

Digital Currencies:

Public and Private, Present and Future

DBS Group Research

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Summary

- *Digital payments and settlements have been around for a long time; even private digital currencies are now more than a decade old. Yet, this year is shaping up to be a landmark in the history of digital finance.*
- *Energized by rapid advances in connectivity, mobility, and data storage, the world of digital payment and currencies has made major strides in recent years. The ongoing pandemic has added fuel to the move toward a society with less cash dependence.*
- *New technological frontiers of payment and settlement at the individual level are opening up. Private digital currencies have proliferated, with profound implications for money supply and storage of value.*
- *Central banks have led the way in money creation through digital means for over half a century. Today they are at once troubled and intrigued by the innovation and expansion taking place in financial technology.*
- *Monetary authorities are catching up, keen to maintain control over money supply and transactions.*
- *Private sector digital currencies, after meeting with a great deal of skepticism from the official sector, have found traction, although are by no means fully set with respect to standards, regulation, and acceptance.*
- *Asia is the world's largest digital payments market, with China comprising almost half of the worldwide transaction value.*
- *Measured by traffic, liquidity and trading volume, half of the world's top ten crypto exchanges are in Asia.*
- *This paper takes stock of the latest developments in the world of digital currencies, public and private. Integral developments in the system of payment and settlements are examined. A list of resources on the latest expert-level thinking is provided at the end of the report.*
- *We plan to publish quarterly updates on this game-changing field.*

Introduction

Little more than a century ago, US Federal Reserve began allowing banks to transfer funds via telegram, free of interest charge. Global finance by then had already been taking advantage of electronic communications; developments related to the First World War reached New York City from Europe nearly instantaneously and financial assets were traded based on such real time information.

*From telegraph
money transfer
network to digital
currency network*

Today, central banks have moved from creating telegraph money transfer networks to creating digital payment networks. This is motivated by the need to bring under control the rapidly growing world of online payments that could reduce the control and oversight of monetary authorities. It is also because private sector-issued digital currencies have been taking flight worldwide. Private payments and private currencies were both seen initially with a degree of dismissive pessimism by central bankers in the past decade; not anymore.

Considerable work is being done these days on digital currencies, catching the attention of the public and policy-makers alike. It is however important to contextualize that there have been many forms to digital payments for over half a century. Central banks have been managing the issuance of reserves to banks electronically for many decades. Mobile payment and digital wallets have been around for nearly two decades. For public and private payment and settlement, systems like Real Time Gross Settlement (RTGS), FedWire, Clearing House Interbank Payments System (CHIPS), Society for Worldwide Interbank Financial Telecommunication (SWIFT), Electronics Funds Transfer System (EFTS) have been operating for decades, offering fast and low cost solutions.

What has changed over the past fifteen years or so is that mobile computing power and connection speed have improved tremendously, bringing instant digital payments and settlements to our fingertips. At the same time, entrepreneurs have come forward with systems of digital currency issuance and settlement that take place privately and globally.

Bitcoin perhaps epitomizes the keen interest in digital currencies, although the universe of cryptocurrency has expanded rapidly. One glance at coinmarketcap.com reveals over 2,500 types of tradable cryptocurrencies, amounting to a market cap of USD360bn.

*Digital currencies
have captured the
investor zeitgeist*

Call it speculative, precautionary, or simply a part of portfolio diversification, digital currencies have captured the investor zeitgeist. Ever since central banks around the world embarked on unprecedented expansion of their balance sheets to combat the Covid-19 pandemic-related economic headwinds, interest in Crypto currencies, along with gold, has resurged.

The issue is fascinating but at the same time daunting. The basic concept of fiat money is formidable, with nontrivial underpinnings. The notion of digital currency entails consideration of payments system, banking, monetary policy, and financial stability. Each of these topics have vast history, extensive literature, best practice, and legal and jurisdictional implications. Add on top of that layers of computer science and cryptography necessary to understand digital cryptocurrencies, it is little wonder that misperceptions abound.

In the following sections, we explain the way digital currencies work, conceptual implications, trends in their usage and proliferation, initiatives in place, and outlook.

Let's start with Cryptocurrencies (Cryptos)

*Cryptographic
methods to secure
ownership and
validate
transactions*

Cryptocurrencies exist primarily on a network of computers, or nodes. "Crypto" refers to the usage of cryptographic methods to secure ownership and validate transactions on this computer network. "Currency" implies that they constitute an electronic system of money, which can be used as a medium of exchange in digital transactions, as a unit of account and as a store of value. Cryptocurrencies' success in the currency arena will depend on whether they are as broadly accepted for payments as fiat currencies.

The above definition is not specific and may also apply for other digital currencies that are linked to gold, or the USD. We outline five definitive features for a bona fide cryptocurrency below:

First, **ownership records are maintained via a distributed, peer-to-peer digital ledger**. Peer-to-peer is a communications model in which each party has equal capabilities and either party can initiate a communication session for the sharing of resources. The dominant method is a distributed blockchain that was first introduced in Bitcoin, and it stands as a major innovation on its own without requiring a currency system. In the blockchain, ownership is linked to a digital address on the cryptocurrency network, with its own private key. All

Features of a bona fide cryptocurrency

operating nodes keep their own records of transactions stored in the blockchain. This ensures the high availability and robustness of any cryptocurrency network.

Second, there is a **consensus protocol or mechanism which determines whether a transaction is recorded in the digital ledger** by nodes in the network. There is no third party involved in verifying bilateral transactions. All transactions are broadcast in the peer-to-peer network, without need for central banks, financial intermediaries or legal enforceability. Owners digitally sign transactions with their private keys, which is verified by the network using the public key and then lodged into the blockchain based on a consensus protocol. Loss of a private key will typically imply the loss of cryptocurrencies at the address.

Third, there is an **incentive system to encourage independent nodes to register transactions honestly in the distributed ledger**. Untrusted agents are given an incentive to maintain honest records of transactions on the blockchain. This is done by the award of Bitcoins for successfully creating a block of transactions in the Bitcoin network. Other cryptocurrencies could require transaction validators to put up a stake. They will be rewarded with a transaction fee if aligned correctly with others and penalised with a loss if they put forward a dishonest transaction. Cryptocurrencies is a surprising example of an insight first espoused by Adam Smith, where individual agents' considerations of their own self-interest lead to the provision of a trusted, entirely decentralized system for transactions.

Fourth, **cryptocurrency supply is entirely determined by an algorithm**. For Bitcoin, a finite number of Bitcoins will be created per block of transactions added to the blockchain. The Bitcoin protocol specifies that the reward per block will be halved every 210,000 blocks, before eventually decreasing to zero at the limit of 21 million bitcoins in existence. Other cryptocurrencies have algorithmic mechanisms to release or create tokens over time, maintaining value by scarcity. Cryptocurrency creation is thus vastly different compared to money creation in the fiat economy, where the central bank fully controls money supply, adjusting it in response to economic needs.

Fifth, **they are highly divisible** in comparison to conventional currencies, helped by an entirely digital existence. The smallest amount within Bitcoin is a Satoshi, which equals one hundred millionth of a Bitcoin (or 10^{-8} of a BTC). In comparison, the smallest physical unit of the US dollar

is a cent (or 10^{-2} of a USD). In digital currency markets, currency quotes are typically given up to one ten thousandth of a unit (10^{-4}), which is still significantly larger than cryptocurrency divisions.

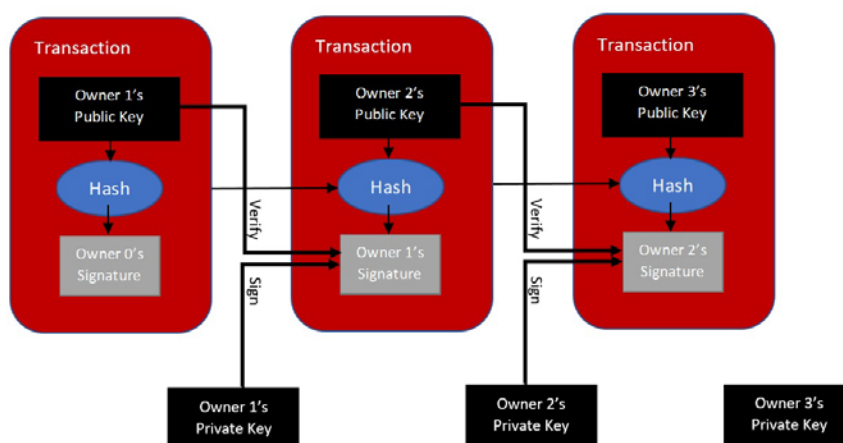
Cryptocurrencies can be used in various contexts where conventional money accounts are somewhat disadvantaged. First, given that the cryptocurrency network is borderless, it is straightforward to wire cryptocurrency payments across countries. Secondly, the cost of transactions can be minimized for overseas purchases if the vendor accepts cryptocurrencies, negating the need to convert into foreign exchange. Both factors suggest that cryptocurrencies can play a useful role in cross-border trade of goods or digital services.

Appeal of cryptos

Since cryptocurrency holdings are largely anonymous, they can also provide privacy for some who wish to keep their asset holdings known only to themselves. Lastly, cryptocurrencies provide an insurance against possible operational failures of the financial system. Admittedly, this is a tail risk, but they could pose some concerns for citizens in emerging market countries with underdeveloped surveillance and policy institutions, or where damage from natural disasters can be exceedingly large. Conversely, a cryptocurrency network is expected to function continuously come what may, if they are broadly distributed across geographies and time zones.

Operational workings of Bitcoin

The Bitcoin network, acting as a distributed server, eliminates the need for a third party to verify transactions and prevent double spending. The server timestamps all transactions, hashing them into an ongoing chain of hash-based-proof-of-work, known as a blockchain. Hashing is the use of a cryptographic hash function that maps data to bits, or hash value. The longest blockchain (among all nodes) serves as the accepted sequence of Bitcoin transactions, and it cannot be changed without redoing all the proof-of-work. A Bitcoin, on its own, is simply a chain of digital signatures recorded as a block. Each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key of the next owner, adding to the end of the coin.



Source: Nakamoto (2008), DBS

The major innovation of the Bitcoin protocol is that it allows the network of untrusted nodes to validate these transactions independently. Nodes must prove that work is done by hash inversion, which is a difficult task that results in a new block added to the blockchain when successful. Nakamoto (2008) shows that if over half of the network's processing power is controlled by honest nodes, the likelihood of attackers successfully outpacing the honest blockchain is vanishingly small as the number of blocks created increases. The longest blockchain will thus be the honest blockchain, as its length proves that it came from the largest pool of CPU power. This ensures the integrity of Bitcoin transactions lodged in the blockchain.

There is an incentive mechanism for nodes to operate honestly. Nodes will be rewarded with coins for successfully starting new blocks, which is akin to mining. It is then more profitable to lodge honest blocks rather than engage in dishonest manipulation of previous transactions, since the probability of success is low while the cost of computing resources needed is high. Nodes can also leave and join back the network at will, accepting the longest proof-of-work chain as the correct record of transactions while they are absent. The Bitcoin network's fully distributed nature with no single point of failure ensures a high degree of fault-tolerance and robustness to attacks.

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

CBDC is digital cash

Central Bank Digital Currencies (CBDCs)

CBDC is a digital currency issued by and a liability of a country's central bank. To the general public, CBDC is the digital form of physical cash. From the perspective of banks, CBDC can be used to settle interbank payments and transactions, like electronic bank reserves held at the central bank. A few key design choices are:

Token or Account-based?

An account based CBDC model maintains a record of all accounts and corresponding balances, which are each tied to holders with known identities. A token based CBDC model keeps a record of objects of value ("tokens"), each of which are controlled by holders whose identities could be known or unknown. Between the two, a token-based model offers greater anonymity, though still less than physical cash because there would still be an electronic trail. The less stringent user-identity requirements, in the case of token-based model, also make it easier to achieve wider accessibility, potentially including foreign entities (e.g. tourists, foreign banks) to own and use.

Interest bearing?

CBDC design choices

Unlike physical cash, there is the option of applying an interest rate to CBDCs. By extension, this gives the central bank the ability to influence monetary policy transmission, including reducing the lower bound on policy rates to below zero.

Accessibility – Wholesale or Retail? Extend usage to Non-residents/Foreigners?

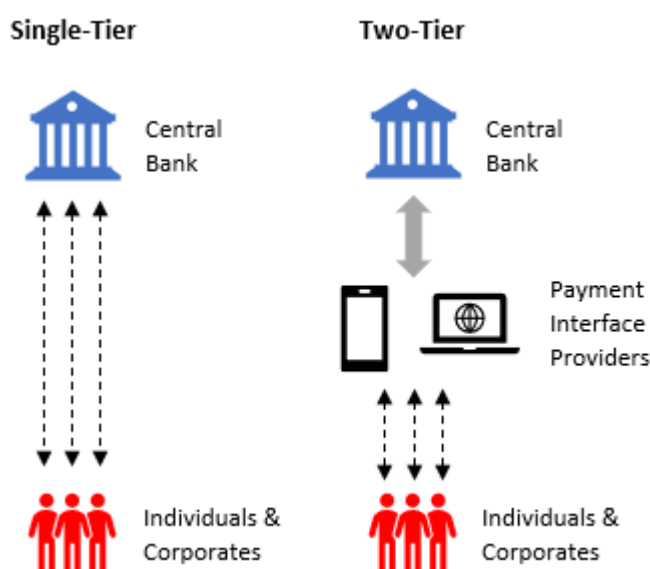
Central banks need to decide if usage of CBDCs would be limited to banks and other financial institutions ("Wholesale") or be made available to the general public, including individuals ("Retail"). Central banks also need to decide if they want to extend usage to non-residents and foreigners (e.g. tourist, foreign banks).

Single-tier or Two-tier model?

Central banks need to decide on the level of operational involvement of the private sector. In a single-tier model, the central bank would be responsible for all tasks, from start to end. In our view, a single-tier model would be challenging for many countries as central banks may

lack the capacity or expertise in customer-facing functions such as screening customers, servicing accounts and providing important complementary services such as e-commerce.

A two-tier model is likely to be more common. In a two-tier model, the central bank outsources some of the tasks to commercial banks who essentially functions as payment interface providers. It is likely that central banks would want to control the issuance and redemption of CBDCs. Distribution, payment services and managing of user accounts/wallets could then be handled by commercial banks. Compared to the single-tier model, the two-tier model entails lower risks of bank disintermediation and allows commercial banks to continue to leverage on their competitive advantages in customer-facing functions.



Centralized ledger versus decentralized ledger technologies

Centralized or decentralized?

Within each possible tier of the CBDC model (central bank to users, central bank to payment interface providers and payment interface providers to users), there is also the choice of centralized vs decentralized ledgers. In the case of a centralized ledger, the payer would connect to the central ledger keeper when initiating a payment/transfer to the recipient. The central ledger keeper would then be responsible for verification of funds availability and updating the ledger. In the case of a decentralized ledger, the ledger is replicated and shared across several trusted and selected participants within a permissioned network (we judge it unlikely that public/permission-less networks, like Bitcoin, will be commonly implemented).

Assuming a two-tier model, in the tier where central bank and selected payment interface providers sits, transactions could take place on the central bank's balance sheet (centralized ledger), with the central bank serving as ledger keeper. The tier where payment interface providers serve end-users (retail customers) could involve some extent or incorporate some elements of decentralized ledger technologies, such as cryptography (to enhance privacy and security) and programmability.

The importance difference between CBDCs and cryptocurrencies are that CBDCs will still largely be controlled by the central bank. They could be managed in a distributed ledger, but ownership determination is not through a consensus protocol, unlike cryptocurrencies. Furthermore, their issuance and value will be determined by policies, not algorithms.

Trend in digital transactions

Share of cash in global transactions keep falling

The global digital payments market is growing rapidly, largely due to the technological advancements of smartphones, and increasing acceptance of digital payment cards at retail stores. Additionally, many governments globally are moving towards a cashless economy, and digital payments are advantageous for this goal, as well as for curbing tax fraud and maintaining money trails. According to a McKinsey [report](#) in 2018, the share of the world's transactions carried out in cash has fallen to 77% from 89% during 2013-17. The share of noncash payments, on the other hand, has increased to 23% from 11%.

Worldwide digital payments transaction value will reach USD4.4tn this year, according to the market and consumer data provider Statista. Total transaction value is expected to show an annual growth rate of 17% (CAGR) in the next four years, resulting in a projected amount of USD8.3tn in 2024.

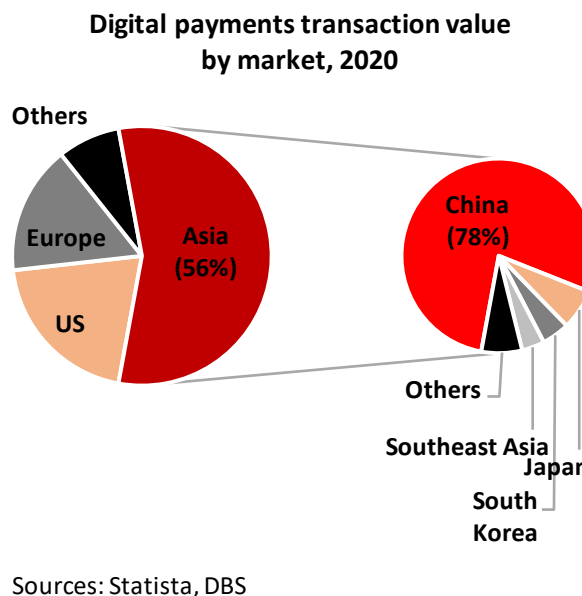
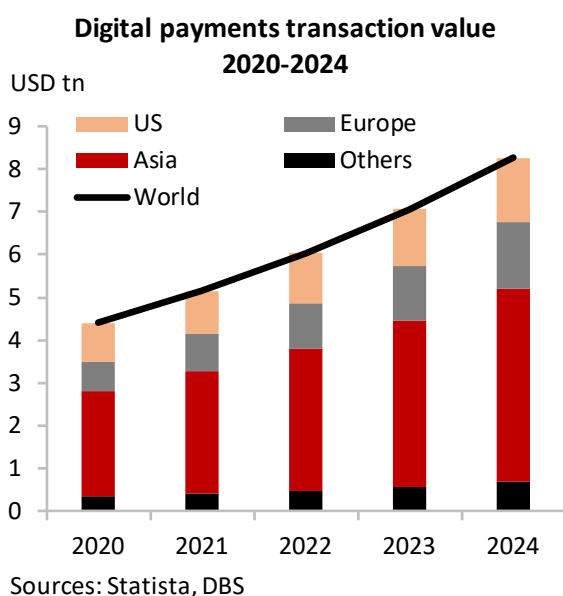
Digital commerce (consumer transactions directly related to online shopping, via credit cards, direct debit, or online payment providers like PayPal and Alipay) **is currently the largest segment, accounting for about two thirds of the total transaction value.** Mobile payments (transactions at Point-of-Sale that are processed via smartphone applications like Apple Pay and Samsung Pay) are expected to grow at a faster pace than digital commerce in the next four years, with the former's share rising possibly to about half of total transactions by 2024.

Asia is the world's largest digital payments market

Asia is the largest digital payments market today, with China alone comprising almost half of the worldwide transaction value. Asia is expected to remain as the world's most important digital payments market; Statista projects digital payments to grow by 16% (CAGR) through the first half of this decade.

Digital payments transaction value in Singapore will rise from USD15bn in 2020 to USD21bn in 2024 (9% CAGR), according to Statista. The number of users will rise to 1.3mn in the mobile payments segment and 3.9mn in the digital commerce segment by 2024. The Monetary Authority of Singapore (MAS) encourages the use of digital payments, especially in the post-pandemic world, and is working with the Association of Banks in Singapore (ABS) to promote greater adoption of e-payments with both businesses and the general public.

In Hong Kong, digital payments transaction value is projected to rise from USD16bn in 2020 to USD25bn in 2024 (11% CAGR). The number of mobile payments and digital commerce users are expected to reach 2.0mn and 6.3mn, respectively, by 2024. Due to the increasing popularity of digital payments, Hong Kong Monetary Authority (HKMA) has initiated an e-cheque service to provide a more convenient way for customers to bank online. Additionally, HKMA has instated the Faster Payment System (FPS), through which customers can make transfers, online payments and top up e-wallets.



Crypto trading volume has surged

Crypto trends

Momentum in the crypto market is picking up as new protocols emerge, and global regulatory bodies begin to develop their own infrastructure. **Bitcoin still dominates the market by far, worth over six times as much as Ethereum, the next largest cryptocurrency.** As of mid-June this year, the market capitalization of Bitcoin was about USD170bn. The total number of Bitcoin circulating on the network was around 18mn BTC. Meanwhile, note that the trading volume of Bitcoin has surged since 2017, rising from an average of USD18mn per day in 2013-16 to USD507mn in 2017-19 (vetted exchanges).

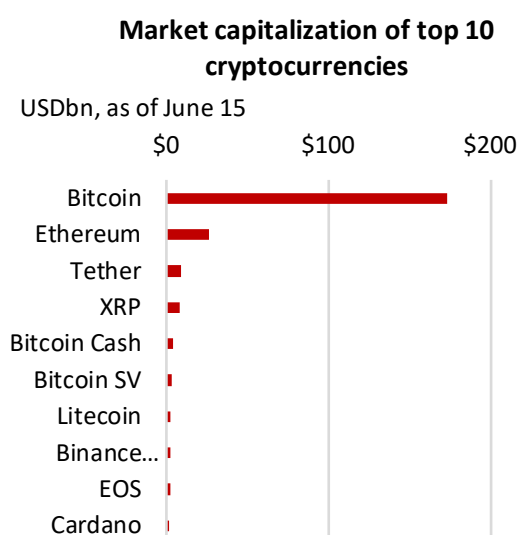
Asia plays an essential role in cryptocurrency markets today. China is the world's leader in Bitcoin mining, accounting for some 70% of Bitcoin computer power globally. **Singapore is a global hub for Initial Coin Offering (ICO).** Since 2017, it has ranked in the world's top three ICO issuance markets (together with the US and Switzerland). Hong Kong also hosts many cryptocurrency exchange and trading platforms, some of which are the largest in the world.

To safeguard against money laundering and terrorism financing as well as strengthen investor protection, the Parliament of Singapore passed [the Payment Services Act](#) in 2019, bringing cryptocurrency dealing or exchange services under the supervision of the MAS. This provides a stable regulatory licensing and operating framework for cryptocurrency entities. In Hong Kong, the Securities and Futures Commission (SFC) unveiled rules in 2018, bringing cryptocurrency funds managers and distributors under its regulatory net.

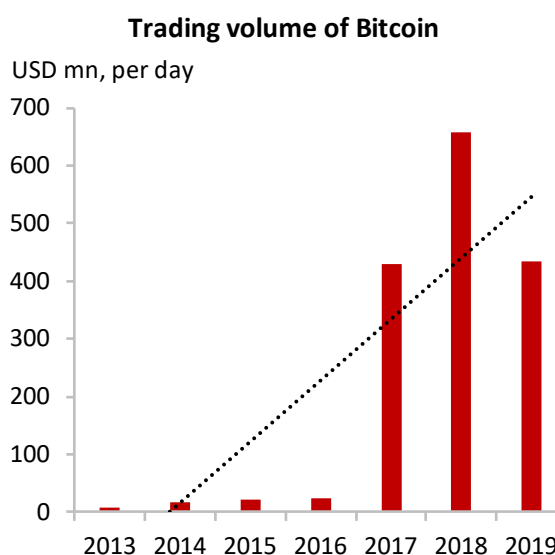
CBDC development trends

Majority of central banks studying CBDCs; some are piloting already

Central banks around the world have been preparing for the possible issuance of digital currencies. A 2019 [survey](#) conducted by the Bank of International Settlement (BIS) of 66 central banks, 80% responded that they are engaging in some sort of work on a Central Bank Digital Currency (CBDC). About 40% said that they have progressed from research to experiments, and 10% have developed pilot projects.



Sources: CoinMarketCap, DBS



Sources: Bloomberg, DBS

Recent CBDC-related developments

July 2020	The Bank of Japan announced that it will begin experimenting with a CBDC, to check its feasibility from a technical perspective.
June 2020	The Bank of Thailand announced the project to develop the prototype of the payment system for businesses using CBDC, which will build upon knowledge from Project Inthanon.
April 2020	The People's Bank of China started the internal tests of a CBDC, named the digital currency electronic payment (DCEP), in four cities — Suzhou, Shenzhen, Xiong'an and Chengdu.
	The Bank of Korea launched a 22-month pilot programme to assess the issuance of a CBDC.
Feb 2020	Sweden's Riksbank began to test its CBDC (e-krona).
	The Federal Reserve said that it was conducting research and experimentation related to distributed ledger technologies and their potential use for digital currencies, including the potential for a CBDC.
Jan 2020	The central banks of the U.K., the eurozone, Japan, Canada, Sweden and Switzerland agreed to take part in joint research on a CBDC.
	The Hong Kong Monetary Authority and the Bank of Thailand announced the outcomes of Project Inthanon-LionRock, a joint CBDC research project to study the application of CBDC in cross-border payments.
Nov 2019	Monetary Authority of Singapore's Project Ubin, a project to explore the use of Blockchain and distributed ledgers, entered Phase 5 of experimentation.

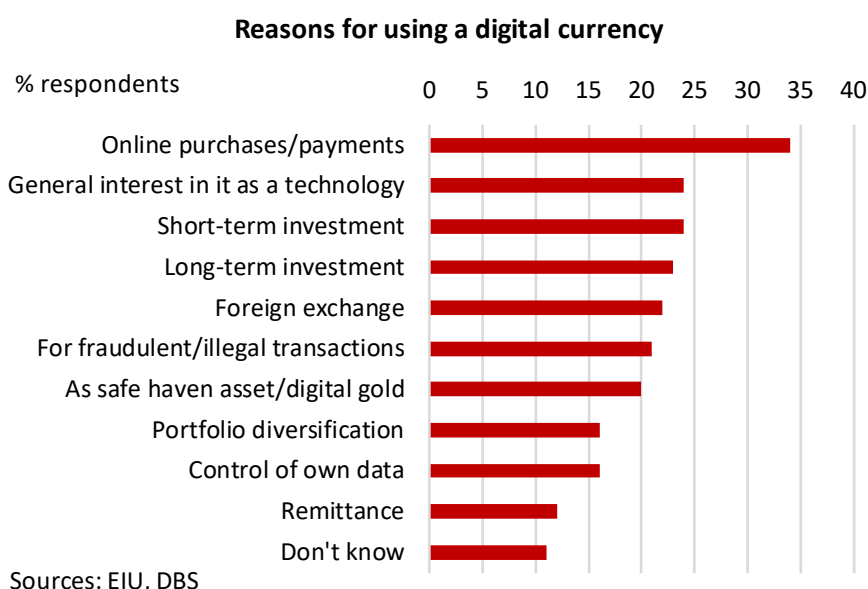
Sources: central banks' websites, coindesk.com, DBS

From cash to less cash to cashless

Usage of digital currencies

Usage of digital currencies has increased as societies move toward cashless transactions. In a 2020 [survey](#) of digital payments users by the Economist Intelligence Unit, over 10% said that they believed their countries were cashless, and 28% said they were extremely likely to use digital payments instead of cash for most or all of their daily transactions, and another third said they were very likely to do so.

The survey found that **there is more resistance to going cashless in developed economies, while developing economies are more optimistic that cashless systems will take hold faster**. Furthermore, younger people (aged 18-38) are more in favour of a cashless society than their older counterparts (aged 39 and over). Most survey respondents reported that online payments was a main reason for using digital currencies. Other significant reasons include interest in digital currencies as a technology, short-term investment, long-term investment, and foreign exchange.



Usage of cryptocurrencies

The usage of private cryptocurrencies is not yet significant. In a 2018 [survey](#) by the BIS, no central banks reported significant use of cryptocurrencies for payments, with 58% of domestic and 40% of cross-border payments not using cryptocurrencies, and 28% of domestic and 32% of cross-border payments being concentrated in niche groups.

Cryptos and acceptance

Most central banks also anticipate that **usage of cryptocurrencies will remain minimal due to low retail acceptance, bans, compliance issues, and public understanding of the risks involved**. Cryptocurrencies can increase the risk of financial crimes such as money laundering and tax evasion, which has prompted governments around the globe to impose regulations. Additionally, cryptocurrencies are not currently widely accepted by retailers or easy to purchase via conventional channels. Cryptocurrencies have been marked by considerable volatility, making them risky to hold. The market price of Bitcoin, for instance, fluctuated between USD200 and nearly USD20,000 during 2014-2019. The dramatic price changes have so far made it difficult for Bitcoin to function as a stable store of value or a means of exchange.

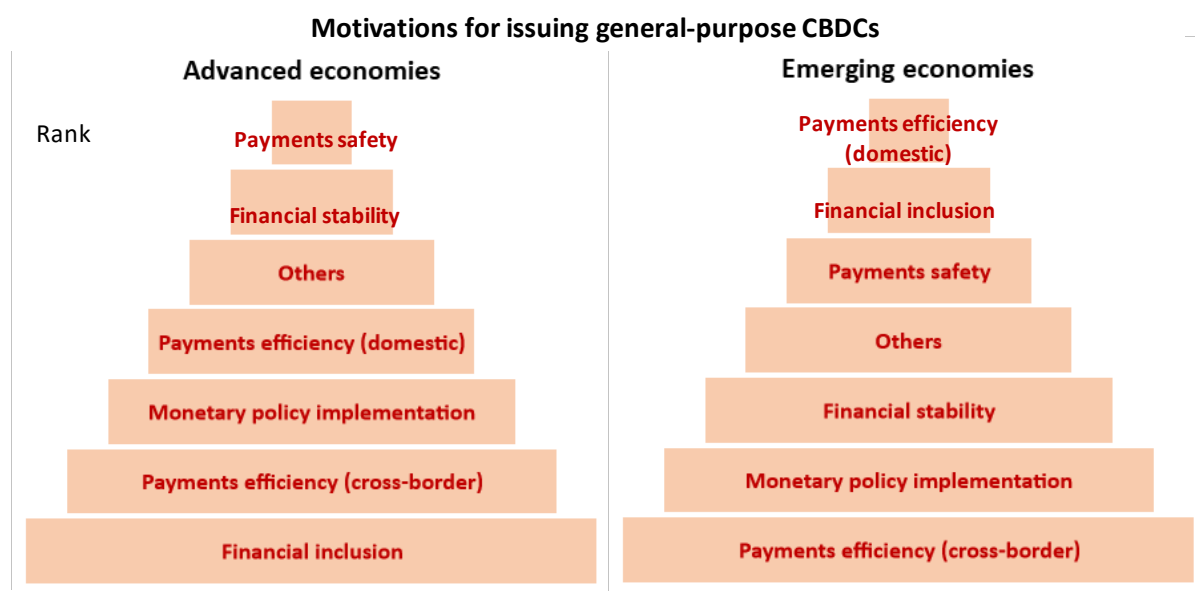
CBDC pilots

The potential benefits of CBDCs for end users would include increased safety and efficiency. CBDCs would also offer benefits for central banks. There are arguments that CBDCs may strengthen the pass-through of policy rate to money and lending markets. They could also alleviate the zero-bound constraint. Another argument is that in countries where a sizable portion of the population does not participate in the formal financial system, CBDCs could improve financial inclusion.

According to a 2019 BIS survey, payments safety and domestic payments efficiency are the most important motivations for central banks to issue CBDCs. When breaking down motivations by economic development, for general CBDCs, emerging economies are largely motivated by not only domestic payments efficiency but also financial inclusion. Advanced economies, on the other hand, are motivated by payments safety and financial stability, while financial inclusion is the least important factor.

CBDC pilots in Sweden and Uruguay

Sweden and Uruguay are notable for their progress on general purpose CBDCs. In Sweden, the Riksbank is working on issuing an e-Krona, a form of electronic payment that would be an alternative to cash. This is largely in response to the declining usage of cash in Sweden, and the state's need to have a role in the payment market. Additionally, retailers in Sweden may respond to the increasingly prohibitive cost of accepting cash by refusing to accept it in the future, and thus groups who do not use electronic payments besides cards, such as the elderly, will need an alternative method of payment so as not to be excluded.



Sources: BIS, DBS

In Uruguay, the central bank has just completed a pilot programme on a general purpose CBDC, which aims to improve financial inclusion. These goals resulted in the Central Bank of Uruguay issuing and circulating the e-Peso as part of the pilot programme as a complement to physical cash.

Cryptocurrency exchanges

Cryptocurrency was envisioned as a peer-to-peer form of electronic cash; however, it is cumbersome and inefficient to trade in a true peer-to-peer setting. Cryptocurrency exchanges are thus essential trading venues that centralise liquidity and ease the hassle of trading.

Asia home to major crypto exchanges

Measured by traffic, liquidity and trading volume, **half of the world's top ten crypto spot exchanges are headquartered in Asia**. These include the Singapore-based Huobi Global and the Hong Kong-based Bitfinex. With regard to the top ten crypto derivatives exchanges, three are headquartered in Singapore, including Huobi, Bybit and Phemex. The largest crypto exchanges are sizeable enterprises. For example, Coinbase, the largest US-domiciled bitcoin spot exchange, offers buy/sell trading functionality in more than 30 countries, yields annual revenue of USD1bn, and employs a thousand people. **Some of the traditional exchanges have also started to offer crypto derivatives**. The Chicago Board Options Exchange (CBOE) and Chicago Mercantile Exchange (CME) launched regulated bitcoin futures in 2017. This has enabled institutional investors to take positions betting for or hedging against its price movement.

Top cryptocurrency exchanges in the world

Rank	Spot exchanges		Derivatives exchanges	
	Name	Headquarter	Name	Headquarter
1	Binance	Malta	Huobi Global	Singapore
2	Coinbase	US	Binance	Malta
3	Huobi Global	Singapore	BitMEX	Seychelles
4	Kraken	US	OKEx	Malta
5	Bithumb	South Korea	Bybit	Singapore
6	Bitfinex	Hong Kong	Phemex	Singapore
7	bitFlyer	Japan	FTX	Antigua and Barbuda
8	Bitbank	Japan	ZBG	Hong Kong
9	Bittrex	US	Deribit	Panama
10	Bitstamp	Luxembourg	BTSE	British Virgin Islands

Sources: CoinMarketCap, CryptoMarketsWiki, DBS

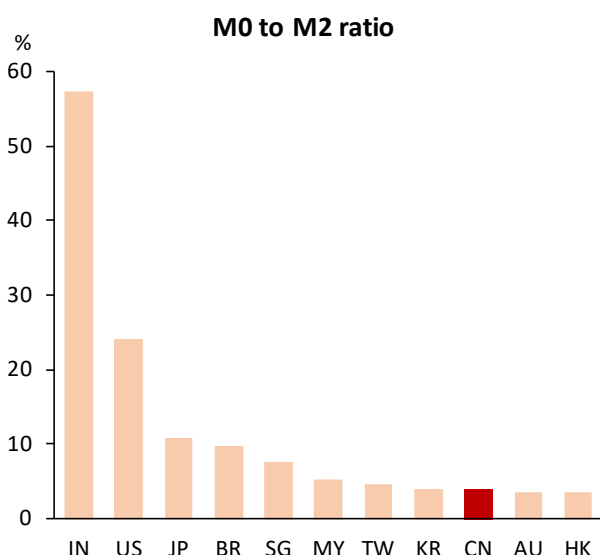
Custodians and market makers

The custodian market for cryptocurrencies has vastly expanded in recent years, enabling a larger number of institutional investors to confidently enter the market. Currently, the world's leading crypto custody services providers include the US-based BitGo, Coinbase, Gemini, itBit, Kingdom Trust, the Hong Kong-based Xapo, among others. The financial services giant Fidelity Investments has also set up Fidelity Digital Assets in 2018 to provide crypto custody services.

A large number of well-established, institutional and algorithmic market makers has entered the crypto market since 2018, which helps to bring order and efficiency to the market. These include the US-based Jane Street, Susquehanna International Group and JUMP Trading, as well as the Netherlands-based FlowTraders.

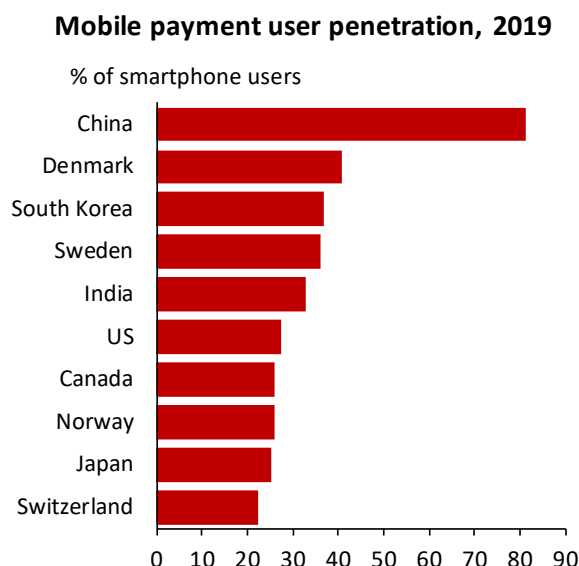
China: Digitizing the Redback

The PBOC has become the first major central bank to launch CBDC. Motivations abound, including the declining use of printed money. China's ratio of M0 to M2 is among the lowest in the world.



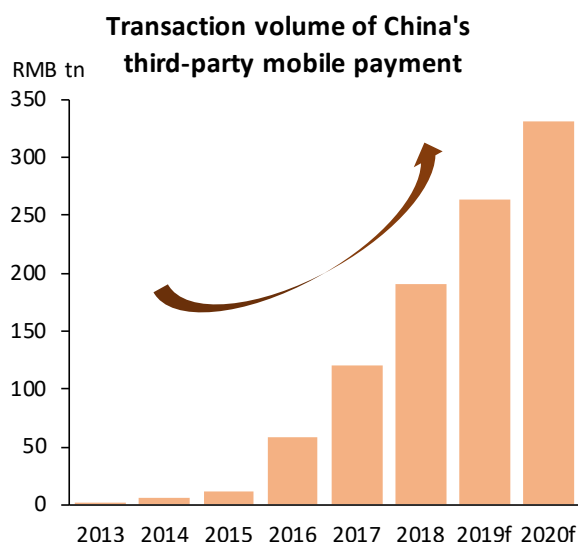
Source: tradingeconomics.com, DBS

China stays ahead of other nations in mobile payment, with 81.4% of smartphone users having accessed payment apps in 2019.



Source: eMarketer, DBS

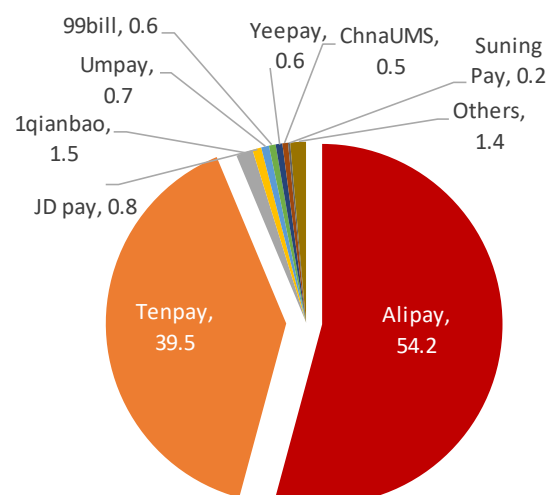
Use of mobile payment services has skyrocketed over the past five years, with total transactions reaching RMB190.5tn in 2018 (~80% of all payments). COVID-19 highlights the need for contactless payment as physical interaction becomes less desirable.



Source: iResearch, DBS

Amid intense competition in China's mobile payment market, Alipay handles more than half of mobile transactions, followed by Tencent's Tenpay (including WeChat Pay).

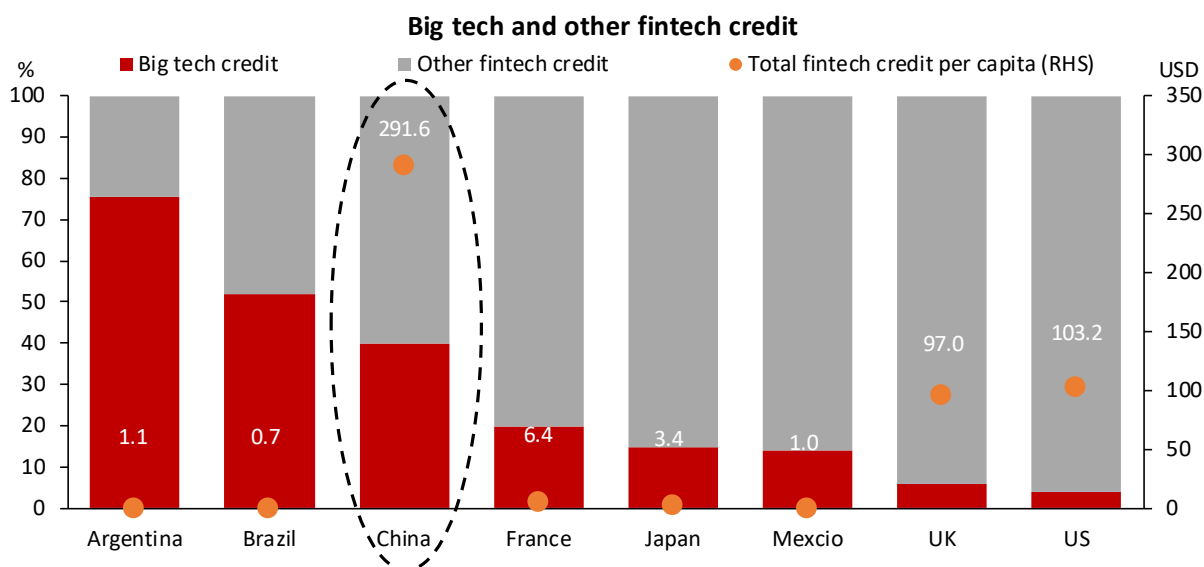
Third-party mobile payment market share (%)



Source: iResearch, DBS

China: Digitizing the Redback (continued)

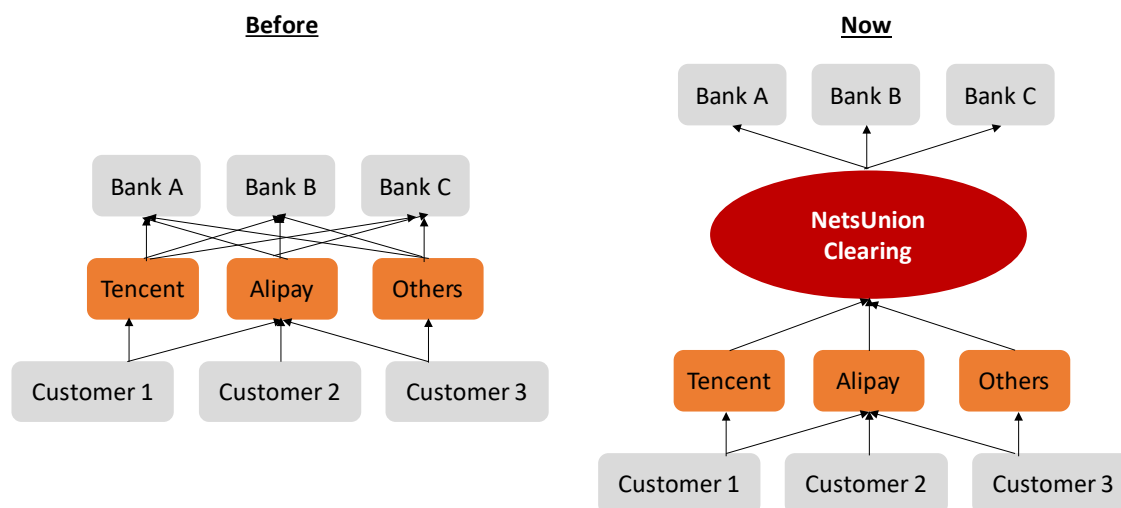
China has one of the highest fintech credit per capita in the world.



Several measures have been taken to address potential financial risks. Since mid-2018, for instance, big tech firms have had to channel payments through an authorized clearing house.

CBDC generate transaction data and circulation information that may promote the development of the credit industry, reducing bad debt and risks facing financial institutions, providing an excellent reference for monetary policy formulation.

The central clearing system in China



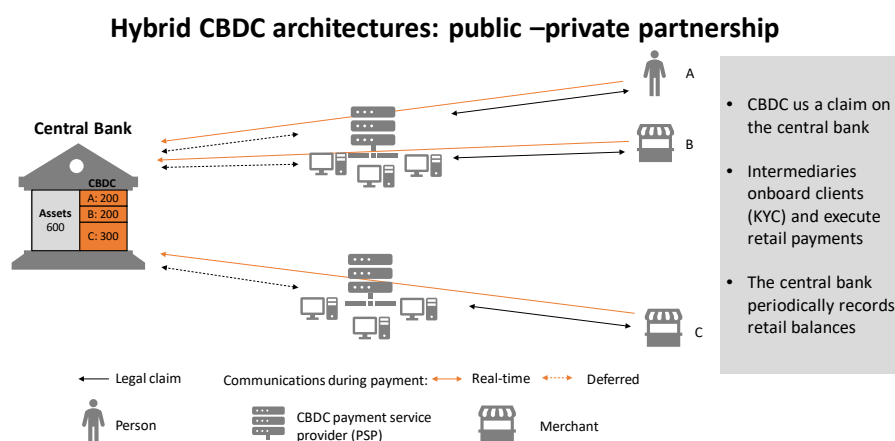
Sources: BIS, DBS

Monetary authorities are at once worried and intrigued by digital currencies

Central banks and multilaterals on digital currencies

In a series of research papers, the **Bank for International Settlements** (BIS) has been exploring the potential of wholesale and retail digital currencies. **Wholesale CBDC** could enable automatic and near instant delivery of a traded security (simplify post-trade clearing and settlement cycle). This can also mitigate risk of fraud and cyber-attacks, as well as improve record-keeping. **Retail CBDCs** could be more far-reaching. In contrast to cash, retail CBDCs could be interest-bearing, influencing monetary policy transmission, by reducing the effective lower bound on nominal policy rates.

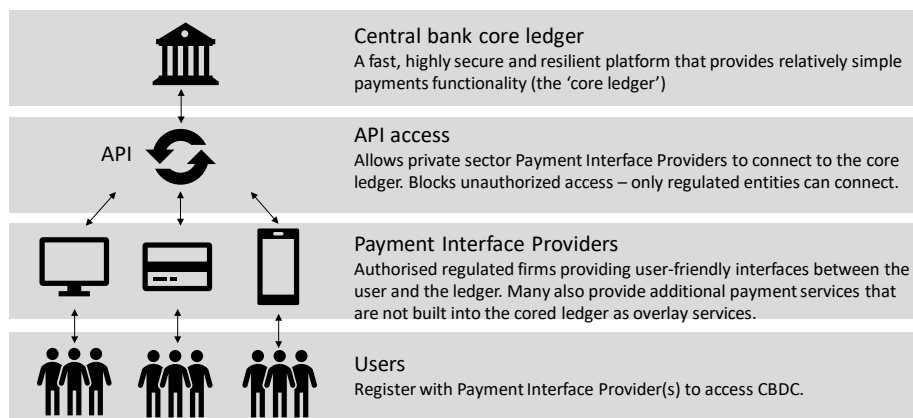
BIS cautions that since retail CBDC could potentially offer safe, reliable and universally accessible settlement instrument just as cash, this could pose significant risk to the banking system due to disintermediation – undermining the role of commercial and retail banks. As such, this could accelerate bank runs at times of stress.



Source: "Central banks and payments in the digital era", BIS Annual Economic Report 2020, Bank of International Settlement

The **Bank of England** has been exploring CBDC for several years. In a recent paper, its staff presented a model, in which a CBDC would serve as a platform with a core ledger provided by the BoE and private sector "payment interface providers" who would handle the interaction with CBDC end-users and provide additional functionality and innovation. The CBDC system will be designed to be compliant with anti-money laundering and data protection regulations, as well privacy and data protection considerations.

Platform model of CBDC



Source: "Central Bank Digital Currency Opportunities, challenges and design", Bank of England

The European Central Bank (ECB) has yet to experience electronic transactions crowding out cash, with 76% of all transactions in the region still settled in cash (over 50% of value). The demand for cash in the euro area currently outstrips the rate of nominal GDP growth. ECB has set up a CBDC taskforce in conjunction with national central banks within the euro system. ECB's recent reports reflect concern about the trade-off between the efficiency of retail payments, and the risk of putting into question the monetary order.

Does the ECB have the legal mandate to issues CBDCs? Since European treaties do not provide expressly for the ECB to issue CBDC, it would need to be integrated in existing treaty provisions.

FedNow could be a game changer in US digital payments

The **US Federal Reserve** has shown no urgency in coming up with a CBDC framework, but its senior officials have recognized the transformative impact of digital wallets, e-transfers, and the imperative to carry out quick and contact-less payments and transfers during the ongoing Covid-19 pandemic. The recently announced FedNow service facilitates end-to-end instant payment services for consumers and businesses. Together with its Real Time Payment (RTP) system, the Federal Reserve is well placed to consolidate its position in the US payment system, supplementing various private sector payment initiatives. The Fed is providing strong fraud detection, constant liquidity, and interoperability with private sector payment platforms, which will help standardize the system of digital payments nationwide.

Fed leadership has shown no haste to develop retail CBDCs so far, with concerns about disintermediating the private banking system. In fact, there is no clarity if the existing provisions of the Federal Reserve Act on

currency issuance apply to a CBDC and whether a CBDC would have legal tender status in the US. For the time being, the view seems to be that even during times of stress, there are plenty of mechanisms available to adequately address credit needs for the economy. Meanwhile, work on improving payment, settlement, and reporting by digital means continues apace. Research continues on the implications of digital currencies on the payments ecosystem, monetary policy, financial stability, banking and finance, and consumer protection.

PBOC is the first major central bank to launch a CBDC

The **People's Bank of China (PBOC)** is the first major central bank to launch a CBDC. In May, a trial was kicked off in four cities: Shenzhen, Suzhou, Chengdu and Xiong'an. In Suzhou, e-RMB are being used for paying salaries to some public servants, while in others, the trial focused on food and retail level payments. The CBDC is issued solely by the PBOC and is legal tender, by definition.

There is a two-tier system for issuance and redemptions. On the first layer, the PBOC issues and redeems CBDC via commercial banks. On the second layer, commercial banks are responsible for re-distributing the digital money to retail market participants.

The two-tier model helps avert disintermediation in the financial sector. Under a one-tier model, PBOC would issue the CBDC directly to the public. CBDC's higher degree of credibility means commercial banks could be crowded out from the retail market, raising the banks' reliance on interbank borrowing. The resulting increase in cost of funding might lead to disintermediation and thus dampen economic activities. By adopting the two-tier system on its digital currency, the PBOC would achieve its goal of replacing paper money without affecting banks' lending capacities.

Instead of a "fractional-reserve" system used in the traditional banking system, the Chinese CBDC requires banks to maintain a 100% reserve ratio. As a result, the CBDC would not have any derivative deposit or money multipliers. Hence, the digital currency is unlikely to have any material impact on the conduct of monetary policy. Longer term, the CBDC might lead to a greater presence of central bank in the financial system, leading to greater contribution of the PBOC in its role of allocating resources in the economy.

The PBOC's CBDC model is different from the "decentralizing" model underpinning many crypto assets, according to PBOC deputy governor Fan Yifei. Firstly, the digital money would be liabilities in the central bank's book, meaning that the creditor-debtor relationship would not change. Which means PBOC must assume a central position in the operation process. Secondly, the central bank must be able to track, monitor and supervise CBDC operation to avoid oversupply by the authorized operating agencies.

It is also different from the centralised model that is associated with traditional electronic payment systems. In the latter case, a transfer of funds necessarily involves moving money between two accounts, between which a strict account-to-account correspondence must be established. By contrast, circulation of the PBOC's CBDC is based on "loosely coupled account links," so that transactional reliance on accounts are significantly reduced. This way, the new money can attain a similar function of currency to cash and be used on a controllably anonymous basis. The public can use it directly for various purchases, and it would prove conducive to the yuan's circulation. It is worth pointing out that without third-party anonymity, CBDC transactions may jeopardise personal data and privacy, but complete third-party anonymity may encourage criminal activities such as tax evasion, terrorist financing and money laundering. Striking a balance is key.

The Hong Kong Monetary Authority (HKMA) has conducted a study on CBDC (Project Lion Rock) and concluded that issuing CBDC for retail payment purposes is limited in view of the efficient payment infrastructure and services available in Hong Kong. To HKMA, a CBDC can serve as a payment instrument for potential applications in securities settlement and cross-border payments for wholesale participants – banks and institutional clients.

MAS and the 5-phase Project Ubin

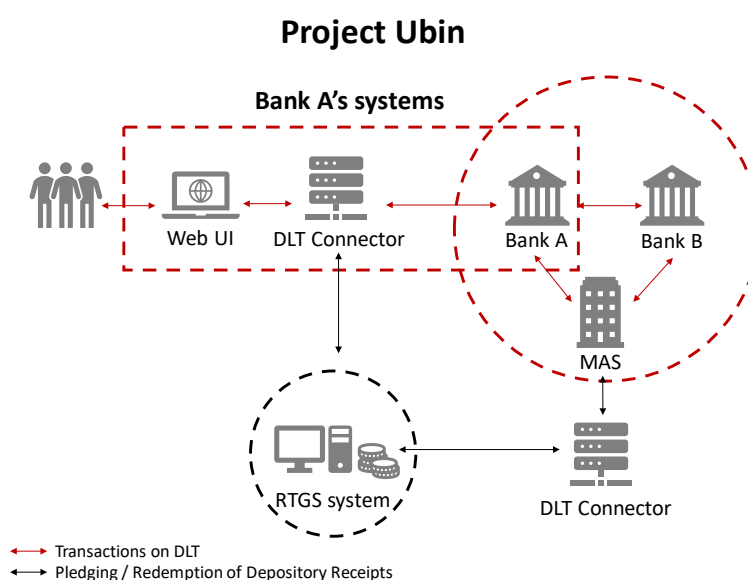
In 2016, **the Monetary Authority of Singapore (MAS)** initiated Project Ubin, a 5-phase project with the industry to explore the use of Blockchain and Distributed Ledger Technology (DLT) for clearing and settlement of payments and securities.

Phase 1

MAS introduced SGD-on-ledger to distinguish it from existing forms of digital central bank money such as the deposits that banks hold at the MAS which are used to make payments via MAS Electronic Payment

System (MEPS+), a system that enables real-time transfer of funds and Singapore Government Securities.

SGD-on-ledger has the following features – (i) no interest is involved, (ii) redeem-ability of the SGD-on-ledger for money is ensured, each token is fully backed by an equivalent amount of SGD held in custody; i.e. the overall money supply is unaffected, and (iii) SGD-on-ledger are limited use instruments and can be designed with additional features such as security to support the use case.



Source: "Project Ubin: SGD on Distributed Ledger", Monetary Authority of Singapore

Phase 2

MAS successfully developed software prototypes of three different models for decentralised inter-bank payment and settlement mechanisms - Corda workstream, Hyperledger Fabric workstream and Quorum workstream. Each prototype was developed to address the following six key criteria:

- (i) Digitalisation of Payments - CBDC with real-time gross settlement capabilities
- (ii) Decentralised Processing - Distributed and resilient infrastructure with no single point of failure
- (iii) Payment Queue Handling Uniform queueing system with prioritisation, holding and cancellation facilities

- (iv) Privacy of Transactions Only relevant parties will have visibility to transaction details,
- (v) Settlement Finality - Final and irrevocable settlement of payment instructions with deterministic finality (vi) Liquidity Optimisation Implement netting and gridlock resolution algorithms to maximise liquidity efficiency.

Phase 3

MAS collaborated with SGX to develop Delivery-versus-Payment (DvP) capabilities for settlement of tokenised assets across different blockchain platforms. This will allow financial institutions and corporate investors to carry out simultaneous exchange and final settlement of tokenised digital currencies and securities assets, improving operational efficiency and reducing settlement risks. This project seeks to explore whether smart contracts can act as a replacement for compliance requirements due to the inherently integrated rulebook. Also, with the DTL system, MAS and SGX aimed at shortening the settlement cycles from T+3 to T+1.

Phase 4

MAS, with a few other central banks, jointly conducted a report on cross-border interbank payments and settlements in 2018. The report identified some key future state capabilities. Future cross-border payment system model has to be equipped with extended availability of domestic and international payment capabilities, visibility of payment statuses, and certainty of outcome to benefit end-users and banks manage their liquidity and cash flows efficiently. Central banks have to ensure consistency of payment standards, greater transparency of regulatory differences and regulatory requirements across jurisdictions, and direct, peer-to-peer payment and settlement to reduce costs.

Additionally, technical infrastructure has to be enhanced with stability and resilience. The report suggested a cross-jurisdictional governance framework to ensure harmonized standards—both in definition and in implementation. Impact on monetary policy and legislation on CBDCs as legal tender will have to be further investigated.

Phase 5

MAS announced the successful development of a blockchain-based prototype co-developed by MAS in collaboration with J.P. Morgan and Temasek that enables payments to be carried out in different currencies on the same network in 2019. Hopefully, it will improve cost efficiencies for businesses. The payments network will provide interfaces for other blockchain networks to connect and integrate seamlessly. It will also support use cases such as DvP settlement with private exchanges, conditional payments and escrow for trade, as well as payment commitments for trade finance.

The way forward for CBDCs and Cryptos

*Point of no return,
but still many open
questions*

There is no point of no return for public and private digital currencies. Both remain brave new frontiers, with new use cases, technological developments, and challenges appearing regularly. Globally, the trend is toward reducing cash dependence, but the momentum varies widely across countries and within societies. Regulators are still coming to terms with the momentous changes at the private sector level, as they are keen to maintain control over cross-border payments and settlements, as well as sovereign rights over the issuance and management of money.

In the world of central bank digital currencies, both wholesale and retail, there is strong movement to use their attributes to improve the speed, reach, security, convenience, and cost of transactions and settlements between banks, nonbank financial institutions, businesses, and individuals. The ongoing pandemic-related economic crisis and the ensuing large-scale money printing have provided motivation toward holding alternative assets like private digital currencies.

Having been around for more than a decade, private digital currencies or cryptos have moved from the domain of marginal individual investors to being offered in regulated exchanges and traded by sophisticated institutional and retail investors. The appeal of cryptos have begun shifting from privacy and anonymity (something that worries regulators) toward convenience and security. The demise of cash is however nowhere in the horizon, and sovereign rights over money matters are not going away either.

The lockdown and physical distancing measures implemented worldwide have accelerated the shift toward noncash transactions, while some nervousness with largescale money printing has added to the use case of private digital currencies. As governments and central banks sharpen their capabilities, initiatives like financial inclusion and providing quick and targeted support to the population will most likely be carried out through the digital route. We see initiatives to create multi-tiered CBDCs aimed at balancing the need for digital currencies against the risk of disintermediating the banking system.

Many issues remain open. Technologies and usage have yet to converge to widely accepted standards. Should central banks work principally through intermediaries or go directly to the citizens with their digital currencies? What is better-- a conventional or distributed infrastructure, account- or token-based access? There remain serious financial stability concerns: financial and payments systems share extensive cross-border linkages, design complications of one country's CBDC could cause stress to spill over to another jurisdiction. A cyberattack on a CBDC arrangement in one jurisdiction could create domestic financial stress, which could, in turn, affect linked economies.

***Many exciting
developments and
innovations in store***

On the crypto side, will the coming years see a currency crisis in some part of the world, where the run is to cryptos, instead of conventional hard currencies as safe haven? Can cryptos overcome security and transparency concerns? Stay tuned for our quarterly updates; many exciting developments and innovations are in store, with profound implication for money, finance, and commerce.

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