Deloitte.

Future of Money, Banking and Payments 2022

Central Bank Digital Currencies: New Strategic Perspectives for Central Banks, Financial Services Providers and Regulators

April 2022

MAKING AN IMPACT THAT MATTERS since 1845

Contents

Introduction

In our previous Deloitte study, 'Future of money: The revolution of stablecoins and the opportunities of Central Bank Digital Currencies in the era of the Coronavirus crisis', published in 2020[1], we have provided a general overview of the development of cryptocurrencies, stablecoins and Central Bank Digital Currencies (CBDCs), and their impacts on the redefinition of the monetary ecosystem.

Two years later, we can observe that digital assets have launched a real revolution and are bringing important changes to the current payment and banking services. As a matter of fact, more than 80 central banks have launched CBDC research and / or experimentation projects around the world. Some countries, such as China, lead the world movement by launching their own CBDC pilot. As a result, traditional banking actors and tech firms are starting to take a serious interest in these assets and want to embrace this movement in order to avoid being left behind, but first, they want to understand it. We therefore present here a knowledge base of elements to reflect on before entering this arena.

This study aims to give a global overview of opportunities offered by CBDCs and strategies for adapting to them, according to 4 points of views: central authorities, financial services providers, regulators and citizens. We first present how central authorities are defining a CBDC strategy and how they can valuate it as an asset. Then, we analyse the direct impacts of these new digital currencies on stakeholders such as commercial banks, in their business strategy, and regulators and end-users, in terms of data use and environmental footprint. Finally, we explore directions that can be followed by financial actors to protect their own interests and to stay competitive in the long-term.

References
1 - Link: https://www2.deloitte.com/fr/fr/pages/services-financier/articles/future-of-money.html

1. Monetary policy options central banks currently explore for digital currencies

Before launching any CBDC project, central banks define which strategy they want to set up

Almost half of the central banks in the world have started CBDC projects. However, due to the current limited academic research on the topic, central banks have done their own assessments on the pros and cons of this new form of money.

1.1. Demystifying CBDC as a new central bank currency and payment instrument

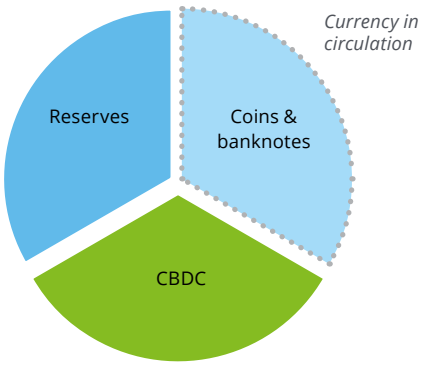
As defined by policymakers, a CBDC corresponds to a new form of money issued by central banks, and more specifically, a new form of digitalised money. It can also be called a 'govcoin' (for government coin), a term coined by *The Economist*.

CBDC's integration to the monetary base

The creation of a CBDC implies the creation of a new element in the monetary base, which is composed of:

- **Coins and banknotes**, or cash, that constitute central money lent to commercial banks at a certain policy rate. With this money, banks can offer credit to households and enterprises against interest rates.
- **Reserves**, held by commercial banks to the central bank. This aims to guarantee a reserve of funds for these banks in case of a systemic crisis, like the 2008 financial crisis.

When considering a CBDC, central banks assess the addition of this new form of money to the rest of the monetary base and the impact it may have on their issuance.



According to the principle of fungibility, a balance must be maintained in the monetary base between cash, reserves and CBDC, which must be issued and circulated at parity. Furthermore, the central bank must guarantee an equality in its balance sheet between this monetary base, which represents liabilities and assets, including gold, foreign reserves and securities.

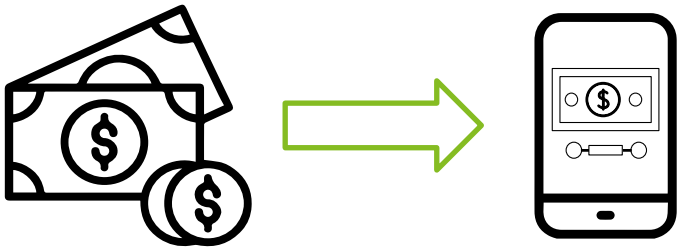
Simplified balance sheet of a central bank with CBDC

Assets	Liabilities (Monetary base)
Gold: 50	Coins and banknotes in circulation: 200
Foreign reserves: 150	CBDC in circulation: 200
Government securities/Treasury bonds: 200	Reserves of commercial banks: 100
Loans to commercial banks: 100	
TOTAL: 500	**TOTAL: 500**

Digital currencies already exist, but not yet fully programmable ones

One of the most often recurring leitmotivs concerning CBDC is the idea that fiat digital currencies already exist through the dematerialisation of cash, with bank cards, online transactions and payment applications. In fact, this phenomenon only corresponds to the digitisation of the accounting of payment operations, which we can translate as inflows and outflows of operations between banks, households and enterprises (that is to say, payments by credit cards, wire transfers, direct debits, or prepaid cards). However, throughout the process, the base currency remains coins and banknotes (cash), and not digital assets. Consequently, CBDC will constitute a new central bank currency that is fully digital: it will not only involve a dematerialisation of operations, but most importantly, a dematerialisation of the money itself through the creation of tokens. Indeed, the currency will be programmable through computer code and will enable instant payments.

From physical money to CBDC, a new fully digital currency



1.2. Using CBDCs to define central bank strategy in terms of monetary policy

Each central bank should clarify the objectives it wants to assign to its CBDC. We have already described these *'raisons d'être'* in our first Deloitte study 'Future of money' (see reference 1 on page 3).

As a new medium of exchange for payments, savings and investment transactions, a CBDC can serve several purposes, whether it can be for domestic or international use.

Mainly, a CBDC aims at optimising banking and financial operations, but its other goal may differ in function of targeted actors. Indeed, CBDC can be delivered to a whole population (retail model) or to only financial services providers and its intermediaries (wholesale model).

An optimisation of financial operations with a wholesale CBDC

A more efficient and decentralised transaction system

One of the main reasons for the creation of a wholesale CBDC is to optimise national and cross-border interbank transactions (payments and loans): to reduce operational costs of these operations and to increase their speed and security through a new architecture based on disruptive technologies like blockchain, a type of Distributed Ledger Technology (DLT) which enables stocking information and sharing it through a secured network. Significant wholesale CBDC projects have emerged, such as Jasper, Khokha, Aber and Ubin (for more details, see figure 5), but the most important are the nine experiments led by the Bank de France (see fig. 1 for a full presentation).
On a payment infrastructure based on blockchain, transaction flows can be computerised and managed in a decentralised way by different actors - peer-to-peer, accessible at any time (24 hours / 7 days), executed automatically through smart contracts (computer programs that control transactions) and fully secured by the technology features. This open system could replace the current massive infrastructure of payment factories that is based on a centralised management of operations. This would be the same process as with a retail CBDC, but it would be extended to all transactions made by citizens / firms.

Better transmission of monetary policy with a retail CBDC

By targeting the whole population, a retail CBDC would allow better transmission of monetary policy and would promote inclusion and economic stability, and thus would strengthen the role of the central bank. With its e-CNY project, China leads the way in retail CBDC: it has already launched a public pilot, which we suggest that you explore in fig. 2.

A quicker monetary policy application and promotion of financial inclusion

Today, central banks rely on commercial banks to provide money to the population, and this process can last several months.

The central bank lends commercial banks liquidities at a price defined by its policy rate (the main central bank interest rate), and then, commercial banks provide loans and payments means to households and firms at specific interest rates. A policy rate that is negative or close to zero will lead to low interest rates offered by commercial banks, and thus, to a massive credit policy. On the contrary, a positive policy rate will cause commercial banks' rates to increase and access to credit to decrease.

With a retail CBDC, monetary policy transmission would be simplified and faster. Indeed, the central bank could inject liquidities directly to firms and households, through central bank accounts and payments, without necessarily involving commercial banks. As a result, the policy rate would be the price of the access to central bank money for economic actors, which could be defined according to the central bank strategy (this point will be developed in the next section).

In this new system, central banks could also better encourage financial inclusion, by providing unbanked populations in some developing countries with guaranteed access to financial services. This is the main objective of the retail CBDC projects of the Sand Dollar and the DXCD (see fig. 5). However, the central bank would always need to guarantee a minimum of liquidities in its monetary base to prevent any systemic crisis.

An optimised control of transactions and the improvement of financial stability

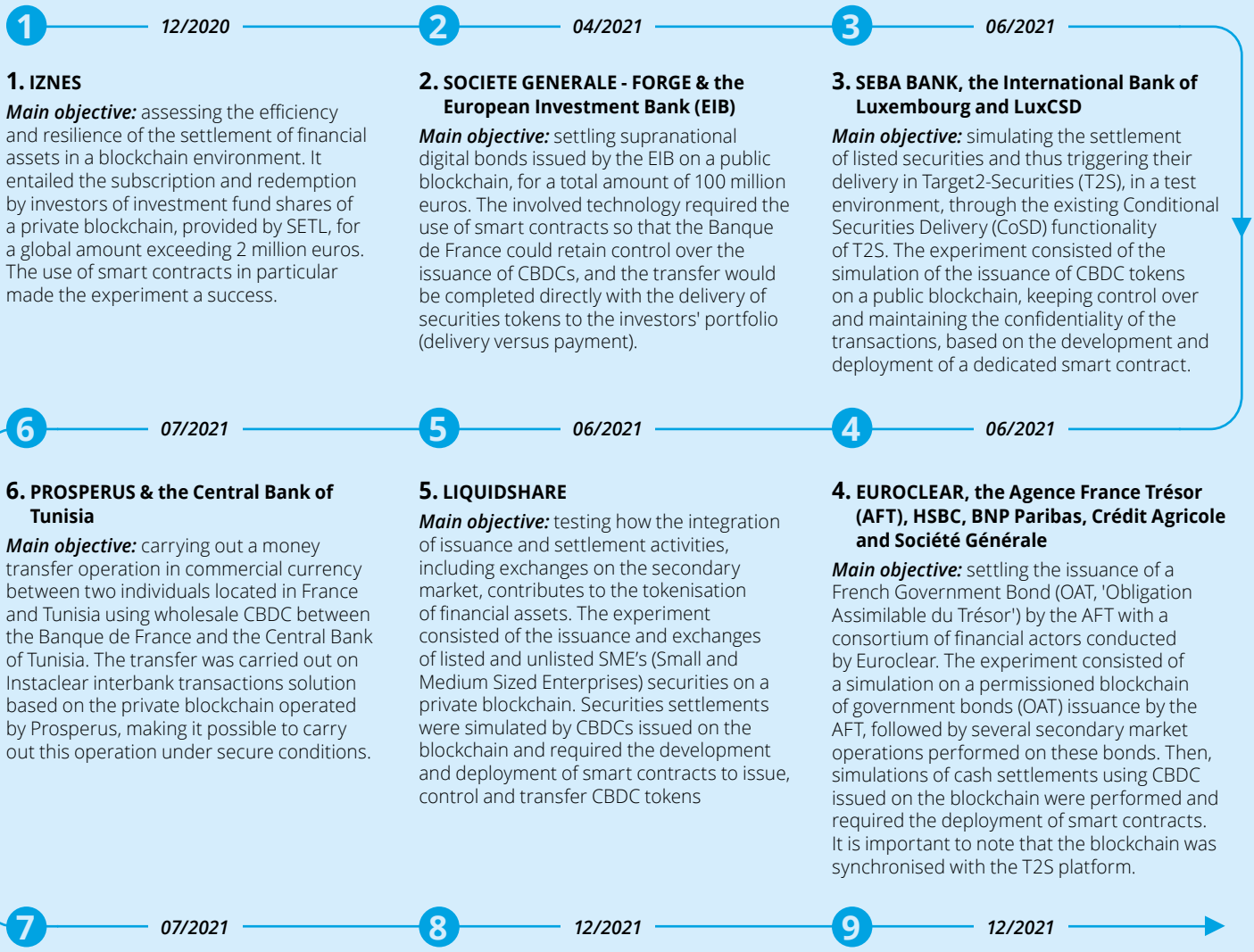
Furthermore, policymakers can use CBDCs to promote monetary and financial stability, as is the case with the e-krona project (see fig. 5). They also have the aim to become a cashless society. Blockchain technology allows to better monitor and trace currency in circulation and financial activities. It can be complemented by data science for tracking illegal activities and tax evasion, under the respect of controlled anonymity - a point that we will describe later in this study (see the second chapter).

An accelerator for the internationalisation of the currency

A CBDC can be limited to the national territory or authorised overseas. Through this international expansion, the CBDC would strengthen the use and role of the traditional currency. However, if the central bank decides to open its digital currency to other countries, whether to other central banks or to private actors, it must ensure that it can meet foreign demand with a minimum level of liquidity. Access to this international CBDC could also be used by some countries as a tool for currency substitution.

Figure 1: First lessons from the Banque de France experiments on a wholesale CBDC[2]

The Banque de France stood out for its work on CBDCs in 2017, with the world's first interbank blockchain implemented by a central bank: the Madre project. Between 2020 and 2021, it has expanded on this approach by launching a series of 9 experiments (which are presented below) with a selected group of financial stakeholders to assess the risks and opportunities of using wholesale CBDCs for clearing and settlement procedures of tokenised financial assets. Following the success of these experiments, the Banque de France wants to pursue CBDCs tests on cross-border operations in 2022.



1. IZNES

Main objective: assessing the efficiency and resilience of the settlement of financial assets in a blockchain environment. It entailed the subscription and redemption by investors of investment fund shares of a private blockchain, provided by SETL, for a global amount exceeding 2 million euros. The use of smart contracts in particular made the experiment a success.

2. SOCIETE GENERALE - FORGE & the European Investment Bank (EIB)

Main objective: settling supranational digital bonds issued by the EIB on a public blockchain, for a total amount of 100 million euros. The involved technology required the use of smart contracts so that the Banque de France could retain control over the issuance of CBDCs, and the transfer would be completed directly with the delivery of securities tokens to the investors' portfolio (delivery versus payment).

3. SEBA BANK, the International Bank of Luxembourg and LuxCSD

Main objective: simulating the settlement of listed securities and thus triggering their delivery in Target2-Securities (T2S), in a test environment, through the existing Conditional Securities Delivery (CoSD) functionality of T2S. The experiment consisted of the simulation of the issuance of CBDC tokens on a public blockchain, keeping control over and maintaining the confidentiality of the transactions, based on the development and deployment of a dedicated smart contract.

4. EUROCLEAR, the Agence France Trésor (AFT), HSBC, BNP Paribas, Crédit Agricole and Société Générale

Main objective: settling the issuance of a French Government Bond (OAT, 'Obligation Assimilable du Trésor') by the AFT with a consortium of financial actors conducted by Euroclear. The experiment consisted of a simulation on a permissioned blockchain of government bonds (OAT) issuance by the AFT, followed by several secondary market operations performed on these bonds. Then, simulations of cash settlements using CBDC issued on the blockchain were performed and required the deployment of smart contracts. It is important to note that the blockchain was synchronised with the T2S platform.

5. LIQUIDSHARE

Main objective: testing how the integration of issuance and settlement activities, including exchanges on the secondary market, contributes to the tokenisation of financial assets. The experiment consisted of the issuance and exchanges of listed and unlisted SME's (Small and Medium Sized Enterprises) securities on a private blockchain. Securities settlements were simulated by CBDCs issued on the blockchain and required the development and deployment of smart contracts to issue, control and transfer CBDC tokens

6. PROSPERUS & the Central Bank of Tunisia

Main objective: carrying out a money transfer operation in commercial currency between two individuals located in France and Tunisia using wholesale CBDC between the Banque de France and the Central Bank of Tunisia. The transfer was carried out on Instaclear interbank transactions solution based on the private blockchain operated by Prosperus, making it possible to carry out this operation under secure conditions.

7. MONETARY AUTHORITY OF SINGAPORE (MAS) & Onyx (J.P Morgan)

Main objective: building a common m-CBDC network allowing both central banks to retain control over the issuance and distribution of their CBDCs and have transparency in cross-border transactions. Cross-border and cross-currency transactions involving Singapore dollar (SGD) CBDC and euro (EUR) CBDC, using a privacy-enabled blockchain based on Quorum technology, smart contracts to allow real-time market transactions and demands. The experiment is designed to be scaled-up to integrate more central banks and improve cost-effectiveness.

8. PROJECT JURA Swiss National Bank, BIS Innovation Hub, Crédit Suisse, Natixis, R3, SIX Digital Exchange, UBS and Accenture

Main objective: investigating the effectiveness of a cross-border wholesale CBDC for international financial transactions by exploring cross-border settlements between two wholesale CBDCs (euro and Swiss franc) and a French digital financial instrument on a blockchain platform. The experiment involved the exchange of the financial instrument between French and Swiss commercial banks against a wholesale digital euro through a 'delivery versus payment' settlement mechanism; and of a wholesale digital euro against a wholesale digital Swiss Franc through a payment versus payment settlement mechanism.

9. HSBC, IBM, R3 & a group of private actors

Main objective: testing a multi-ledger based on blockchain aimed at simplifying end-to-end multi-asset transactions (CBDCs, digital bonds and foreign exchange (FX)). More specifically, the test consisted of the issuance of a digital bond and its subscription with a settlement in CBDC. All transactions were made across different blockchain platforms based on IBM's Hyperledger Fabric and R3's Corda. This system has shown successful interoperability between different platforms for the transfer of data and assets.

References

2 - Sources: Banque de France's press releases

Figure 2: Focus on the world's first major retail CBDC: the user experience of the e-CNY (digital renminbi)[3]

Since April 2020, the Chinese central bank, the People's Bank of China (PBoC), has launched a pilot of the digital yuan: a wallet application for Android and iOS. This trial program will initially target top cities such as Beijing, Shanghai and Shenzhen, and then expand to other cities through several waves of communication. The central bank has made it publicly accessible in January 2022. According to officials (as of April 2022), e-CNY is used in 23 cities and 260 million wallets have been created. The 2022 Winter Olympic Games organised in February in China have marked a turning point for the e-CNY as a new opportunity to test the currency and the potential international expansion: only e-CNY, Visa and cash were proposed as payments systems to domestic and foreign participants; and the digital renminbi has gained popularity, with an average of $315,000 in transactions per day.

1 DOWNLOAD

In just one advertising wave in 6 second-tier cities in early April 2021, 240 million CNY (31 million €) were invested in virtual red envelopes - a common way of acquiring users in China - to stimulate wallet downloads and thus e-CNY usage. Eligible users for the e-CNY trial program receive an SMS containing an **invitation code** to download the wallet from the IOS or Android app store. Often, the message is accompanied by a **virtual red envelope** of 10 to 200 CNY (1 to 28 €), which can be used via the e-CNY wallet.

Wallet home screen

2 LOGIN

Upon opening the application, one has to register with an ID and phone number and then activate the wallet by attaching it to a bank account from a list of choices. **8 banks** are present in the list, including **6 public banks** and **2 commercial banks** owned by Alibaba and Tencent.

Public banks

Commercial banks

3 TOP-UP

To use the e-CNY, the wallet must first be **topped up** either via the attached bank account or by a **transfer** from another bank account. It is of course possible to **send** the e-CNY back to a bank account if necessary.

Loading screen

4 USAGE

The e-CNY wallet application has the classic features of a payment application and is rather simple to use. There are 3 modes of use:

In-app transfer

- by swiping up or down on the main screen, QR codes are displayed to pay and receive e-CNY. The counterparty just needs to scan the code to transfer money. The transaction can even be done offline.
- It is also possible to transfer money to a dedicated wallet via the phone number given at the registration stage.

Contactless physical payment

- Users can also make contactless payments to merchants on their phone with an e-CNY payment terminal.

Online payment

- The e-CNY wallet is well integrated into consumer applications such as Jindong (e-commerce platform), DIDI (Uber counterpart) and Eleme (Deliveroo counterpart). Users can pay with e-CNY using these applications as well as through a traditional payment application.

Transfer by phone number or by QR code

Using e-CNY in the e-commerce application

Payment by pay station

References

3 - Sources: PBoC's press releases and communications on the e-CNY trial program. The screenshots were taken from the public app.

1.3. Valuating a retail CBDC

As it has been previously explained, the central bank could propose a policy rate directly to firms and households, which would represent the price of the access to the central bank's digital money. The price of a CBDC would be indexed to the value of the stable fiat currency, that is, legal tender, such as the dollar, the euro and the pound sterling[4], and so, it would represent a public stablecoin, as a non-volatile digital currency.

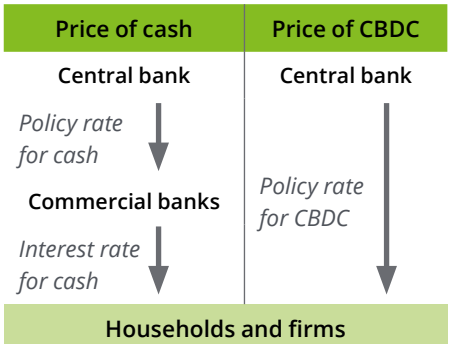
In order to define the different possible valuations of a retail CBDC, we will compare its price to the price of cash in a situation where both assets are offered to the population. It is important to note that due to a lack of current research and data, we don't take into account some external factors associated to CBDCs such as payments transactions costs, payment facility determined by the level of equipment and willingness of consumers to adopt and use the new money.

On one hand, the price of the CBDC is defined as a policy rate dedicated to the issuance of a CBDC, in a model where the central bank directly provides money to the population without the intermediation of commercial banks.

On the other hand, the price of cash corresponds to the interest rates of commercial banks, determined by a central bank's policy rate limited to cash.

For this price, we will refer to the current Eurozone accommodating policy: the policy rate proposed by the European Central Bank (ECB) for cash is 0%, and commercial banks' interest rates remain low (1.14% for the average of real estate interest rates in France in February 2022, according to the Banque de France data published in April 2022).

Price of cash versus price of a CBDC



For our analysis, both prices will be compared in the 3 following scenarios (see, in addition, fig. 3).

Scenario 1: A positive CBDC policy rate, superior to the commercial banks' interest rate

In this case, the price of the CBDC would be superior to the price of cash. As a result, the population will prefer borrowing cash rather than CBDCs.

By restricting and protecting the access to its digital currency, a central bank can choose this scenario to make CBDC an attractive safe value for investors, particularly international investors, and to make it remunerative in order to compensate for the loss of money linked to a negative policy rate for cash.

Scenario 2: A positive CBDC policy rate, inferior or equal to the commercial banks' interest rate

If the price of the CBDC is inferior or equal to the price of cash, the population would tend to prefer to borrow CBDC. Even if it is equal, it could represent the safest currency. Consequently, the issuance of CBDCs would be remunerative for the central bank. With this competitive low rate, the monetary authority would have a direct impact on the population by diversifying and increasing their access to money and their purchasing power.

As a result, this policy could create a direct competition with commercial banks on credit offering. It could have an indirect consequence on the level of reserves of the central bank: if commercial banks are less profitable, they would have more difficulty providing money deposits to the central bank. This could lead to a liquidity crisis.

Also, this scenario could lead to increasing indebtedness of vulnerable households and firms, increasing inflation by injecting too much liquidity into the economy, and finally, decreasing the national currency value against foreign currencies.

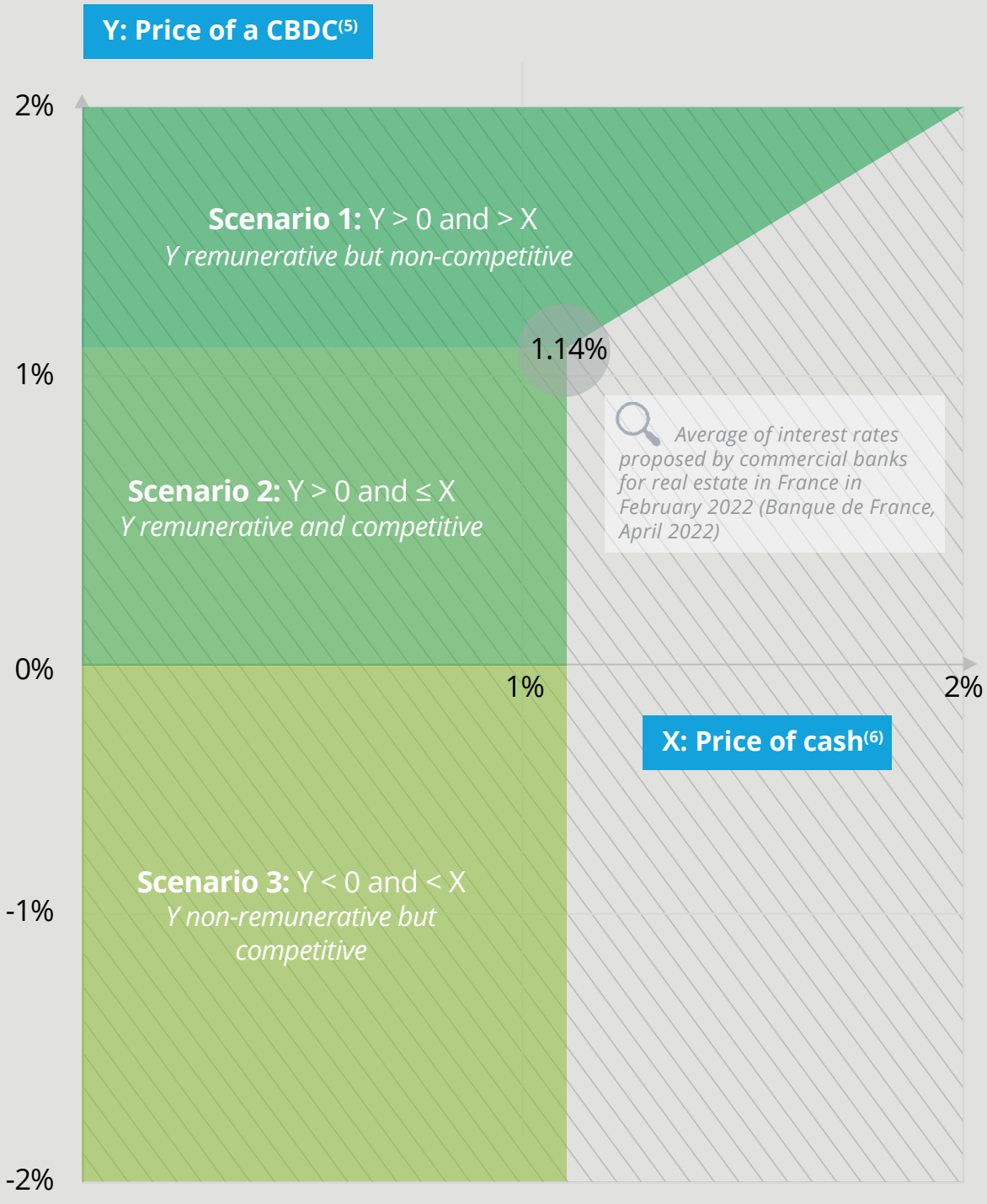
Scenario 3: A negative CBDC policy rate, inferior to the commercial banks' interest rate

The price of the CBDC would be highly inferior to the price of cash, and even more competitive against commercial banks offering. Nevertheless, being negative, this CBDC rate wouldn't be remunerative for the central bank. By doing so, the central bank could want to support specific households and firms that need funding.

References

4 - In the case of international payments, the interest rate of a CBDC could depend on the exchange rate of the fiat currency.

Figure 3: Representation of the 3 valuation scenarios of a retail CBDC
(internal analysis)



References
5 - The price of a CBDC corresponds to the policy rate a central bank can define for the access to CBDCs.
6 - The price of cash refers to the mean of interest rates proposed by commercial banks for the access to traditional money.

2. Stakeholders' perspectives: impacts of CBDCs on commercial banks, regulators and end-users

The creation of a CBDC implies new priorities for commercial banks in terms of revenue strategy and for regulators and citizens in terms of data protection and environmental impact

2.1. Identifying strategic issues and implications for commercial banks related to retail CBDCs

As previoulsy explained, the creation of CBDCs would have different impacts on commercial banks. It would significantly redefine the relationship between them and the central bank in the money supply.

Are retail CBDCs the end of the current banking system and the beginning of financial instability?

What has been said thus far makes clear that one of the main issues for commercial banks is the reassessment of their own role. Indeed, the direct CBDC model is based on a disintermediation system in which the central bank is directly linked to households and firms. The launch of a CBDC with a competitive interest rate could lead to a preference for CBDC, and consequently, to a transfer of funds in cash from commercial banks accounts to CBDCs accounts of the central bank, which could appear to be more secure and liquid. The banking sector could then be undermined, seeing its services, customers and profits diminished. Commercial banks could then respond by changing their interest rate.

The issuance of CBDCs could also be a source of financial instability. First, a very high demand for CBDCs could affect overall liquidity. A minimum reserve guarantee should be imposed to ensure a stock of liquidity for the banks. Moreover, in the event of an economic crisis, households could make massive transfers of funds from commercial banks to the central bank, leading to instability and perhaps even to a systemic crisis. The central bank could avoid this movement, for example by imposing a CBDC holding threshold. Also, the choice of an intermediated CBDC system - where commercial banks would be involved in CBDCs issuance, would not guarantee an absence of risk. It would be necessary to monitor transactions and to impose a guaranteed system to protect the currency in circulation from any fraud or other illegal activity by an intermediary.

Comparison of 3 retail CBDC architecture models: models of relationships between a central bank and commercial banks (see fig. 4, next page)

In addition to the direct paradigm, two other patterns can be identified to redefine the roles of banks in a CBDC system : the indirect model and the hybrid model. In these 3 potential systems, it's important to highlight that cash and CBDC would both be issued. The cash emission model would not change.

The direct CBDC model: repositioning the central bank as the only provider of CBDCs for citizens

As it has been considered for the e-krona, Sand Dollar and DXCD projects (see fig. 5 for more information), the central bank would issue CBDCs directly to economic actors and would directly manage all transactions with them (bank deposits and payments) and AML (Anti-Money Laundering) and KYC (Know Your Consumer) processes and associated services. As a result, in theory, commercial banks would be completely disintermediated and would be excluded from the CBDC system.

The indirect (or synthetic) CBDC model: developing the role of commercial banks as intermediaries

In this model chosen for the Jasper, Khokha and Aber projects (see fig. 5), only commercial banks would have access to CBDCs. As Payment Services Providers (PSP), they would issue their own e-money, which would be 100% backed by the CBDC. This new service could be a source of new incomes and services for commercial banks.

The hybrid CBDC model: combining a direct access for end citizens to the central bank, and a new role for commercial banks

The central bank would directly issue CBDCs to end-users and would rely on commercial banks, or other PSPs, to manage the transactions, KYC and related services. This balanced relationship model would be easier to implement and would bring the central bank and consumers closer. However, commercial banks would have to accept transferring a part of their traditional role. Some central banks oscillate between this architecture model and the previous one such as the PBoC with the e-CNY, the ECB with the digital euro and the Monetary Authority of Singapore with the Ubin project (see also fig. 5).

2.2. Defining a regulatory framework for CBDCs to become legal tender and to meet citizens' expectations of data privacy

Commercial banks are not the only actors to be impacted by the creation of CBDCs: the population, and therefore regulators, must also be considered. For central banks, the main underlying issue is to understand how a CBDC can gain enough trust from citizens to be widely accepted and used.

This new form of money also brings new concerns and expectations in terms of potential benefits for consumers. Indeed, CBDCs remain relatively abstract for them, and they want first and foremost to protect their own interests, particularly in regard to data protection. Nevertheless, the current crypto-ecosystem regulation is very embryonic and so new legal frameworks need to be defined.

The CBDC ground zero regulation and the legal tender issue, first requirement for the recognition of the currency

There is no existing national or international legal framework specific to CBDCs. So far, regulators have mainly focused on private cryptocurrencies and stablecoins, and on how to regulate the issuers and buyers/sellers. In contrast to most of the European Union's harmonised financial services, crypto services are licensed and regulated locally in each EU member state; i.e., a service licensed in one country cannot easily be passported to another country. Also, some member states require licensing and some do not.

The EU is working on a European accreditation of crypto-assets issuers and providers with the MiCa project, which is inspired by the French PACTE law. In that perspective, European Commission has launched in April 2022 a new consultation document on the digital euro[7] to gather evidence regarding the potential design of a future framework on that subject.

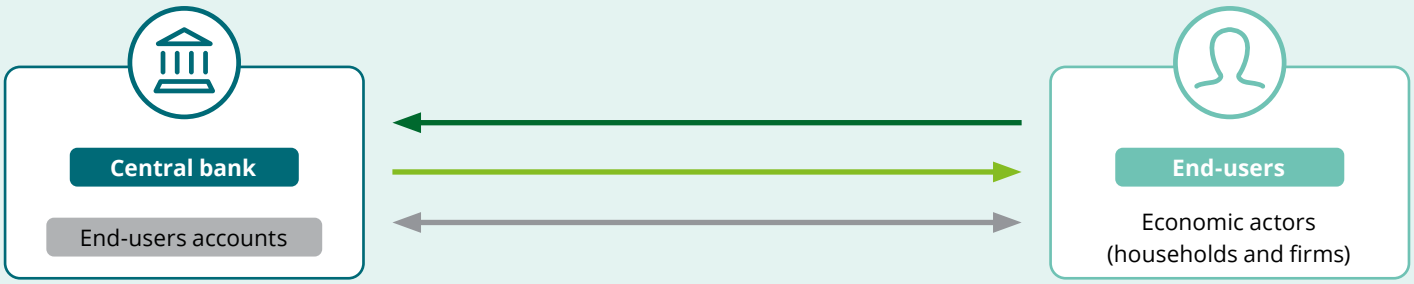
References

7 - https://ec.europa.eu/info/consultations/finance-2022-digital-euro_en

Figure 4: The main retail CBDC architecture models involving a central bank and commercial banks[8]

The direct CBDC model: the most radical

This is a single-tier system that is fully operated by the central bank. This would lead to a transfer of client-facing and back-office operations from commercial banks and fintechs to the central bank (e.g., bank account opening, day-to-day banking transactions, customer services, AML/KYC processes and innovative initiatives).

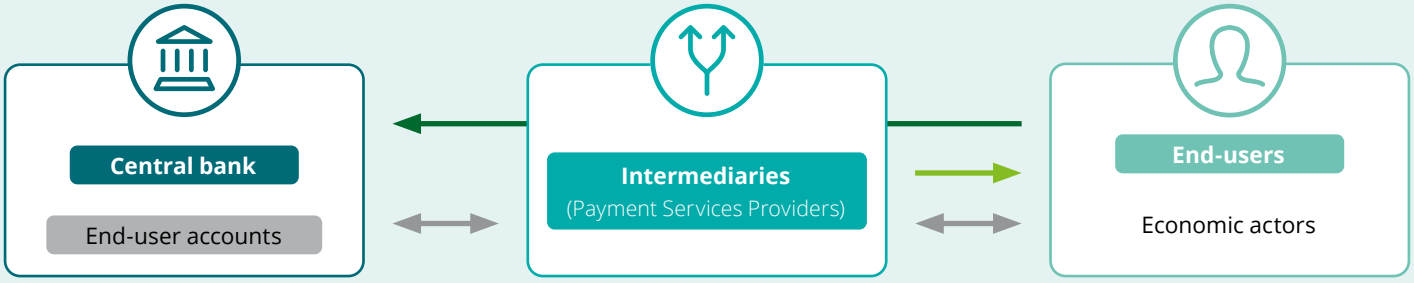


The indirect CBDC model (or synthetic model): the most conservative

This is a two-tier system in which commercial banks would receive CBDCs from the central bank and redistribute it through their own 'e-money', which would be fully backed by the value of the CBDC.

The hybrid CBDC model: the most collaborative

This is a two-tier system in which end-users claim CBDCs from the central bank and commercial banks (or other PSPs) serve as intermediaries in account openings / KYC processes and execution of payments.



Legend: CBDC claim | AML/KYC responsibilities | Payment transactions

References

8 - Sources: Bank for International Settlements (BIS) publications (2020-2021) and Deloitte analysis

- In fact, **France** was pioneer in this area by adopting in 2019 the first framework for the qualification of digital assets services providers as 'PSAN'.
- **Germany** has also taken a vanguard role in crypto regulation. Having recently introduced a transparent legal regulatory framework to enable the business of issuing, trading and storing 'custodianships' of some types of digital assets, it is able to attract major asset managers and commercial banks to offer services under German licenses. The role of a crypto custodian is clearly defined as is the requirement that individual assets be registered with a 'Crypto Securities Register'. Such registers are to be provided by a clearly defined and licensed role of a crypto securities register. German crypto regulations are one reason for the boom in crypto assets in Germany, as it gives legal certainty for investors, banks and issuers.
- Besides, the British government has announced on March 5, 2022, the introduction of measures such as the recognition of stablecoins as a valid means of payment or the establishment of a regulatory framework to fight against fraud and financial losses through the creation of a self-regulatory body[9].

Nonetheless, the crypto-regulatory works remain limited to very few countries, and the BIS and the OECD have raised awareness on the lack of global consensus on regulating cryptocurrencies. As a result, much remains to be done. In any case, one of the priority points in the definition of a CBDC legislation is the recognition of legal tender, i.e., the fact that a CBDC is accepted as an official payment tool by the central bank of a country or a monetary zone, in the same way as fiduciary money. A CBDC could obtain this status by being recognised as a dematerialised form of cash, which is quite different from how it is usually defined.

Data protection requirements and the issue of anonymisation: a dilemma between the account-based versus the token-based model

Another issue that legal framework of CBDCs may address is the personal data protection of citizens, in compliance with the regulations already in force, such as the General Data Protection Regulation (GDPR) in the EU. While privacy is paramount for the population, according to the results of the ECB's first public consultation on the digital euro published in 2021[10], the central bank may have access to all citizens' banking information in the case of retail CBDCs. However, some of them would be open to share information under certain conditions: **the 11th Deloitte France study on the relationships between banks and clients**[11] shows that 2 in 3 French people are favorable to it if they can obtain more personalised services.

Consequently, the central bank may take into consideration the choice of data to be retained and encrypted as a function of the public's acceptances: which data are essential for proper use of the CBDC, and how to articulate their use with existing data protection standards. This results in the need to define the degree of anonymity of the transactions made with the CBDC. To do this, one of the first steps for central banks to solve this issue is to choose one of the following models for the storage of CBDCs:

- **The account-based storage model:** provided by a central bank or a financial institution, it requires all users to identify themselves (e.g., with an ID) to execute a CBDC operation. As an example, the United Arab Emirates and Saudi Arabia have chosen this model for Aber, their CBDC project.
- **The token-based storage model:** based on digital tokens issued via a payment card or mobile application, it permits users to be anonymous thanks to the blockchain technology (access with private/public keys, i.e., password-like digital signatures). This pattern is the one most chosen by central banks: the e-CNY, the Sand Dollar, Khokha, DXCD and Ubin base their storage on it.

Ensuring the security of operations and countering illegal transactions (AML/CTF)

A strict application of data anonymisation would undermine the scope and effectiveness of AML/CFT standards, that aim at curbing illegal transactions. The results of the digital euro public consultation don't support full anonymity, and the economic agents require to avoid involvement with illicit activities. In this sense, the European Parliament has voted, on March 30, 2022, on the need for KYC on all digital asset transfers including from non-depository wallets[12]. This law proposal requires validation by the European Commission and the European Council. Therefore, transparency laws will have to protect consumers and a balance will have to be found among the control, visibility and anonymisation of transactions, in order to deter illegal activities, while respecting the protection of citizens' rights in terms of their personal data.

In order to prevent any risk, a compliance system must also be set up by central banks and regulators should check that standards are being respected. The respect of citizens' data rights and the fight against illegal transactions could be monitored through audits. In this regard, Deloitte has developed its own audit tool, COINIA, to audit crypto-assets. It verifies various digital information (e.g., smart contracts) stored on blockchain and includes features that connect, download and analyse these types of information.

COINIA, the Deloitte tool for auditing crypto-assets[13]

Finally, beyond the fight against illegal operations, central banks must secure transactions and anticipate cyberattacks by putting in place risk mitigation methods. With the DORA project, the EU has begun to work on an operational framework for computer resilience for the crypto-ecosystem.

References

9 - https://www.gov.uk/government/consultations/uk-regulatory-approach-to-cryptoassets-and-stablecoins-consultation-and-call-for-evidence
10 - https://www.ecb.europa.eu/paym/digital_euro/html/pubcon.en.html
11 - https://www2.deloitte.com/fr/fr/pages/services-financier/articles/relations-banque-clients-un-monde-de-possibilites.html
12 - https://www.europarl.europa.eu/news/en/press-room/20220324IPR26164/crypto-assets-new-rules-to-stop-illicit-flows-in-the-eu
13 - https://www2.deloitte.com/cn/en/pages/audit/articles/explore-audit-innovation-with-deloitte-ai-robot-vol-8.html

Figure 5: Zoom on global CBDC projects (live, in a pilot or advanced research phase)[14]

The information used for the table below was current as of April 2022 and may evolve based on the experiments and future decisions of central banks (based on architecture model and technology used). At that time, we did not have enough information regarding DTCC's Project Lithium in the US.

Status	Project / Country	Retail / Wholesale CBDC	Account / Token-based	Architecture model	Technology used & provider	Main objectives	Agenda
LAUNCHED	**Sand Dollar** Bahamas	Retail: domestic payments Wholesale: interbank settlements	Token-based	Direct CBDC	Blockchain: NZIA	• Improve financial inclusion (geographical infrastructure constraints) • Reduce illegal economic activities and strengthen AML procedures	2019 – Pilot 2020 – Launched (retail)
	DCash or DXCD (Digital Eastern Caribbean Currency Dollar) Eastern Caribbean Currency Union	Retail	Token-based	Direct / Hybrid CBDC	Blockchain: Bitt	• Modernise ECCU financial system (increase payment efficiency and resiliency) • Increase financial inclusion	2020 – Announced 2021 – Launched
	eNaira Nigeria	Retail: domestic and cross-border transfers	Account-based	Hybrid / Indirect CBDC	Blockchain: Bitt	• Increase financial inclusion	2017 – Start of research 2021 – Launched
PILOT	**E-CNY**: also called digital renminbi or yuan, and DCEP (Digital Currency Electronic Payment) China	Retail: domestic payments	Token-based	Hybrid / Indirect CBDC	CBDC not based on blockchain	• Accelerate digitalization of cash • Reduce transaction costs	2014 – Start of research 2020 – Pilot 2022 – Testing in 20+ cities
	Digital euro Eurozone (project lead by the European Central Bank)	Retail: payments within the Eurozone	To be determined	To be determined	To be determined	• Create a more competitive, innovative and resilient European payment system, emblem of the ongoing process of European integration	2021 – Start of research
RESEARCH	**E-krona** Sweden	Retail: domestic payments	To be determined	Direct CBDC	Blockchain: R3's Corda	• Deal with the decline of the use of cash • Increase efficiency of financial transactions	2017 – Start of research 2019 – Phase 1 2021 – Phase 2 2022 – Phase 3 (Pilot)
	CBDC experiments France	Wholesale: cross-border & interbank settlements, bonds	To be determined	Hybrid / Indirect CBDC	Blockchain / DLT	• Investigate risks and opportunities in using wholesale CBDCs for clearing and settlement procedures • Contribute to the global research lead by the Eurosystem on the advantages of a CBDC	2020/21 – 9 wholesale experiments
PILOT	**mCBDC / mBridge** Bank of International Settlements, Thailand, Hong Kong, United Arab Emirates, China	Wholesale: cross-border & interbank settlements	Token-based	Hybrid / Indirect CBDC	Blockchain: Besu	• Reduce cross-border transaction costs • Increase financial efficiency (speed)	2019 – Proof of concept of Inthanon-LionRock (HK & Thailand) 2021 – Trial platform developed 2022 – Pilot with 22 financial institutions
	Dunbar BIS, South Africa, Australia, Malaysia, Singapore and South Africa	Wholesale: cross-border & interbank settlements	To be determined	Hybrid CBDC	Blockchain: R3's Corda and Quorum	• Increase the resiliency of interbank payment systems	2021 – 2 prototypes for a shared platform
RESEARCH	**Jasper-Ubin** Canada, Singapore, United Kingdown	Wholesale: cross-border & interbank settlements	To be determined	Hybrid/ Indirect CBDC	Blockchain: R3's Corda	• Offer a simpler and more efficient alternative to the existing cross-border payment processes	2016 – Start of research
	Aber United Arab Emirates, Saudi Arabia	Wholesale: cross-border & interbank settlements	Account-based	Indirect CBDC	Blockchain: IBM's Hyperledger Fabric	• Improve the efficiency of international remittances • Make settlements between those 2 central banks and other selected banks	2019 – Start of research

References

14 - BIS, press releases from respective central banks

2.3. Complying with pledges of environmental protection

An increasing number of consumers expect to have products that are designed to be environmental-friendly and to have more information on their environmental impacts, as has been shown in the public consultation of the ECB (a CBDC must be environmentally friendly and to rely on 'technological solutions that minimise its ecological footprint and improve that of the current payments ecosystem'). At this stage, little information is available on the environmental performance of CBDCs, and no publicly available study provides a comparison with the cash system in an exhaustive and rigorous way that demonstrates whether it is a more environmentally friendly solution.

Energy impact of the blockchain technology

Most CBDC initiatives pursue the hypothesis that blockchain yields the infrastructure for central bank issued digital currencies. Environmental impacts of blockchains are strongly dependent on their design and on verification mechanisms.

The mechanisms that are most used in public blockchains are Proof-of-work (PoW), Proof-of-Stake (PoS) and Delegated Proof-of-Stake. One of the reasons that the EU has called for the ban of PoWs is that studies focusing on PoW mechanisms for Bitcoin show that this protocol is the one with the highest energy consumption. For the other protocols, no study seems to have quantitatively analysed their environmental impacts. But, due to a different verification system, they are not likely to be as energy intensive as the PoW.

In private blockchain networks, the verification mechanism is BFT (Byzantine Fault Tolerance). BFT is a low-energy-consumption protocol, and thus a private blockchain network is comparable in its energy consumption to a classic IT system. The choice between public and private networks is decisive for energy consumption. For the moment, there is no unanimous favour for either of these two choices, and CBDC experiments are underway on both public and private networks.

One of the key challenges, therefore, is the choice of the protocol and its related energy consumption while designing the CBDC architecture and infrastructure. Then, the efficiency of the system should be considered so as to optimise its energy consumption. Studies with a detailed and systematic approach assessing environmental impacts of CBDCs are rare and almost exclusively focused on energy consumption. However, very few mention the associated environmental impacts (e.g., contribution to climate change, mineral resource consumption or pollution).

Existing studies should therefore go further and propose a quantitative assessment of all typologies of environmental impacts of CBDCs from a full life cycle perspective to gain a systemic and holistic view of the performance of the different technologies.

The Life Cycle Assessment (LCA): a methodology standardized at ISO level for the assessment of environmental impacts

To estimate the environmental footprint of CBDCs and compare their architectures with each other as well as with cash, the LCA methodology is relevant. An LCA aims at assessing the potential environmental impacts of a product (manufactured good or service) from the extraction of the raw materials (e.g., metals in printed circuit boards of servers), to the end-of-life stage through the use phase, i.e., from cradle to grave. This 'cradle-to-grave' approach has been standardised at the international level through ISO 14040 and ISO 14044. This methodology has the following four steps: goal and scope definition, inventory analysis, impact assessment and interpretation of results. The methodology consists of carrying out an inventory of natural resources taken from the environment and emissions into the environment for each life-cycle phase of the system under study (see fig. 6 for more details). Then, based on this inventory, environmental impact indicators are quantified based on state-of-the-art scientific impact characterisation methods. LCA is thus a multi-criteria approach, as results are presented through several environmental impact indicators.

The LCA methodology brings robustness and comparability between systems and scenarios. It can be used in the context of a 'design for the environment' approach or for support to decision-making. When designing a CBDC, LCA can help identify environmental hotspots along the value chain. Then, the methodology can also be used to compare different monetary systems to understand the benefits or weaknesses of each technology. Deloitte can support any players wishing to perform LCA studies to better understand the environmental performance of their CBDC technology.

Figure 6: The 5-step lifecycle of a CBDC technology[15]

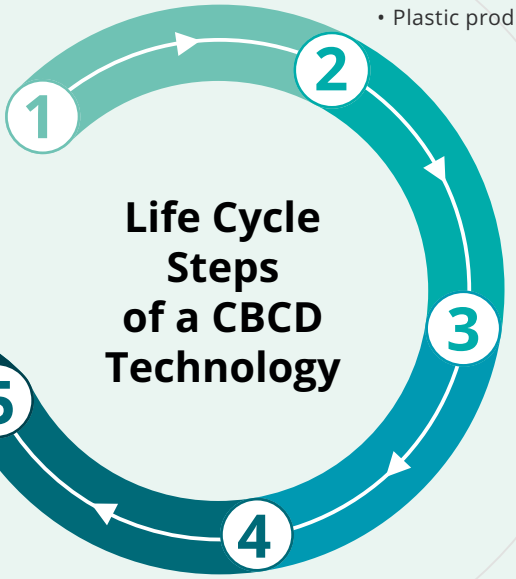
With an LCA approach, the following life-cycle stages should be considered to understand the hotspots of the technology along its life cycle. This figure illustrates the life-cycle stage perspective – a complementary view would be given by looking at the digital service following the data flow through the different IT blocks (terminals, networks and datacenters).

1. Raw materials extraction

- Metal extraction (copper, aluminium…)
- Transportation

2. Materials production

- Metal transformation
- Plastic production



3. Equipment assembly

- Assembly of datacentres equipment, storage equipment, terminals

5. End-of-life of equipment

- Electronic waste

4. Use of CBDC

- Energy consumption of IT equipment in all IT blocks of the digital service (terminals, networks, datacenters)
- Hardware maintenance

References

15 – Pictures: Deloitte, Pixabay

3. Actions commercial banks, investment banks and other financial services providers may undertake today

This last part presents potential strategies that can be followed to avoid being left behind and maintain competitiveness in a changing banking ecosystem

3.1. Getting a head-start by understanding top and bottom line effects early

Looking at current developments in the broad spectrum of digital currencies for non-central-bank players, we see a variety of activities that financial services providers - such as asset managers, brokers, exchange and clearing houses - engage in today. These actors have a major role in wholesale applications of crypto-assets and CBDCs which allow efficiency gains to be realised at on different layers of these institutions' value chains. However, these new forms of settling securities or transferring funds across borders don't always result in a positive bottom-line effect for all value chain participants. If any of them go wrong, they may lose their share in the process. Winners will be those who navigate strategic risks today and understand new roles one may take within digital networks enabling CBDCs. In the following section, we summarise actions that leaders in financial services providers should consider to stay ahead of the curve.

Identifying new opportunities

In terms of business strategy

Financial services providers should measure how CBDCs will impact their business model and their organisation (e.g., collateral management and impact on the balance sheet for investment banks) to develop a strategy in line with central banks' vision. For instance, commercial client transactions may become a major game changer within the treasury space. New processes will likely be defined and implemented. Therefore, it will be important for treasury leaders to assess and simulate impact scenarios on their current business.

In terms of the value chain

Corporate development leaders may initiate an analysis along different product lines to create transparency on anticipated effects, positive or negative, on value chain segments. Securing a lucrative role within the shifting and increasingly modularised value chain will be key to many organisations, especially to those facilitating transactions. Product and service owners should continue their path in prioritising potential CBDC applications and realising opportunities to leverage them to achieve a positive bottom-line, which may include these be cuts in transaction costs, reduced risk or new revenue creation opportunities (such as new approaches to processing payments and integration with new systems or new services).

In terms of asset management

As an example, wholesale applications of crypto-assets can be made by security settlements. One of the best known use cases in France is the pilot led by the Société Générale and the Banque de France on settling bonds on a public blockchain. To give more context, Société Générale has issued a covered bond and a structured product as 'security tokens' that was the first financial transaction settled in CBDC. The French bank and its subsidiary FORGE have realised 3 main successful experiments since 2019: the issuance in 2019 of a € 100 million covered bonds by Société Générale SFH on Ethereum and subscribed by Société Générale; the issuance in 2020 of a € 40 million covered bond by Société Générale SFH on a public blockchain, subscribed by Société Générale and paid to the issuer at the same time with a CBDC (digital euro) issued on a blockchain by the Banque de France; and the last issuance of a structured product in 2021 as a 'security token' on Tezos and subscribed to by Société Générale Assurances. Further, security tokens are eligible for a direct integration into traditional banking systems through SWIFT. The objective of the FORGE subsidiary as of 2022 is to offer to professional customers structuring, issuance, exchange and custody services for crypto- assets. These experiments prove the technical, legal, regulatory and operational feasibility of this type of new financial product. It highlights the ongoing thinking about new financial products and services that can be offered by investment banks in the near future and how these banks can distinguish themselves from competitors. This is an important step that proves that CBDCs are not just a fantasy, but a fast-approaching reality.

Anticipating hurdles

In terms of compliance, KYC and risk management

New privacy, identity and data standards will be implemented in a CBDC infrastructure with an impact on processes such as KYC and AML checks. In case of a blockchain-based CBDC, dedicated processes will have to come into effect in order to be compliant. Changes in counterparty risks and new types of transaction relationships will result in a shifting risk exposure. Leaders in risk management may map out scenarios to understand the implications for key pillars of compliance requirements.

In terms of technology

Success in enabling CBDCs and related products or services will be highly dependent on the ability to modularise current infrastructure and to create a flexible platform ecosystem connected to digital currency networks and decentralised ledgers.

It is a good time to modernise information technology systems to ensure that the CBDCs use cases they want to implement adopting will fit with their infrastructure. Leaders of financial services providers' IT departments are well underway in not only prototyping but also increasingly adopting applications and interfaces to their project portfolio to help their company to participate in CBDCs and settlement tokens. The current preferred scenarios under discussion by central banks are a basis for IT innovation teams to develop and increase the scope of sandboxes. As a prototyping pipeline, it allows them to build skills, grow partner ecosystems, assess risks and requirements early on, and stay aware of technological innovation. To ensure success in these goals, we advise banks to launch experiments and partnerships but also to promote the training and enrolment of technical resources. The continuous monitoring of systems that may be affected by the adoption of CBDCs and other crypto-assets will especially help in understanding and quantifying potential cyber security exposure, legacy interdependencies and infrastructure / cloud requirements.

3.2. Going further by considering a potential hybrid CBDC architecture as a future payment system…

Currently, commercial banks are using Target2 or private networks like Euro2 to issue payments. How will these be connected to CBDC systems, and what role will commercial banks have in the new organisation? As intermediaries, commercial banks should be responsible for the management of a network node in order to secure the decentralisation of the network. Indeed, even if this support has a significant technical cost, they must participate in the common effort. This will allow them to have better control of transactions, which is a matter of sovereignty for the commercial banks.

With the hybrid architecture, commercial banks will be able to offer their customers services and interfaces allowing the use of CBDCs. We advise them to start thinking about products in order to stand out among their competitors (e.g., offer a seamless experience to their end-users considering high compatibility between several assets, such as digital euro, digital renminbi, digital dollar and others, data monetisation, remittance payments). If commercial banks are allowed to host electronic wallets, they need to think about private key management and should consider the type of storage they want to implement, either local storage or a subscription to an HSM (Hardware Security Module) offered by a cloud operator.

3.3. ...or by developing your own stablecoin, in anticipation of an indirect/synthetic model

First, a definition of a stablecoin is needed. In contrast to highly volatile cryptocurrencies such as Bitcoin and Ether, stablecoins are digital financial assets whose values are regular and reliable, as they are backed by fiat currencies (dollar, euro, yuan, yen, pound sterling, etc.). Indeed, their values depend on the values of these traditional currencies. Two major examples of stablecoins are presented below. When a stablecoin is issued, it implies the creation of a digital token characterised by a certain amount of money and its equivalent in a bank account: a reserve amount in fiat currencies. Furthermore, the issuance of a stablecoin is easy, as it only requires 5 lines of computer code to develop a token on a blockchain. As a result, a payment transaction in token is a line of code in a distributed ledger.

The stablecoin Pax Dollar (USDP) issued by Paxos and used by Novi, the digital wallet of Meta

The goal of this project in the pilot phase is to encourage financial inclusion by offering American and Guatemalan people free international money transfers. Although, most of the Guatemala population does not have access to classical banking services, every each citizen has a smartphone. The USDP technology is based on the Ethereum blockchain and is accessible to the public.

For each asset issued, a dollar is stocked on a bank account held by an American commercial bank. Each month, an auditor controls the number of USDP in circulation and the balance of the bank accounts attached.

The Lugh, the stablecoin developed by Société Générale

The Lugh is the first stablecoin backed by the euro and is accessible on Coinhouse. Based on Tezos's blockchain, transactions in Lugh are open to the public. For each token issued, a euro is stocked on a bank account held by Société Générale. Each month, an auditor controls each month the tokens in circulation and the equivalent money created in bank accounts.

Many private institutions in the banking and tech ecosystem, such as PayPal, have begun to consider taking advantage of the crypto-revolution by issuing stablecoins. As CBDC projects are in the early stages and stablecoins are increasingly trending in international firms, banks have some time to propose their own solution, in order to prevent any impact on the evolution of the payment system and possible decrease in market share. Also, by creating their own stablecoin, they would anticipate the potential set-up of an indirect/synthetic CBDC model. In fact, in this model, commercial banks issue their own digital currency which is backed by a CBDC.

It is also important to note that some public administrations are working on the regulation of stablecoins. For instance, according to the last report on stablecoins of the US Department of the Treasury published in November 2021(15), well-regulated stablecoins should be faster, more efficient and more inclusive means of payments. So, if a bank plans to issue a stablecoin, it is important to keep in mind that new regulatory frameworks could be implemented by state authorities. As mentioned before, the French law PACTE is an example of a first step that has been taken to regulate the new options and services that banks, and other financial services providers, could develop in the near future.

References

16 - https://home.treasury.gov/news/press-releases/jy0454

Conclusion

To conclude, central banks, financial services providers and regulators should consider CBDCs as new opportunities rather than threats.

- **Central banks** should aim to anticipate future needs of Financial Service Providers based on consumer trends such as digital payments and increased cross-border commerce.
- **Financial Services Providers** should understand the commercial opportunities associated with CBDCs and stablecoins, anticipate risks today and implement initial strategies and feasible use cases with digital assets.
- **Regulators** should define common regulation of digital assets and build on what already exists in advanced countries. They should emphasise setting new standards on data privacy, financial security and environmental footprints.

Nevertheless, the success of the digital assets' revolution may lie in the collaboration of these three players and the consideration of a bottom-up approach to consumers expectations. Much more remains to be done, but central banks, financial actors and regulators are encouraged to consider the potential impacts of CBDCs in order to be prepared for any change in the global banking ecosystem, so that they can be one step ahead.

Sources

- BANK FOR INTERNATIONAL SETTLEMENTS (BIS):
  - 2021, *BIS Annual Economic Report: CBDCs: an opportunity for the monetary system*
    https://www.bis.org/publ/arpdf/ar2021e3.htm
  - 2020, *BIS Working Paper: Rise of the Central Bank Digital Currencies : drivers, approaches and technologies*
    https://www.bis.org/publ/work880.htm
  - 2020, *BIS Quarterly Review: The technology of retail central bank digital currency*
    https://www.bis.org/publ/qtrpdf/r_qt2003j.htm

- WORLD ECONOMIC FORUM, 2020, C*entral Bank Digital Currency Policy-Maker Toolki*t
  https://www3.weforum.org/docs/WEF_CBDC_Policymaker_Toolkit.pdf

- EUROPEAN CENTRAL BANK (ECB):
  - 2022, *Targeted consultation on a digital euro*
    https://ec.europa.eu/info/consultations/finance-2022-digital-euro_en
  - 2021, *Report on the public consultation on a digital euro*
    https://www.ecb.europa.eu/paym/digital_euro/html/pubcon.en.html

- EUROPEAN PARLIAMENT:
  - 2022, P*ress release: Crypto assets: new rules to stop illicit flows in the EU*
    https://www.europarl.europa.eu/news/en/press-room/20220324IPR26164/crypto-assets-new-rules-to-stop-illicit-flows-in-the-eu

- BANQUE DE FRANCE, 2020, *La monnaie digitale de banque centrale.*
  https://publications.banque-france.fr/sites/default/files/media/2020/01/14/la_monnaie_digitale_de_banque_centrale.pdf

- US GOVERNMENT - DEPARTMENT OF THE TREASURY, 2021, *President's Working Group on Financial Markets Releases Report and Recommendations on Stablecoins*
  https://home.treasury.gov/news/press-releases/jy0454

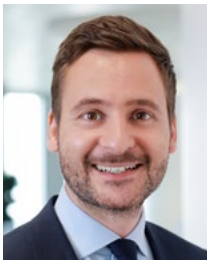
- UK GOVERNMENT – HM TREASURY, 2022, *Consultation outcome: UK regulatory approach to cryptoassets and stablecoins: consultation and call for evidence*
  https://www.gov.uk/government/consultations/uk-regulatory-approach-to-cryptoassets-and-stablecoins-consultation-and-call-for-evidence

- Press releases of central banks concerned by CBDC projects quoted in the study

Deloitte's other publications mentioned in the study:

- Deloitte, 2020, *Future of money : The revolution of stablecoins and the opportunities of Central Bank Digital Currencies in the era of the Coronavirus crisis.*
  https://www2.deloitte.com/fr/fr/pages/services-financier/articles/future-of-money.html
- Deloitte, in partnership with VIAVOICE, 2021, *Relations banques – clients (11e édition) : un monde de possibilités.*
  https://www2.deloitte.com/fr/fr/pages/services-financier/articles/relations-banque-clients-un-monde-de-possibilites.html
- Deloitte, 2021, *Explore audit innovation with Deloitte AI Robot.*
  https://www2.deloitte.com/cn/en/pages/audit/articles/explore-audit-innovation-with-deloitte-ai-robot-vol-8.html

Authors



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