



CBDCs: The Digital Evolution of Money

Exploring the transformational opportunities
and challenges of new sovereign monies.

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About Ripple

Ripple is a crypto solutions company that transforms how the world moves, manages and tokenizes value. Ripple's financial 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 opportunities 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 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.

By joining Ripple's growing, global network, financial institutions can process their customers' payments instantly, reliably and cost-effectively.

For more information about how Ripple can offer faster, lower-cost and more transparent global payments, please visit us at ripple.com/contact.



SECTION I

Introduction



Central Bank Digital Currencies (CBDCs) and stablecoins have the potential to help digitize entire economies and represent a powerful force for unlocking the Internet of Value.

98%

global GDP represented by countries pursuing CBDC projects

Today, 130 countries, representing 98% of global GDP,¹ are pursuing CBDC projects. Some, including the United States and South Africa, have entered exploratory phases. Many projects throughout the European Union are in development, while China has reached a pilot phase and is nearing full scale launch in mainland areas. The Atlantic Council reports that 19 of the G20 countries are now in advanced project stages.²

Elsewhere, including in Nigeria and the Bahamas, solutions have been launched and use cases continue to evolve. The Bank for International Settlements now predicts that 20% of the world's population will have access to a CBDC within the next few years.³

Considering the benefits of CBDC

In a recent Ripple survey of global finance leaders,⁴ eighty-five percent (85%) of respondents think that their country will launch a digital currency within the next four years. The majority of leaders cited financial inclusion as a key CBDC benefit; and many of them feel the technology will deliver enhanced national competitiveness (44%), ensure greater efficiencies within payment systems (43%), and advance innovation more broadly (42%).

According to McKinsey, CBDCs may help Central Banks address systematic objectives including: ensuring financial inclusion, reducing fraud and money laundering, stimulating payments innovation, and creating a new vehicle for monetary policy, among others.⁵

Worldwide, jurisdictions appreciate various CBDC functionalities for a range of reasons. For instance, some recognize the opportunity to expand the portion of currency reserves made up of sovereign money – or the money issued by a monetary authority versus private bank money owed by banks to their customers and borrowers. Increasingly, many Central Bankers want to counter the dysfunction of some bankmoney regimes, and employ bank money that is not threatened by crises.⁶

CBDCs are needed to support the most significant positive impacts of asset tokenization, an increasingly targeted mechanism for transforming tangible assets (e.g. real estate and intellectual property) into digital tokens stored on the blockchain.⁷ With tokenization, anyone can view the process of asset transfer through ownership.⁸

Efficient settlement of asset exchange is not as impactful if the cash component of the transaction isn't as equally efficient and able to be coupled into a single atomic

1 Jones, M. "Study shows 130 countries are exploring central bank digital currencies" Reuters, 2023. <https://www.reuters.com/markets/currencies/study-shows-130-countries-exploring-central-bank-digital-currencies-2023-06-28/>

2 Atlantic Council CBDC Tracker. <https://www.atlanticcouncil.org/cbdctracker/>

3 Bank for International Settlements. Ready, Steady, Go? Results of the third BIS survey on central bank digital currency. <https://www.bis.org/publ/bppdf/bispap114.pdf>

4 Ripple, 2023 New Value Report: Crypto Trends in Business and Beyond. <https://ripple.com/lp/2023-new-value-report/>

5 Denecker, O. et al. "Central bank digital currencies: An active role for commercial banks," McKinsey & Co. 2023. <https://www.mckinsey.com/industries/financial-services/our-insights/central-bank-digital-currencies-an-active-role-for-commercial-banks>

6 Huber, J. "The Case for Sovereign Money", Sovereign Money. <https://sovereignmoney.site/the-case-for-sovereign-money-21>

7 Cointelegraph, Ripple Labs to revolutionize real estate industry through tokenization. <https://cointelegraph.com/news/ripple-labs-revolutionize-real-estate-industry-through-tokenization>

8 Dickens, S. "Ripple Powering the Next Evolution of Central Bank Digital Currencies", Futurum Research Group. 2022. <https://ripple.com/lp/cbdc-futurum-report/>

update. Wholesale CBDCs, for example, are designed to settle large-scale, high-value securities transactions and interbank transfers, affording operational efficiencies around speedier settlement times and greater liquidity when settling other assets like tokenized real estate.

In addition, tokenization improves privacy and agility as assets move peer-to-peer without the need for centralized intermediaries within decentralized networks. Governments increasingly recognize the implications of tokenization to improve conventional asset ownership and investment models.⁹ Tokenization also provides more flexibility and options under appropriate governance (i.e. central banks in the case of CBDCs). This enables a new balance between data sharing and privacy needs, providing increased transparency and certainty that isn't possible with traditional technologies.

From transfer, payment and settlement of an asset, to tracking and updating a lien on an asset for credit availability (e.g. tokenized real estate), CBDCs help to enable a wide range of use cases for tokenized assets beyond just value exchange. With the underlying blockchain technology, the holy grail of instant transfer and settlement via a distributed ledger is made possible across any tokenized asset.

CBDCs and new risk frontiers

Despite expected benefits, CBDC deployment exposes new risk frontiers. While these may shift depending on design models, implementation challenges can include:

- Increased centralization of payment processing and sensitive user data (it is possible a central bank would store user activity and transactions)
- Reduced regulatory oversight of financial systems
- Increased difficulty reversing fraudulent or erroneous transactions
- Challenges in payment credential management and key custody
- Susceptibility to erroneous or malicious transactions enabled by complex, automated financial applications
- Increased reliance on third parties (e.g. non-banks)

“Introducing a CBDC is about finding the delicate balance between developments on the design front and on the policy front.

Getting the design right calls for time and resources, and continuous learning from experience—including shared experiences across countries. In many cases, this will require close partnerships with private firms to successfully distribute CBDCs, build e-wallets, add features, and push the bounds of technology.

But the policy aspects are also paramount, including developing new legal frameworks, new regulations, and new case law”¹⁰

Kristalina Georgieva,
IMF Managing Director

The IMF recently articulated the challenging reality of entering the brave new world that is the future of money. Implied here is that technological development is paramount – but only the beginning. For widespread CBDC uptake, governments will need to navigate policy and financial industry dynamics, while convincing the general public of the merits of centrally controlled cash alternatives.

⁹ Andersen, D. “Gaining speed on tokenization is vital for UK’s financial future, banking group warns”, Cointelegraph 2023. <https://cointelegraph.com/news/gaining-speed-on-tokenization-vital-for-uk-s-financial-future-banking-group-warns>

¹⁰ Georgieva, K. The Future of Money: Gearing up for Central Bank Digital Currency, IMF, 2022. <https://www.imf.org/en/News/Articles/2022/02/09/sp020922-the-future-of-money-gearing-up-for-central-bank-digital-currency>

SECTION II

CBDC: An Explainer

What is a Central Bank Digital Currency?

CBDCs are tokenized bank monies, and the sovereign equivalent of cryptocurrencies like Bitcoin, Ether, and XRP.

CBDCs leverage the security and access benefits of blockchain—a popular form of decentralized ledger technology. As such, CBDCs present more resilient payment infrastructure, reduce transaction costs, enhance information sharing, and facilitate data reconciliation.¹¹

As implied by their name, CBDCs are issued and controlled by a country's Central Bank and used by consumers and businesses alike for payments, as a medium of value, and beyond. Unlike traditional digital payments—which are electronic transactions representing the exchange of paper money—a CBDC is a digitally native form of the fiat currency itself.

If a CBDC is intended for use by households and firms for everyday transactions, it is referred to as “general purpose” or “retail.” In contrast, “wholesale” CBDCs exist to support settlements between commercial banks, central banks, and other financial institutions.¹²

The ABCs of CBDCs

Although specific mechanics vary depending on a country's goals, regulatory environment, and the technological capabilities of a central bank, CBDC delivery follows this basic form:

Issuance: A Central Bank creates a new form of digital currency, much like they would print paper money. Each digital unit is unique and can't be duplicated. This is made possible through blockchain or other forms of distributed ledger technology (DLT).

Distribution: In a two-tier distribution and issuance model, users hold positions with financial institutions in digital wallets: the central bank distributes the digital currency to commercial banks, which then distribute it to customers via digital wallets. A direct issuance model, on the other hand, is where users hold position directly with the central bank (as opposed to with a commercial bank) in a digital wallet, though distribution may still be received in a two-tier model through financial institutions.

Use: Individuals and businesses can use the CBDC to make transactions, just as they would with physical cash. They can make payments, store value on e-wallets or even earn interest, depending on the specific currency design.

Processing: While some CBDC implementations are based on centralized systems, the Ripple CBDC Platform uses a decentralized operating model based on XRP Ledger technology. The Central Bank creates their own private version of the ledger which they govern, allowing them to run the validation network, include specific institutions, or fully outsource operations to authorized entities.

Security and Privacy: CBDCs are designed to be secure and to prevent fraud and counterfeiting.¹³ This usually involves advanced cryptographic techniques. However, the degree of privacy provided to users of a CBDC can vary. Some designs allow for complete anonymity, like cash, while others allow the central bank to track transaction data for the purposes of preventing illegal activities, like money laundering or tax evasion.

11 Mandeng, O. “The (R)evolution of money III CBDC is here, careful design needed now” Accenture, 2022. <https://www.accenture.com/us-en/insights/blockchain/evolution-money>

12 Bank for International Settlements. Ready, Steady, Go? Results of the third BIS survey on central bank digital currency. <https://www.bis.org/publ/bppdf/bispap114.pdf>

13 Wallis, J. “Privacy and Central Bank Digital Currency”, Ripple 2023. <https://ripple.com/insights/privacy-and-central-bank-digital-currency/>

Spotlight

Ripple CBDC Platform

Many Central Banks now rely on third-party platforms for minting, managing, and transacting CBDCs. Today, the Ripple team is working with the governments of Palau, Bhutan, Montenegro, Hong Kong, and others to manage the full CBDC lifecycle.

Ripple's comprehensive platform supports global banks' commitment to lead in financial innovation and access: Each solution is built on a private ledger that is based upon XRP Ledger technology—the blockchain with over a decade of proven performance and 80 million closed ledgers since 2012. Currently, the Ripple CBDC Platform consists of several modules to enable CBDC issuance, operations, and ongoing management.¹⁴

Issuer: Enabling issuers (e.g. central banks, monetary authorities or commercial banks) to manage the full lifecycle of their fiat-based digital currency—from minting and distribution all the way to redemption and destruction—in a highly secure manner, taking advantage of the XRP Ledger's built-in multi-signing capabilities.

Operator: This allows participants (commercial banks or NBFIs) who are holding significant amounts of the digital currency to manage and participate in inter-institutional settlement and distribution functions.

End-user wallets: Users can hold, send, receive and pay for goods and services using their wallet.

Ledger: Digital currencies leverage the ledger to record and provide settlement functionality. This ledger enables the innovation of money through programmability and robust controls that central banks and monetary authorities require.

The Benefits of Ripple CBDC Platform

Ripple CBDC Platform offers these important benefits to users:



Stability, security and resilience



Financial inclusion through easy wallet access to funds



Interoperability with disparate payment systems and overlay services

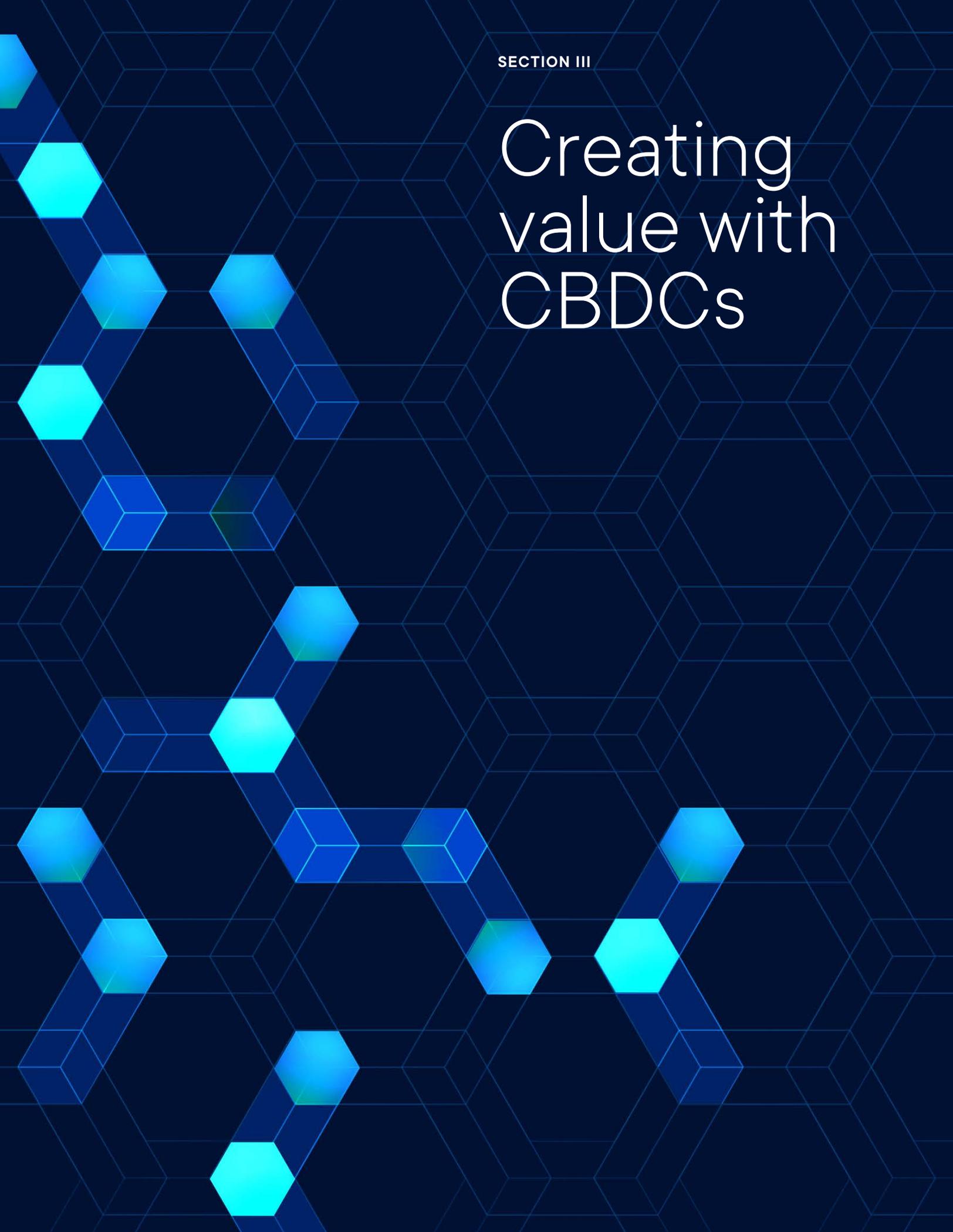


Reduced energy consumption

¹⁴ Ripple, "Ripple Launches CBDC Platform for the Development of CBDCs and Stablecoins", 2023. <https://ripple.com/ripple-press/ripple-launches-cbdc-platform-for-the-development-of-cbdc-and-stablecoins/>

SECTION III

Creating value with CBDCs



A primary value proposition for CBDCs is the ways in which they enhance existing payments infrastructure, in particular increasing efficiency while reducing costs and failure rates.¹⁵

A few of the payments types supported by CBDCs include:

- Interbank Payments
- Cross-Border Payments
- Retail Payments
- Supplier Payments
- Benefits & Relief Payments
- Government Issued Subsidies
- Billing & Collections
- Utility Payments

Strategists from the Tony Blair Institute note how CBDCs, because of their programmable nature, allow governments to embed compliance in payments and enforce government policies, or to embed digital IDs and automate government payments.

CBDCs may also catalyze digitization of entire payments value chains, maximizing broad adoption by users and retailers.¹⁶

As monetary instruments, CBDCs introduce safety measures to improve the payment experience. According to the IMF, they hold the potential to alleviate counterparty risks and provide liquidity while adding interoperability and efficiency.¹⁷ Thanks to the interoperable nature of blockchain and distributed ledger technology, multiple record-keeping systems can be updated as part of a single business transaction, with processing attributes the same as a single system, such as atomicity. This helps ensure multiple operations can be grouped into a single entity, and transactions must either fully happen or not happen at all.

But to unlock CBDCs' latent value, payments functionality must improve existing user and service providers' experiences. The Ripple CBDC platform, for instance, targets 24x7 availability, real-time E2E transacting, low/zero unit cost, and cryptographic-based settlement certainty.

While much remains to be done, CBDC innovation is poised to add efficiency via low transaction costs, open participation, contract consistency, and transparency.

Expanding financial inclusion

In Ripple's 2023 New Value Report survey of global institutional and enterprise finance leaders, a notable takeaway was that financial inclusion ranked in the top three most important considerations for CBDC use.¹⁸

CBDCs hold particular promise for developing markets including large subsections of Africa, Latin America, and Southeast Asia where infrastructure lacks and physical financial services access is limited. With a CBDC, individuals in those areas would not only have an ability to send and receive payments anywhere, anytime, but also the ability to safely and securely hold digital value—including those who don't have a traditional bank account.

Importantly, end users of digital currencies (e.g. corporate or retail participants) could hold their digital currencies securely and be able to pay and receive payment for goods and services in the same way other payment and banking apps provide this today. Critically, CBDC design should also include offline transactions to provide 'digital' cash, and cater to situations where internet connectivity or electricity might not be readily available.

Other research points to how CBDC issuance can increase bank deposits from the previously unbanked by incentivizing the opening of bank accounts for access to CBDC wallets.¹⁹

Data from CBDC usage could support credit building to reduce credit-risk information asymmetry in lending. And if CBDC data is shareable with banks, those without bank accounts could build credit and access lower interest rate loans.

15 PYMNTS, "Ripple CBDC Head Makes the Case for Blockchain-Based Money, 2023. <https://www.pymnts.com/cbdc/2023/ripple-cbdc-head-makes-the-case-for-blockchain-based-money/>

16 Wright, J. et al. "Central Bank Digital Currencies Can Increase Financial Inclusion," Tony Blair Institute for Global Change, 2022. <https://www.institute.global/insights/tech-and-digitalisation/central-bank-digital-currencies-can-increase-financial-inclusion>

17 Adrian, T. et al. "Technology Behind Crypto Can Also Improve Payments, Providing a Public Good" IMF, 2023. <https://www.imf.org/en/Blogs/Articles/2023/02/23/technology-behind-crypto-can-also-improve-payments-providing-a-public-good>

18 Ripple, 2023 New Value Report: Crypto Trends in Business and Beyond. <https://ripple.com/lp/2023-new-value-report/>

19 Tan, B. "Central Bank Digital Currency and Financial Inclusion," International Monetary Fund, 2023. <https://scholar.harvard.edu/brandonjoeltan/publications/central-bank-digital-currency-and-financial-inclusion-1>

Streamlining cross-border payments

Designing national CBDCs with access frameworks and interoperability options will help facilitate efficient payments across borders and currencies, while reinforcing the role of Central Bank money as an anchor for the payment system and as a primordial settlement asset.

As CBDC availability across borders expands, cheaper and more accessible remittances “will benefit senders and recipients, help to buffer economic shocks, and stimulate growth.” Take for example how several sub-Saharan African central banks are exploring CBDCs to promote more cost-effective remittances. According to the IMF, the region is the most expensive in the world to send and receive money, with an average cost of just under 8 percent of the transfer amount. CBDCs could make sending remittances easier, faster, and cheaper by shortening payment chains and increasing competition among service providers.²⁰

An expanding global payments market may also amplify CBDC opportunities. FXC Intelligence reports that the global B2B cross-border payments market is expected to increase by 43% to \$56.1 trillion by 2030. Combined with wholesale and consumer cross-border payments, the overall market is expected to grow by 53% to \$290.2 trillion in 2030.²¹

In addition, increased payments clearance speeds could help grow trade volumes, both in-region and globally. A follow-on effect may be that central banks explore stylized models for cross-border CBDC use, including interoperability arrangements based on compatible, interlinked, or even coordinated, single system infrastructure for better

“Faster, cheaper, more transparent and more inclusive cross-border payment services would deliver widespread benefits for citizens and economies worldwide, supporting economic growth, international trade, global development and financial inclusion.”²⁵

Bank for International Settlements 2021 *Central Bank Digital Currencies for Cross-Border Payments*

cross-border flows and market integration. As markets integrate, better investment and risk-sharing opportunities may also emerge.²²

Furthermore, McKinsey points to how digital-native assets like CBDCs and stablecoins can provide investment and risk-sharing opportunities, specifically for those in treasury-related roles. Not only could they “enable the creation of new investment solutions” for things like equities and FX, but also make these efficient investments “if integrated effectively into existing products and services.”²³

With respect to softening fallout from economic shocks, governments could use CBDCs to distribute targeted welfare payments, especially during sudden crises such as a natural disaster, regardless of citizens’ current location or access to a bank.²⁴

\$ **290** T

Expected value of cross-border payments market by 2030

20 Fuje, et al, “More African Central Banks Are Exploring Digital Currencies,” International Monetary Fund, 2023. <https://www.imf.org/en/Blogs/Articles/2022/06/23/blog-africa-cbdc#>

21 Ingham, L. et al. “How big is the B2B cross-border payments market?” FXCIntelligence, 2023. <https://www.fxcintel.com/research/reports/how-big-is-the-b2b-cross-border-payments-market>

22 BIS, “Central bank digital currencies for cross-border payments” 2021. <https://www.bis.org/publ/othp38.pdf>

23 McKinsey & Co. “How finance sector treasurers can get ready for CBDCs and stablecoins” 2022. <https://www.mckinsey.com/capabilities/risk-and-resilience/our-insights/how-finance-sector-treasurers-can-get-ready-for-cbdc-and-stablecoins>

24 Fuje, et al, “More African Central Banks Are Exploring Digital Currencies,” International Monetary Fund, 2023. <https://www.imf.org/en/Blogs/Articles/2022/06/23/blog-africa-cbdc#>

25 Bank for International Settlements, “Central bank digital currencies for cross-border payments” July 2021. <https://www.bis.org/publ/othp38.pdf>

Emphasizing sustainability

One estimate from Cointelegraph proposes that the banking sector consumes 56 times more energy than Bitcoin, the world’s largest cryptocurrency.²⁶

Beyond the obvious energy demands to support global financial services, research also highlights the underappreciated environmental cost of cash. Producing cash (including coins) requires water, energy, and fuel. Each of these inputs has its own price or can be translated into the amount of CO₂ it produces.

According to research out of Tufts University, a lifecycle view to calculating the environmental cost of cash is helpful in understanding the negative externalities of cash production. As such, “banknotes may not be the lesser environmental evil after all.”²⁷

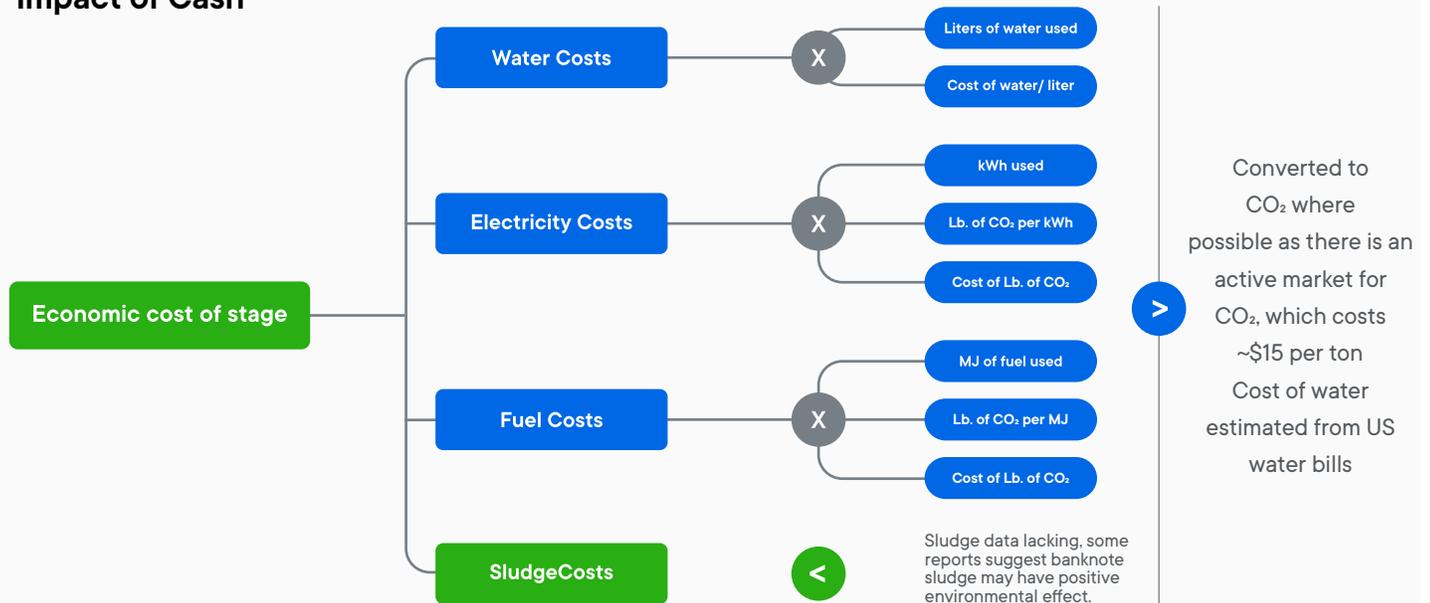
As climate concerns grow, the role of digital money in pursuit of energy efficiency is becoming more pronounced. The IMF advocates for efficient CBDC software stacks, and central banks are under pressure to ensure sustainability within currency experiments.²⁸

Some central banks and card companies are considering whether CBDCs could be accessed through physical cards. Concerningly, card payments use more energy than payments from digital wallets – which is how most crypto transactions are made. Conversely, IMF points out that cards can help adoption and inclusion, particularly when digital literacy or mobile network connectivity are a concern.

Depending on the blockchain underpinning them, some CBDCs rely on proof-of-work consensus which consumes fossil fuels at unsustainable rates. Other blockchains have moved to more sustainable proof-of-stake models, but most of those networks still charge considerable gas fees to process transactions.

Emerging digital currency technology proves that alternatives to Proof-of-Work and Proof-of-Stake exist for building performant and efficient CBDC infrastructure. In exploring CBDC infrastructure types, governments and partner enterprises can target more [climate-friendly consensus protocols](#).²⁹

Calculating the Environmental Impact of Cash



Fletcher graduate school of global affairs at Tufts University, Analysis of the Environmental Costs of Cash in the United States

26 Hall, J. “Banking uses 56 times more energy than Bitcoin,” Cointelegraph 2022. <https://cointelegraph.com/news/banking-uses-56-times-more-energy-than-bitcoin- valuechain-report>

27 Tufts University, “How Green is the Greenback? An Anlysis of the Environmental Costs of Cash in the United States,” 2021. <https://sites.tufts.edu/digitalplanet/how-green-is-the-greenback-an-analysis-of-the-environmental-costs-of-cash-in-the-united-states/>

28 Agur, I. et al. “How Crypto and CBDCs Can Use LEss Energy Than Existing Payment Systems,” IMF 2022. <https://www.imf.org/en/Blogs/Articles/2022/06/16/how-crypto-and- cbdcs-can-use-less-energy-than-existing-payment-systems>

29 Cadet, C. EMTECH. “CBDCs are a Chance to Build a Greener Future,” Nasdaq 2022. <https://www.nasdaq.com/articles/cbdcs-are-a-chance-to-build-a-greener-future>

Reinforcing monetary policy control

Central Banks are particularly keen on virtual money technologies that allow them to maintain or expand sovereignty over monetary policy. The Bank Policy Institute summarizes a widely sought policy benefit surrounding CBDC incorporation:

“[The most significant benefit] is the potential for interest rates to no longer be constrained by the zero-lower bound (ZLB), assuming that a CBDC could pay negative interest and paper currency were eliminated.”³⁰

In the US, for instance, the Federal Reserve could reduce interest rates as far as needed in the event of a deflationary spiral. In addition, a CBDC that paid interest could increase Fed control of interest rates, especially when the Federal Open Market Committee opts to tighten monetary policy.³¹

Others argue that a more diverse toolkit of viable responses from CBDCs eliminates the need for the “stick of a cost-of-borrowing tool that punishes the poor to reduce inflation” when needed.

By example, a CBDC could offer savings returns to directly reduce consumer demand from the general public. Various supply controls could have the effect of building “[...] up the savings of the poor and middle class, which will serve as an automatic stabilizer” for whole economies.³²

Deloitte finds that CBDCs can incorporate design features that ease policy transmission, such as directly distributing currency to the public in lieu of checks (like those distributed through the recent COVID-19 relief packages in the US). They may also perform as fast-acting mechanisms to address market stresses in areas of trade facilitations, foreign exchange stability, and currency control.³³

30 Nelson, B. “The Benefits and Costs of a Central Bank Digital Currency for Monetary Policy,” BPI, 2021. <https://bpi.com/the-benefits-and-costs-of-a-central-bank-digital-currency-for-monetary-policy/>
31 Ibid

32 Marsh, L. “New digital currency (CBDC) monetary policy tool to stop inflation without causing a recession,” University of Notre Dame, 2022. <https://www.aeaweb.org/conference/2023/program/paper/8bS83KE5>

33 Deloitte, “Central Bank Digital Currencies (CBDC): Regulatory and policy considerations in the US,” 2021. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/risk/us-deloitte-cbdc-policy-considerations.pdf>

Inviting other innovation and new money services

Tokenizing real world assets (RWAs)

Tokenized assets may be fintech's shining moment – especially as the “digital representations of value” extend to both liquid and illiquid assets including carbon credits or real estate.

Boston Consulting Group (BCG) estimates the tokenization of global illiquid assets to be a \$16 trillion business opportunity by 2030. Citi predicts an estimated growth factor for tokenized assets of 80x in private markets, with \$4 trillion of value in the next seven years.³⁵

Tokenizing RWAs on blockchains offers upgrades to traditional market infrastructure by improving settlement times, reducing manual processings, increasing transparency, and removing intermediaries. Some central banks are looking to create a tokenized settlement asset, i.e. CBDC, to enable the true benefits of tokenized RWAs to be realized, and enhancing Delivery vs. Payment (DVP).

Recently, Ripple was selected to showcase a real estate asset tokenization solution as part of the Hong Kong Monetary Authority's (HKMA) inaugural e-HKD Pilot Programme. The pilot will reinforce how critical a tokenized settlement asset, like a CBDC, is to support RWA digitization, with a goal of quickly realizing home equity via a CBDC.³⁶

Ripple and Fubon Bank are working on this [innovative pilot use](#) case combining the e-HKD, tokenized real estate, and lending protocols to run on a private and secure ledger, built with the same technology as the XRP Ledger. The pilot intends to help individuals unlock access to home equity faster and more efficiently and provide banks opportunities to access lending markets and customers which are not currently available or serviceable.

80x

Estimated growth factor for tokenized assets in private markets

Developing regulatory-compliant infrastructure with DLT

Earlier this year, the European Union unveiled innovative financial legislation designed to mitigate digital currency risks, while broadening trading and settlement capabilities, and thereby expanding CBDC and cross-border payment capabilities.

Key to this is the proposed Distributed Ledger Technology (DLT) Pilot Regime, which allows EU firms to utilize DLTs without legislative constraints. As part of the scheme, firms can apply to be exempt from certain requirements under the Markets in Financial Instruments Regulation (MiFIR), Markets in Financial Instruments Directive II (MiFID II), and/or Central Securities Depositories Regulation (CSDR).³⁷

Building upon this foundation laid by the EU's initiatives, Ripple and blockchain technology research lab SUPER HOW? have [partnered to develop regulatory-compliant infrastructure](#) through the Axiology Project, within the scope of the DLT Pilot Regime Regulation.

The project supports instant issuing and settlement of a securities asset, and will deliver significant learning for a future CBDC which can then be issued by European banks.

³⁴ Financial Times and Ripple. “Why the smartest businesses will soon be using tokenised assets.” 2023. <https://www.ft.com/partnercontent/ripple/why-the-smartest-businesses-will-soon-be-using-tokenised-assets.html>

³⁵ Citi. “Money, Tokens, and Games” 2023. <https://icg.citi.com/icghome/what-we-think/citigps/insights/money-tokens-and-games>

³⁶ Morales, J. “Hong Kong CBDC Pilot Helps Ripple Showcase Real Estate Tokenization” Be(in) Crypto 2023. <https://beincrypto.com/ripple-real-estate-tokenization-hong-kong-cbdc/>

³⁷ Khatri, A. “The EU DLT Pilot Regime: key takeaways” Cube 2023. <https://www.cube.global/en-us/resource/the-eu-dlt-pilot-regime-key-takeaways/>

SECTION IV

Surveying active CBDC projects

Exploring how Ripple and global governments are putting high performance financial infrastructure to work.

Many governments and central banks are working with Ripple to develop performant, future-proofed financial infrastructure powered by blockchain to mint, manage, transact, redeem and destroy CBDCs. This enables central bankers around the world to make digital versions of national currencies in a highly secure, reliable way, while supporting efficient monetary policy implementation.

Bhutan's central bank, the Royal Monetary Authority (RMA), has announced plans to work with the [Ripple CBDC Platform in a national pilot](#). This move to work with Ripple is driven by the nation's desire to enhance digital and cross-border payments, expand financial inclusion efforts, and extend its commitment to sustainability as the only carbon-negative country in the world.

The Republic of Palau [is working with](#) Ripple to tailor a digital currency to the needs of their citizens. The Republic of Palau Stablecoin (PSC) aka 'Kluk', is a prototype digitization of the US Dollar under development in partnership with Ripple, using the XRP Ledger.³⁸

"By digitizing our currency, we hope to mobilize our economy and government processes to improve financial transactions and empower our citizens. As a smaller country, Palau has the advantage to be innovative and nimble in releasing our stablecoin," said Surangel Whipps Jr, President of the Republic of Palau.



The Central Bank of Montenegro, or CBCG, also [announced plans](#) to develop a strategy and pilot program to launch the country's first digital currency in the form of a CBDC or a national stablecoin. Radoje Žugić, Governor of the Central Bank of Montenegro noted, "As a central bank committed to following up-to-date national banking trends, the CBCG is actively ensuring it maintains an efficient financial system. We look forward to collaborating with Ripple on the pilot project for creating a CBDC or stablecoin[...]"

"With Ripple's groundbreaking technology, we can experiment with CBDCs within our existing payments infrastructure while ensuring efficient and cost-effective cross-border transfers."

Yangchen Tshogyel
Deputy Governor,
Royal Monetary Authority of Bhutan

Žugić notes a critical goal is to analyze the advantages and risks that CBDCs or national stablecoins could pose with respect to the availability of electronic means of payment, "security, efficiency, compliance with regulations, and most importantly the protection of end users' rights and privacy."³⁹

Banco de la República, Colombia's central bank, is also [exploring blockchain use cases](#) with Ripple and partner Peersyst. Together, the partners will work with the information and communications ministry to pilot use cases to enhance the country's high-value payment system using Ripple's CBDC Platform.

Highlighting [the significance of this project](#), Minister Mauricio Lizcano, ICT Minister of Information and Communication Technologies, emphasized: "Potential efficiencies can be evaluated through the results obtained in the development of a solution with blockchain technology. In turn, this manages to improve and complement the processes in the entities in a safe and efficient way. In addition, it will provide a technological solution. This solution will allow simulations of different use cases in the high-value payment system."

³⁸ McGleenon, B. "Ripple Runs CBDC pilot with Pacific island nation of Palau" The Block 2023. <https://www.theblock.co/post/241424/ripple-runs-cbdc-pilot-with-pacific-island-nation-of-palau>

³⁹ Businesswire, "Central Bank of Montenegro Signs Agreement with Ripple to Develop a Digital Currency Strategy and Pilot" 2023. <https://www.businesswire.com/news/home/20230411005396/en/Central-Bank-of-Montenegro-Signs-Agreement-with-Ripple-to-Develop-a-Digital-Currency-Strategy-and-Pilot>

SECTION V

Barriers to wide-spread CBDC adoption

Formidable issues still stand in the way of broader CBDC expansion. A primary gating factor is the fact that there is no uniform, global regulatory framework for CBDCs. This means technology and solution providers such as Ripple must work with each country individually to comply with their standards and regulations.

Other factors slowing the growth of CBDCs include lack of end user adoption, little-to-no consumer education, fears about privacy and security protections, digital identity verification, lack of interoperability among CBDCs and offline access to transactions.

These issues must be solved at scale and often in coordination among countries and jurisdictions to ensure continued and faster growth. That being said, they aren't unsolvable.

Reconciling control vs. innovation

To achieve monetary control goals, central banks can't relinquish control to a completely decentralized digital currency model. While a fully centralized model may provide the desired control, bankers and government institutions will miss out on innovations like programmable money and smart contracts that blockchain technology enables.

Overly-centralized models would also reduce the ability of private sector players to access and collaborate with CBDCs, thereby limiting some financial utility, inclusion, and currency capabilities.

According to Juniper Research, broad CBDC acceptance will require central banks to "think differently" – and design end-to-end processes that include a variety of stakeholders.⁴⁰ Plans must account for how to incentivize adoption and utilization to achieve [real-world utility](#) for things like retail goods, bills, and utilities.

Confirming digital identities

While many private digital assets make a virtue out of anonymity, robust identity infrastructure and the ability to clearly connect users and transactions will be a key condition for central banks.

[Persistent issues](#) with establishing national digital identity information could inhibit widespread CBDC uptake, particularly in developing economies. For citizens who don't have a passport, driver's license, or any other form of identification, this presents a hurdle. Markets must develop more non-traditional ways of establishing identity for those people to gain access to financial services.

With the use of a CBDC, those individuals would have the ability to leverage information associated with a digital wallet, allowing them to meet basic Know Your Customer (KYC) requirements. In places where mobile phone usage is high, for example, but access to financial services is low, leveraging [registered SIM cards and mobile phones](#) as a way of proving identity for payments without a traditional ID number could help.

⁴⁰ Maynard, N. "CBDCs & Stablecoins: Key Opportunities, Regional Analysis & Market Forecasts 2023-2030." <https://www.juniperresearch.com/researchstore/fintech-payments/cbdc-stablecoins-research-report?ch=CBDC>

Supporting offline access to digital transactions

CBDC usage will grow with internet usage through mobile devices, especially given the [increasing rate](#) of global smartphone penetration. However, implementing critical telecommunications infrastructure won't be enough to match the pace of innovation needed to ensure constantly available internet access on a 24/7 basis.

This goes for both developing nations and countries like the US, where 7% of all Americans say they don't use the internet.⁴¹ CBDC platform design needs to consider offline access to ensure those without internet connectivity are not excluded. The design should cater to different form factors such as smartphones, feature phones and physical devices designed to support offline payments. Having internet access as a prerequisite to success may affect CBDC adoption and usage, both for those without regular access to the internet and for instances where unexpected power outages occur. This has been illustrated in places like the Bahamas, for example, where natural disasters and

limited infrastructure for backup and recovery resulted in failed transactions using their digital Sand Dollar.

With this in mind, CBDCs that accommodate offline scenarios will be critical to implementation and provide end users with a true digital cash equivalent.

Adding interoperability

Interoperability would allow participants in different CBDC systems to conduct, clear, and settle payments or transactions across systems without the risk and deteriorating experience of participating in multiple systems.

Currently, no universally agreed-upon framework for CBDC interoperability exists. Establishing this will buoy global adoption, usefulness, and may be essential to unlock consumer benefits and achieve financial inclusion targets.

The World Economic Forum identifies generally accepted principles that must form the basis of an agreed-upon set of CBDC interoperability standards.⁴² These include:

Principle	Description
Standardization	Establishing common standards across CBDC systems can facilitate interoperability. Adopting international standards can enhance compatibility and ease of integration.
Openness and inclusivity	Interoperability should promote inclusivity by enabling open participation from various stakeholders.
Scalability	CBDC interoperability should be designed to handle a large number of transactions and support future growth. The underlying infrastructure and protocols should be scalable and accommodate increased demand without compromising efficiency or security.
Resilience and business continuity	Interoperability systems should be resilient to disruptions and capable of maintaining operations. DLT could be a method used to enhance system reliability and minimize single points of failure.
Stakeholder collaboration	Collaboration between central banks, regulatory bodies, financial institutions, technology providers and industry stakeholders is essential for creating an interoperable CBDC ecosystem. Engaging in partnerships, standardization efforts and pilot projects can facilitate the development of interoperability frameworks and drive innovation in cross system transactions.
Cross-border integration	CBDC interoperability should address cross-border transactions, facilitating seamless transfers and exchanges between different CBDCs. Interoperability frameworks should consider foreign exchange regulations, settlement procedures and mechanisms to enable efficient cross-border transactions while maintaining compliance.

Retrieved: "Central Bank Digital Currency Global Interoperability Principles" (World Economic Forum)

41 Evans, D. "China's digital yuan could pose challenges to the U.S. dollar," CNBC 2021. <https://www.cnbc.com/2021/07/24/the-us-is-deciding-how-to-respond-to-chinas-digital-yuan.html>

Without seamless cross-border functionality, most CBDC projects will underachieve their potential. Just as the global internet thrived by early agreement on common protocols like TCP/IP, HTTP and FTP, so too should central banks start coordinating on CBDC standards to avoid creating silos and being constrained by existing methods of coordinating cross border payments.

Ensuring robust security

Supporting financial access to CBDCs for billions of end users with digital wallets invites significant security risks. Moreover, as financial activities extend to payments, transfers, and money management, vulnerabilities will multiply.

Insecurities exist in both physical and digital form, for example simply leaving a mobile device at a restaurant or other public place. Virtual risks can include anything from phishing scams and social engineering hacks, to Denial-of-Service (DoS) and double-spend attacks. Fortunately, mitigation measures do exist.

One option is a blockchain-based private ledger CBDC that uses a multi-signature (“multi-sig”) wallet requiring two other trusted parties to hold credentials to reduce issues of unauthorized use.

Central banks and program designers will need to account for potential cybersecurity threats such as fraud, Anti-Money Laundering (AML), credential theft or risks posed by quantum computers, which can compromise the cryptography employed to secure CBDC accounts.⁴³

Establishing regulatory clarity

A current lack of global regulation is slowing some of necessary innovation and risk-taking.

Mastercard notes the absence of clarity and consistency as particularly problematic, and shows growing concern over issues of international regulatory arbitrage with respect to US competitiveness⁴⁴.

In many cases, regulators are playing catch up and struggling with the speed of change. Jurisdictions have varying levels of skill sets and resources to support policymaking, and timelines for regulatory clarity are inconsistent across markets. Still, most regulatory frameworks are being built outside of the US, and progress towards regulatory clarity has been made in other parts of the world, including Europe where lawmakers and the European Central Bank have proposed a digital euro,⁴⁵ and the United Kingdom where exploration of a digital pound is underway, and crypto and stablecoins are now regulated financial assets by law.⁴⁶

However, given CBDCs interconnectivity with traditional banking and financial services ecosystems, poor regulatory clarity may have an impact on innovation, risk management, and, by extension, financial stability.

42 World Economic Forum, “Central Bank Digital Currency Global Interoperability Principles” 2023. https://www3.weforum.org/docs/WEF_Central_Bank_Digital_Currency_Global_Interoperability_Principles_2023.pdf

43 World Economic Forum, “4 key cybersecurity threats to new central bank digital currencies” 2021. <https://www.weforum.org/agenda/2021/11/4-key-threats-central-bank-digital-currencies/>

44 Ledger Insights, “Mastercard calls for digital asset regulatory clarity, inclusion in trade agreements” 2022. <https://www.ledgerinsights.com/mastercard-digital-asset-regulatory-clarity-trade-agreements/>

45 Jones, H. “EU to set out legal underpinnings for a digital euro” 2023. <https://www.reuters.com/markets/currencies/eu-set-out-legal-underpinnings-digital-euro-2023-06-26/>

46 Shumba, C. et al. “UK Crypto, Stablecoin Rules Receive Royal Assent, Passing into Law” 2023. <https://www.coindesk.com/policy/2023/06/29/uk-crypto-stablecoin-rules-receive-royal-assent-passing-into-law/>

Assuaging privacy and surveillance concerns

A growing number of stakeholders are voicing concerns over potential government tracking and surveillance activities related to CBDCs.

In the US, for example, the “CBDC Anti-Surveillance Act” was proposed to prohibit the use of a digital dollar for the implementation of monetary policy. Bill sponsors raise worries that CBDCs could expose individuals to unnecessary tracking and tracing surveillance risks.⁴⁷ Some argue that these levels of government control aren’t compatible with economic or political freedom.⁴⁸

Clearly, the issue of CBDC privacy has become even more important as divisions between country and regional governments, their leaders, central banks, and monetary authorities, and users grow.

According to research published by the Digital Euro Association (DEA) working group, privacy levels will be a key determinant of adoption.⁴⁹ While navigating this, as well as the balance between preserving user privacy and complying with various regulations such as AML/CFT can seem daunting, this can also be viewed as an opportunity rather than a challenge. Blockchain technology addresses both improvements in the ability to monitor and enforce regulations, as well as consumer privacy protections. What was once a pure trade-off in traditional, centralized technologies is now achievable.

47 Sinclair, S. “Anti-Surveillance CBDC Bill Won’t Protect Privacy,” 2023. <https://blockworks.co/news/cbdc-surveillance-bill-emmer-privacy>

48 Michel, N. “Central Bank Digital Currencies and Freedom are Incompatible,” 2022. <https://www.cato.org/commentary/central-bank-digital-currencies-freedom-are-incompatible>

49 Digital Euro Association, “Privacy and Central Bank Digital Currencies” 2023. <https://ripple.com/reports/CBDC-DEA-Whitepaper.pdf>

SECTION VI

Conclusion



As CBDC development and uptake quickens, a markedly new arc in the history of money is expected.

Importantly, how the underlying technology is implemented and monetary policies are set will determine whether sovereign backed digital assets open the door to enhance global trade and financial inclusion or maintain the siloed, inefficient status quo.

Some central banks are moving faster than others. Still, governments are extraordinarily interdependent. Future global CBDC success will require agreement on common standards and protocols that will enable interoperability – a few mavericks with pioneering agendas are promising, but won't make it far on their own.

While challenges remain, CBDCs have exciting potential. With an estimated \$5 trillion worth of CBDCs in various currencies circulating throughout major economies over the next decade,⁵⁰ the degree to which governments and private sector participants explore these issues and collaborate on solutions may dictate when (not if) this new form of money changes the world.

50 "Money, Tokens and Games: Blockchains Next Billion Users and Trillions in Value," Citi 2023. <https://icg.citi.com/icghome/what-we-think/citigps/insights/money-tokens-and-games>

Total estimated CBDC circulation in the next 10 years

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