



Working Paper #2022-01

CENTRAL BANK DIGITAL CURRENCIES (CBDCs)  
The coming of national e-currencies

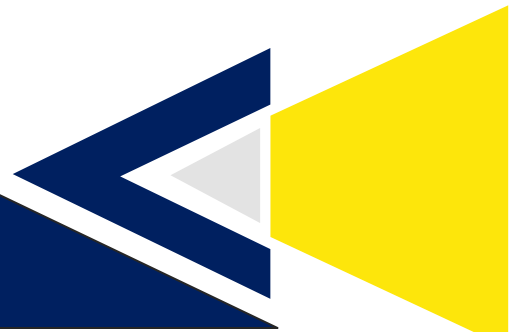
Jeffrey Bohn, UC Berkeley CDAR and One Concern  
Gilles Papadopoulos, Swiss Re Management  
Jürg Unger, Swiss Re Management

November 22, 2022

University of California  
Berkeley

**Berkeley** Consortium for  
Data Analytics in Risk

 **Swiss Re**  
Institute



**CENTRAL BANK DIGITAL CURRENCIES (CBDCs):  
The coming of national e-currencies**

## Table of Contents

Introduction .....	5
Defining Central Bank Digital Currencies (CBDCs) .....	5
Why might CBDCs be useful? .....	8
Functionality, provision, and economics .....	9
CBDC Challenges .....	10
Early Initiatives.....	10
Digital Yuan .....	13
Design.....	13
Future architecture development.....	14
Benefits of the digital yuan .....	15
Implications for the insurance industry .....	16
Conclusion.....	17

# CENTRAL BANK DIGITAL CURRENCIES (CBDCs)

## The coming of national e-currencies

Jeffrey R. Bohn\*

Gilles Papadopoulos<sup>+</sup>

Jürg Unger<sup>1</sup>

November 22, 2022

### Abstract

Central Bank Digital Currencies (CBDCs) offer a new form of digital money, with many national monetary authorities exploring the concept and running pilot projects. CBDCs potentially offer speed, efficiency, reduced costs, security, and better implementation of monetary policy, all encouraging the digital economy. However, challenges in establishing the currencies are significant, not least in the context of foreign exchange transactions. Despite these challenges, we expect the widespread use of CBDCs may come sooner than many think.

## Executive Summary

The first e-currency project to move beyond pilot status in a major global currency denomination – the e-CNY or digital yuan – was used at the Beijing Winter Olympics and has been deployed within China on a restricted basis. This launch marked over a decade of progress in creating digital currencies. The most prominent examples of these new exchange media have been decentralised cryptocurrencies, such as BitCoin. Despite enthusiasm among many in the financial community, valuations of these “crypto assets” have fluctuated significantly— with relatively frequent sudden drops in value in relation to reserve currencies (e.g., USD, EUR, or JPY)— prompting stability concerns. A parallel development focuses on a range of tools, concepts, institutions, and protocols that coalesce into an emerging ecosystem using blockchain labelled Decentralized Finance or DeFi. These developments are of more interest among government authorities than the speculative excesses and instability of the cryptocurrency markets (though DeFi still has its detractors.) DeFi could lead to capabilities

---

\* Consortium for Data Analytics in Risk (CDAR), University of California at Berkeley; Corresponding author: jbohn@berkeley.edu

<sup>+</sup> Swiss Re Management Ltd.

<sup>1</sup> Swiss Re Management Ltd.

that will better suit the proper creation of a completely digitized financial system. Partly as a result of this combination of enthusiasm and concern, more than 80 central banks are currently exploring the deployment of Central Bank Digital Currencies (CBDCs), of which the digital yuan in China is the most prominent and advanced. CBDCs are likely to stimulate digitally-driven commerce; while potentially enabling central banks to improve monetary policy implementation and monitoring.

Available technologies that could be used for CBDCs are still too slow, difficult to scale, and insufficiently secure to support widely distributed national digital currencies. Distributed ledger technologies (DLTs), such as blockchain, which are used for cryptocurrencies, have yet to meet the rigorous criteria necessary to issue and maintain CBDCs. However, private companies have made significant progress with DLTs and other platforms in addressing aspects of an end-to-end CBDC issuance and payment system. A final system design of a CBDC will likely include numerous public/private partnerships to deliver necessary system components and functionalities. An important point to remember as these systems are developed and deployed is that no one solution works in every context as highlighted in a recent comprehensive report on CBDCs compiled by leading academics and industry experts. They conclude: “What is clear from the research is that there are no ‘right’ choices for monetary authorities when considering CBDC.” (Ogden, 2021)

The first widespread use of CBDCs will likely be in wholesale financial transactions e.g., posting collateral, repatriating profits, or managing payments. Retail CBDC transactions will be much further into the future due to the more challenging speed and scale requirements as well as regulatory risk aversion. This said, focused experiments in various contexts over the next several years will facilitate deeper understanding with respect to the pros and cons of CBDCs.

Over the next decade, several large countries will likely deploy successful CBDCs. Developing countries have already made initial steps toward issuing CBDCs in order to boost financial resilience and inclusion. These countries are characterized by smaller and less complex financial ecosystems making it relatively less challenging to issue CBDCs. Larger developed countries can learn from the experiences that arise from smaller, developing country CBDC issuance. In this paper, we highlight CBDC trends and developments, as well as their many challenges.

## Introduction

The stated primary objective of most central banks is to guard the value of a currency by keeping prices stable and working to ensure a robust financial system. This objective results in central banks playing a significant role in money and payment management. Central banks generally manage money supply and use a range of tools to influence the amount of liquid money (i.e., liquidity) available in the financial system. In addition, they maintain resilient and reliable payment systems.

CBDCs represent the next step in currency evolution and management of money. Much of the required digital financial infrastructure is already in place, including electronic ledgers, digital payment infrastructure, and settlement systems. Bank accounts are examples of digital currencies as long as these monies are not converted into physical cash. Although digital currencies, CBDCs are not cryptocurrencies, such as Bitcoin. Cryptocurrencies always make use of distributed ledgers, are not centrally administered, are stored in digital wallets, and are cryptographically scarce (BIS, 2021). They are largely outside the scope of this paper.

### Payments in 2021

Electronic payments are increasing-- a trend boosted by the Covid-19 pandemic. Contactless cards, digital wallets, and digital payment settlements have become commonplace, with new financial service providers entering the marketplace. The reach of companies such as Alipay, PayPal, and MPesa is impressive. Alipay, for example, provides services to more than 1.2 billion people in 50 countries, managing more than USD233 billion in users' wallets (Smith, 2021). Next generation payment enablers (e.g., Diem, structured as a cryptocurrency backed by real assets and administered by Meta) could capture even larger markets. If these alternative payment systems gain enough traction, central banks may find their monetary policies' effectiveness and their domestic currencies' attractiveness reduced. This trend is a key driver behind central banks establishing Central Bank Digital Currencies (CBDCs).

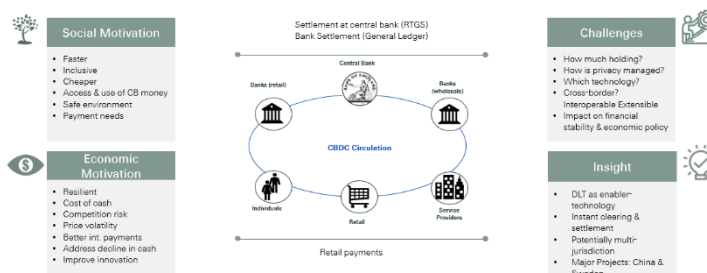
### Defining Central Bank Digital Currencies (CBDCs)

A CBDC is defined as "an electronic form of money issued by the Central Bank, which can be used by business and households to store value and make payments" (Bank of England, 2020). Unlike a decentralized cryptocurrency, CBDCs are regulated by a domestic monetary authority and are therefore centralized. CBDCs have two important characteristics: 1) A CBDC unit is a

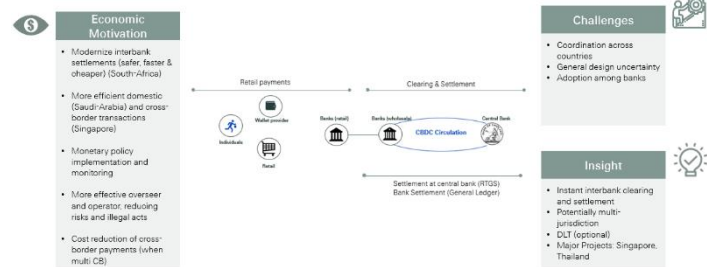
one-to-one substitute for a unit of cash. 2) A CBDC is a digital currency, not a cryptocurrency. Although it could be managed on blockchain, a CBDC functions much differently from a cryptocurrency (see above).

CBDC function can be broken down into wholesale and retail. Wholesale CBDCs are designed to facilitate large transactions. As such, these instruments should improve monetary policy monitoring, reduce financial crime risk, reduce transaction costs, and facilitate international payments (assuming multiple central banks have interoperable systems.) The goals of central banks differ. For example, South Africa’s central bank is exploring the use of a CBDC to modernize its interbank settlement system-- making it safer, faster, and cheaper. Singapore’s monetary authority would like to improve its cross-border transactions efficiency. Saudi Arabia is focused on improving its domestic transactions. Many developing countries are evaluating CBDCs to promote greater financial inclusion.

Wholesale CBDCs face several challenges. The primary challenge is that despite many years of investigation, no country or expert is clear on which technology is most suitable. Moreover, wholesale CBDCs will only function with buy-in of domestic banks and other central banks. This “network effect” is difficult to achieve in practice. Even if a few central banks adopt CBDCs, their usefulness and scale will depend on the extent to which an actual network of globally interoperable systems are implemented.



Retail CBDCs also face similar system-related challenges as faced by wholesale CBDCs. This said, pressure from retail customers may drive relatively faster adoption due to the clear and widespread advantages.



Retail CBDCs will allow individuals to make payments faster, safer, and at any time of their choosing. The 24/7 nature of CBDCs aligns with increasing digital commerce. Retail CBDCs will thus be more socially inclusive. Around 2 billion individuals without a bank

account will gain a free wallet and benefit from low or no transaction fees. This outcome would be in line with financial inclusion as documented in the United Nations' Sustainable Development Goals (SDGs). Retail CBDCs act as a springboard to advance the availability of personal financial services to the unbanked and underbanked in the context of a new digital financial system (this outcome aligns with the definition of financial inclusion by the WorldBank<sup>2</sup>). Possible deployment models range from indirect CBDC issuance (e.g., via bank loans) to a direct model, where no intermediaries are needed apart from the Central Bank. CBDCs will provide a government-authorized solution for storing value and making payments in geographies where physical infrastructures are difficult to build and/or a widespread financial payment system is not sustainable given high maintenance costs for relatively low volume (e.g., Pacific Islands). Furthermore, similar to M-pesa (though deployed in a government-authorized way), CBDCs facilitate a large underbanked population gaining access to credit, creating more opportunities to establish microbusinesses. The downstream effects increase transparency in supply chains, improve efficiency in export production, and attract foreign capital into the country (UNDP, 2021). Additionally, obtaining access to banking services means that underbanked segments of society will also benefit from access to services that were out of reach before e.g., insurance coverage, utilities etc. At the same time, while curbing the use of cryptocurrencies, CBDCs provide the benefits of a digital money system that includes system-based approaches for fighting money laundering and tax evasion (Asian Development Bank, 2021).

Retail CBDCs eliminate costs related to managing the physical creation, issuance, and usage of cash. Smaller-unit digital transactions become economically viable without the costly storage and accounting demands. CBDC transaction records will make illegal transactions and money laundering more difficult (although there may be civil liberty concerns related to privacy protection). CBDCs will also provide competition for payment platforms such as Alipay and stable coins.

As with wholesale CBDCs, retail CBDCs design (blockchain, cloud) still need to be finalised-- as do interoperable payment systems across countries. Distinct challenges for retail CBDCs include the following: the amount individuals and institutions can hold; privacy and data

---

<sup>2</sup> Financial Inclusion is defined as "businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way." (World Bank Group, 2022)



access; and the impact on financial stability, particularly if current intermediaries – retail banks – are increasingly cut out.

## **CBDC architectures and functionalities**

According to a survey conducted by the Bank for International Settlements, consumers' primary requirement is that a CBDC embody a cash-like claim backed by a central bank. This digital claim must be at least as intuitive and convenient as current electronic payment systems. CBDCs should be accessible to all and embody privacy-by-default.

Within these constraints, two questions shape the requirements of CBDCs:

1. Is the CBDC a direct claim on the central bank or is the claim indirect, via payment intermediaries?
2. What is the operational role of the central bank and of private sector intermediaries in day-to-day payments?

Central banks further have to choose between an identity-based and an encrypted system. For an identity-based system, each individual's actual identity will have to be confirmed via a know-your-customer (KYC) process, adding a layer of complexity to deployment. An encrypted system avoids identity requirements; but requires a different level of complexity to prevent anonymous illicit transactions. Regardless of the system chosen, it will have to align with other central banks to facilitate cross-border payments.

Distributed ledger technology (DLT) may enhance CBDC stability and resilience while satisfying privacy and security requirements. This said, no DLT today can match the speed and efficiency of current digital payment systems. One exciting potential alternative could arise from 'programmable money' enabled via smart contracts. Independent of the final solution, design choices will reflect a difficult trade-off between innovation and robustness.

## **Why might CBDCs be useful?**

System development to support CBDCs can become particularly useful in addressing social inequity and hindering money laundering & tax evasion. Implementing a system that meets these requirements must trade-off speed & efficiency with inclusiveness & transparency. Despite these design, development, and deployment challenges, CBDCs could be an

important tool in promoting a society's social welfare. Other challenges, result from requirements that CBDC systems will have to be open to competition, interoperable, and extensible. There will inevitably be requirement conflicts. A safe, reliable, fast payment system does not easily lend itself to an inclusive, innovative, and competitive system. Balancing these conflicting requirements constitutes one of the primary challenges in deploying a widespread, scalable CBDC.

### **Functionality, provision, and economics**

CBDCs assign responsibilities at each stage of the payment process between private operators (fintech, payment providers, and technology firms) the public sector (regulators and central banks). Private sector participants should bring more innovative and competitive user-facing facilities; public sector institutions (particularly regulators) should protect against oligopoly or monopoly abuses of market share.

The Bank of England recently proposed a model in which a central bank takes responsibility for all stages of CBDC transactions (Bank of England, 2020). The Bank quickly realised that this model would not meet a CBDC's primary objectives. It thus modified its suggestions to a platform model, with the central bank providing the core ledger, upon which private firms could provide payment provider interfaces (Bank of England, 2020).

A well-designed CBDC should enable households and businesses to make near-real-time, efficient, and reliable payments in order to support competition, efficiency, and innovative payment systems. CBDCs can foster a potentially fairer and more efficient digital economy by encouraging smart contracts and programmable money. They will facilitate lower issuance costs as they replace declining banknotes and coins. Further, CBDCs can support traceability and monitoring of exchange streams providing useful information for monetary-policy makers. CBDCs are likely to provide building blocks for better cross-border payments.

A well-constructed CBDC is likely to enhance the ability of central banks to control and manage monetary policy. CBDCs can facilitate greater transactional transparency that are likely to improve efforts to address financial fraud and money laundering (although greater security may come at the cost of some reduction of openness and freedom; the details will matter as to how best to balance transparency and security). Central banks will have a better overview of monetary flows and balances, helping them manage the money supply. Clearer

overview of money flows could also support more effective fiscal policies. As CBDCs gain traction, costs arising from maintaining physical cash will decrease.

### **CBDC Challenges**

Adoption of CBDCs will have to be phased in, so that a sudden adjustment does not adversely affect current bank lending (Bank of England, 2020). Some policy analysts are concerned that CBDCs and cryptocurrencies may dilute monetary policy control. Other researchers find this reduction in central bank control a positive outcome (Deutsche Bank Wealth Management, 2020). There are concerns that private sector participants in the CBDC space become monopolistic and anti-competitive. Pilot studies will provide clearer insight into potential stressors to the payment system.

Several outstanding issues still need to be settled:

- Who can hold CBDCs?
- Should CBDC accounts be allowed to be interest bearing?
- Should there be a holding amount limit?
- How will interoperability and cross-border regulation be managed?
- To what extent should CBDCs be allowed to be converted into other CBDC, cryptocurrencies, and deposits?

Sources of useful information to start answering these questions are initiatives testing a range of relevant design principles and architectures. Let us consider some of these initiatives.

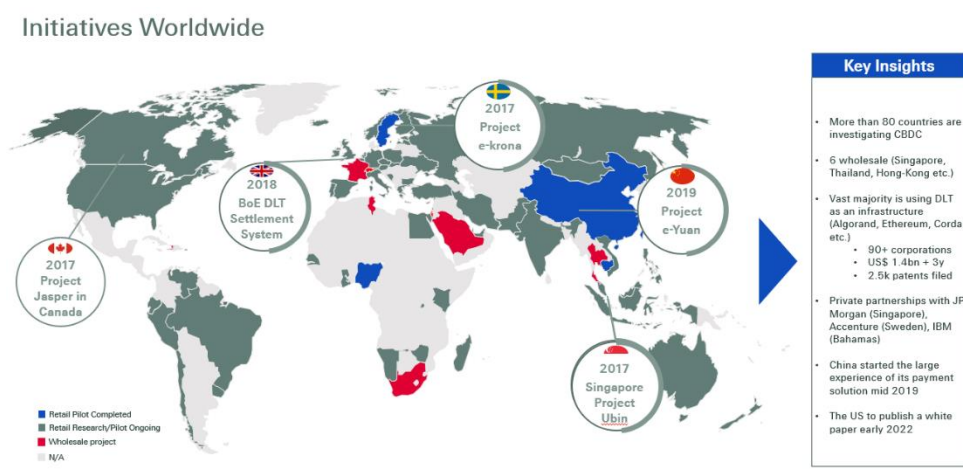
### **Early Initiatives**

The Dutch Central Bank carried out several cryptocurrency trials in 2015, concluding that DLT-based cryptocurrencies are not scalable and vulnerable to illegal activities (Davis, 2021). The German Bundesbank and the Deutsche Börse in 2016 tested a blockchain-related transfer of securities, finding the transactions too slow and expensive (Bloomberg Economics, 2019). Later in 2018, Deutsche Bank with the Deutsche Börse successfully completed a blockchain prototype for security settlement. Developed on Hyperledger Fabric 1.0, this prototype supported security transactions, interest payments, and bond maturity repayments. Despite some success, this prototype was too slow and suffered from many of the challenges highlighted in this paper (Deutsche Bundesbank, 2018).

The People's Bank of China (PBoC) issued its own CBDC, called the Digital Currency/ Electronic Payment (DCEP), for the 2022 Beijing Winter Olympics (see below). In Japan, a successful Anti-Money Laundering (AML) and analytics solution was introduced for a blockchain-based coin by Confirm, pegged to the yen. This prototype demonstrated more promise and may prove the basis for a fully digital yen (Pawel Kuskowski - Forbes, 2020).

Today, more than 83 countries are actively investigating CBDCs, some having already finished pilots such as

China and Sweden. Most initiatives are focused on retail CBDCs, including Canada and the United Kingdom. Only six



countries are focusing on wholesale CBDC. Singapore started its "Ubin" project in 2017 with Corda as the blockchain-based foundation supported by JP Morgan. France recently successfully completed its wholesale CBDC-like pilot with the launch of a government bond. In 2017, the country began clearing and settlement of payment and securities pilot using Hyperledger (a blockchain protocol) in partnership with Deloitte and Nasdaq (Nasdaq, 2018).

From these initiatives, we can conclude that technology architectures continue to fall short in terms of speed and efficiency from the perspective of a scalable and convenient CBDC. This said, some of the narrow successes point to a future with CBDCs. Offering interest and other incentives may be needed at first to persuade enough early adopters to lead to the virtual improvement reinforcement spiral where more transactions leads to more private company focus on innovation, which then makes the CBDC even more attractive, and so on. CBDCs' flexibility will foster more opportunities as new use cases are addressed.

More than 90 private companies are supporting central banks in developing CBDCs, accounting for more than USD 1.4 billion in investment. The vast majority of CBDC pilots are based on a blockchain infrastructure, except the notable exception of China. We next turn to

a more detailed characterization of one interesting initiative in the Bahamas, which illustrates particular successfully CBDC features.

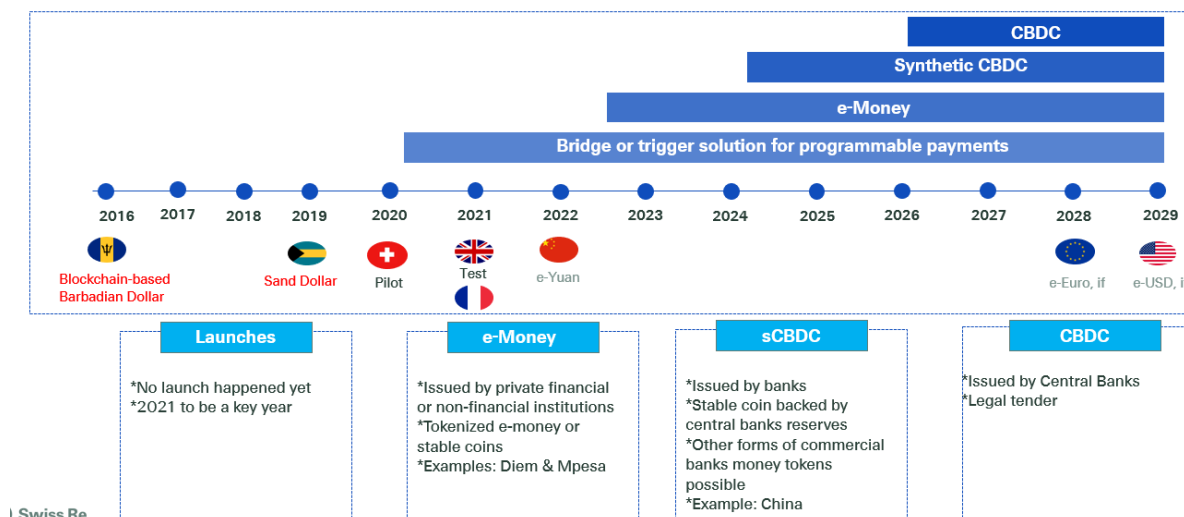
### **The Sand Dollar**

During the devastating 2019 storms in the Bahamas, many payment facilities were incapacitated across the country. In response, the Central Bank of the Bahamas launched its Sand Dollar in October 2020. The Sand Dollar is one-to-one convertible with the Bahamian dollar, itself pegged one-to-one to the US dollar. The Sand Dollar has two enrolment levels, one without ID – limited to holding 500 Sand Dollars in an e-wallet at any given time, with monthly transactions of 1,500 Sand Dollars – and level two, requiring ID and a link to a bank account, with a 8,000 holding ceiling and 10,000 monthly transaction limit in the e-currency. The Sand Dollar is based on blockchain technology. Some critics expressed concerns that ID requirements are relatively lax and may facilitate tax evasion. These concerns are misplaced. This blockchain deployment ensures transparency and size limits on holding the Sand Dollar (plus the small size of the Bahamian economy) limits the risk of any material tax evasion or money laundering. (Global Finance, 7 October 2021). From this initiative, we see the value of holding limits and the importance of implementing technology that guarantees transparency. Developing different tiers linked to ID requirements provides one path for managing who holds a CBDC.

Other smaller economies may follow in the footsteps of the Bahamas, indeed Barbados launched a blockchain currency in 2016 through a private company. These smaller economies may be in a better position to experiment and evolve technology and designs to implement inter-operability. They can coordinate with larger economies to work on cross-border regulation in the context of actual CBDC transactions. Despite early enthusiasm based on these initiatives, for most large, interconnected economies, the launch of a CBDC is only realistic towards the end of the current decade. The one exception, as discussed below, is the Chinese yuan. The figure below details the predicted path for development and deployment. Payments become the foundation upon which these digital currencies are built. The public-private partnerships in different countries will likely drive CBDC evolution as government regulators work on design and structure while private companies work out the kinks in the technology architectures. Sudden innovations could speed up this process. Regardless of how the technology develops, internationally negotiated cross-border regulations and standards

will be necessary to scale CBDCs. Otherwise, these digital currencies will languish as obscure projects studied and slowly developed on the margins of the global economy.

Figure 1: Predicted evolution of CBDC development and deployment



China's efforts appear to be furthest along from the perspective of deploying a viably scalable and widely used CBDC. We next discuss the e-CNY or digital yuan.

## Digital Yuan

In early 2019, the People's Bank of China (PBoC) announced its intention to become the first major central bank to launch a CBDC. Only a year later, China's national Digital Currency Electronic Payment (DCEP) system was tested across the country. In Shenzhen, for example, nearly 50,000 residents received a digital payment of CNY 200 (USD 30), which could be spent across 3,400 retail outlets. In 2021, more than 140 million Chinese took part in a digital yuan pilot, with a goal of deploying the digital currency after the Winter Olympics, in Beijing, using the Games as a large-scale pilot.

### Design

The Chinese DCEP does not use blockchain technology, mainly for political reasons (though technology considerations may also be a motivation); the DCEP will be centrally managed by the PBoC. DCEP data are collected in real time to reflect monetary creation and flows. This information reflects what can be used in monetary policy management.

The currency will be issued and distributed based on a two-tiered system and backed by the yuan (see figure below). In the first layer, the PBoC will issue DCEP to intermediaries, the four

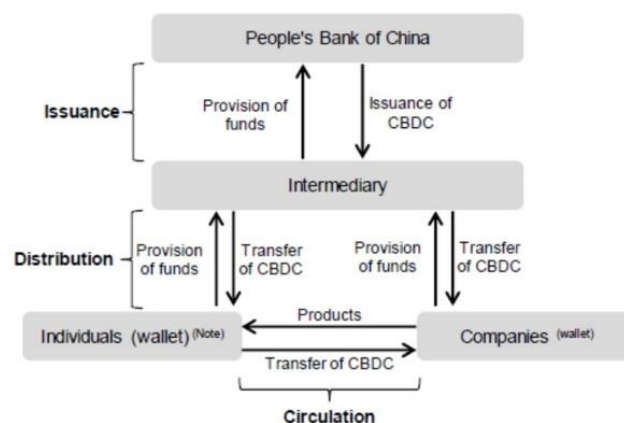
major state-owned banks as well as non-financial players such as Alibaba and Ten Cent. The second layer will cover the interactions between these intermediaries and retail market participants and individuals. Companies taking part in this monetary experiment include local hotels, unmanned supermarkets, and international chains such as Starbucks, McDonalds, and Subway. Intermediaries receiving DCEP distribute and circulate to retail participants through electronic wallets. The mobile wallet launched by China Construction Bank in mid-2020 includes features such as deposits, withdrawals, and detailed transaction information. This wallet connects the users' bank accounts with their DCEP wallets. These wallets can be used to repay credit cards, upgrade-- and even cancel-- the DCEP wallet. The Bank wallet also allows users to pay/receive/transfer funds with a simple click or by scanning another wallet QR code. A WeChat function allows users to easily send a "red packet" gift of money at New Year. Lastly, users can send and receive digital currency to their bank account.

### **Future architecture development**

DCEP is run on a centralized private network, with the PBoC having complete access and control of the currency (they can create and destroy at will). As a consequence, the DCEP is only distributed through partnering financial institutions and is not generally available to the public. This said, President Xi announced that China's development of blockchain technology should accelerate. China has invested in a material way into blockchain development and is expected to invest more than USD billions in the space over the next few years. Specifically, China has launched the Blockchain Service Network aimed at unifying all blockchain-related projects. Project "Algorand" has started investigating how to build bridges between the DCEP and other currencies, without unveiling further details (CBDC Tracker, 2021).

## Benefits of the digital yuan

Figure 2. System of CBDC Issuance, Distribution and Circulation



Digital yuan issuance will enable the PBoC to better monitor currency transactions and control monetary policy. Given the DCEP’s centralised design, the risk of financial crime is substantially reduced. Eventually, the digital yuan could lead to material cost savings as physical cash issuance decreases.

Lack of control over its payment clearing process is a sensitive issue for the Chinese government. Currently, international yuan clearing and settlement is largely channelled through SWIFT (Society for Worldwide Interbank Financial Telecommunication) and CHIPS (Clearing House Interbank Payments System). CHIPS is a US company; while, despite claims to neutrality, most of SWIFT’s directors are American, with databases located in the US. A digital yuan will give authorities more control and access to relevant payment data.

The digital yuan will contribute to internationalising China’s currency. The yuan became an official reserve currency held by the International Monetary Fund in 2016. However, six years later, only 2.6% of official exchange reserves were held in yuan against 59% in US dollars (IMF, 2022). Domestically, the government can mandate use of the digital yuan to pay for publicly provided services. Internationally, as no bank account would be required for CBDC deployment, China could target yuan wallets for the two billion unbanked individuals across the globe, just as Meta was envisioning with Diem (until its quiet disappearance). The Chinese government could also promote the use of its digital currency for the 65 countries directly involved in its Belt and Road initiative. Its speed, convenience, and safety will be a major competitive advantage for international businesses trading with China. The would expand China’s surveillance capabilities abroad and make it easier to manage exchange rates without



the need to impose foreign exchange controls. The information gleaned from tracking these currency flows would also provide an advantage for planning and policy.

### **Implications for the insurance industry**

The insurance industry's profitability directly relates to the extent to which suitably diversified portfolios can be constructed and the quality of the models used to price different types of risk. In addition, claims processing,

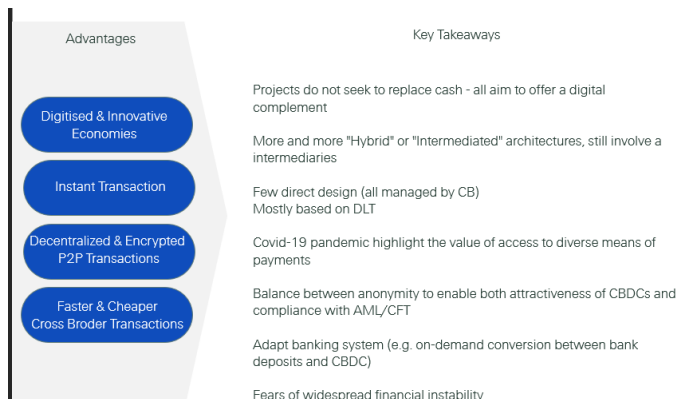
There are a number of implications of CBDCs for the insurance industry.

- Operationally, CBDCs will create smoother payment systems between insured parties and insurers and will help support the digitalisation of insurance products. In some lines, CBDCs may facilitate the emergence of digital disruptors and allow new market entrants.
- The ability of CBDCs to reach a two billion population without a bank account could open new markets to insurers, particularly in micro insurance products.
- CBDCs suggest a change in risk profile around payments. Transition, in particular, may disrupt payment processes or have other unforeseen consequences that could result in claims (although well-designed pilots should help minimise this risk).
- Insurers, as with other investors, will seek to understand the risk and return profile of digital currencies and assess their contribution to their portfolio.
- CBDCs will have an impact on the implementation and effectiveness of monetary policy and so in wider macroeconomic stability and growth.

The extent and impact of all these potential implications remain at this point largely speculative. However, this is a space insurers should be closely monitoring.

## Conclusion

Retail and wholesale CBDCs bring convenience, speed, and depending on architecture, security to digital transactions. Deploying and scaling CBDCs remain a challenge. The design of most CBDCs is on DLT/block-chain-- even though this technology is not yet capable of supporting a widely-used digital currency. Many governments and companies are working to remedy these current weaknesses. Experienced market observers still expect DLT/blockchain to support future CBDCs (Bank for International



Settlements, 2021). Small countries continue to experiment with standard DLT/Blockchain. Larger countries, such as the China, are also exploring other types of technology architectures.

Beyond technological architectures, the challenges for scalable deployment CBDCs include developing guidelines in the context of implementations and responsibilities among monetary authorities and private intermediaries (e.g., know-your-customer, reporting, auditing, etc.), balancing privacy and control with the risk of tax evasion and money laundering and know-your-customer guidelines. The current lack of a global regulatory framework governing the issuance of CBDCs poses a particularly difficult challenge for cross-border and cross-CBDC settlement, which will likely continue even after the technical issues are resolved.

We predict that CBDCs will eventually offer a more effective domestic settlement system that is safer, faster, and cheaper than current systems. In the short-to-medium term, the overall purpose of CBDCs is not to replace cash, but rather to provide an alternative payment solution via a series of experimental platforms. These multi-faceted developments are important milestones in the natural evolution of money, from physical to digital.

Research and discussion will be key to the success of a CBDC. We recommend a higher level of deep and technical discussions between monetary authorities and private-sector entities to map out possible CBDC paths and pilots. Without sufficient scaling and multiple interactions, we are unlikely to realize the inherent and widespread potential benefits of CBDCs.

There are a number of implications of CBDCs for the insurance industry.

- Operationally, CBDCs will create smoother payment systems between insured parties and insurers and will help support the digitalisation of insurance products. In some lines, CBDCs may facilitate the emergence of digital disruptors and allow new market entrants.
- The ability of CBDCs to reach a two billion population without a bank account could open new markets to insurers, particularly in micro insurance products.
- CBDCs suggest a change in risk profile around payments. Transition, in particular, may disrupt payment processes or have other unforeseen consequences that could result in claims (although well-designed pilots should help minimise this risk).
- Insurers, as with other investors, will seek to understand the risk and return profile of digital currencies and assess their contribution to their portfolio.
- CBDCs will have an impact on the implementation and effectiveness of monetary policy and so in wider macroeconomic stability and growth.

The extent and impact of all these potential implications remain at this point largely speculative. However, this is a space insurers should be closely monitoring.

## References

Asian Development Bank. (2021). *CENTRAL BANK DIGITAL CURRENCIES*. Manila: Asian Development Bank. Retrieved from <https://www.adb.org/sites/default/files/publication/720016/central-bank-digital-currencies-pacific.pdf>

Bank for International Settlements. (2021, June 23). *III. CBDCs: an opportunity for the monetary system*. Retrieved from BIS: <https://www.bis.org/publ/arpdf/ar2021e3.htm>

Bank of England. (2020, March 12). *Central Bank Digital Currency: opportunities, challenges and design*. Retrieved from <https://www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper>: <https://www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper>

Bank of England. (2020). *Central Bank Digital Currency Opportunities, challenges and design*. Bank of England. Retrieved from <https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf?la=en&hash=DFAD18646A77C00772AF1C5B18E63E71F68E4593>

- Bank of International Settlement. (2020). *Bank of International Settlements - Rise of the central bank digital currencies*. Monetary and Economic. BIS Publication. Retrieved from <https://www.bis.org/publ/work880.pdf>
- Bank of International Settlement. (2020). *Central bank digital currencies: Foundational Principles & Core Features*. BIS Publications. Retrieved from <https://www.bis.org/publ/othp33.htm>
- Beattie, A. (2021, August 23). *The History of Money*. Retrieved from Investopedia: [https://www.investopedia.com/articles/07/roots\\_of\\_money.asp](https://www.investopedia.com/articles/07/roots_of_money.asp)
- Bechtel, A. (2020). Programmable money and programmable payments. Frankfurt .
- BIS. (2021). *Distrust or speculation? the socioeconomic drivers of U.S. cryptocurrency investments*. Bank for International Settlements. Retrieved from <https://www.bis.org/publ/work951.pdf>
- BIS Working Paper. (2020). *Bank of International Settlements - Rise of the central bank digital currencies*. Monetary and Economic. BIS Publication. Retrieved from <https://www.bis.org/publ/work880.pdf>
- Capgemini. (2020). *Capgemini's World Payments Report 2020*. Capgemini.
- CBDC Tracker. (2021). *Today's Central Bank Digital Currencies Status*. Retrieved from CBDC Tracker: [cbdctracker.org](http://cbdctracker.org)
- Davis, J. (2021, August 8). *International Security Implications of Central Bank Digital Currencies*. Retrieved from Lawfare: <https://www.lawfareblog.com/international-security-implications-central-bank-digital-currencies>
- Deutsche Bank Wealth Management. (2020). *CIO\_Special\_-Central\_bank\_digital\_currencies\_-\_Money\_reinvented*. Deutsche Bank Wealth Management. Retrieved from [https://www.db.com/newsroom\\_news/CIO\\_Special\\_-Central\\_bank\\_digital\\_currencies\\_-\\_Money\\_reinvented\\_-\\_WM.pdf](https://www.db.com/newsroom_news/CIO_Special_-Central_bank_digital_currencies_-_Money_reinvented_-_WM.pdf)
- Forkast. (2020). *Visa hops on USDC's Eth2 wagon. China flexes DCEP digital currency in biggest test yet. Will US tighten Libra/Diem's tether?* Retrieved from Forkast: <https://forkast.news/visa-ethereum-usdc-china-dcep-digital-yuan/>
- Foster, C., Blakstad, S., Gazi, S., & Bos, M. (2021). *Digital currencies and CBDC impacts on least developed countries (LDCs)*. Swiss Agency for Development & Cooperation.
- Gesellschaft für Informatik. (2018). *The Bitcoin Universe: An Architectural Overview of the Bitcoin Blockchain*. Bonn: Gesellschaft für Informatik. Retrieved from <https://dl.gi.de/bitstream/handle/20.500.12116/16570/DFN-Forum-Proceedings-001.pdf?sequence=1&isAllowed=y>
- Gu, M. (2021). *China's National Digital Currency DCEP / CBDC Overview*. Retrieved from Boxmining: <https://boxmining.com/dcep/>
- IG. (2021). *Fiat currency definition*. Retrieved from IG.com: <https://www.ig.com/sg/glossary-trading-terms/fiat-currency-definition>
- IMF. (2022). *IMF Data Composition of Official Foreign Exchange Reserves (COFER)*. Washington: IMF. Retrieved from <https://data.imf.org/?sk=E6A5F467-C14B-4AA8-9F6D-5A09EC4E62A4>

- Kharpal, A. (2020). *China hands out \$1.5 million of its digital currency in one of the country's biggest public tests*. Retrieved from CNBC: <https://www.cnbc.com/2020/10/12/china-digital-currency-trial-over-1-million-handed-out-in-lottery.html>
- KWAN, C. H. (2021). *China Aiming to Issue a Central Bank Digital Currency*. Retrieved from Research Institute of Economy, Trade and Industry, IAA: <https://www.rieti.go.jp/en/china/19122701.html>
- Nasdaq. (2018, November 19). *MAS & SGX on How Project Ubin is the Way of the Future for Blockchain Interoperability*. Retrieved from Nasdaq: <https://www.nasdaq.com/articles/mas-sgx-on-how-project-ubin-is-the-way-of-the-future-for-blockchain-interoperability-0>
- Ogden, Tessa (2021). *Foreword in Central Bank Digital Currency: Considerations, Projects, Outlook*, editor Dirk Niepelt, Centre for Economic Policy Research.
- Smith, C. (2021). *Alipay-statistics*. Retrieved from expandedramblings: <https://expandedramblings.com/index.php/alipay-statistics/>
- The Guardian. (2020, July 20). *Will coronavirus mean the demise of banknotes?* Retrieved from The Guardian: <https://www.theguardian.com/business/2020/jul/28/coronavirus-banknotes-covid-19-cash-paper-money>
- UNDP. (2021). *Digital-Currencies-and-CBDC-Impacts-on-Least-Developed-Countries-LDCs*. Geneva: UNDP. Retrieved from <https://www.undp.org/sites/g/files/zskgke326/files/2021-06/UNDP-UNCDF-TP-1-2-Digital-Currencies-and-CBDC-Impacts-on-Least-Developed-Countries-LDCs-EN.pdf>
-