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Central Bank Digital Currency

A Brief Introduction

March 2020

Research and Insights

Macro Report



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1. Executive Summary

Welcome to our first Macro Report on Central Bank Digital Currency (CBDC).

Key Takeaways

- CBDC, in simplest terms, is a digital form of fiat currency established by governments or central banks
- CBDC can have many variations and possible designs:
 - Wholesale vs Retail
 - Central Bank-managed vs Synthetic
 - Interest-bearing vs non-interest-bearing
 - Deposit limit vs no deposit limit
 - Centralized vs DLT-based
 - Programmable vs Non-programmable
 - Token-based vs Account-based
 - Privacy-preserving vs non-privacy-preserving
- CBDC may bring opportunities:
 - Supporting a resilient payments landscape
 - Fostering competition, efficiency and innovation in payments
 - Enhanced financial inclusion
 - Enhanced monetary policies
 - Meeting future payments needs in a digital economy
 - As an enabler for better cross-border payments
 - Countering new digital currencies
- But also risks:
 - Banking-sector disintermediation
 - Run risk
 - Implications for central bank balance sheets and credit allocation
 - Additional burden to the central bank
 - Cyberattack and system outage
 - Digital dollarization
- More central banks are currently (or will soon be) engaged in CBDC work

2. Introduction

Since 2018, Central Bank Digital Currency (CBDC) has become a widely discussed topic among policy makers. The crypto community also shows significant interest towards CBDC since it may have a profound impact on cryptocurrencies in general.

The purpose of this document is to explain:

- What CBDC is
- Possible designs for CBDC
- Opportunities and risks for CBDC
- Countries exploring CBDC

We will not deep dive into how CBDC is different from cryptocurrencies, nor how CBDC may affect the crypto industry in general. The purpose of this report is to merely introduce what CBDC is, and some possible design considerations for CBDC.

Interested readers may consider upgrading to [Crypto.com Private](#) so you can get access to our monthly newsletter. Our April feature article on “Digital Currencies” will discuss the relationship between CBDC and cryptocurrencies in more detail.

3. What is CBDC

This section will go into the main content for this article. We will explain what Central Bank Digital Currencies are, elaborate on some possible designs, and discuss opportunities and risks associated with CBDC.

3.1 Definitions

CBDC, in its simplest term, is a digital form of fiat currency established by the government or central bank. The Bank of England has called it a “digital banknote” instead of physical banknote.

There are two form of central bank money that exist today as indicated by liabilities in the central bank’s balance sheet. One is money in circulation, which we will call “physical banknotes,” and the other, central bank reserves held by certain commercial banks.

It is arguable that CBDC already exists, but only accessible by accredited financial institutions in the form of central bank reserves.

The only way for consumers to directly hold central bank money is via holding physical banknotes. Once CBDC is introduced, it provides an alternative to physical banknotes. In times of crisis, consumers could convert their money into CBDC, since it is safest and most liquid form of money on the top of the [money hierarchy](#).

Also, CBDC could potentially provide a new payment infrastructure that can bring more options to consumers, as credit cards today are usually the only option for e-commerce.

3.2 Possible Designs

CBDC can have many variations and possible designs. We will introduce them one by one in this section.

Wholesale vs Retail

Wholesale CBDC works like electronic central bank reserves, which only accept deposits from financial institutions. Some marginal improvements can be made on settlement, payment and cross-border remittance by introducing wholesale CBDC.

Retail CBDC means that retail users (including households, SMEs) can hold digital money directly via the central bank. Most of the discussions on CBDC focus on retail CBDC, since wholesale CBDC is not too different from how the financial infrastructure works today.

Entities eligible to access central bank's money as of today

Currently eligible	Not currently eligible
<ul style="list-style-type: none">• Credit Institutions (Banks, Credit Unions)• Systemic Financial Market Infrastructures (FMIs)• Payment Service Providers (PSPs)	<ul style="list-style-type: none">• Non-bank financial institutions (Pensions, Insurers, Traders)• Non-financial corporations (MNCs, SMEs)• Households

Central Bank-managed vs Synthetic

Central bank-managed CBDC would require the central bank to manage all issues related to the CBDC, including building frontend wallets, interfacing with customers, maintaining the technology, monitoring transactions, etc.

Synthetic CBDC (sCBDC) means that the central bank only offers essential features (the core ledger), and further services such as digital wallet, lending and borrowing, customer services, etc. are out-sourced to and managed by the private sector.

Interest-bearing vs non-interest bearing

Interest-bearing CBDCs means that the CBDC will provide interest.

Non-interest bearing CBDC means that the CBDC will not provide interest.

Deposit limit vs No deposit limit

Deposit limit CBDCs would put a cap on CBDC holdings (mainly for retail CBDC).

No deposit limit CBDCs would not put a constraint on the maximum holdings for CBDC.

Centralized vs DLT-based

Centralized CBDCs are stored and processed in a centralized database. In contrast to the opinions of many crypto enthusiasts, there is no inherent reason that CBDC cannot be built using more conventional centralized technology.

DLT-based CBDCs are stored and processed in a [distributed ledger technology](#) (DLT) enabled system. It would most likely take the form of a [permissioned blockchain](#) governed by central bank(s) and accredited financial institutions.

Programmable vs Non-programmable

Programmable CBDC would offer [smart contract](#) functionalities. While smart contract can spur innovation, it also brings additional security risks. As a side note, smart contracts can be different from the kind used in Ethereum, and need not be [Turing-complete](#) nor DLT-based.

Non-Programmable CBDC means that the CBDC doesn't offer [smart contract](#) functionalities.

Token-based vs Account-based

Token-based CBDCs are constructed with the architecture that is similar to that of Bitcoin's [UTXO](#) architecture. Arguably, this architecture can afford users greater anonymity than account-based CBDC.

Account-based CBDC would be constructed with architecture similar to that of Ethereum's. It exists as a claim on the central bank by an entity (be it individuals in retail CBDC, or accredited financial institutions in wholesale CBDC).

Privacy-preserving vs Non-privacy-preserving

Privacy-preserving CBDC means that, if third parties are involved in transaction processing or validations, they will not be able to see all transaction details, mostly likely via advanced cryptographic techniques like zero-knowledge proofs.

Non-privacy-preserving CBDCs, on the other hand, allow third parties involved in transaction processing to see all transaction details.

Privacy for CBDCs will likely exist as a spectrum. Fully non-private CBDCs are unlikely because of customer protections as well as regulations like General Data Protection Regulation (GDPR), while full anonymity is similarly unfeasible due to anti-money-laundering (AML) obligations.

We now classify the above possible designs in the matrix below:

Operation	Economics
<ul style="list-style-type: none">• Wholesale vs Retail• Central bank-managed vs Synthetic	<ul style="list-style-type: none">• Interest-Bearing vs non-interest-Bearing• Deposit limit vs no deposit limit
Technology	Privacy
<ul style="list-style-type: none">• Centralized vs DLT-based• Programmable vs non-programmable	<ul style="list-style-type: none">• Token-based vs account-based• Privacy-preserving vs non-privacy-preserving

To summarize, there are many possible designs for CBDCs, and each requires the policy makers to carefully evaluate their costs and benefits. There are even more design elements that we haven't yet discussed, like transaction throughput, settlement finality, storage and custody, lending activities, etc.

However, we will not discuss in detail CBDC implementation in this article, as we believe the information provided thus far will give our readers a good first impression on how a CBDC could look like.

In the meantime, let's continue to the next section – opportunities and risks associated with CBDC.

4. Opportunities and Risks

It is clear that there are many benefits to CBDCs, but why have central banks been slow in implementing them? In this section, we will discuss the opportunities and risks associated with the launch of a CBDC.

Most of the content below is from IMF's deputy managing director Tao Zhang's keynote address on CBDC [here](#) and The Bank of England's CBDC discussion paper [here](#).

Here is an overview:

Opportunities	Risks
<ul style="list-style-type: none">• Supporting a resilient payments landscape• Fostering competition, efficiency and innovation in payments• Enhanced financial inclusion• Enhanced monetary policies• Meeting future payments needs in a digital economy• As an enabler for better cross-border payments• Countering new digital currencies	<ul style="list-style-type: none">• Banking-sector disintermediation• Run risk• Implications for central bank balance sheets and credit allocation• Additional burden to the central bank• Cyberattack and system outage• Digital dollarization

4.1 Opportunities

Supporting a resilient payments landscape

Currently, cards and cash are typically the only two options for point-of-sale transactions, with cards usually being the only option for e-commerce. By providing a new way to make payments via CBDC, it could diversify the range of payment options, improving the overall payment system availability and resilience as a whole.

Fostering competition, efficiency and innovation in payments

While card payments appear near instantaneous to the user, the merchant can wait up to three days to receive funds. CBDC can provide an alternative to encourage more competition to enhance the speed and efficiency of the payment industry.

Enhanced financial inclusion

CBDC may provide a digital means of payment without requiring individuals to hold a bank account. In a world where cash becomes less widely used, there is no guarantee that the current private sector provision of the retail payment systems can meet the needs of all users, leaving underbanked portions of society particularly at risk.

Enhanced monetary policies

By promoting financial inclusion, CBDC can also enhance the transmission of monetary policy. For example, the US Congress has recently proposed the use of “[digital dollar](#)” as a way to distribute stimulus to all eligible US citizens. However, the proposal was later withdrawn for unknown reasons.

Meeting future payments needs in a digital economy

The future economy will be increasingly digitalized. CBDC should be designed to meet future needs, including the support of “programmable money” through smart contracts and enabling microtransactions. This may create new services and business models such as automatic routing of tax payments to tax authorities at point of sales, or electricity meters paying suppliers directly based on power usage.

As an enabler for better cross-border payments

Current cross-border payments are expensive, slow and opaque. Individual domestic CBDCs could be designed around a common set of standards intended to support interoperability. This might enable ‘atomic’ transactions between CBDC systems which is impossible with the infrastructure in place today.

Countering new digital currencies

New digital currencies, including cryptocurrencies, stablecoins (e.g. USDT, or Facebook’s proposed Libra) can be widely adopted if they provide functionality and efficiency benefits over existing payment systems. CBDC can be designed to better meet those needs in order to reduce the demand for new privately issued money-like instruments. This in turn will allow governments to better monitor and regulate markets.

4.2 Risks

Banking-sector disintermediation

Individuals could transfer money from commercial banks to CBDC holdings. In turn, banks might feel pressed to raise deposit rates or access more expensive and volatile wholesale funding, which could weigh on profitability and possibly leading to more expensive or lower provision of credit to the real economy. Banking-sector disintermediation could also interrupt the [money creation process](#), which may reduce [money supply](#) and hurt the economy.

Run risk

In times of crisis, bank customers could withdraw bank deposits to instead hold CBDC, which might be seen as safer and more liquid. By making the top [money hierarchy](#) accessible to households, there is a bigger risk for a bank run as compared to today, where bank deposits are effectively the safest and most liquid option, since holding and transferring large amounts of cash is costly and risky.

Implications for central bank balance sheets and credit allocation

In case demand for CBDC is high, the central bank's balance sheet could grow considerably. In addition, the central bank may need to provide liquidity to banks that experience large-scale outflows. As a result, central banks would take on credit risk and have to decide how to allocate funds across banks, opening the door to political interference.

Additional burden to the central bank

Offering CBDC could be very costly for central banks, and could pose risks to their reputations. Offering full-fledged CBDC requires central banks to build frontend wallets, interface with customers, maintaining the technology, monitoring transactions, etc. Failure to satisfy any of these functions could undermine the central bank's reputation and the functioning of the economy as a whole.

Cyberattack and system outage

As CBDC will be a critical piece of infrastructure, the system needs to be extremely resilient towards potential attacks and system outages. Successful cyberattacks on a CBDC may have a nationwide or global impact, affecting global financial stability.

Digital dollarization

If a mature CBDC system is established, cross-border payment and foreign currency exchanges will become increasingly convenient. Of particular importance is the fact that if large global platforms (e.g. Facebook, Amazon) begin accepting CBDC, using foreign CBDC as a store of value and medium of exchange could become more convenient than the domestic currency in some smaller economies.

Digital dollarization will have a severe impact on international financial stability and is one core reason why Facebook's Libra has faced significant opposition from policy makers globally.

We have added further content in the subsequent section to allow the readers to better understand what "dollarization" is.

4.3 Dollarization

Dollarization is the use of a foreign currency in parallel to, or in lieu of, the domestic currency. It is also called “currency substitution.”

Although its name seems to imply that the US dollar is involved, this is not necessarily the case. Currencies that have been used as substitutes include the US dollar, the euro, and the Australian dollar.

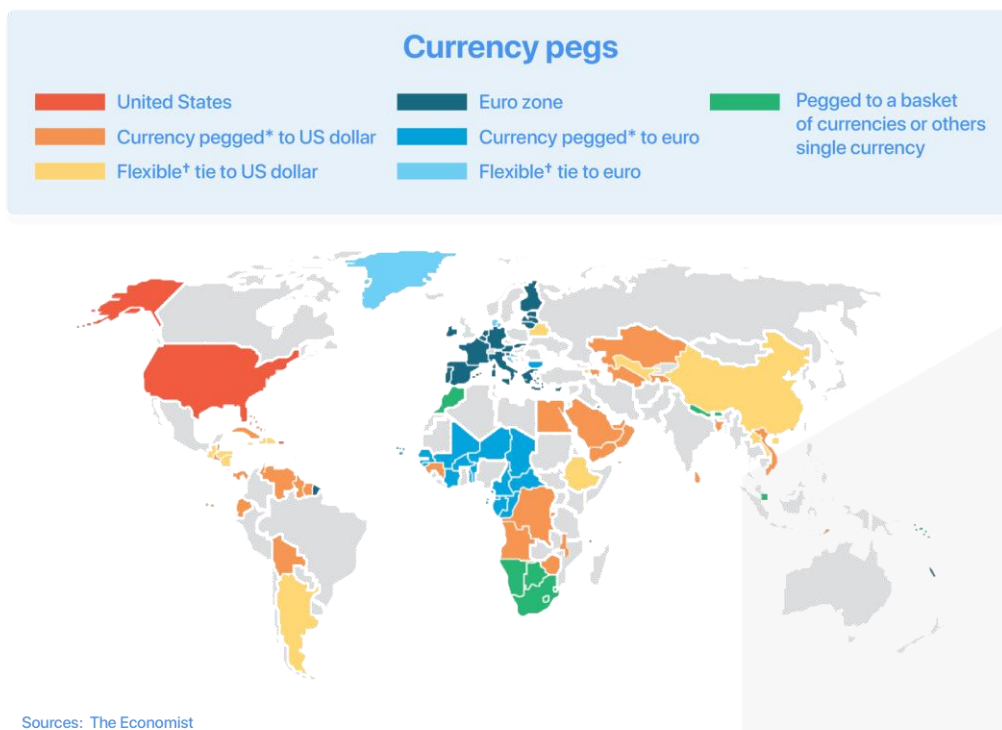
Dollarization can occur in three forms:

- Unofficial
 - When residents choose to use foreign currency even when it is not legal tender. They hold or use foreign currency because of convenience, or because the local currency has (or is expected to have) high levels of inflation and cannot be relied upon as a store of wealth
- Official
 - When a country adopts a foreign currency as its sole legal tender, and ceases to issue domestic currency
- Semi-official
 - When the foreign currency is legal tender alongside the domestic currency

Dollarization may occur for any combination of geographical, historical, political, or economic reasons. Panama adopted the US dollar as legal tender after independence. Cambodia is partially dollarized due to the convenience of using US dollar as medium of exchange for foreigners. Venezuela is largely dollarized due to a longstanding economic crisis and hyperinflation resulting in a loss of trust towards its domestic currency.

As we have introduced in the “[History of Money](#)” university article, the gold standard was abandoned after World War I. The Bretton Woods system was introduced after World War II to allow other countries to peg their currencies to the US dollar, which was in turn backed by gold. In 1971, however, the Bretton Woods system was terminated as the US government ceased US dollar-gold conversions, thus giving rise to the modern-day fiat currency system.

In the same article, we also discussed the concept of the *impossible trinity*, wherein having a hard peg requires a country to give up either free capital movement or its power to exercise independent monetary policies. Since complete control over capital flows is difficult, having a hard peg means that the country needs to give up its power to exercise independent monetary policies, which is highly undesirable from the government's perspective.

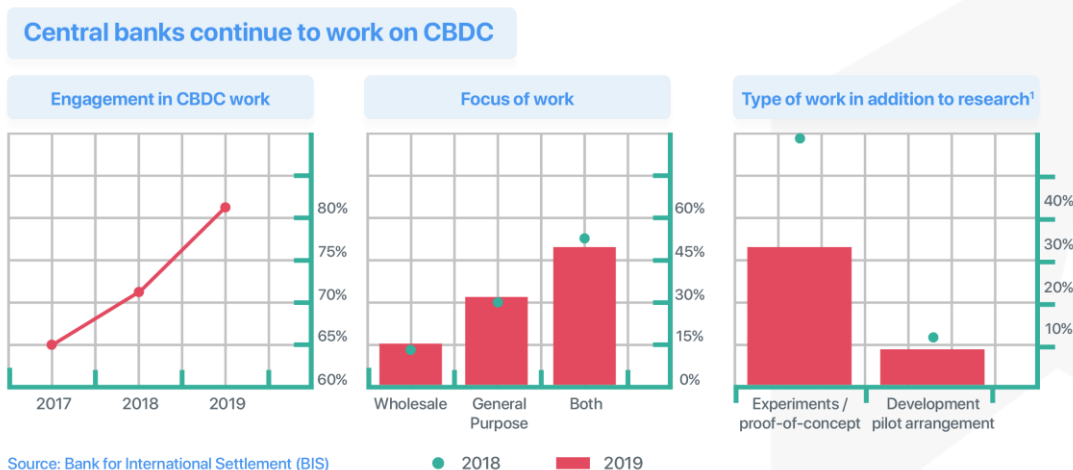


The US dollar pegs make USD a very good substitute for domestic currency in smaller economies. In the late 1990s, banking and currency crisis has triggered dollarization in some Southeast Asia and Latin America countries, resulting in serious policy and economic issues for these countries.

5. Countries exploring CBDC

The Bank for International Settlement (BIS) has conducted 2 surveys to central banks globally, one in [2018](#) and one in [2019](#). In 2018, few thought it likely that they would issue a CBDC in the short or medium term. One year on, a significant minority of central banks in countries representing a fifth of the world's population look likely to issue a CBDC very soon.

More central banks are currently (or will soon be) engaged in CBDC work. Some 80% of central banks (up from 70%) are engaging in some sort of work, with half looking at both wholesale and general purpose CBDCs. Some 40% of central banks have progressed from conceptual research to experiments, or proofs-of-concept. A further 10% have developed pilot projects.



Central banks currently not looking at CBDCs are typically either from smaller jurisdictions, or report that they face more pressing priorities, or both. Nonetheless, many central banks continue to rely on research conducted by international organizations (in particular the BIS and the IMF) or regional networks.

Here are some countries that have announced CBDC projects:

Country	Type	Date	Status	Details	Source
China	Wholesale / Retail	Sep 2019	Launch expected in 2020	Completed basic functions and drafting laws that will help its implementation	Ref
Sweden	Wholesale / Retail	Mar 2020	Pilot underway	Launched “E-Krona” pilot to study feasibility	Ref
South Korea	Wholesale / Retail	Apr 2020	Pilot announced	Announced pilot program till Dec 2021	Ref
United Kingdom	Wholesale / Retail	Mar 2020	Exploratory	Issued CBDC discussion paper in full detail	Ref
United States	Wholesale / Retail	Mar 2020	Exploratory	House Democrats suggested the creation of a ‘digital dollar’ for distributing the stimulus package, but the proposal was later withdrawn	Ref
Hong Kong, Thailand	Wholesale	Jan 2020	Pilot completed	Completed Project LionRock-Inthanon for cross-border remittance	Ref
France	Wholesale	Mar 2020	Pilot announced	Launched experimental program on ‘Digital Euro’	Ref
Canada, Singapore	Wholesale	May 2019	Exploratory	Issued a design paper named “Enabling Cross-Border High Value Transfer Using Distributed Ledger Technologies”	Ref
ECB, Japan	Wholesale	Jun 2019	Exploratory	Issued a research paper named “Synchronised cross-border payments”	Ref

6. Summary

We will conclude our CBDC report here. A recap on key takeaways:

Key Takeaways

- CBDC, in simplest terms, is a digital form of fiat currency established by governments or central banks
- CBDC can have many variations and possible designs:
 - Wholesale vs Retail
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 - Digital dollarization
- More central banks are currently (or will soon be) engaged in CBDC work

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