Abstract

This paper examines various digital assets, their interconnections, and the evolution that has led to the development of Central Bank Digital Currencies (CBDCs). Cryptocurrencies initially generated substantial excitement but have not replaced cash, and their lack of regulatory frameworks poses significant risks. Current monetary and payment systems lack safety and efficiency, which competition could improve. Global stablecoins like the digital Yuan and Dollar have prompted stakeholders to reassess economic and financial systems to stay relevant amid emerging technologies that challenge traditional roles and business models. Despite the initial hype, Distributed Ledger Technology (DLT), which underpins most digital assets, may not be the future unless performance issues and other frictions are resolved. Attention is now focused on CBDCs, which utilize more traditional databases. CBDCs aim to combine the benefits of cryptocurrencies and stablecoins while ensuring security, efficiency, financial inclusion, and stability.

**Exploring the Interconnections and Future Prospects of Money, Digital Assets, Cryptocurrency, Central Bank Digital Currencies and DLT   
A Literature Review**

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# Introduction

Over the past 15 years, the emergence of digital assets—including cryptocurrencies, stablecoins, and sovereign digital currencies—has generated both excitement and concern among governments, central banks, firms, and individuals (Tapscott, 2021). Governments worry about maintaining their monopoly on currency creation, their role as lenders of last resort (Keister & Sanches, 2021; Fung & Halaburda, 2016) and protecting jobs. (Productivity Commission, 2016). Meanwhile, banks and tech firms face potential obsolescence as new instruments challenge traditional business models (Claeys et al.). Individuals are attracted to these innovations for their potential in facilitating cross-border remittances, investment opportunities, and even illicit activities (De Filippi et al., 2022; Danho & Habte, 2019).

Despite growing interest, significant doubts remain about the potential of digital assets to replace traditional payment methods or national currencies. Cryptocurrencies, for example, are not widely accepted as means of payment, stores of value, or units of account (Ammous, 2018; World Economic Update ECA, 2018). Similarly, stablecoins face adoption challenges due to concerns about the underlying assets to which they are pegged.

Current monetary and payment systems are fraught with challenges. Cryptocurrencies, recognized as the most developed application of blockchain, offer decentralized payment systems but face limitations such as high costs and volatility (World Economic Update ECA, 2018). Policy challenges include the lack of regulatory frameworks for cryptocurrency transactions and smart contracts, tax code ambiguities, and potential impacts on financial stability and intermediation. Policymakers and stakeholders are reevaluating these systems in response to the rapid evolution of digital assets and the need for robust regulatory frameworks to ensure financial stability and consumer protection. The advent of global stablecoins like the digital Yuan and digital Dollar has intensified the competitive pressure on governments and central banks to develop solutions that provide safety, security, and financial inclusion, leveraging state-backed stability.

Distributed ledger technology (DLT) is crucial in this context as it promises to revolutionize digital services and enhance consumer choice. However, DLT faces performance issues and "last mile" frictions that must be resolved for it to move beyond a niche innovation. Despite these challenges, ongoing experiments with DLT are expected to yield lasting solutions (Catalini & Gans, 2020).

This thematic literature review explores the evolution of digital assets, culminating in the development of Central Bank Digital Currencies (CBDCs). It begins with an overview of digital assets, followed by an examination of the hype surrounding cryptocurrencies, stablecoins, and DLT. The shortcomings of current monetary and payment systems, along with the catalysts for CBDC introduction, are then discussed. The review concludes by considering the inevitable adoption of CBDCs and the suitable designs for different nation-states.

# Digital Assets, Cryptocurrency, Fiat Money, CBDCs and DLT

## Foundational Technology

### Digital Assets and Cryptocurrency: A Transformative Shift

Digital assets and cryptocurrencies represent a transformative shift in how value is stored and transferred in the digital age (Tapscott, 2021). Digital assets encompass a broad category of intangible assets in digital form, including cryptocurrencies, tokens, and digital files. They should Toygar argues, indeed be considered assets due to their real, monetary, and personal value. These assets typically rely on encryption, digital signatures, and cryptographic algorithms to ensure security, verify ownership, and maintain integrity (Tapscott, 2021).

Among digital assets, cryptocurrencies stand out as a revolutionary subset (World Economic Update, 2018). Designed to function as a medium of exchange, they use cryptography to secure transactions, control the creation of new units, and verify asset transfers, with blockchain technology serving as their primary foundation. Van der Merwe (2021) discusses the artificial scarcity of cryptocurrencies, which enhances their perceived investment value and potential for portfolio diversification. Together, digital assets and cryptocurrencies are reshaping financial systems, offering new opportunities and challenges for secure and efficient digital transactions (Claeys et al., 2018); (Productivity Commission 2016)

### Traditional Money vs. Cryptocurrencies: A Comparative Analysis

Traditional money, or fiat currency, is government-issued and widely accepted as a medium of exchange (Claeys et al., 2018; Hughes, 2017). In contrast, cryptocurrencies are decentralized digital currencies that enable secure, borderless transactions without the need for a central authority. While cryptocurrencies share some properties with traditional money, such as being exchangeable for goods and services and acting as a store of value, they are distinct due to their underlying blockchain technology and decentralized nature (Claeys et al., 2018).

Claeys et al. (2018) observe that cryptocurrencies lack key characteristics of traditional money: they are rarely accepted as payment in everyday life, do not serve as a unit of account, and are poor stores of value due to price volatility. Unlike fiat money, which holds value by government decree and is issued by a central authority, cryptocurrencies are created through decentralized processes and valued based on market demand. This aligns with Van der Merwe (2021) and Claeys et al. (2018), who note the speculative nature of cryptocurrencies and their lack of the typical characteristics of fiat money outside the crypto-economy. They warn of inherent risks, especially high price volatility, which necessitates over-collateralization in decentralized lending and borrowing platforms.

The World Economic Update ECA (2018) analysis, which aligns with Claeys et al. (2018), concludes that while cryptocurrencies offer advantages like easier storage and transfer, their volatility poses substantial drawbacks, making them a less optimal medium of exchange and store of value compared to legal tender. The report advocates for cautious optimism and further exploration of these technologies' roles in future economic systems.

Although cryptocurrencies provide benefits such as resistance to political interference and robust data security, which make it difficult for governments to seize or freeze funds, these same features also attract illicit activities. This dual nature fosters skepticism and presents significant regulatory challenges (Hughes, 2017). Additionally, the Productivity Commission (2016) warns that the “disruptive nature of these technologies poses risks of increased inequality and the dislocation of labor and capital.”

### Blockchain Technology: Fundamentals and Transformative Potential

Blockchain serves as the foundational technology for numerous digital cryptocurrencies, including Bitcoin. This decentralized ledger records all transactions across a network of computers (Monrat et al., 2019). According to Yaga et al. (2019), Decentralized Ledger Technology (DLT), or blockchain, provides a decentralized, secure, and transparent method of recording transactions. Each block in the blockchain contains a cryptographic hash of the previous block, a timestamp, and transaction data. This section explores the fundamentals of blockchain, its operational mechanics, and its transformative potential across various industries.

#### Components of Blockchain Technology

Distributed Ledger Technology (DLT) is characterized by several key components that ensure its robustness and reliability. Bryson et al. (2017) highlight that decentralization is a fundamental aspect, removing the need for a central authority by distributing the ledger across multiple nodes. This decentralization enhances transparency and resilience, as no single entity has control over the entire network. De Filippi (2016) argues that, despite the apparent dichotomy between transparency and privacy, there is no real conflict between the two. With advanced cryptographic techniques, it is increasingly possible to preserve individual privacy in decentralized architectures.

The distinctive features of blockchain, such as decentralization, immutability, transparency, and auditability, enhance the security and integrity of transactions, making them tamper-proof (Monrat et al., 2019; Yaga et al., 2019; Ammous, 2016). Another critical component of DLT is the use of consensus algorithms, which allow the distributed network to agree on the validity of transactions. Various algorithms, such as Proof of Work (PoW) and Proof of Stake (PoS), ensure that all participants in the network reach a consensus, maintaining the integrity and consistency of the ledger. Complementing these features is cryptographic security, which uses advanced cryptographic techniques to secure data, authenticate participants, and protect the integrity of transactions. Together, these components form the backbone of DLT, enabling secure, transparent, and reliable digital transactions (Yaga et al., 2019).

#### Blockchain Protocols

Blockchain protocols vary widely, encompassing permissioned, permissionless, and hybrid models (Solat et al., 2020). Permissioned protocols restrict access to authorized entities under central authority control, ensuring greater control and privacy. In contrast, permissionless protocols are decentralized, allowing participation and consensus from all network nodes, thus emphasizing openness and transparency. Hybrid protocols blend these approaches, combining decentralized consensus with controlled access to balance the benefits of both models (Solat et al., 2020).

Understanding these distinctions is crucial for navigating the blockchain landscape. Permissioned models prioritize control and privacy, making them suitable for enterprise applications that require stringent access controls. Permissionless protocols, by emphasizing openness and transparency, are ideal for public applications where inclusivity and decentralization are paramount. Hybrid models balance these aspects to suit specific use cases, offering a flexible approach to blockchain implementation (Liu et al., 2019).

Each protocol type offers unique advantages and limitations, influencing how blockchains function and evolve. As blockchain technology advances, exploring these protocol variations is essential for designing efficient and effective blockchain solutions (Solat et al., 2020; Liu et al., 2019).

#### Blockchain Applications

Blockchain technology represents ownership of various assets, including currency, digital content, intellectual property, equity, information, contracts, and physical assets. Since its combination with other technologies to create Bitcoin in 2008, blockchain has expanded beyond cryptocurrency into industries like finance, healthcare, government, manufacturing, and distribution (Monrat et al., 2019). It is poised to revolutionize digital media transfer, art, remote services, power distribution, crowdfunding, electronic voting, identity management, and public records governance.

Blockchain can offer substantial advantages for cross-organizational workflow management systems, potentially transforming workflows by eliminating the need for a central authority and enabling standardized, decentralized operations (Fridgen et al.). The World Bank examines how blockchain can enhance government services, with applications in land registries and public procurement, emphasizing the need for privacy and transparency (World Economic ECA, 2018).

Ammous (2016) categorizes potential blockchain applications into digital payments, contracts, and database and records management. Monrat et al. predict blockchain will transform finance by operating without central authorities, facilitating cross-border transfers, and fostering financial innovations. Blockchain's tamper-proof data storage and efficient record management are also expected to benefit healthcare, voting, and supply chains.

However, blockchain applications face challenges at the interface between offline records and digital representations, limiting use cases beyond digital-centric applications like cryptocurrency (Catalini, 2020). Key economic drawbacks include redundancy, scaling, regulatory compliance, irreversibility, and security. Blockchain’s most promising applications, such as payments, contracts, and asset registry, are viable only to the extent that they operate using the decentralized currency of the blockchain. All blockchains without currencies have not moved from the prototype stage to commercial implementation because they cannot compete with current best practices in their markets (Ammous, 2016).

In conclusion, organizations should adopt blockchain technology only when its unique features are essential for their operations, considering its inefficiencies (Yaga et al.) and before implementing a blockchain solution, it is crucial to determine the specific demand being met and whether common systems, such as mapping data in a database, are sufficient (Pohl et al.).

#### Cost Restraints of Blockchain Technology

Catalini and Gans (2008) report that blockchain technology faces two main costs associated with implementing and maintaining the technology: verifying transaction details and expanding the network. Low verification costs enable efficient transactions without intermediaries, while reduced networking costs facilitate scaling. These cost dynamics influence the technology's design and potential applications. With blockchain's decentralized nature, transaction verification and contract enforcement can occur without third-party involvement. However, challenges arise when verifying offline events digitally, necessitating complementary innovations. Lowering verification costs is crucial for enabling the establishment of rights and rules without intermediaries.

#### Summary

Blockchain technology, with its robust fundamentals and innovative operational mechanics, stands poised to revolutionize numerous industries. By ensuring decentralized, secure, and transparent transactions, blockchain not only enhances operational efficiency but also opens up new avenues for growth and development. As this technology continues to evolve, its transformative potential will increasingly drive advancements across finance, healthcare, supply chain management, and beyond, ushering in a new era of digital innovation and trust. Scott advocates for sensitivity to diverse cultural and political contexts in implementing blockchain technology, emphasizing that one-size-fits-all solutions are inadequate for addressing real-world challenges. Catalini and Gans warn that although blockchain solutions can prevent digital information leakage, they encounter significant frictions and costs at the interface between offline records and their digital representations. Finally, as reported by the ECA update report, while the transformative potential of DLT is widely acknowledged, trusted intermediaries are likely to remain essential in many cases.

### Central Bank Digital Currencies (CBDCs)

Building on the foundational insights into blockchain technology, digital currencies are set to revolutionize the financial landscape. According to Feyen et al. (2021), digital money addresses deficiencies in financial inclusion and cross-border remittances. Central Bank Digital Currencies (CBDCs), as digital forms of a nation's fiat currency, are issued and regulated by central banks, unlike decentralized cryptocurrencies. They operate within the existing financial system to provide stable and secure digital payments, aiming to enhance payment system efficiency, reduce transaction costs, especially for cross-border payments, and improve financial inclusion by offering digital financial services to unbanked and underbanked populations (Feyen et al., 2021; Engert & Fung, 2017).

CBDCs leverage Distributed Ledger Technology (DLT) to maintain secure and immutable transaction ledgers, which can be decentralized or centrally controlled. They utilize tokenization, with each digital token representing a specific value of the fiat currency, enabling seamless transfers. Operating on permissioned networks, CBDCs ensure a regulated environment with central bank-controlled access. Some implementations also incorporate smart contracts to automate regulatory compliance and transaction processing, further enhancing efficiency and security. By modernizing and securing financial systems, CBDCs represent a significant innovation in monetary policy and financial infrastructure.

#### Payment Challenges Driving CBDC Issuance

The issuance of Central Bank Digital Currencies (CBDCs) is increasingly driven by the evolving landscape of payment challenges in today's digital economy (Engert & Fung, 2017). Traditional payment systems often face inefficiencies, high costs, and limited accessibility, particularly for cross-border transactions and underserved populations. These challenges underscore the need for more efficient, secure, and inclusive payment solutions. CBDCs offer a promising avenue to address these issues by leveraging advanced digital technologies to streamline transactions, reduce costs, and enhance financial inclusion. The need to efficiently channel financial support to individuals, firms and healthcare systems also provides a strong motivation for governments and central banks to review and redesign existing electronic systems.

This section explores the specific payment challenges motivating central banks worldwide to consider and implement CBDCs as a transformative solution for the future of finance.

##### Primary Challenges

Safety

Catalini and Gans observe that as an increasingly large share of economic and social activity is digitized, keeping data secure has become more problematic and information leakage more prevalent. Safety in payment systems involves ensuring the reliability, security, and integrity of financial transactions. It includes concerns such as data protection, settlement integrity, consumer protection, regulatory compliance, and managing systemic risks. Didenko et al. and Fung with Halaburda (2016) highlight these multifaceted safety concerns, which encompass stability, integrity, data protection, and the reliability of intermediaries. Engert and Fung weigh in with suggestions that there are the risks associated with anonymity in digital currencies, suggesting that complete anonymity could facilitate criminal activities and thus be undesirable. Disruptions in critical payment systems can have significant economic impacts, posing challenges related to consumer protection, anti-money laundering measures, tax enforcement, and compliance with international regulations. The emergence of digital currencies heightens these concerns, as their failures could result in financial losses, reduced confidence, and economic disruptions. To address these issues, regulators and central banks may need to enhance oversight and consider issuing their own digital currencies to bolster system safety and mitigate systemic risks.

Efficiency

Efficiency in payment systems plays a critical role in advancing financial inclusion and reducing processing expenses and time. Key factors include speed, cost-effectiveness, accessibility, liquidity management, cross-border payments, and innovation. Examples like Mpesa demonstrate the pursuit of faster payment services.

Effective liquidity and cash management are essential for system efficiency, often achieved through timely fund transfers and standby arrangements facilitated by central banks. Cross-border payments encounter challenges due to their slow speed, high costs, and lack of transparency, which can deter investment from payment service providers. Fung and Halaburda (2016) examine how new payment structures could address these issues. They argue that if private digital currencies can significantly enhance efficiency and achieve widespread adoption**,** a Central Bank Digital Currency (CBDC) might become unnecessary. However, CBDCs could still serve as a viable policy tool to improve the effectiveness of central bank currency operations and payment systems, particularly in mitigating issues such as security concerns and transaction costs.

##### Other Challenges

Electronic money, Bitcoin and distributed ledger technology (DLT), and sovereign digital currencies have all served as precursors to the development of Central Bank Digital Currencies (CBDCs).

###### Electronic Money

Electronic money, once envisioned as a contemporary equivalent of physical banknotes, has evolved into a potential "three-tiered" electronic financial framework. Under this model, direct customer relationships with commercial banks and credit institutions could shift towards direct accounts held with central banks. Before the advent of cryptocurrencies, electronic money platforms were already disrupting modern payment systems, as highlighted by Didenko et al. (2020). Despite notable successes such as Mpesa in Kenya, these platforms encountered challenges in major economies due to competition from established financial entities. Although electronic money usage has risen, especially amid the Covid-19 pandemic, its original intention was not to replace cash and traditional debt systems. Therefore, while electronic money has prompted reassessments of monetary and payment systems, its overall impact has been limited, as noted by Keister et al.

###### Bitcoin and Distributed Ledger Technology (DLT)

Bitcoin emerged as the inaugural challenger to traditional bank-linked payment systems, with the intention of rivaling or even supplanting existing state-backed currencies and payment infrastructures that serve as the bedrock of global financial systems. Since its inception, numerous variations of Bitcoin have emerged, each seeking to refine and enhance the original model. This proliferation of cryptocurrencies has prompted a quest for opportunities to enhance monetary and payment systems. Central to this exploration is the underlying distributed ledger technology (DLT), which holds promise for reducing systemic risk and enhancing operational efficiency. Monrat, et al.

###### Stablecoins and The Libra

Stablecoins, according to Van der Merwe (2021), are a type of cryptocurrency designed to maintain a stable value by being pegged to assets such as fiat currencies or commodities. Unlike traditional cryptocurrencies, whose prices can fluctuate wildly, stablecoins offer more consistency, making them useful for everyday transactions, savings, and cross-border payments. They combine the benefits of digital currencies with the stability of traditional financial systems, serving as a potential solution to cryptocurrency volatility and deficiencies in financial inclusion, cross-border payments, and remittances in emerging markets and developing economies (Feyen et al.).

Didenko et al. report that Facebook's Libra, later rebranded as Diem, emerged as a revolutionary stablecoin with the potential to reshape conventional financial systems by reaching over 2 billion users through a digital identification framework. Its introduction prompted significant attention from policymakers, central bankers, and regulators, leading to a reconsideration of sovereign digital currencies (SDCs). However, the Libra/Diem initiative raised concerns necessitating a coordinated global regulatory approach, including:

1. Disrupting monetary policy and posing risks to financial stability.
2. Hindering competition in payment services and undermining operational resilience due to lack of interoperability.
3. Challenges in legal classification and reliance on underlying asset stability mechanisms.
4. Risks related to inadequate consumer protection, personal data security, money laundering, and terrorism financing.

The original vision of Libra as a global stablecoin backed by a basket of currencies has been significantly altered, and the Diem project has been dissolved. However, the initiative has sparked increased interest and development in the stablecoin and digital currency space, leading to various other projects and central bank digital currencies (CBDCs) emerging.

###### Sovereign Digital Currencies

Central banks are exploring Sovereign Digital Currencies (SDCs) to enhance competition and efficiency in payment systems. Unlike stablecoins, which are backed by assets like fiat currencies and issued by private entities, SDCs are directly issued by national governments or central banks. Examples include the Digital Yuan (e-CNY) by the People's Bank of China and the proposed Digital Dollar (CBDC) by the United States Federal Reserve. SDCs function as official digital representations of fiat currencies, operating as legal tender and backed by the full faith and credit of the issuing authority, akin to physical cash and traditional bank reserves.

These state-backed digital currencies aim to replace traditional forms of payment, offering risk-free transactions that could reduce systemic risks and enhance financial stability. However, their adoption may impact bank funding and credit provision, potentially affecting overall financial stability. SDCs could also mitigate the impact of financial institution collapses and introduce innovative wholesale payment systems for governments. Integrating blockchain technology into SDCs could enhance recordkeeping and market integrity but raises privacy concerns. Regulators must address challenges in designing and regulating SDCs, including their impact on private bank deposits and overall financial stability, to ensure their acceptance and stability in the market.

The Digital Yuan

China's Digital Yuan, also called the Digital Renminbi (RMB) or e-CNY, is a central bank digital currency (CBDC) issued by the People's Bank of China (PBOC). Unlike stablecoins, it is backed by the Chinese government and aims to enhance electronic payments, providing a stable and secure method for digital transactions (Fullerton & Morgan, 2022). The Digital Yuan seeks to improve financial inclusion, lower transaction costs, especially for cross-border payments, and provide better data for economic monitoring.

Pilot programs have been widely implemented in various Chinese cities and significant events like the 2022 Winter Olympics, integrating the Digital Yuan with major financial platforms such as Alipay and WeChat Pay. It combines blockchain and traditional database technologies to ensure security and efficiency, supporting both online and offline transactions. The PBOC is working on a regulatory framework to prevent fraud and ensure data privacy (Fullerton & Morgan, 2022).

Cheng (2024) contends that while the Digital Yuan collects transaction data, it does not significantly enhance the Chinese Communist Party's (CCP) surveillance capabilities, as existing systems are already extensive. Despite concerns about data centralization, the advantages of reduced transaction costs, the yuan's internationalization, and increased financial inclusion make the Digital Yuan beneficial for the Chinese people.

Looking ahead, plans include expanding pilot programs, exploring cross-border transactions, and improving technological aspects such as transaction speeds and security. If successful, the Digital Yuan could position China as a leader in the CBDC space, influencing other nations and potentially reshaping the global financial landscape.

The Digital Dollar

The United States is considering the introduction of a Digital Dollar in response to China's Digital Yuan, which poses a potential threat to the US Dollar's dominance in global trade (Duffie, 2021). According to Didenko et al., a Digital Dollar could help secure the US Dollar's status as the world's reserve currency and enhance the efficiency of domestic financial interventions, such as crisis stimulus distributions. Unlike the Digital Yuan, which focuses on digitizing monetary operations within existing systems, the Digital Dollar aims to integrate monetary and payment components, potentially involving a collaboration between the government and the private sector or a synthetic CBDC model with private stablecoins accessing central bank liquidity.

The Digital Dollar would feature digital tokens for transactions and a universal account-based payment system directly linked to the US central bank. However, Jiang (2024) highlights the potential risks, noting that the Digital Dollar could either uphold American values of freedom and liberty or become a tool for extensive government surveillance. Duffie acknowledges the challenge of balancing cybersecurity and privacy while preventing illegal payments.

Jiang argues that, if designed effectively, the Digital Dollar could enhance privacy protections and improve digital payment systems under modernized AML/CFT laws, allowing a degree of anonymity. Currently, the Digital Dollar is in the research and development phase, with the Federal Reserve conducting pilot programs and studies to evaluate its feasibility, though no official launch date has been set.

#### Summary

The exploration and potential issuance of Central Bank Digital Currencies (CBDCs) are driven by a variety of factors, primarily the need to address payment challenges in an increasingly digital economy. Fung and Halaburda argue that the rapid technological advancements in payment systems necessitate a thorough analysis of whether CBDCs could address current payment gaps and improve overall efficiency. Their framework also considers the essential attributes that a central bank digital currency should possess to ensure widespread adoption and effective usage. While the primary focus is on the retail payment system, the authors acknowledge that other important considerations, such as broader economic and financial system impacts, require further research.

From enhancing the safety, efficiency, and inclusivity of payment systems to tackling issues like stability, integrity, and consumer protection, CBDCs present a promising solution. However, significant challenges remain, including regulatory and privacy concerns, the impact on traditional banking structures, and the need for robust technological frameworks.

As central banks navigate these complexities, the development and implementation of CBDCs will require careful consideration of both their benefits and potential drawbacks, ensuring that these digital currencies can fulfill their promise of revolutionizing the financial landscape. Engert and Fung (2017).

### Commonalities: Digital Assets, Cryptocurrency, CBDCs and DLT

All these technologies rely heavily on cryptography to secure transactions and ensure data integrity. Both cryptocurrencies and many CBDCs use DLT as their core technology, providing a decentralized or distributed way of recording transactions. Various consensus algorithms are used to validate transactions and maintain the integrity of the ledger. Digital representation of assets or currency units is a common theme, whether in cryptocurrencies or CBDCs.

### Differences: Digital Assets, Cryptocurrency, CBDCs and DLT

Cryptocurrencies typically operate on public, permissionless blockchains where anyone can participate, emphasizing decentralization and resistance to censorship through peer-to-peer transactions without intermediaries. They use decentralized consensus mechanisms like Proof of Work (PoW) and Proof of Stake (PoS), and often incorporate advanced features such as smart contracts (e.g., Ethereum) to enable programmable transactions and decentralized applications.

In contrast, Central Bank Digital Currencies (CBDCs) generally use permissioned networks controlled by central banks, restricting participation to authorized entities to maintain regulatory control and stability. CBDCs focus on ensuring compliance with monetary policies and financial regulations, often employing more centralized or federated consensus methods suitable for regulated environments. They typically prioritize stability, security, and integration with existing financial systems over extensive programmability.

## Economic and Financial Implications

### Impact on Traditional Financial Systems

Digital assets, cryptocurrencies, CBDCs, and DLT are poised to transform traditional financial systems. (Tapscott, A) These technologies offer new investment opportunities, enhance liquidity through fractional ownership and 24/7 trading, and facilitate peer-to-peer transactions without intermediaries. (The World Economic Update). This shift Mantyamaki et al observe, pressures traditional banks to innovate, especially in cross-border payments, and raises regulatory challenges related to money laundering, tax evasion, and consumer protection.

Feyen et al report that CBDCs provide central banks with new tools for monetary policy and can improve financial inclusion by offering services to unbanked and underbanked populations. However as argued by Niepelt (2021); Keister and Sanches (2021) they may reduce the role of commercial banks in the payment system, impacting their deposit bases and credit creation capabilities. DLT enhances transparency and security by providing a tamper-proof record of transactions, which can reduce fraud and increase trust in financial systems. It also streamlines processes and reduces operational costs, though it requires significant investment and faces legal and technical hurdles. Danho and Habte (2019)

Overall, the integration of digital assets, CBDCs, and DLT into traditional financial systems promises to drive significant innovation and efficiency. Despite the promise of these technologies, Danho and Habte caution that challenges remain. Regulatory, technical, and infrastructural issues need careful management, and the lack of common protocols and definitions currently limits their effectiveness in significantly boosting financial inclusion

### Role in Local and Global Economies

Digital assets, cryptocurrencies, CBDCs, and DLT are transforming both local and global economies by enhancing financial inclusion, increasing transaction efficiency, and fostering innovation. Locally, these technologies offer new investment opportunities and economic participation, especially in regions with limited banking access, promoting entrepreneurship and economic growth (Feyen et al). CBDCs can also streamline government disbursements, reducing corruption and ensuring aid reaches intended recipients.

Globally, the adoption of cryptocurrencies varies by country and is influenced by factors like education, democracy, and regulatory quality (Bhimani, 2022). While blockchain can reduce costs and create decentralized trust for mobile financial services, its impact on financial inclusion is currently limited by the lack of common protocols (Danho and Habte, 2019). DLT and cryptocurrencies facilitate cross-border transactions, lowering costs and benefiting international trade and remittances, particularly for developing economies (World Bank ECA).

As more countries adopt these technologies, global financial infrastructures are likely to become more interconnected and efficient. However, this shift presents regulatory and security challenges that require coordinated international efforts. Implementing blockchain technology should be sensitive to diverse cultural and political contexts, avoiding one-size-fits-all solutions (Scott, B.)

### Summary

In summary, digital assets, cryptocurrencies, CBDCs, and DLT are set to transform both traditional financial systems and local and global economies. These technologies offer new investment opportunities, enhance transaction efficiency, and promote financial inclusion, particularly in regions with limited banking access. While they pose regulatory and security challenges, they also promise to streamline international transactions, reduce costs, and foster economic growth and innovation. The shift towards digital financial systems necessitates careful management of infrastructural, technical, and regulatory issues, with an emphasis on sensitivity to diverse cultural and political contexts. As countries increasingly adopt these technologies, they are likely to drive significant changes in global financial infrastructures, enhancing interconnectedness and efficiency while ensuring robust oversight and security.

## Regulatory and Legal Aspects

### Current Regulatory Landscape

The regulatory landscape for digital assets, cryptocurrencies, CBDCs, and DLT is rapidly evolving due to technological advancements and their impact on traditional financial systems. Hughes (2017) and Monrat et al. highlight the compliance challenges blockchain platforms face across different jurisdictions. Toygar et al. and Hughes discuss the legal complexities of digital asset ownership, transfer, and inheritance, pointing out the need for clearer cyber laws. The lack of standardization creates legal uncertainties, slowing adoption. Existing regulations are often unsuitable for blockchain's decentralized nature, limiting government intervention and central banks' control. While regulations are essential, Monrat et al. argue for a balance to avoid stifling innovation. Global regulators are focusing on consumer protection, taxation, financial stability, AML/CTF compliance, standards, and financial inclusion. As these technologies mature, regulatory frameworks are expected to become more standardized, fostering a safer and more inclusive financial ecosystem.

### Challenges for Harmonizing Regulations

The fragmented global regulatory landscape poses significant challenges for harmonizing regulations across countries. Bossu et al. (2020) highlight that the lack of robust legal frameworks creates legal, financial, and reputational risks for central banks issuing CBDCs. Addressing these risks involves complex legal reforms and fundamental policy challenges regarding the status of CBDCs as "currency." Hughes notes that varied regulatory frameworks, influenced by economic, political, and social factors, complicate the creation of unified regulations. The rapid development of digital assets, cryptocurrencies, CBDCs, and DLT often outpaces regulatory updates, further hindering harmonization. Regulators frequently lack a deep understanding of these technologies, resulting in inconsistent regulation and enforcement. Toygar et al. emphasize the legal and regulatory gaps in digital asset ownership, transfer, and inheritance, highlighting the need for better-defined cyber laws.

Walch (2017) discusses the challenges posed by ambiguous and misleading blockchain terminology, which complicates regulation and adoption. She urges regulators to develop a clear understanding of blockchain technology to make informed decisions. The lack of uniformity in regulations increases compliance costs for international businesses, as they must navigate different requirements across jurisdictions. Harmonizing regulations also involves reconciling stringent data protection laws, like the GDPR in the EU, with those in other regions. Ensuring robust cybersecurity measures that meet international standards is essential but challenging due to varying levels of technological infrastructure and expertise. Balancing innovation with financial stability and consumer protection requires regulators to prevent systemic risks without stifling innovation, while also combating fraud and money laundering.

### Opportunities for Harmonizing Regulations

Organizations like the FATF, IMF, and BIS can lead efforts to create standardized regulatory frameworks for digital assets, CBDCs, and DLT. Countries can harmonize specific regulations through agreements, facilitating smoother cross-border operations. Regulatory sandboxes allow controlled experimentation with new technologies, refining regulations for broader adoption. Insights from these sandboxes can be shared globally, aiding regulatory harmonization (De Filippi et al., 2022).

RegTech can streamline compliance, making it easier for companies to adhere to multiple regulatory regimes. Blockchain technology can enhance transparency and reduce fraud risk in regulatory compliance. Developing international standards for digital assets and DLT can provide a common regulatory framework, reducing inconsistencies. Establishing cooperation frameworks can ensure consistent enforcement across jurisdictions.

Engaging the private sector in the regulatory process ensures practical and innovation-supportive regulations. Industry input can help shape effective regulations, while training programs can enhance regulators' technical knowledge for better regulatory quality and consistency. Continuous dialogue between regulators, industry players, and academia can foster understanding and alignment, supporting regulatory harmonization. The World Bank ECA suggests that international coordination under the United Nations could help develop and enforce a global cyber law framework, managing and protecting digital assets more effectively.

### Summary

The regulatory landscape for digital assets, CBDCs, and DLT is rapidly evolving, reflecting the growing impact of these technologies on traditional financial systems. However, the fragmented global regulatory environment poses significant challenges for harmonization, with varied regulatory frameworks influenced by different economic, political, and social factors. This results in legal uncertainties and increased compliance costs for businesses operating internationally. Despite these challenges, there are significant opportunities for harmonizing regulations. Organizations like the FATF, IMF, and BIS can lead efforts to create standardized frameworks, while regulatory sandboxes and RegTech can streamline compliance processes. Engaging the private sector and enhancing regulators' technical knowledge through training can ensure practical and supportive regulations. International cooperation and continuous dialogue between regulators, industry players, and academia can further support the harmonization of regulations, fostering a safer, more inclusive, and innovative global financial ecosystem.

# Future Prospects and Emerging Trends

## Digital Assets, Cryptocurrency and DLT

The World Bank's 2018 ECA Economic Update highlights the benefits and challenges of cryptocurrencies and blockchain, noting their potential but also their volatility compared to legal tender. The report suggests cautious optimism and further exploration (World Bank, 2018).

The future of digital assets is driven by institutional adoption, stablecoins, CBDCs, and DeFi. Integration with AI and IoT will enhance financial inclusion, economic empowerment, transparency, and data privacy. Despite challenges, cryptocurrencies can transform financial inclusion and value preservation in underserved regions (Chainalysis, 2020).

Financial institutions are adopting digital assets, boosting confidence. DeFi platforms will improve financial services, and advances in privacy and regulatory compliance will continue. AI will optimize trading and detect fraud, while IoT will automate processes via smart contracts.

Digital assets will democratize financial services, reduce costs, and increase accessibility. Investment in digital assets and DeFi will drive wealth creation. Blockchain's transparency will combat corruption, verify product authenticity, and promote ethical consumption. Clearer regulatory frameworks will support DLT adoption in finance and healthcare, aided by automated RegTech solutions. DLT's synergy with AI will automate smart contracts and enhance data integrity, while its integration with IoT will ensure secure networks and expand financial access.

In conclusion, the convergence of digital assets with AI and IoT will reshape global finance, promoting inclusivity, efficiency, and transparency across sectors.

## CBDCs

Feyen et al. discuss the transformative potential of digital money, focusing on CBDCs and global stablecoins. CBDCs, regulated by central banks, promise improved financial efficiency, reduced cross-border transaction costs, and enhanced inclusion, though challenges like privacy concerns and impacts on traditional banking systems must be managed. Integration with AI and IoT could further bolster security and automate financial processes, benefiting businesses and individuals alike (Feyen et al.).

Despite their potential benefits, stablecoins face significant risks and challenges, particularly in emerging markets and developing economies (EMDEs), where existing fintech solutions may offer more competitive advantages. Barontini et al. note that while many central banks are collaboratively exploring the implications of central bank digital currencies (CBDCs), few plan to issue them in the near term. Depending on its design, a CBDC could significantly impact banks' business models and the future development of the payment ecosystem. While a CBDC will compete with bank deposits, it does not necessarily lead to bank disintermediation. Many questions remain open (Niepelt, 2021).

# Strategic Direction for Stakeholders

## The Proposed Design of Payments and Money

Understanding the strategic direction for stakeholders in digital finance is crucial. As traditional money, digital assets, cryptocurrencies, CBDCs, and DLT become interconnected, stakeholders must navigate a complex ecosystem. This section examines the roles of governments, financial institutions, technology providers, and end-users, offering insights for effective collaboration and innovation. Didenko et al. emphasize customizing payment and money design to each economic system's specifics, avoiding a one-size-fits-all approach. Engert and Fung (2017) advise central banks to cautiously implement CBDCs, starting with non-anonymous models similar to traditional banknotes to learn and adapt gradually. They describe a benchmark CBDC model like physical cash, focusing on implications for monetary policy, financial stability, and the banking system. Didenko et al. predict a future with intermediated services, new currencies, and FPS, potentially eliminating traditional banks and e-money operators in some scenarios. By considering these dynamics and strategic recommendations, stakeholders can better navigate the future of digital finance, fostering collaboration and innovation.

### Technology

Designers tend to favor Distributed Ledger Technology (DLT) for token-based systems, while conventional infrastructure supports account-based systems. Sovereign Digital Currencies (SDCs) are expected to adopt an account-based approach, which, although rooted in the DLT technologies of Bitcoin, will likely evolve independently from these technologies due to performance limitations.

### Efficiency vs Safety vs Financial Inclusion

Engert and Fung highlight different CBDC models based on varying priorities. For efficiency, access is restricted to top-tier institutions. For safety and diverse user inclusion, a hybrid model is preferred. For financial inclusion in developing nations, retail access is prioritized, especially for rural and economically disadvantaged groups. Central banks consider CBDCs to improve retail payment systems and financial inclusion while addressing seigniorage and interest rate concerns. However, they might later revert to a hybrid Sovereign Digital Currency model to maintain trust and stability.

### Architecture (Retail vs Wholesale vs Hybrid)

Didenko et al. (2020) classify Sovereign Digital Currencies (SDCs) into two main categories based on public access to the central bank: centralized and decentralized. Centralized SDCs, also known as retail or general-purpose SDCs, involve central banks maintaining retail accounts directly, similar to commercial banks, allowing users to interact with the central bank. In contrast, decentralized SDCs, referred to as wholesale SDCs, rely on market players to manage the currency, with access limited to Top Tier Institutions. The choice between these architectures depends on the central bank's reliability and its capability to improve financial inclusion.

### Governance

Governance of CBDCs will likely be led by a central bank, which will handle crucial tasks like key operations, account balancing, and approval for major redesigns, while legal ownership may be distributed among Top Tier Institutions. This central role ensures the central bank's supervision and guarantees critical information flow. Governance efforts will primarily focus on domestic projects, with cross-border cooperation addressed only through existing mechanisms until more robust solutions are developed.

# **Conclusion: The Future of Payments**

The evolution of digital currencies, from cryptocurrencies to stablecoins and now Central Bank Digital Currencies (CBDCs), highlights a journey of addressing inherent limitations and exploring new potential. Initial cryptocurrencies aimed to serve as electronic cash immune to manipulation, but performance issues and high volatility rendered them impractical for everyday use. Stablecoins emerged as a solution to price instability by tying their value to assets, yet private sector versions struggled with credibility and adoption.

Global stablecoins, such as the Libra posed significant disruptions to existing monetary and payment systems, raising concerns about monetary policy efficacy and central bank functions. To mitigate these threats, policymakers and regulators turned to CBDCs, which are digital forms of money issued by central banks, offering potential as both retail and wholesale versions. Retail CBDCs would be universally accessible, while wholesale CBDCs would cater to select participants like top-tier banks.

CBDCs are expected to be distributed through public-private partnerships, leveraging private sector efficiency while being backed by central banks. The implementation of CBDCs may utilize Distributed Ledger Technology (DLT) if performance issues are resolved, but traditional databases might still be preferred for stability, as seen with the Digital Yuan.

DLT promises enhanced payment system efficiency through secure and tamper-resistant transaction histories, aiding in combating financial crimes and improving transparency. It could provide a unified data set that supports innovation and future developments in payment services. Potential benefits of DLT for CBDCs include increased financial inclusion, national currency creation for countries using foreign legal tender, and innovative debt-raising mechanisms.

Different DLT models—permissionless for fully decentralized systems and permissioned for centralized or hybrid SDCs—offer various advantages, such as eliminating intermediary risks and ensuring data integrity with real-time updates. This could lead to groundbreaking fast payment systems with instant settlement and finality.

The progression from cryptocurrencies to CBDCs reflects a response to each model's shortcomings, with blockchain and DLT being central to this evolution. Despite initial associations with cryptocurrencies, governance and practical considerations may favor more traditional technologies for CBDCs. Ultimately, the future of digital currencies will likely resemble conventional payment systems, structured as semi-private, semi-public entities, ensuring stability and broad acceptance.