140 million users and was modeled after popular Asian super apps.

Several instant payment programs are already available in Costa Rica (SINPE Móvil), Argentina (Transferencias 3.0), and Mexico (SPEI and CoDi), but success and adoption levels vary. Notably, the two fully interoperable bank account schemes in the region, Pix and SINPE Móvil, enjoy nearly universal adoption by their nations' respective consumers.[67]

Where interoperability mandates do emerge, improved payments infrastructure tends to appear from marketplace participants. For instance, private efforts were behind building underlying infrastructure in both Colombia (TransfiYa, powered by Minka) and Peru (Yape).

36%

of consumer transactions are cash-based, and the shift toward digital payments is gaining momentum.

Coming Waves of CBDCs and Crypto

Key Latin American markets are showing interest in digital asset adoption, in particular, CBDCs. Currently, Brazil, Argentina, Colombia, and Ecuador rank among the top 20 in global adoption of digital assets. Through CBDCs, these governments likely seek protection against uncertain domestic macroeconomic conditions, circumvention of capital controls, improved financial inclusion for unbanked populations, cheaper and faster payments, and stronger competition.[68]

As national regimes target these benefits, they create an opening for the crypto and blockchain sectors to build payments systems that make low-cost, faster and more seamless transactions a real possibility.

Bitso, Latin America's leading crypto exchange, recently launched a suite of products supporting international crypto payments. The company notes that this new set of products will allow businesses to send and receive payments in crypto or stablecoins in the countries where Bitso operates. With modern APIs, users will be able to make payments in real time, from any country in the world at more competitive costs compared to traditional options.[69]

The various integrations and alliances made by Bitso will allow its institutional clients to access more efficient cross-border payment methods.[70]

Of course, not all crypto assets are created equal. Using a digital asset that was designed specifically for payments will be key to implementing a successful digital payments system that can handle high transaction volumes without the frictions associated with legacy payment rails.

Surveying Crypto-Positive Trends

Latin America remains highly dependent on the US dollar: from US remittance flows and USD as a reserve currency, to economies like Costa Rica and El Salvador that use dollars interchangeably with local bills. Some regional businesses even use USD as a liquidity source by routing payments through American banks to transfer funds to international accounts within the region. This interconnectivity means crypto adoption in the United States is likely to influence crypto adoption levels in Latin America.

In addition, Latin American workers are opting to receive salary payments in both US dollars and cryptocurrencies.

BRAZIL

Travelex Bank Taps into Blockchain for Payments

As the first specialized exchange bank to be approved by the Central Bank of Brazil, Travelex Bank has emerged as a pioneer financial institution in Latin America using blockchain solutions for cross-border payments. By leveraging Ripple Payments — a cross-border payment solution powered by blockchain technology — Travelex can support dramatically more efficient payments. And with Ripple's global payments network that provides around-the-clock access to liquidity, real-time settlement, and local currency payouts, Travelex customers can leapfrog the process of establishing correspondent banking relationships while adhering to global compliance and security standards.

Deel, a Latin American HR firm partnering with Coinbase, reported a nearly 30% increase in crypto withdrawals in the first six months of 2023. According to company leadership, the region's existing banking systems present challenges — particularly around transaction speeds — which have driven consumers to crypto.[71] Persistent inflation issues and variation in banking processes among Latin American countries are also behind crypto adoption, as this payment technology offers needed stability and accessibility.

Many see Brazil as the de-facto fintech pioneer in Latin America, and it's worth noting the intensity with which the country is pushing smart and progressive crypto use and regulation.

In August of 2023, IMF officials praised Brazil's CBDC, calling it the regulator's "flagship initiative" to deepen the reach of digital financial services in the region. Dubbed DREX, the Digital Real is set to launch at the beginning of 2025.

Importantly, Brazil's CBDC project is distinct from many others worldwide. While regulators in emerging markets tend to prioritize financial inclusion, the IMF contends that the Pix system already addresses this. The real significance of the Digital Real is the additional innovation layer; the "smart platform" which seeks to harness the benefits of a public blockchain in a safe and reliable environment.[72]

From a compliance perspective, businesses in the region are able to use the same fiat compliance measures, like Know Your Customer (KYC) and Anti-Money Laundering (AML), for crypto transactions to ensure the safety of these flows and help protect the integrity of the financial system.

Barriers to Digital Payments Progress

Many in the established bank sector perceive crypto as a threat, and unfortunately, sector incumbents still exert influence in the financial markets and among regulatory and legal structures in the region.

Thus, any major shift towards crypto is likely to encounter some structural resistance. This may mean incumbents lean on cozy governmental relationships to slow upstart innovations and enact favorable regulatory rulings. In addition, unless required by law, financial institutions may also choose to curb interoperability and maintain closed ecosystems to inhibit competition.

Further, banking institutions are for-profit businesses, and many struggle to adapt product and service availability for lower income citizens. In many countries, a few national banks still hold the majority of deposits within a given nation, and thus can control related payments, borrowing, or lending services. These large banks often impose high, excessive fees on individuals in order to open an account.[73]

While digital and so-called "neobanks" add an important counterforce, their banking models aren't invincible.

Regional central bankers have noted how neobanks' credit segment is under tremendous pressure, since fintechs tend to concentrate on high-risk unsecured loans like credit cards or personal loans. Brazil's central bank reported that neobank credit delinquencies rose over 10% at the end of 2022 as inflation pressures mounted, increasing from 6% the year prior.[74]

Separately, regulators took measures to boost financial services availability via fintechs. These include facilitating the implementation of some AML/CFT requirements using digital tools. Other measures included permitting electronic-KYC (eKYC), facilitating digital onboarding, and even waiving of transaction fees for payments and remittances and the increase of transaction limits/thresholds.[75]

Should these measures expire or change, fintech companies—including crypto or mobile payment providers—may experience system shock and some unpredictable impacts.

Due to the region's dependency on USD and US-clearing institutions, as costs rise in the United States, fear and volatility seep into the Latin American market. Adding insulation from others' financial swings underscores why achieving interoperability across Latin America is so critical.

While the crypto-winter dynamic has unfortunately cast doubt, education will be integral for hundreds of millions of consumers to grasp the distinctions between crypto as a store of value and crypto enabling better payment methods.[76]

05

Europe: No Time Like the Present for Instant Payments

Instant payments continue the forward march as the transaction method of choice for consumers and businesses across the European Union and the United Kingdom. Entities like the European Commission (EC) are behind the progress, working to build more resilient financial infrastructure and make instant payments universally available. But ambitious projects still come with formidable challenges.

In June 2023, the EC published proposals for the Payment Services Directive 3 (PSD3) and the Payment Services Regulation (PSR) in an attempt to keep pace with the rapid developments in the electronic payments market.

Minimally, the financial data access and payments package seeks to sustain an efficient market for retail financial services that ensures:[77]

- the same rules across the EU
- clear information on payments
- fast and instant payments
- consumer protection
- a wide choice of payment services

Today, one in three EU payment service providers does not offer instant euro payments, and up to 70 million payment accounts in the euro area do not allow holders to send and receive instant payments. In many cases, instant payments cost much more than traditional money transfers—often as much as €30 per payment.[78]

PSD3 and PSR measures emphasize creating a better environment for digital transformation including reducing fraud, improving open banking functions, and harmonizing administrative rules for over 270 e-money institutions and 800 payment institutions.

The efforts establish clear rights and obligations to manage customer data sharing in the financial sector, even beyond payment accounts. In practice, this should lead to more innovative financial products and services for users and stimulate competition in the financial sector.[79]

The EU also aims to support a single payment area which lets citizens and businesses make cross-border payments as easily and safely as they would in their home country, and subjects cross-border payments to the same charges as domestic payments.[80]

Payments Proposals Signal UK Progress

In the UK, the Faster Payments System enables payments to move quickly and securely to and between UK bank accounts, 24 hours a day. In 2022, Faster Payments saw massive processing growth.

In Q2 of 2023, the system saw 1.2 billion payments processed, a 14% increase over the amount processed at the same time the year prior. The total amount of payments processed during this quarter was £914 billion, a 15% increase on total payments processed in Q2 of 2022.[81]

These impressive volumes prove that change is imminent for financial institutions with implications across products and services strategy, cash-flow, compliance, and customer retention. Through a variety of public-private development initiatives, all payment service providers, including banks and other financial institutions, will have easier access to real-time capabilities.[82]

1.2B

The UK's implementation of the Faster Payments System resulted in a 14% YoY increae in total payments processed between 2022 and 2023.

Although the UK has long been considered a pioneer in real-time payments, urgency still exists to stay ahead of other G7 economies with respect to payments architecture. Notably, The UK's Payment Systems Regulator (PSR) is advancing its New Payments Architecture (NPA) program, an initiative designed to better accommodate interbank payments, including the clearing and settlement of payments from one account to another. The initiative also aims to consolidate current systems used for processing payments like Faster Payments, Cheque, and Credit Clearing.[83]

The NPA will drive adoption of the ISO 20022 financial messaging standard and deliver new real-time payment products. Moving to the messaging standard allows richer data to accompany transactions, supporting faster allocation and reconciliation of incoming payments.

The expectation is that NPA helps support infrastructure which reduces the cost to serve, reduces the fraud endemic, and lays out the framework for an eventual replacement to the Faster Payments Scheme.[84]

Highs and Hiccups with New Payments Systems

Frustration with traditional correspondent banking models — especially when juxtaposed against the world of always-on, domestic P2P payment services — has catalyzed other payments systems and providers to improve their efforts.

According to a PwC survey, 42% of respondents felt strongly that there would be an acceleration of cross-border, cross-currency, instant B2B payments in the next five years.[85]

However, ambitious pan-European payments collaborations often face challenges, punctuated by the European Payment initiative and the more recent P27 initiative. Even across well-intentioned campaigns, conflicting interests and misalignment among coalitions, plus a lack of critical mass participants, are problematic.

In the case of P27 — a Nordic-led, highly-anticipated cross-border payments initiative — none of the scalable mobile payment schemes (e.g., MobilePay and Vipps) were supported and project complexities eventually doomed the operating model.[86]

Trends Supporting Instant Payments

A few key trends have buttressed the accelerated adoption of instant payment methods across Europe. First, both the B2B and B2C payments landscape is rapidly modernizing. There is increased expectation from both consumers and businesses that international payment rails function as seamlessly as domestic rails.

The European Central Bank is well-underway exploring a digital euro — or some equivalent digital means of payment — that is universally accepted throughout the euro area. According to the ECB, a digital euro would offer a pan-European payment solution under European governance that would help make the European payments landscape more resilient, competitive, and innovative. The European Central Bank is on track to begin its digital euro pilot ahead of a possible launch in 2028.[87]

42%

of respondents felt strongly that there would be an acceleration of cross-border, cross-currency, instant B2B payments in the next five years.

Financial institutions will need to move quickly to onboard and implement institutional-grade digital asset software infrastructure in order to keep up with demand and offer digital euro services to their customers. Otherwise, they risk the ECB likely overtaking the market and enabling direct to consumer digital euro apps.

Also encouraging the shift to digital is bullishness around more efficient distributed ledger technology, such as blockchain. Moreover, sovereigns everywhere are expressing a desire to break dependency from international card schemes for on- and offline payments.

Over 90% of central banks globally are researching or piloting CBDCs, including Swedish central bank Riksbank which started investigating digital currencies in 2017. The country is well-ahead of global peers, and in 2023, the Riksbank revealed they would be testing the technical solution for the e-krona, performing studies aimed to capture end user feedback, and preparing for the possible procurement of an issuable e-krona.[88]

So while Europe is already making headway with new payment rails to bolster the region's economies, their technological lead and digital-first approach stand to put them at an even greater competitive advantage.

Conclusion

These trends mark an era of streamlined payment experiences that are faster, more inclusive, and transparent for both businesses and individuals. Advancements are constant, and each turn of innovation uncovers new fronts for growth. For ecosystem players today, the imperative is to just get started—creating, building, trialing, or exploring payment solutions that will satisfy modern needs and expectations.

For more than a decade building blockchain solutions for finance, Ripple has had its sights on enabling the world to move value as seamlessly as information moves today—starting with a payments solution that makes global transactions vastly more efficient.

To learn more about how you can expand your reach and accelerate your payments with Ripple Payments, contact our team today.

Endnotes

1. https://insights.discoverglobalnetwork.com/global-trends/how-open-banking-is-changing-financial-services
2. https://www.globenewswire.com/en/news-release/2023/01/19/2591894/0/en/Open-Banking-Market-to-Hit-131-3-Billion-by-2028-Thanks-to-Rising-Preference-for-Digital-Payments-Globally.html
3. https://www.paymentsed.org/wp-content/uploads/2023/08/2023_PaymentsEd_Link_FedNow_-_updated_7.25.2023-Open-Banking.pdf
4. https://thefintechtimes.com/coinbase-officially-expands-into-canada-following-interac-e-transfer-integration/
5. https://thepaypers.com/interviews/open-banking-is-thriving-in-north-america-as-open-finance
6. https://navigate.visa.com/na/money-movement/unlocking-the-opportunities-of-open-banking/
7. https://www.paymentsjournal.com/6-ways-fednow-will-transform-the-payments-industry/
8. https://www.federalreserve.gov/paymentsystems/fednow_about.htm
9. https://www.fisglobal.com/en/-/media/fisglobal/files/campaigns/global-payments-report/FIS_TheGlobalPaymentsReport2023_May_2023.pdf
10. https://www.pymnts.com/news/banking/2023/2023-looms-as-big-year-for-iso-20022-according-to-wells-fargo/
11. https://www.frbservices.org/financial-services/fednow/instant-payments-education/what-is-iso-20022-why-does-it-matter.html
12. https://www.frbservices.org/financial-services/fednow/instant-payments-education/what-is-iso-20022-why-does-it-matter.html
13. https://cryptoslate.com/stablecoin-volume-outpaced-mastercard-paypal-in-2022-as-digital-payments-wars-loom/#
14. https://www.fidelity.com/learning-center/trading-investing/what-is-a-stablecoin
15. https://www.pewresearch.org/short-reads/2022/10/05/more-americans-are-joining-the-cashless-economy/
16. https://www.nytimes.com/2023/07/14/business/small-business-cashless-digital-payments.html
17. Bernstein research. Global Digital Assets: Primer 1.0 on Stablecoins: The ~$3Tn digital currency market
18. https://ciosea.economictimes.indiatimes.com/news/strategy-and-management/emerging-digital-banks-in-apac-and-their-prospects/99051063
19. https://www.asiafundmanagers.com/us/digital-banks-in-asia-the-next-frontier-in-finance/
20. https://ciosea.economictimes.indiatimes.com/news/strategy-and-management/emerging-digital-banks-in-apac-and-their-prospects/99051063
21. https://www.fisglobal.com/en/-/media/fisglobal/files/campaigns/global-payments-report/FIS_TheGlobalPaymentsReport2023_May_2023.pdf
22. https://go.2c2p.com/2c2p-infobrief/
23. https://thefintechtimes.com/thunes-latest-partnership-bridges-payments-between-china-and-the-rest-of-world/
24. https://www.businesswire.com/news/home/20230529005014/en/Asia-Pacific-Continues-Growth-Trajectory-in-Real-Time-Payments-Market-Leads-the-Way-in-Cross-Border-Payment-Linkages
25. https://business.outlookindia.com/banking/upi-records-10-billion-transactions-learn-about-recent-innovations-in-digital-payment
26. https://www.mckinsey.com/industries/financial-services/our-insights/the-2023-mckinsey-global-payments-report#/
27. https://business.outlookindia.com/banking/indias-upi-transaction-volume-surged-62-yoy-in-hi-2023know-trends-in-digital-payments
28. https://www.reuters.com/technology/india-singapore-launch-real-time-link-cross-border-payments-2023-02-21/
29. https://www.equinix.com/resources/whitepapers/non-cash-payments-in-japan
30. https://www.kapronasia.com/asia-payments-research-category/will-japan-achieve-its-cashless-vision-target.html
31. https://economictimes.indiatimes.com/tech/technology/indias-ecommerce-market-to-reach-150-billion-by-2026-fuelled-by-rise-in-upi-transactions-report/articleshow/98933077.cms?
32. https://www.fisglobal.com/en/global-payments-report
33. https://economictimes.indiatimes.com/tech/technology/ecommerce-user-base-in-india-to-outpace-us-in-two-years-bain-report/articleshow/94767324.cms
34. https://www.pymnts.com/smbs/2022/75-percent-of-small-businesses-dissatisfied-with-cross-border-payment-solutions/
35. https://www.ppro.com/countries/india/
36. https://datastorageasean.com/news-press-releases/79-apac-consumers-according-recent-f5-research-are-willing-sacrifice-data
37. https://www.weforum.org/agenda/2023/06/asia-pacific-region-the-new-ground-zero-cybercrime/
38. https://techwireasia.com/2023/09/how-can-ai-and-cybersecurity-bridge-apacs-talent-gap/
39. https://blog.checkpoint.com/research/global-cyberattacks-continue-to-rise/
40. https://www.jpmorgan.com/payments/paymentsunbound/volume-2/whats-next-for-asia-pacific
41. https://thepaypers.com/interviews/digital-transformation-and-the-power-of-payments-in-apac-interview-with-joseph-chan–1262567
42. https://www.connectingafrica.com/author.asp?section_id=761&doc_id=784458#close-modal
43. https://www.povertyactionlab.org/blog/10-22-20/rise-mobile-money-sub-saharan-africa-has-digital-technology-lived-its-promises
44. https://www.gsma.com/sotir/#download
45. https://blog.ebanx.com/en/mobile-money/
46. https://www.cnbc.com/2023/03/26/bitcoin-is-poised-to-blow-up-africas-86-billion-banking-system.html
47. https://www.dw.com/en/how-digitalization-improves-remittances-to-africa/a-65052455
48. https://remitscope.org/africa/
49. https://techcrunch.com/2023/09/04/kotani-pay/
50. https://bitpay.com/blog/africa-embracing-crypto/
51. https://african.business/2022/10/finance-services/africa-crypto-transactions-increase-despite-bear-market
52. https://fortune.com/crypto/2023/10/08/stablecoins-dollarization-global-south-bitcoin-usdc/

53. https://african.business/2023/08/african-banker/improving-interoperability-for-increased-transaction-flows-in-africa
54. Ibid
55. Ibid
56. https://www.statista.com/topics/6770/mobile-money-in-africa/#topicOverview
57. https://clearbridgemobile.com/open-vs-closed-loop-mobile-payments/
58. https://enactafrica.org/research/interpol-reports/mobile-money-and-organised-crime-in-africa
59. https://cointelegraph.com/news/crypto-exchange-licences-south-africa-by-year-end
60. https://www.gfmag.com/magazine/march-2023/africa-digital-payments-progress#
61. https://www.centralbanking.com/central-banks/currency/digital-currencies/7956294/car-to-drop-crypto-as-legal-tender
62. https://www.dowjones.com/professional/risk/glossary/anti-money-laundering/kyc-vs-aml/
63. https://americasmi.com/wp-content/uploads/2023/03/digital-payment-trends-in-2023_kushki.pdf
64. https://www.paysafe.com/en/lost-in-transaction-2023-download/
65. https://www.pwc.com/gx/en/industries/financial-services/publications/financial-services-in-2025/payments-in-2025.html#macro2
66. https://www.jpmorgan.com/solutions/treasury-payments/insights/four-trends-latin-america
67. https://americasmi.com/wp-content/uploads/2023/03/digital-payment-trends-in-2023_kushki.pdf
68. https://www.imf.org/en/News/Articles/2023/06/22/cf-interest-in-cb-digital-currencies-picks-up-in-latam-the-caribbean-while-crypto-use-varies
69. https://www.latamrepublic.com/bitso-the-mexican-startup-leading-the-cryptocurrency-revolution-in-latin-america/
70. https://ffnews.com/newsarticle/cryptocurrency/bitso-will-connect-latin-america-with-companies-around-the-world/
71. https://www.bloomberglinea.com/english/latin-american-workers-are-opting-for-payment-in-us-dollars-and-crypto-deel-says/
72. https://www.fintechnexus.com/imf-praises-digital-real-brazils-cbdc-expected-for-2024/
73. https://jsis.washington.edu/news/digital-banking-and-economic-development-inclusion-and-exclusion-in-latin-america/
74. https://www.fintechnexus.com/neobanks-expand-their-share-in-brazils-1-trillion-credit-market/
75. https://www.imf.org/en/Publications/fintech-notes/Issues/2023/03/28/The-Rise-and-Impact-of-Fintech-in-Latin-America-531055
76. https://www.rsm.global/latinamerica/en/insights/where-crypto-can-pay-stablecoins-digital-dollars-latin-america
77. https://finance.ec.europa.eu/consumer-finance-and-payments/payment-services/payment-services_en#strategy
78. https://finance.ec.europa.eu/system/files/2022-10/instant-payments-factsheet_en.pdf
79. https://finance.ec.europa.eu/publications/financial-data-access-and-payments-package_en
80. https://finance.ec.europa.eu/consumer-finance-and-payments/payment-services/payment-services_en#strategy
81. https://newseventsinsights.wearepay.uk/data-and-insights/faster-payment-system-statistics/
82. https://www.electronicpaymentsinternational.com/comment/faster-payments-and-future-growth-for-corporates-charles-bennett-expert-comment
83. https://www.fintechfutures.com/2023/07/psr-delivers-update-on-progress-of-new-payments-architecture/
84. https://www.finextra.com/blogposting/24078/new-payments-architecture-infrastructure-must-drive-innovation-and-reduce-costs
85. https://www.pwc.com/gx/en/industries/financial-services/publications/financial-services-in-2025/payments-in-2025.html#macro2
86. https://insights.flagshipadvisorypartners.com/insights/p27-lessons-learned-from-the-latest-failure-in-pan-european-payment-collaborations
87. https://www.reuters.com/markets/currencies/study-shows-130-countries-exploring-central-bank-digital-currencies-2023-06-28/
88. https://www.finextra.com/newsarticle/41859/cbdc-in-the-nordics-what-is-the-status-in-sweden-denmark-norway-finland-and-iceland

SUGGESTED READING MATERIALS

6. Suggested Reading Materials

6.1. Short The Rip - The New Era of Blockchain Based Financial Instruments

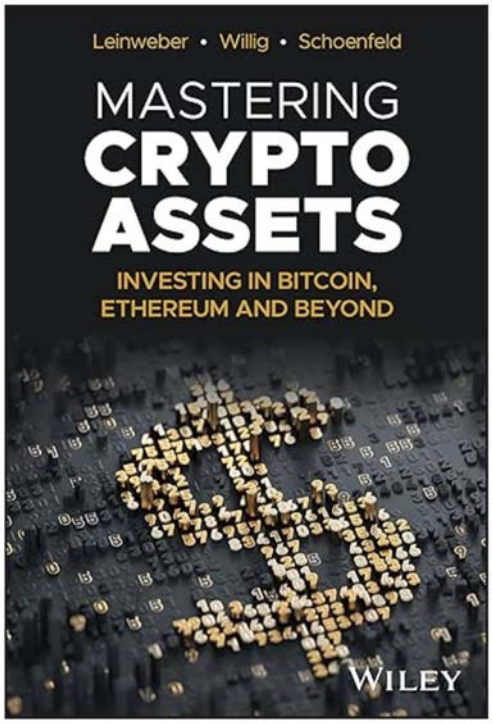
Title: Short The Rip - The New Era of Blockchain Based Financial Instruments

Author: Tilmar Wilhelm Goos and Prof. Dr. Pornphisud Mongokhavai

About the book:
Short the Rip is a groundbreaking exploration of how blockchain technology is revolutionizing the global financial world. With a title inspired by the trading strategy of profiting from market volatility, this book delves into the transformative power of blockchain-based financial instruments, showing how they are reshaping investment strategies, trading practices, and risk management.

But the impact of blockchain goes far beyond financial markets. Short the Rip demonstrates how blockchain is innovating payment systems, redefining the concept of money, and addressing critical issues of data security and privacy. Through captivating case studies, innovative research, and expert insights, the book offers a dynamic analysis of decentralized finance (DeFi), tokenization, and smart contracts, illustrating their potential to disrupt traditional financial paradigms. This book is a must-read for academics, finance professionals, and policymakers. It provides a forward-looking perspective on how blockchain technology aims to transform financial systems and societal interactions, offering essential knowledge for navigating the new era of digital finance.

6.2. Mastering Crypto Assets



Title: Mastering Crypto Assets: Investing in Bitcoin, Ethereum and Beyond

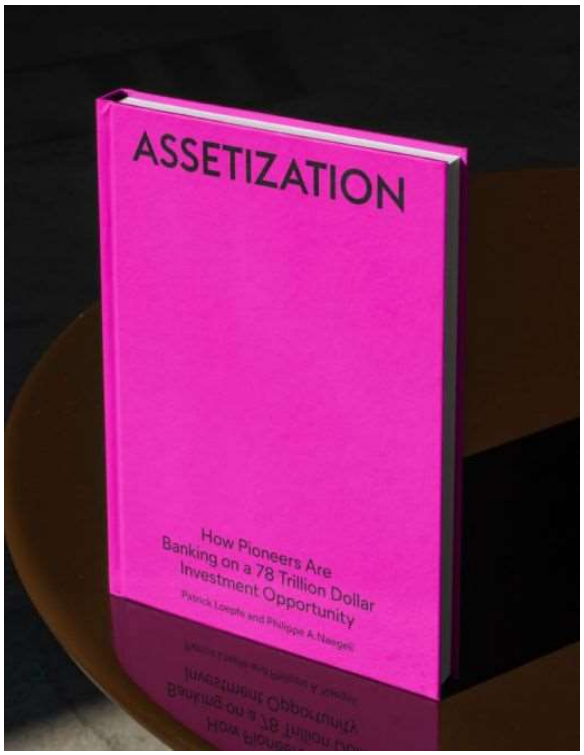
Author: Martin Leinweber, Jörg Willig and Steven A. Schoenfeld

About the book:
A definitive, all-encompassing book on digital assets of all types for investors In Mastering Crypto Assets: Investing in Bitcoin, Ethereum and Beyond, a team of seasoned investors and digital asset strategists presents a comprehensive guide aimed at institutional and professional investors for integrating crypto assets into traditional portfolios. The book offers in-depth explanations of the structure of this new asset class and its impact on investment portfolios. It guides readers on using fundamental and quantitative criteria to select blockchain-based assets, grounded in a robust foundation of knowledge and evidence. The authors demonstrate how to apply quantitative valuation concepts to digital assets like Bitcoin, understanding their role as digital stores of value in a traditional investment portfolio.

The book also delves into the unique risk and return characteristics of various digital asset sectors, adapting conventional investing methods to the digital realm. It goes beyond direct crypto asset investments, introducing related equities and strategies for accessing digital assets in restricted settings. It discusses both indexed and active strategies in the context of crypto assets. A key feature of the book is exclusive interviews with industry figures such as Jan van Eck (VanEck), Peter L. Brandt (Legendary Trader), and Fred Thiel (Marathon Digital), with these interviews accessible through QR codes in the book for extended video content. This provides a dynamic and interactive learning experience. Moreover, the book benefits from invaluable research assistance from Figment and CCData, enriching its analytical depth. It also includes insightful guest articles from digital asset experts like Matthew Sigel (VanEck), Marco Manoppo (Digital Asset Research), Marcel Kasumovich (Coinbase Asset Management), Timothy Peterson (Cane Island Digital Research), Gregory Mall and Rohan Misra (AMINA), and thought leaders from Token Terminal. Mastering Crypto Assets is an invaluable resource not just for institutional and

individual investors, but for anyone keen on adopting a sound, evidence-based approach to digital asset investment.

6.3. Assetization - The Book



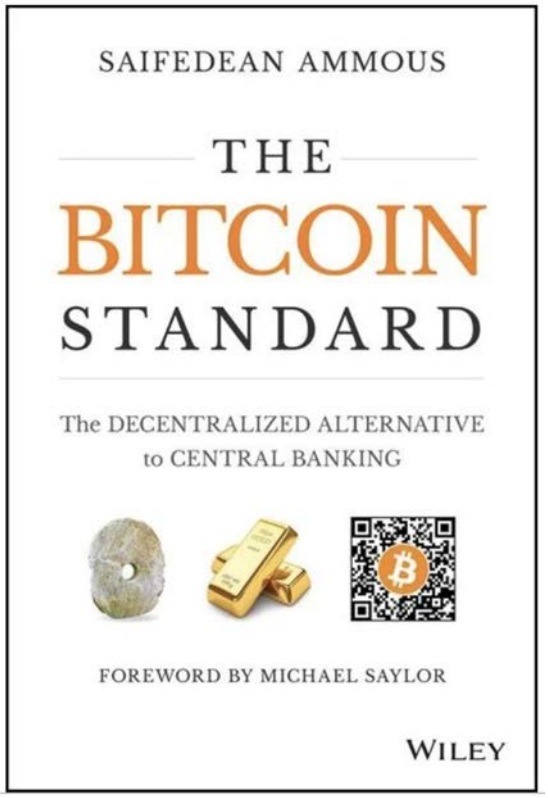
Title: Assetization

Author: Patrick Loepfe & Philippe A. Naegeli

About the book:
There is an almost unfathomable investment opportunity on the horizon – the Opportunity of Assetization. Driven by technology and innovations in securitization and tokenization, Assetization makes it possible to turn almost anything or idea into an investible asset. The result will be a profound democratization of investing and a radical expansion of the global investment universe. The opportunity is almost limitless. It includes over 78 trillion dollars of dormant, non-bankable assets just waiting to be awakened.

It is so vast and so compelling, in fact, that we wrote a book about it. In it we uncover the Assetization opportunity in detail and show how pioneers are already exploring this final frontier of finance.

6.4. The Bitcoin Standard



Title: The Bitcoin Standard

Author: Saifedean Ammous

About the book:
When a pseudonymous programmer introduced "a new electronic cash system that's fully peer-to-peer, with no trusted third party" to a small online mailing list in 2008, very few paid attention. Ten years later, and against all odds, this upstart autonomous decentralized software offers an unstoppable and globally-accessible hard money alternative to modern central banks. The Bitcoin Standard analyzes the historical context to the rise of Bitcoin, the economic properties that have allowed it to grow quickly, and its likely economic, political, and social implications.

While Bitcoin is a new invention of the digital age, the problem it purports to solve is as old as human society itself: transferring value across time and space. Ammous takes the reader on an engaging journey through the history of technologies performing the functions of money, from primitive systems of trading limestones and seashells, to metals, coins, the gold standard, and modern government debt. Exploring what gave these technologies their monetary role, and how most lost it, provides the reader with a good idea of what makes for sound money, and sets the stage for an economic discussion of its consequences for individual and societal future-orientation, capital accumulation, trade, peace, culture, and art.

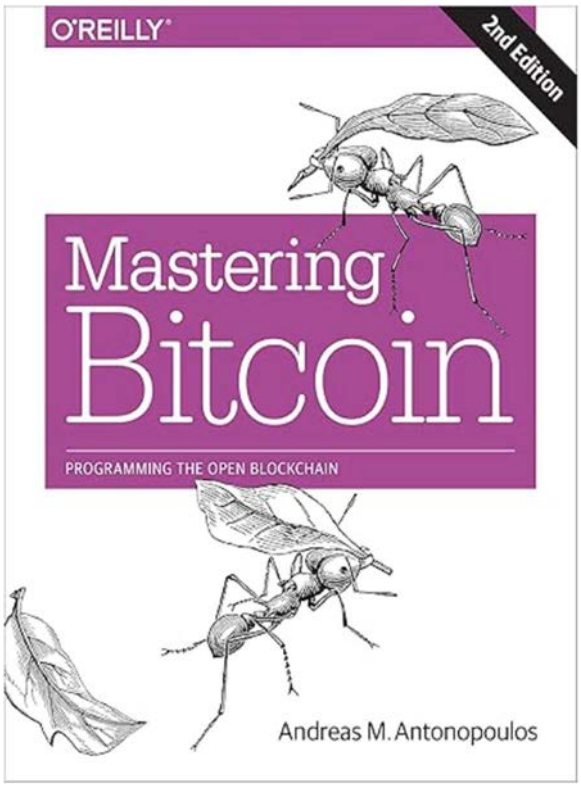
Compellingly, Ammous shows that it is no coincidence that the loftiest achievements of humanity have come in societies enjoying the benefits of sound monetary regimes, nor is it coincidental that monetary collapse has usually accompanied civilization collapse. With this background in place, the book moves on to explain the operation of Bitcoin in a functional and intuitive way. Bitcoin is a decentralized, distributed piece of software that converts electricity and processing power into indisputably accurate records, thus allowing its users to utilize the Internet to perform the traditional functions of money without having to rely on, or trust, any authorities or infrastructure in the physical world. Bitcoin is thus best

understood as the first successfully implemented form of digital cash and digital hard money. With an automated and perfectly predictable monetary policy, and the ability to perform final settlement of large sums across the world in a matter of minutes, Bitcoin's real competitive edge might just be as a store of value and network for final settlement of large payments—a digital form of gold with a built-in settlement infrastructure.

Ammous' firm grasp of the technological possibilities as well as the historical realities of monetary evolution provides for a fascinating exploration of the ramifications of voluntary free market money. As it challenges the most sacred of government monopolies, Bitcoin shifts the pendulum of sovereignty away from governments in favor of individuals, offering us the tantalizing possibility of a world where money is fully extricated from politics and unrestrained by borders.

The final chapter of the book explores some of the most common questions surrounding Bitcoin: Is Bitcoin mining a waste of energy? Is Bitcoin for criminals? Who controls Bitcoin, and can they change it if they please? How can Bitcoin be killed? And what to make of all the thousands of Bitcoin knock-offs, and the many supposed applications of Bitcoin's 'blockchain technology'? The Bitcoin Standard is the essential resource for a clear understanding of the rise of the Internet's decentralized, apolitical, free-market alternative to national central banks.

6.5. Mastering Bitcoin



Title: Mastering Bitcoin. Programming The Open Blockchain

Author: Andreas M. Antonopoulos

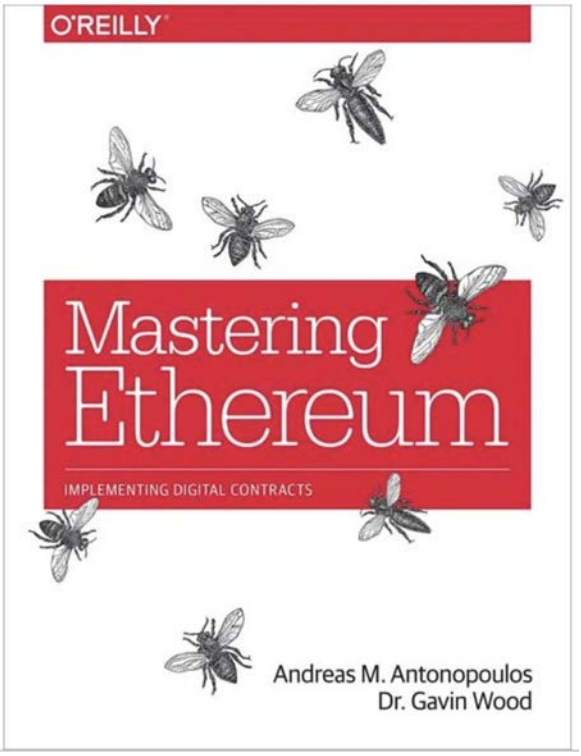
About the book:
Join the technological revolution that is taking the financial world by storm. *Mastering Bitcoin* is your guide through the seemingly complex world of bitcoin, providing the knowledge you need to participate on the internet of money. Whether you are building the next killer app, investing in a startup, or simply curious about the technology, this revised and expanded second edition provides essential detail to get you started.

Bitcoin, the first successful decentralized digital currency, is still in its early stages and yet it's already spawned a multi-billion-dollar global economy open to anyone with the knowledge and passion to participate. *Mastering Bitcoin* provides the knowledge. You simply supply the passion.

The second edition includes:

- A broad introduction of bitcoin and its underlying blockchain ideal for non-technical users, investors, and business executives
- An explanation of the technical foundations of bitcoin and cryptographic currencies for developers, engineers, and software and systems architects
- Details of the bitcoin decentralized network, peer-to-peer architecture, transaction lifecycle, and security principles
- New developments such as Segregated Witness, Payment Channels, and Lightning Network
- A deep dive into blockchain applications, including how to combine the building blocks offered by this platform into higher-level applications
- User stories, analogies, examples, and code snippets illustrating key technical concepts

6.6. Mastering Ethereum



Title: Mastering Ethereum

Author: Andreas M. Antonopoulos Gavin Wood

About the book:
Ethereum represents the gateway to a worldwide, decentralized computing paradigm. This platform enables you to run decentralized applications (DApps) and smart contracts that have no central points of failure or control, integrate with a payment network and operate on an open blockchain. With this practical guide, Andreas M. Antonopoulos and Gavin Wood provide everything you need to know about building smart contracts and DApps on Ethereum and other virtual-machine blockchains.

Discover why IBM, Microsoft, NASDAQ, and hundreds of other organizations are experimenting with Ethereum. This essential guide shows you how to develop the skills necessary to be an innovator in this growing and exciting new industry.

- Run an Ethereum client, create and transmit basic transactions, and program smart contracts
- Learn the essentials of public key cryptography, hashes, and digital signatures
- Understand how "wallets" hold digital keys that control funds and smart contracts
- Interact with Ethereum clients programmatically using JavaScript libraries and Remote Procedure Call interfaces
- Learn security best practices, design patterns, and anti-patterns with real-world examples
- Create tokens that represent assets, shares, votes, or access control rights
- Build decentralized applications using multiple peer-to-peer (P2P) components

CVA RESEARCH JOURNAL 2024
THE FUTURE OF PAYMENTS & SETTLEMENTS NETWORKS

CRYPTO VALLEY ASSOCIAITON, SWITZERLAND
PUBLISHED DECEMBER 11TH, 2024

www.cryptovalley.swiss