

FINANCE, COMPETITIVENESS & INNOVATION GLOBAL PRACTICE

Payment Systems Development Group

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CENTRAL BANK DIGITAL CURRENCY

Background Technical Note

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ACRONYMS AND ABBREVIATIONS

AML	Anti-Money Laundering
API	Application Programming Interface
BIS	Bank for International Settlements
CFT	Combating the Financing of Terrorism
CPMI	Committee on Payment and Market Infrastructures
CPSS	Committee on Payment and Settlement Systems
DLT	Distributed Ledger Technology
FPS	Fast Payment System
KYC	Know Your Customer
PAFI	Payment Aspect of Financial Inclusion
PSP	Payment Service Provider



I. INTRODUCTION¹

Money performs three functions: medium of exchange (facilitates exchange between two parties), store of value (stores value from one period to another), and unit of account (acts as numeraire of value). There are a number of different types of money that perform these functions. For example, cash in circulation, deposits at commercial banks, commercial bank reserves at central bank, privately issued assets, etc. Not all of them are equivalent, some are riskier than others in certain functions, and almost all of them are today in digital form. Cash is an obvious exception; however, it features unique properties such as anonymity, universal acceptance (within the given jurisdiction), and instantaneous exchangeability without the need of a third-party intervention.

In recent years, due to innovations in technology, the concept of digital currency has emerged out of the desire of some private entities to replicate specific properties of cash in the digital space. Digital currencies have been issued in various electronic formats and value propositions, and in an uncountable number of platforms, which allow for real-time, peer-to-peer and not-in-person transactions. In studying the emerging phenomenon, the Committee on Payments and Market Infrastructures (CPMI) has noted that digital currencies feature some but not all the characteristics of a currency and some characteristics of commodities or assets.²

Digital currencies, especially those that have an embedded decentralized payment mechanism based on the use of distributed ledger technology (DLT), can have a range of impacts on various aspects of financial markets and the wider economy.³ These impacts include potential disruption to business models and systems, as well as facilitating new economic interactions and linkages. In particular, the

implications of digital currencies on retail payment services can be especially important, as they have the potential to facilitate certain retail payment transactions (e.g., for e-commerce, cross-border transactions and person-to-person payments), and possibly make them faster and less expensive for end users such as consumers and merchants. However, the risks can also be considerable.

Central banks, too, are considering issuing their own digital currencies. A central bank digital currency (CBDC) is a central bank liability that is digitally created and recorded on centralized or decentralized ledgers, denominated in an existing unit of account, and convertible in physical cash, commercial bank money and other forms of money on demand by the holder at authorized entities.⁴ As physical cash, CBDC would be legal tender. While central banks already provide digital money to select entities (typically commercial banks and other authorized financial intermediaries) in the form of reserve balances that are used for settling large-value (wholesale) obligations, CBDC would be a true innovation if it were made available to general purpose users, that is, for retail transactions among individuals and businesses. “Retail” CBDC would truly represent a digital extension of state-issued cash that would be ubiquitous and used and accepted by all in the economy.

Central bank motivations for issuing CBDC are several and differ widely.⁵ However, the common thread underpinning them all is the recognition that a digital form of (state-issued) cash should ultimately exist in the economy, which is supported by the central bank’s pivotal role in guaranteeing the stability of its value, ensuring the elasticity of its supply, and overseeing the overall security of its system (which should not fail and should not tolerate serious mistakes).⁶

CBDC has attracted conspicuous research on the various aspects of CBDC, from design, to implementation and implications. The related literature is now vast, with analytical and experimental contributions from several central banks of advanced and emerging market economies, and analysis and studies from the CPMI and the Bank for International Settlements (BIS), international financial organizations, academic scholars, private sector institutions, policy experts and market practitioners from all over the world.⁷ More and more central banks have indicated being engaged in some form of work on CBDCs. The BIS has released the results of a survey from 63 respondents in January 2019,⁸ and has recently published the update in January 2020 with responses from 66 central banks.⁹ Most of their work involves proof-of-concept, while less than 10 central banks noted current engagement in pilots in the latest BIS survey, and some central banks have started doing small scale pilots to understand some properties of CBDCs better.¹⁰

This report discusses the main technical features of domestic retail CBDC and its potential implications. The report is organized as follows. Section 2 will provide a general description of CBDC as they have evolved in the literature. Section 3 will discuss the economics of CBDCs; in particular it will explore the implications of CBDC for monetary policy, financial stability, financial intermediation, payments and settlements, financial integrity, and financial inclusion in general, and in the context of a developing economy as well as the potential efficiency gains from the use of CBDCs. Section 4 will evaluate the legal and regulatory aspects. The last section will conclude, raising issues for further analysis.¹¹

The report is part of a World Bank three-piece package on CBDC. It provides technical background information to the World Bank flagship report on *Central Bank Digital Currency: The Payments Perspective*, and it is a companion to the *Central Bank Digital Currencies for Cross-Border Payments*.



II. CENTRAL BANK DIGITAL CURRENCIES: GENERAL ASPECTS

Money has a crucial role in a market economy as it facilitates exchanges. Acceptance of any form of money in an exchange means that the payee is confident that next time, s/he can use that same money in exchange for a good or service and there will be someone else accepting it. Money carries value across time and space and, given its acceptance, it can be exchanged at no or negligible cost against goods services, assets or other currencies. Paper money, and more recently, electronic monies—none of which has intrinsic value—are accepted in exchange and trades based on this premise of trust. Hence, the value of money lies in public trust—the trust that the instrument used as money will endure as a faithful representation of value and will continue to be accepted by the society that has adopted it. This, in turn, requires an institutional set up (including, inter alia, a system of rules, infrastructures, and agencies) that helps preserve these money features over time.

In a market economy, the central bank is tasked with the prime responsibility to protect public trust in money. In order to do so, the central adopts policies to preserve the (internal and external) value of money, which typically includes the reserve liabilities issued by the central bank to select financial intermediaries, the demand liabilities issued by commercial banks convertible at par with central bank money on demand, and all forms of (electronic) money issued by non-bank entities and convertible in fiat money on par terms and upon demand.

All such forms of money co-exist in modern economies and are exchangeable via payment systems supported by central banks, which are widely accessible by banks and non-banks. Central bank money is in the form of reserves and settlement accounts held at the central bank by the institutions participating in the payment systems as well as banknotes in circulation. Commercial bank money is a

claim against the relevant commercial banks rather than being a legal tender. Electronic monies issued by non-banks are claims on commercial bank deposits and, indirectly, on cash. Hence, the big distinction between central bank money, on the one hand, and commercial bank and non-bank electronic monies, on the other, is that the former does not bear default risk while the latter carry the possibility of their issuers eventually defaulting on their liabilities.

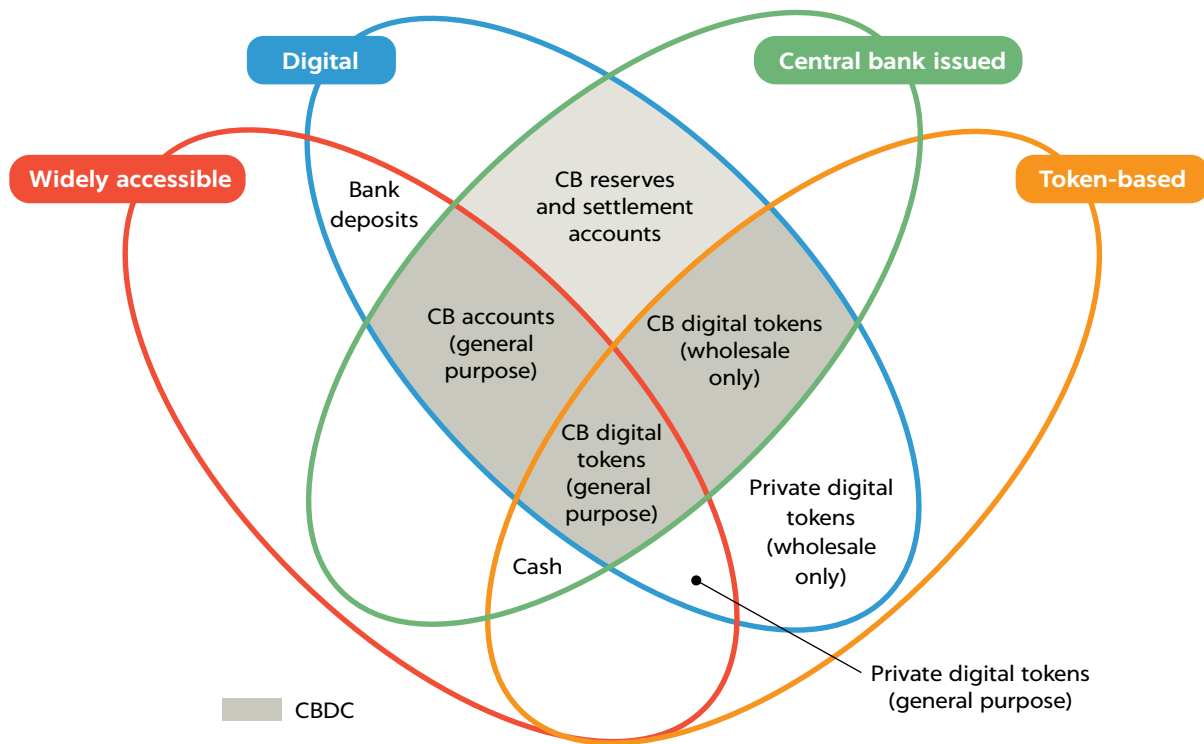
Four key properties of money and five design features of CBDC can be identified:¹²

- i. Type of issuer: central bank vs. other entities
- ii. Form: digital vs. physical
- iii. Accessibility: restricted vs. widely, that is, money that is available only to certain agents and in certain jurisdictions vs. money that is available to everyone everywhere
- iv. Technology: token-based vs. account-based: account-based monies are held on the accounts of authorized entities, while token-based monies are representations of value encapsulated in (physical or digital) records, and their transfer from one agent to another does not require reconciliation of two databases.¹³

The gray shaded areas in Chart 1 show three different forms CBDC can thus take: general purpose CB accounts, general purpose CB digital tokens, and wholesale only CB digital tokens.

- The general-purpose, account-based version is the one where the central bank provides accounts to general public.
- The general-purpose central bank digital tokens would primarily target retail payments.

CHART 1 The Money Flower



Bech and Garratt, cit.

The wholesale-only central bank digital tokens would be for large value payment and settlement transactions.¹⁴

Furthermore, there are important design features to consider:

- i. Anonymity: physical cash is anonymous.
- ii. Availability: limited to central bank operating hours vs. an ongoing and uninterrupted (i.e., 24 hour/7 day) basis. Currently, access to digital central bank money (reserves) is limited to the issuing central bank's operating hours, while cash is available on a 24/7/365 basis.
- iii. Zero vs. non-zero interest bearing. Currently, cash does not bear interest while CBDC could carry a non-zero interest rate.
- iv. Transfer mechanism: person-to-person (P2P) vs. via an intermediary indirect. Currently, cash is transferred P2P, while CBDC be transferred PSP or via an intermediary depending on design.
- v. Limits or caps: these can be used to deter undesirable uses. Limits are typically set on cash transactions due to financial integrity considerations.

Different combinations of these properties and design features would yield different types of CBDC. Each property and design feature fit different use cases and bear different implications for monetary policy, financial intermediation, financial integrity, financial inclusion, payments and settlement systems.

There are some additional considerations:

- CBDC needs to be one-to-one convertible to reserves/banknotes to ensure proper functioning of the payment system.¹⁵
- In the current setup with no CBDC, general public does not have access to central bank money that is not in physical form (notes and coins). In fact, central bank money has always been considered safer than commercial bank money (bank deposits), and CBDC might enable access to the same safety of cash but in digitally (similar to bank deposits) in the form of central bank money by the general public.



III. ADVANTAGES AND DISADVANTAGES OF CBDC¹⁶

This section discusses the main advantages and challenges of CBDC. The areas of interest include the impact of CBDC on: use of physical cash; access to central bank money, retail payment services provision, Government payments, financial inclusion, retail payments market, monetary policy, financial intermediation, financial stability; and financial integrity.

CBDC AND CASH

Some countries have been discussing the introduction of CBDC as a way to counter the decline in the use of physical cash when the economy is evolving toward a “less cash” society. By designing CBDC so as to mimic the properties of physical cash, it would act as a substitute for it and prevent the money in the economy from being entirely originated by the private sector. In many developing economies, cash has been, and continues to be, the most widely used payment instrument, and this case is in general not applicable.

The issuance of CBDC might introduce significant changes in the usage of physical cash. As CBDC were made available to all individuals and entities in the economy, this might prompt a momentous change, especially if the central bank promoted its use and availability across the whole national jurisdiction. However, one should not forget the challenges posed in many countries by a still great digital divide across society, also exacerbated by gaps in the underlying infrastructure, as well as the deliberate choice by many individuals and businesses who prefer to be digitally excluded, as evidenced for instance in all cases where, even if social benefits are distributed through bank accounts, many people cash-out immediately the money that is deposited and transact in cash.

In providing the new form of cash for the digital world of today and tomorrow, CBDC could assist countries in their constant search for the socially optimal combination of payment instruments. It would support country efforts to move toward a cashless society or it would complement physical cash in those countries that want to continue its use. On the other hand, CBDC would preserve the role of the state as money issuer in those countries where the use of cash is minimal, and the monies used for retail payments are issued by the private sector. And, finally, CBDC could either promote or supplement competition and innovation in the NPS, where the private sector is slow or stagnant. In this last respect, CBDC would impose on the central bank (and state more broadly) an even higher responsibility than is currently the case to extend the use of digital currency to those segments of the population or areas of the country that are not serviced by the private sector. Thus, there is no just one single objective or purpose for issuing CBDC, and any decision to issue it should be driven by a clear strategic view as to the needs that its issuance would address in a specific country context.

CBDC AND ACCESS TO CENTRAL BANK MONEY

CBDC can reinforce the central role of central bank money in today’s digital world. The history of retail payment services, since the origin of modern banking, can be understood as the attempt from the payments industry and the society at large to economize on the use of physical cash through instruments (e.g., mobilizing bank deposits through cheques and other means, and lately electronic transfer facilities and e-monies) that have eventually become cash substitutes for the public using them. This constant attempt has been motivated by the high cost of handling and storing cash,

and the impossibility of using it in non-in-person transactions. CBDC could potentially re-position a digital, state-issued form of legal tender at the center of transactions. The innovative potential of this solution as a way to make digital payment services universal, ubiquitous and instantaneous in contemporary economies cannot be overemphasized, much as its disruptive potential cannot be neglected.

Money instruments issued by the private sector (either in the form of commercial bank deposits, electronic monies or other digital currencies) are by their very nature risky, due to the possibility of failures occurring along the supply process. Risks involve the potential illiquidity and insolvency of the issuers of the instruments or of the holders of the funds received against their issuance. In this regard, one reason for issuing CBDC is to provide money holders with a safe alternative. For this purpose, in evaluating whether CBDC features advantages vis-à-vis private sector instruments, consideration should be given to the coverage and extent of the existing deposit insurance schemes protecting such instruments and how fast the guarantees would take effect in the event of failures. In addition, central banks would have to consider whether issuing CBDC is worth the efforts in those countries where cash is still largely used as the most secure form of money for transacting and for storing value.

CBDC AND RETAIL PAYMENT SERVICES

Improving payment system performance is a most important motivation for central banks to issue CBDC. The central banks of advanced and emerging market economies, recently surveyed by the BIS earlier noted, have ranked payments safety and domestic payments efficiency as the first motivating factors for potentially issuing a (wholesale or a retail) CBDC. Central banks in emerging market economies, in addition, have expressed high recognition for CBDC as an instrument to promote financial inclusion. In fact, they have generally stronger motivations than central banks in advanced economies to work on retail CBDCs, which can act as a substitute or a complement to cash.

CBDC would lead to fast, secure and efficient payments, and would facilitate transactions that would otherwise be foregone.¹⁷ In theory, general public would have access to central bank money, which is risk-free and digitized, to make everyday transactions and to store pre-cautionary funds. This would improve efficiency and safety of payments and reduce the overall cost of transactions. A CBDC system linking all agents in the economy would make real-time payment and settlement services accessible everywhere, always

and to/from anybody, and on a 24 hour/7-day basis around the whole year. In fact, fast payment systems (FPS) could achieve the same outcomes;¹⁸ however, the settlement of payments at the retail level would take place in commercial bank deposit liabilities, and PSPs might incur mutual credit risk depending on the FPS architecture.¹⁹

Strengthening cross-border payments might also be an important central bank motivating factor for introducing CBDC. While the surveyed central banks have generally attributed low importance to cross-border payments efficiency, the recent strong push by the G20 under the Saudi Arabian presidency for developing a roadmap to enhance cross-border payments can be expected to induce central banks to evaluate additional actions, including the potential that CBDC carries in this area and to adapt their preferences accordingly.²⁰

CBDC AND GOVERNMENT PAYMENTS

CBDC could support payments to and from the Government. It would provide a very effective mechanism to facilitate payments from all residents to all government agencies across a single platform as well as to enable the government to reach every agent everywhere in the economy and at any time, for both regular or ad hoc transfers and payments. This feature would be especially valuable during certain types of emergencies.

In cases of national emergencies, as governments need to transfer money to people and facilitate their payments activity, CBDC may play a special role. However, as experience under the Covid-19 pandemic has shown worldwide, public authorities may encounter significant challenges in getting funds to those in need and enabling access to money.²¹ The use of CBDC could be of great assistance. The central bank could agree to act as government agent and execute CBDC fund transfers on the government's behalf to individuals and businesses that government identifies to be in need of financial support. Through CBDC, government could send direct payments much more rapidly than through checks or tax refunds and could provide geographically and temporally targeted relief. During crises, also, CBDC could be used as a payment conduit for delivering fiscal stimulus packages to households and businesses, which would be especially useful when businesses risk closing because they run out of money and people lose their jobs or become ill. It should be noted that similar effects could be achieved through the use of FPS solutions, provided that all government payment beneficiaries have access to transaction account facilities at PSPs.

CBDC AND FINANCIAL INCLUSION

CBDC should play a key role in fostering financial inclusion. Notwithstanding the progress achieved over the years in expanding people's access to payment services, low-income and vulnerable groups everywhere today continue to face tremendous difficulties in making and receiving payments. There is thus much scope to broaden the availability of payment services to people that are still financially excluded, and to improve their quality in terms of convenience, transparency and speed. While CBDC is not per se the solution to universal financial access in a country, considering it as a new form of cash and legal tender places the central bank under an even more pressing obligation to make sure that CBDC access is guaranteed everywhere, always and to everybody across the national jurisdiction: CBDC inevitably raises the profile of financial inclusion as a national policy priority. In this area, central banks could draw useful policy guidance from the work done by the CPMI and World Bank on payment aspects of financial inclusion (PAFI),²² but might need to go beyond the PAFI approach in order to ensure that CBDC is available to all agents in the economy. In particular, where financial inclusion is a national priority and the private sector is not enough responsive to the financial inclusion agenda, the introduction of CBDC could be one of the available options to expedite the process, precisely because of the special responsibility falling upon the central bank to facilitate CBDC access to all individuals and businesses across the country. It is also to be noted that the reasons why the private sector is unresponsive should be carefully studied, and the conclusion might indeed lead to accelerate CBDC adoption.

The special responsibility of the central bank to facilitate CBDC access to all in the country could make a big push on the financial inclusion agenda. CBDC introduction would require the central bank to activate the four PAFI "catalytic pillars" that act as drivers of access to and usage of basic transaction instruments, by i) designing CBDC transaction functionalities in ways that are convenient for even non-sophisticated users, ii) creating a network of readily available access points as part of the provision of CBDC as a "public utility", directly and/or through PSPs; iii) supporting awareness and financial literacy as necessary to disseminate knowledge of the new instrument across the population and the country, and iv) leveraging large-volume recurrent payment streams. In line with the new recent PAFI work by the CPMI-World Bank,²³ the CBDC technology would expand the range of payment products, make them ubiquitously accessible, enhance user experience and awareness, and achieve efficiency gains.²⁴ At the same time, however, these benefits

would come with certain risks in terms of operational and cyber resilience, the protection of funds received from customers, data protection and privacy, digital exclusion and market concentration. If not adequately managed, these risks could undermine financial inclusion outcomes.

CBDC AND THE RETAIL PAYMENTS MARKET

CBDC could put competitive pressure on a stagnant payments market, in particular on the retail side. Where the market is characterized by the dominance of relatively inefficient payment services provided by less than innovative players, the introduction of CBDC could exert pressure on the efficiency of other payment instruments and support a positive disruption in the market. For example, as retail CBDC might be offered in principle at little or zero cost to the payers and payees - much as for cash today - it could improve the overall efficiency of the retail segment of the NPS, by pressing private sector providers to attain higher level of efficiency on the instruments they issue and to supply customers with higher quality and an expanded range of services.

CBDC should aim at promoting competition and innovation in the NPS.²⁵ Issuance of CBDC should not be seen as replacing *tout court* physical cash or private-sector monies (including new digital currencies). All these forms of monies can well coexist, and CBDCs can act as a complementary means of payment that addresses specific use cases and market failures as well as a catalyst for continued innovation in payments, finance and commerce at large. Moreover, CBDC can be introduced with a view to allowing the public and private sectors to exploit their respective comparative advantages: central banks can focus on ensuring trust, stability and integrity in payments and let private-sector PSPs keep doing what they should do best—interfacing with customers and compete amongst each other to win customer preferences and expand the market for digital payments. This coexistence would require a level playing field aimed to make sure that competition is open and fair, including between market incumbents and new entrants. Open and fair competition would in turn require market protection from abusive and monopolistic practices and the adoption of appropriate rules for handling data as the raw materials of the digital world, from access, to sharing, portability, and protection. Finally, interoperability would be important for an environment that need to be open to innovation, enabling PSPs (acting on their own behalf or on behalf of their customers) to access CBDC via multiple channels, including back-end interfaces and APIs.²⁶

CBDC AND MONETARY POLICY

CBDC may change the implementation of monetary policy depending on the CBDC design.²⁷ Specific considerations in this respect would include the accessibility of CBDC and whether it is interest bearing. Simply put, wider access to central bank money and interest bearing CBDC (which would make it an attractive asset to hold) together could make monetary policy outcomes more pronounced because of substitution effects. For example, CBDC may substitute for various money market instruments, as a liquid risk-free asset for final settlement. If CBDC can be used by non-residents, it may become a substitute for internationally used banknotes.²⁸ If CBDC is designed to be more attractive, the effects on monetary policy transmission would be more prominent. At the same time, it is important to note that emerging economies do not have effective monetary policy transmission due to vulnerabilities in the domestic financial system and the presence of a large informal sector. Hence, the issuance of CBDC may not necessarily make monetary policy transmission more effective.

It is also important to note that with the issuance of CBDC, depending on its design, the issuing central bank would have different policy tools at its disposal, compared to the traditional tools. These would include, for example, the ability to apply negative interest rates on CBDC, targeting the CBDC rate, effecting helicopter drops, etc. The central bank can also consider imposing limits or caps on the quantity of CBDC holdings or the use of CBDC. Quantitative limits on CBDC use would be analogous to limits on cash withdrawals for individual commercial bank deposit holders and would be aimed at protecting the commercial banks' deposit base at times of stress. In practice, under quantitative limits, commercial bank deposit holders would not be allowed to convert their demand deposits into CBDC beyond a certain threshold. However, the consequences of this are not clear for the one-to-one convertibility of the CBDC to reserves and banknotes, specifically at times of stress when this type of a policy would otherwise be the most useful.

CBDC may lead to better control of monetary policy in two ways

- i. Use of negative (nominal) interest rates: if CBDC is interest-bearing—in this case, people would pay the central bank to store their currency. This would be to discourage holding money and to stimulate spending. Compared to CBDC, cash does not pay interest and hence applying negative interest rates on cash is not feasible. The lower bound to interest rate is thus zero, and the stimulus has a limit.²⁹
- ii. Use of “helicopter drops:” account-based CBDC would enable the central banks to make transfers of funds directly into the account of individual agents. This would allow central banks to execute monetary policy operations in a more precise (targeted) and rapid way than is possible with conventional or unconventional (e.g., quantitative easing) types of monetary instruments. Helicopter drops can be done universally, on all accounts, or on a selective basis, depending on the situation (see also Annex 2).

It is expected that CBDC would have an impact on seigniorage. Seigniorage is the profit of the central bank from the issuance of the currency. It is the face value of the currency minus the cost of printing and distributing. Alternative private digital currencies may significantly reduce the seigniorage revenues from a fiat currency, and hence the case for a CBDC. However, at the same time, replacing cash with a CBDC that may end up failing to appeal to users could also inadvertently accelerate the decline of seigniorage revenues. It is not fully understood as of yet which way seigniorage revenues would go in this case as the two effects are in the opposite direction.

CBDC, FINANCIAL INTERMEDIATION AND FINANCIAL STABILITY

Financial intermediation might change dramatically, should CBDC become very attractive. A large flow of retail deposits into CBDC could cause a loss of low-cost and stable funding for banks, leading them to raise interest rates or seek to replace outflows through more costly and uncertain wholesale funds and term deposits. Banks might have to shrink their balance sheets. Also, as the demand for CBDC grows very large, and cash holdings do not decline in parallel, central banks may need to hold less liquid and riskier securities, thereby influencing the prices of such securities and potentially affecting market functioning, and may also need to provide substantial maturity, liquidity and credit risk transformation at times to both banks and markets. Central banks might end up exerting a larger impact on lending and financial conditions than warranted.

CBDC might facilitate bank runs during times of financial distress. CBDC would essentially create a new store of value without default risk, in addition to cash. If faced with systemic financial difficulties, households and businesses might suddenly shift their deposits towards CBDC as a risk-free asset, as the digital nature of the instrument would allow for faster and larger “digital runs” of depositors on their

banks. Even with deposit insurance protection, the stability of retail funding could weaken to the extent that the central bank offers a very safe alternative, and the incentives to run toward the central bank would be sharper and more pervasive if deposits were not insured or if deposit insurance was limited. Annex 4 discusses other CBDC implications for financial stability.

CBDC AND FINANCIAL INTEGRITY

Like in the case of physical cash, CBDC anonymity could prove attractive to users interested in keeping privacy. Privacy includes aspects such as the amount of data accessible to other counterparts to the transaction and reducing the data potentially exposed in case of security breaches. For example, without a legitimate purpose or authorized content, a provider would have access to information on all the transactions of a person and make illegitimate use of this information. Technology allows for separating information on the account from that on the account holder. Thus, depending on the choices regarding CBDC design and the degree of intermediation by PSPs, the information on the account holders could be managed by the provider(s) of the payment interfaces, while the central bank would keep the accounts of all users on its books.

Thus, given the cash-like nature of CBDC, anonymity in its use is a key issue to consider. Should CBDC users be anonymous, like physical cash users, or should the digital nature of the instruments make its users' identity known? On the policy level, decisions on anonymity on digital cash use should be driven by principles, not technology. In particular, even if digital technologies allow today to overcome the anonymity that is intrinsic in the use of physical cash, to the extent that a society allows the continued use of cash as a way to protect anonymity in (certain) transactions and even the usage of certain other instruments characterized by anonymity or pseudo-anonymity (e.g., bitcoin and other virtual currencies), the same characteristics could be allowed for the use of digital cash. In other words, identification of CBDC users should not be required simply because its underlying technology allows for it; rather, it should be a question of legal rights and opportunity, even more so as CBDC were intended to replicate cash in the digital world.³⁰

Defining the boundaries of CBDC anonymity should take into account, as appropriate, the existing compliance regulation on AML/CTF. On the operational level, users of DLT- or token-based CBDC would need access keys whenever they wished to transfer their tokens to other users. A DLT- or token-based system can be designed to be anonymous, so that the actual identity of the users having access to the private keys would not be known to the central bank. However, it should be noted that transactions on account- and DLT-based digital systems are traceable, since the history of all transactions is stored on them. Also, it is possible that even in a DLT- or token-based system regulators would insist that CBDC wallet providers carry out some "know your customer" (KYC) checks for holders. On the other hand, with account-based CBDC, the identity of the account holders would typically be checked before opening the accounts, under (KYC) requirements. However, financial institutions have the flexibility to open accounts with limitations on balances, daily, or monthly transactions with minimum identification requirements or with a full exemption of identification or verification. This flexibility could in principle be built into account-based CBDC systems.

CBDC should be compliant with AML/CFT regulations and requirements and should guarantee at least the same level of market integrity that is required of the existing instruments. Relevant Financial Action Task Force (FATF) provisions should be applied as needed to the planned CBDC and compliance with them should be ensured through its entire lifecycle. In this context, an analysis of CBDC from an AML-CFT perspective would be necessary. This implies that the identity of CBDC users, at least above certain transaction thresholds, might need to be known to at least some authorities or regulated institutions in the wider CBDC network, which can validate the compliance of these transactions with prevalent laws and regulation. As the Bank of England (BoE) argues,³¹ one possibility to operationalize this arrangement would be for the core ledger to store only pseudonymous accounts and balances and for each account in the core ledger to be linked to a PSP which knows the identity of each user. The PSP would be responsible for applying AML/CFT checks to users and for reporting suspicious transactions to the relevant authorities. Based on this solution, the central bank would not hold granular personal data on users (thus reducing the privacy concerns that could arise in connection with holding personal user data) and yet AML/CFT requirements could still be met by CBDC. Consistently with the above provisions, payments and balances below certain thresholds might be granted a simplified regime.



IV. CBDC: DESIGN ASPECTS

Essentially, the features of CBDC will depend on its intended use. Different use cases require CBDC to be designed in different ways, with different features. This section focuses on three options and their related use cases for domestic retail CBDC.

OPTION A

Description

This option aims to replicate the properties of physical cash.

Design

The following design features would apply. CBDC would be :

- General purpose (anyone in the economy can hold and use it)
- Issued in the form of digital token based on DLT
- Anonymous
- Available for use on a 24/7/365 basis
- P2P exchangeable (with no need for intermediary)
- Exchangeable with physical cash on a 1:1 parity
- Non-interest bearing.

Desirability

The likely advantages of Option A include:

- P2P exchangeability
- CBDC would serve as a unit of account
- CBDC would serve as a substitute of cash as a medium of exchange, with the following important considerations:

- It could facilitate expansion of access to digital payment services
- It can be used to make payments remotely, although wallets would not come with additional financial services such as savings, credit or insurance attached to them
- CBDC would provide for faster money transfers
- CBDC might save on the cost of providing physical cash especially, but not exclusively, in high-inflation environments, where maintenance and issuance of physical cash can be costly
- CBDC may limit the appeal and use of privately issued digital currencies, if the central bank intends to discourage use of instrument of uncertain value and liquidity
- CBDC could afford lower costs of managing a centralized bank ledger and would make additional oversight data available
- CBDC could reduce the costs of supplying cash. Assuming a downward shift of physical cash usage caused by CBDC uptake, costs entailed in the physical production and maintenance of cash would drop, and the costs of printing, maintaining fitness, storage (building and maintaining vaults and depots) and corresponding insurance, and distribution would decline.³² The cost reduction would include also lesser use of human resources dedicated to these activities
- Potential increase in seigniorage:³³ given the reduction in the costs of supplying cash, a corresponding increase in seigniorage income would result.

Further considerations

While Option A would replicate cash in many ways, it would bring up the following considerations:

- Anonymity would make CBDC difficult to recover if stolen or lost
- Compared to bank deposits covered by insurance, the risk of loss would be higher
- This option would not stop illicit financial transactions as it would preserve the anonymity of digital cash
- While default-free, CBDC based on option might be less appealing than commercial bank deposits as these come with additional services that are appealing to the users (e.g., various forms of savings, credit, insurance)³⁴
- While CBDC may substitute cash in “less cash” economies, thereby reducing informality (and tax evasion) and lowering the costs of producing and managing physical cash, it would be exposed to technology-related challenges including inter alia as cyber risk, connectivity issues, and lack of digital skills.

OPTION B

Description

In principle, Option B would give central banks a new monetary policy tool. Under this option, a central bank would be creating a digital currency that bears (positive or negative) interest (unlike cash that bears no interest). Also, as technology would allow for CBDC issued under this option to be embedded with smart contracts that would kick in under certain contingencies, changes in interest rates could be pre-programmed and triggered contingent on pre-specified events.

While this option has many theoretical benefits from the standpoint of monetary policy, it is not clear whether it would be possible to implement it in practice. The option carries a number of political and social consequences, which are discussed below. In addition, from a legal perspective, issues may arise as to whether interest can be paid on the currency.

Design

The design features under Option B would be the same as under Option A, except that CBDC would be interest bearing.

Desirability

Option B would have the following additional advantages:

- CBDC would improve monetary policy by allowing non-linear transfers and more direct implementation and transmission³⁵
- It would allow monetary policy to break below the effective lower bound (ELB),^{36,37}
- The CBDC rate would not have to be the same as the policy rate.³⁸

Further considerations

While Option B would add the CBDC interest rate as a new powerful monetary policy tool, whether to use it should require careful evaluation of its potential undesired consequences:

- While negative interest rates on CBDC would not necessarily mean negative long-term interest rates, it would imply a reduction in overall interest rates. These would, in turn, have effects on the pension funds and other long-term capital markets
- Risk-averse savers would be worse off as low risk saving options would be paying very low, zero or even negative interest rates, although they may still prefer to keep funds as bank deposits to ensure safekeeping as opposed to directly investing in firms with a high possibility of losing their savings
- From a social and political perspective, transfer of wealth via negative interest rates on CBDC can be seen as expropriation or taxation by the central bank. Questions on the legitimacy and the duration of financial repression could be raised. This may require a change in the central banks’ roles and mandates, before deciding to issue CBDC, which would have serious implications for the nature of the central bank.
- Co-existence of cash and interest-bearing CBDC would be problematic
- Interest-bearing CBDC might be preferable to bank deposits, with the implications for financial intermediation and financial stability discussed earlier (Section III).

OPTION C

Description

CBDC would be in the form of accounts held at the central bank. The non-anonymity deriving from the account nature of CBDC could make it less preferable for those who value anonymity in the use of money. The anonymity fea-

ture of cash is valued by many, and the non-anonymity of CBDC might have consequences in terms of the demand for it. For example, as a medium of exchange, CBDC under Option C would be less preferable since people may not be willing to have their transactions traceable. This is not a consideration only from those involved in illicit activities, but also from those who value privacy. As a store of value, however, Option C would provide a safer alternative (since non-anonymous CBDC would carry no risk of loss), and this would affect the demand for it positively. The effects on CBDC demand would be reinforced if CBDC were to pay interest.

Design

The following design features would apply for CBDC under Option C:

- The central bank would open and maintain accounts for all users in the economy; alternatively, a tiered system can be used where banks would distribute CBDC (Section V).

Desirability

Option C would have the following advantages:

- The traceability of transactions would contribute to the prevention of illicit activities and reduce informality (and tax evasion).
- The underlying technology could be used in association with non-anonymity to ban certain transactions or to enable automatic payment of certain financial obligations (e.g., taxes) individuals and businesses), at specific times and subject to specific economic conditions. Such programs would give the central bank additional tools to control the money supply and to target interest rates. While these are technical possibilities offered

by the option, their legal implications would have to be evaluated before deciding on their use,

- Account-based CBDC would enable the central banks to do “helicopter drops” more effectively than with (anonymous) digital tokens.³⁹

Further Considerations

Further considerations regarding Option C include the following:

- The option would facilitate AML/CFT policy objectives and implementation
- The co-existence of physical cash might make it difficult for the authorities to take the advantage of the non-anonymous CBDC⁴⁰
- Eventually, if the authorities aimed at encouraging usage of CBDC, they may be facing a choice between setting CBDC rate high enough as to make it attractive (with the potential consequences noted earlier), on one side, and restricting the use of physical cash (or even eliminating it altogether), on the other
- Restrictive actions on cash, however, would raise questions on the availability of people’s choice of payment instrument and, more broadly, on the socially optimal combination of payment instruments.

Table 1 below provides a summary of the different options that are discussed in this section and their design features. It also includes a comparison to the existing forms of central bank money (banknotes in circulation and reserves at the central bank). These options have been the most widely discussed ones in the literature and some central banks have drafted proofs-of-concept or started small scale piloting of these types of CBDC.

TABLE 1 Properties of Central Bank Money in Different Forms

	Existing forms of central bank money		Forms of CBDC analyzed in this report		
	Banknotes	Central Bank Reserves	Token-based CBDC		Account-based CBDC
			Option A	Option B	Option C
Access	General purpose	Limited to authorized financial intermediaries	General-purpose		General-purpose
Anonymity	Anonymous	Non-anonymous	Anonymity possible		Non-anonymous
Availability	24/7	Central bank working hours	24/7 feasible		24/7 feasible
Interest	Not possible	Possible	Possible		Possible
Transfer	P2P	Centralized	P2P		Centralized
Use limits	No limits on ownership Possible limits on payments	Possible	No limits on ownership Possible limits on payments		Possible
Risk of loss	Yes	No	Yes	Yes	No



V. CBDC: ARCHITECTURE ASPECTS

CBDC could potentially be made accessible by all individuals, enterprises and other entities. Retail CBDC could be arranged in one or two tiers. In a one-tier retail CBDC, the central bank would operate the CBDC infrastructure, distribute CBDC directly to the public and manage the accounts of all users (individuals and enterprises) keeping records of all balances and updating them with every transaction. In this type of model, the central bank could outsource some operations, like call center, user interface and the handling of user complaints. In a two-tier model, on the other hand, the central bank would distribute CBDC to the public via intermediaries, typically referred to in this report as payment service providers (PSPs). PSPs could be banks or nonbank entities and would be licensed and overseen by the central bank. In a two-tier system, the first tier could have similar functions to a wholesale CBDC system. In both models, the central bank would be the issuer of CBDC, and CBDC would be liability of (claim on) the issuing central bank.

In light of the strategic objectives of the central bank, the two models might need to co-exist. As the central bank will hold the responsibility to make CBDC available to all the economy's agents (as this is the case for physical cash), it will have to mobilize all the resources needed to this end. In practice, this means that, where feasible, the central bank will have to leverage private-sector PSPs, which are best positioned to interface with customers, in order to deliver CBDC services. Also, if necessary, the central bank will have to use alternative solutions, including creating dedicated capacity or using agent networks, to ensure that CBDC is made available to customers of regions that are not reached by private-sector providers.

THE ONE-TIER MODEL

In a one-tier model, access to the system could either require identification and verification or could be anonymous. It would be technically possible to separate personal information of account holders or access to tokens from the system itself. Accordingly, the system would hold references to personal information that could be stored in a different system and managed by a different organization. This solution provides two major advantages: the first is to hide personal information from financial transactions, and hence protect privacy; the second is that personal information would be separated from access to multiple institutions, therefore allowing for stronger protection from cyber-attacks. Another option includes having an anonymous account below a certain balance or transaction limit and requesting identification above this threshold. And a third option is to provide users with the ability to control access to their own personal information based on their choice and subject to AML/CFT requirements.

THE TWO-TIER MODEL

A two-tier model may feature different allocations of CBDC functionalities to the central bank and PSPs, respectively. There are activities that can be done only by the central bank, others that the central bank can either execute directly or decentralize to PSPs, and those that are typical of PSPs and PSPs would have a comparative advantage in performing. The level of decentralization chosen will depend on several factors as: the level of market competitiveness and the extent to which the central bank should compete with,

complement or supplement private-sector PSPs; the level of maturity of PSPs and the retail payments ecosystem more broadly; the approach that best allows the central bank to achieve its objectives of issuing CBDC; the need to maintain an efficient interplay between CBDC and all other payment instruments, including physical cash; and the ability of the central bank to manage and mitigate the risks associated with service provision.

A two-tier model could feature different levels of decentralization of CBDC functionalities. As for the management of user accounts, the central bank could choose among different options. It may elect to manage all user accounts directly in its books, letting PSPs only in charge of enrolling users. Alternatively, the central bank may elect to manage omnibus/pool accounts for PSPs, while each PSP would manage the accounts of its own users, without providing details to the central bank on individual users' accounts. In another variant yet, the central bank would manage the PSP accounts, PSPs would manage the user accounts *and* would periodically feed information on user balances to the central bank. Both these variants would fall within a model also called "hybrid" CBDC.⁴¹ In particular the last variant would enable the central bank to transfer CBDC holdings from one PSP to another in the event of a technical failure. This would in turn require i) a legal framework that allows for portability of CBDC balances in bulk (that is, give the central bank the power to switch retail customer relationships from a failing PSP to a fully functional one) and ii) the technical capability to do so promptly when necessary.

User interface applications could be designed to link users directly to the central bank system or to the PSP systems. Regardless of having a mobile, card, or web application developed by one of the licensed PSPs, the central bank could either allow the payment instrument to have direct access to the central bank system or limit access to only the PSPs' back-end systems. In the latter case, the user application would access the PSP systems. Hence, the PSP back-end systems would communicate with the central bank system, simulating typical intermediated transactions. In a system where the user accounts were managed by the PSPs, it would be mandatory for the user application to communicate with the PSP systems, whereas in cases where all accounts or tokens were managed directly by the central bank, both options would be applicable (that is, the user application would access either the PSPs' or the central bank's systems).

The central bank could choose to manage its own central CBDC ledger or share the ledger operations with other PSPs. A DL among multiple operators would increase the resilience

of the system and increase its availability. The DLT could operate based on different modalities. According to one modality, all data would be made accessible by all PSPs, which could then validate the transactions and reach consensus. Alternatively, PSPs could be permitted to access only their own users' data, while the central bank would be able to access all transactions of all users. As a third modality, all transaction data would be shared among all PSPs, while each PSP would keep and not share their own users' personal information. For instance, the central bank could provide the core settlement function and APIs that are accessible by PSPs, and each PSP could develop its applications to end users, add features and facilities to the application, and compete with other PSPs on the quality of services provided to the end-users. However, all PSPs would be accessing the same APIs and the settlement function supplied by the central bank. According to a third modality, the central bank would provide a settlement function and a messaging application. In the case of centralized management of accounts or tokens, the central bank might need to present an authentication technique and in a programmable CBDC, the central bank may provide a layer or a function to allow PSPs to add further functionalities or specific controls or limitations to the CBDC.

The contractual arrangement between the central bank and PSPs could be framed in different ways. The arrangement would change depending on whether PSPs would be in charge of service provision as principal providers or whether they would act as agents to the central bank. Whatever the arrangement, the responsibilities and liabilities of the central bank and PSPs, respectively, should be reflected clearly in the contractual agreement, including in exceptional circumstances. For example, the arrangement should enable the central bank to redeem the claims of users in the case of a PSP insolvency. This would require the central bank either having direct access to user accounts or receiving reports from the PSPs (on a regular basis or in the event of failures). Finally, the arrangement should clarify the liability and responsibility of the central bank and the PSPs, respectively, in the event of fraud, noncompliance, or services underperformance.

The introduction of DLT-based CBDC could improve the efficiency and quality of supervision and the collection of statistics on payments. A DLT-based CBDC could allow for "embedded supervision," that is, a regulatory framework that provides for compliance to be automatically monitored by reading directly from the ledger, thus reducing the need for firms to actively collect, verify and deliver data.⁴² By the same fashion, a DLT-based CBDC could improve the speed, and reduce the cost, of the collection process of PSP data for statistical purposes.



VI. CBDC: LEGAL ASPECTS

The introduction of CBDC might require amendments to the existing legislation.⁴³ The need for legal adjustments differs considerably depending on how CBDC is designed, and on existing legal order in the relevant jurisdiction. However, there are several general legal issues that need to be considered for the concrete implementation of any of the described options.

The central bank needs to have the authority to issue CBDC. In general, central banks have the power to issue currency. Unless relevant legislation expressly states otherwise (for instance, by specifically stating that currency can only take the form of banknotes and coins, and so implying that these are paper-based banknotes and metallic coins), the central bank should be able to issue currency also in digital form.⁴⁴

The issuing of CBDC must not conflict with any of the central bank's statutory objectives, tasks, and assignments. Provided that the central bank can issue currency also in digital form, as for the kind of option among the above that the central bank would choose, this must be consistent with the objectives that are recognized to the functions and tasks of the central bank as stated in relevant central bank and/or monetary legislation. Depending on how the CBDC mechanism is designed, this may mean that the central bank supplies lending or receives deposits from the public, which might be considered not permitted when addressed to the general public. If the central bank was to supply CBDC accounts, especially if these could accrue interest, these accounts would be regarded as deposit accounts.

In particular, safe and efficient payment system must be safeguarded. Central banks usually also have the task of promoting a secure and efficient (national) payment system. This entails in practice several sub-tasks according to relevant legislation, such as the provision of systems for the settlement of payments, as well as of means of payment both in physical form and as holdings in accounts. If the legislation contains no explicit ban on holdings in accounts and if the CBDC mechanism contributes to a safer and/or more efficient payment system, it could be considered to come within the framework of the central bank mandate.⁴⁵

The CBDC must be considered legal tender under the country legal order. Normally, only banknotes and coins issued by the central bank are deemed to be legal tender, that is to say: no one can refuse banknotes and coins as valid payment. In practice, however, parties can derogate to such principle and can be bound to accept bank money by contract. Moreover, in the plurality of countries it is recognized practice to accept bank money as legal tender (i.e., as valid payment that it is believed cannot be refused). It must be ensured that this would also apply to CBDC.⁴⁶

However, considering that CBDC is legal tender, it is necessary that creditors are provided with options in the form of various payment instruments for its acceptance, based on cost, technology and risk associated with each instrument. Parties to transactions are normally free to agree on the kind of instrument they are ready to accept for payments, based on cost, needed technology, or risk of the instrument used. Thus, in the absence of legal clarifications to this extent, the introduction of CBDC might raise inconsistencies. For example, whereas as a liability of the central bank CBDC would be considered legal tender (and its

acceptance would be compulsory), creditors might not be equipped to accept it for payments. Similarly, public policy considerations may lead to the imposition by the central bank of regulatory restrictions on the use of specific payment instruments (a well-known example being the imposition of limits on the use of cash, cheques or e-money).

It must be assessed whether relevant e-money legislation applies to CBDC. E-money legislation currently exists in many countries, establishing several specific regulatory requirements for such instruments. However, definitions of e-money differ according to domestic legislation and consequently it must be assessed whether such legislation would apply also to digital currency in general, and to CBDC in particular. If this is the case, it must be assessed whether all relevant provisions would be appropriate to CBDC.⁴⁷

However, no legal confusion should arise between CBDC and e-money. CBDC would be a liability of the central bank and CBDC holders would hold claims on the central bank, while e-money is a liability of its issuer(s) and its holders would hold claims on its issuer(s), even where regulation requires the funds received in exchange for the e-money to be held at the central bank. Also, while a central bank can create additional liabilities—including CBDC—by fiat, e-money issuers may not do the same since their liabilities must be matched by the funds received in exchange. While concerns on the existence of the underlying matched funds can raise doubts on the value of e-money, this cannot occur with CBDC. Furthermore, while a central bank can create additional CBDC by fiat, e-money issuers may not do the same since their liabilities must be matched by the funds received in exchange.

In any event, if a central bank issues a CBDC to the general public, this could mean that the central bank is exposed to the same legislation as other market participants. In addition to anti-money laundering regulations, such as KYC regulations and overseeing transactions, this can involve data protection legislation, consumer protection legislation in the payment services field, responsibility for unauthorized transactions, tax legislation, cyber-crime and the like. The regulatory framework to apply would depend on which option is chosen, but in principle the central bank should be subject to the same provisions as any other market participant issuing similar digital currency mechanisms.

The use of CBDC would require data and privacy protection. As for all digital financial services, breaches of privacy and particularly data security may result in identity theft, harm to financial records, fraud and other risks. Mitigating such risks would necessitate legal and regulatory provisions that, inter alia, clarify the rights of users, define data types, give control to users over their personal data and, and set out the legal obligations of data controllers, data processors when interacting with data users and with each other.

Each CBDC design option chosen needs to be carefully assessed also under the private law of the relevant country. As declared since the outset, the legal issues identified above are general and are not meant to address individual features of each option or model. However, it must be at least stressed that any ‘token-based’ model might imply a debate on the legal status of a ‘token’, whether this is considered as a digital asset implying that it is not a fungible good. Although this would take to the never-fully-solved issue of the legal status of money, which goes beyond the analysis of the specificities of CBDC, legal certainty requires that clarity is made also in relation to this aspect under the relevant legal order.

If a central bank issues CBDC to the general public, it is exposed to the same legislation as other PSPs or payment system operators. Central banks are often empowered to operate systems. Rarely their statute limits this power to wholesale systems. However, it has been unusual until now for central banks to directly provide payment services to the general public (besides physical cash) and to entertain direct relations with the users. If that were the case, the central bank should in principle be subject to the same standards as any PSP and the services provided by the central bank should be subject to the same rules as the services provided by PSPs. That includes among others compliance with provisions on privacy and legal standards on security and protection against cyber-attacks. Any challenge to user data or breach of security leading to misappropriation of funds might affect trust on the instrument and jeopardize central bank reputation. Whereas cash entails other risks (as that of forgery or of steal), CBDC is subject to risks related to the technology that underpins its use and circulation. Also, in a two-tier system, failure of a PSP would trigger claims on the intermediated CBDC.

ANNEX 1: GLOSSARY OF RELEVANT TERMS

TERM	DEFINITION	SOURCE
Cryptocurrency	Refers to a math-based, decentralized convertible virtual currency that is protected by cryptography (i.e., it incorporates principles of cryptography to implement a distributed, decentralized, secure information economy)	FATF (2014) Virtual Currencies: Key Definitions and Potential AML/CFT Risks
Digital currency	Can mean a digital representation of either virtual currency (non-fiat) or e-money (fiat) and thus is often used interchangeably with the term “virtual currency”	FATF (2014) Virtual Currencies: Key Definitions and Potential AML/CFT Risks
Distributed Ledger Technology (DLT)	Distributed ledgers use independent computers (referred to as nodes) to record, share and synchronize transactions in their respective electronic ledgers (instead of keeping data centralized as in a traditional ledger). Blockchain is one type of a distributed ledger which organizes data into blocks, which are chained together in an append only mode	World Bank (2017) Distributed Ledger Technology (DLT) and Blockchain
E-money or electronic money	E-money is a record of funds or value available to a consumer stored on a payment device such as chip, prepaid cards, mobile phones or on computer systems as a non-traditional account with a banking or non-banking entity	World Bank (2012) Developing a Comprehensive National Retail Payments Strategy
Electronic wallet	E-money product, where the record of funds is stored on a particular device, typically in an IC chip on a card or mobile phone	World Bank (2012) Developing a Comprehensive National Retail Payments Strategy
Mobile money	E-money product where the record of funds is stored on the mobile phone or a central computer system, and which can be drawn down through specific payment instructions to be issued from the bearers’ mobile phone. Also known as m-money	World Bank (2012) Developing a Comprehensive National Retail Payments Strategy
Virtual currency	A digital representation of value that can be digitally traded and functions as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value, but does not have legal tender status (i.e., when tendered to a creditor, is a valid and legal offer of payment) in any jurisdiction. It is not issued nor guaranteed by any jurisdiction and fulfils the above functions only by agreement within the community of users of the virtual currency	FATF (2014) Virtual Currencies: Key Definitions and Potential AML/CFT Risks

ANNEX 2. IMPACT OF CBDC ON MONETARY POLICY

It is held that CBDC would have a limited impact on monetary policy implementation. Flows into CBDC would drain the amount of reserves in the system in exactly the same way as flows into banknotes and central bank deposits held by non-monetary counterparties (e.g., the treasury, foreign central banks or financial market infrastructures), and the central bank would not need to change its *modus operandi*: demand for CBDC would just be another factor to consider for policy responses to be consistent with continued control over short-term interest rates. The central bank would retain discretion in choosing the assets required as collateral to accommodate the demand for CBDC. Subject to the overall supply of such collateral, the central bank would make available all the demand for CBDC, as is the case with banknotes.

However, CBDC might affect the effectiveness of monetary policy, depending on its design features. If, for instance, CBDC were widely accessible and paid a positive interest rate to its holders, it might prove very attractive to people and make monetary policy outcomes more pronounced due to stronger substitution effects. In particular, the introduction of CBDC would change the demand for, and composition of, base money and increase the elasticity of the demand for money to interest rates. Moreover, by exposing a broader section of the economy (households, financial and nonfinancial businesses) to an interest-sensitive instrument, the transmission mechanism of monetary policy could be strengthened. Also, if bank deposit holders considered CBDC to be a good alternative to deposits, banks would have less scope for independently setting the interest rate on retail deposits and would have to follow central bank decisions to change the CBDC rate. Thus, changes in the policy rate would be more directly transmitted to bank depositors, thus enhancing pass-through. The same would

hold through the foreign exchange channel, as the use of CBDC facilitated currency management, thereby leading to stronger and faster exchange rate movements for given policy interest rate changes. An attractively remunerated CBDC could also be attractive to professional financial market participants. It might therefore substitute for money market instruments (e.g., government bills, reverse repos, central bank bills and FX swaps) and would make a most liquid and safest (default-free) asset to be used as settlement instrument. The CBDC interest rate would establish a hard floor under money market rates.

CBDC would add to the central bank's set of monetary policy tools. These include the ability to apply negative interest rates on CBDC and to carry out "helicopter drops:" If CBDC were interest bearing, the central bank could apply negative (nominal) interest rates (implying that CBDC holders would actually pay the central bank for storing their currency). In a world without cash, or where use of cash is limited, this would discourage the public from holding CBDC and push them into spending them. Since cash pays zero nominal interest, negative interest rates on CBDC would push holders to move funds into cash. This would set a natural lower interest rate bound equal to zero, thus limiting the extent to which negative interest rates can be used to stimulate spending. In fact, the "effective" lower bound is less than zero considering storage, insurance and transport costs associated with cash and the loss of convenience associated with cashless payments. Ways to make holding cash less attractive would include terminating its legal tender status and applying a discount on its face value or abolishing high denomination notes. Notice, however, that if CBDC did not bear interest, it might limit the scope for monetary policy undesirably. This is because holding it would be less costly than holding cash, thus setting the

effective lower bound effectively to zero and preventing short- and long-term interest rates from descending into negative territory.

An increasing number of central banks are struggling with the lower bound limit on interest rates, including the Bank of Japan and the ECB. As the global neutral rate is trending down,⁴⁸ more and more countries will encounter this barrier, including emerging market and developing economies where inflation has been trending lower.⁴⁹ This trend has been accelerated by the shock from COVID-19. Removing the impediment of the lower bound on interest rates through a CBDC could increase the effectiveness of central bank policy and help avoid global deflation and secular stagnation.⁵⁰ As constraints on changes to the policy rate have mounted, many central banks have turned to quantitative easing. These purchases are currently made through the financial system, but with a CBDC could be channeled directly to individuals (see below). This would help allay some of the concern about inequality that accompany central bank asset purchases,⁵¹ while potentially also making them more effective as stimulus.

CBDC would enable central banks to effect “helicopter drops”, that is, to make transfers of funds directly to individual agents (in the form of gift).⁵² Depending on the situation, helicopter drops could be done universally, on all accounts or on a selective basis. It should also be noted that no central bank has used helicopter money to date.

CBDC might affect the overall process of money supply. This would be the case if the availability to the general public of CBDC as the safest and most liquid asset in the economy, as well as its immediate accessibility on demand, were to make it highly preferable to bank deposits. Under such (admittedly extreme) condition, the resulting loss of funding to banks might jeopardize their money creation function via lending. This would reduce the overall elasticity of the money supply in the economy, that is, the capacity of money supply to

satisfy dispersed demands for it, which the banking system typically ensures through its decentralized credit allocation decision process. Banks would possibly be forced to fund their loans with costlier finance than sight deposits, which might reduce the overall supply of money and require the central bank or government (through the budget) to implement compensatory measures.

The risks discussed above could be avoided if CBDC purchases were subject to quantitative limits, analogous to the limits applicable in many jurisdictions on cash withdrawals from commercial bank deposits. Under such limits, deposit holders would not be allowed to convert their deposits into CBDC beyond a certain threshold, thereby preventing dangerous hemorrhages from the banking system in particular during times of stress. Imposing limits, however, would also bear negative consequences.

As an alternative, the central bank could consider adopting a dual remuneration regime. According to this regime, a relatively attractive remuneration would apply to CBDC up to a quantitative ceiling and a lower interest rate would apply to larger amounts.⁵³ This would allow CBDC holdings below the threshold to serve as means of retail payments, while those beyond would act as a store of value. However, with a dual regime, a relatively high first-tier remuneration could be used to encourage below-threshold CBDC holdings, while a relatively less attractive second-tier remuneration could be used discourage above-threshold CBDC. This way, CBDC would not become a large-scale store of value and the risks discussed earlier would be prevented. Finally, this regime would preserve the ability to apply negative rates, since remuneration could always be applied in a way that does not undermine the monetary policy stance. It must be noted, however, that for this regime to be effective the central bank should have a way to ensure that one person/entity maintains only one account or should be able to tie all the accounts of the individual/entity. This would necessarily require a universal identity system.

ANNEX 3. CBDC AND BANK MONEY CREATION⁵⁴

It is generally argued that, at times of high uncertainties or crisis, the very existence of CBDC could facilitate the switch from bank deposits, since CBDC could allow for “digital runs” towards the central bank with unprecedented speed and scale; the switch could be large in times of stress, with the incentives to run being sharper and more pervasive than is currently the case, especially if bank deposits are not insured or if deposit insurance is limited. This is because, in a fiat money regime where money issuance is unconstrained by a convertibility rule to another asset or currency, such as under a fixed exchange rate or currency board arrangement, the central bank (unlike commercial banks) can always cover its obligations by issuing its own currency. This grants central bank money an unparalleled level of safety (and, hence, liquidity).

The availability to the general public of CBDC as the safest and most liquid asset in the economy, as well as its immediate accessibility on demand, could make it highly preferable to bank deposits, even in normal times.

As referred to money, the concept of “safety” reflects the likelihood of money retaining its value, and hence its acceptability as a means of payment. Central banks are more creditworthy institutions than commercial banks as issuers of money. They have explicit or implicit state support. In addition, central banks tend to be risk-averse institutions that seek, as far as possible, to engage only in low-risk financial activities.⁵⁵

In the (admittedly extreme) event of dominant public preference for CBDC, banks might not have enough reserves to ensure deposit convertibility into CBDC and would have to liquidate part of their assets (e.g., securities, loans) in exchange for central bank reserves, possibly depressing the

value of those assets and incurring balance-sheet losses. The loss of funding would jeopardize the banks’ money creation power. The central bank might intervene and purchase those assets at par in exchange for reserves; however, this would require the central bank to absorb the attendant risk.

In principle, the central bank could compensate banks with pass-through funding.⁵⁶ Yet, if such transfers were free of charge or below market rates, they would be a subsidy and then questions would arise as to why the central bank should subsidize a banking business that, without it, would be unviable as a going concern, or how the central bank would decide to allocate funds across banks (that is, according to which criteria). Besides, the subsidy would have the nature of a fiscal operation, with budget and equity implications. For instance, if the central bank were permanently to subsidize banks, why then should the public sector not extend a similar subsidy to all businesses that were permanently to suffer from funding issues? On the other hand, if compensatory funding took place at wholesale market rates, this could be costly for banks and impinge on the aggregate credit supply (see below). In any case, preserving bank money creation would require the central bank to support the funding of banks; this would weigh on the central bank’s balance sheet and bear implications for central bank risk taking, and ultimately for central bank capital.

Consideration should be given also to the impact of CBDC on the cost of bank money creation via lending. Interest-bearing CBDC induce banks to increase the rate they offer on deposits, since they would always find it profitable to at least match the interest rate on CBDC.⁵⁷ Thus, even if the take-up of CBDC were small, its mere existence would encourage banks to make their deposits more attractive to customers, seeking to expand the depositor base and, hence, their

funding. All else equal, this would enhance banks' money creation. On the other hand, however, the effect of CBDC on bank deposit rates would reduce banks' profits and/or imply a higher cost of credit to the economy as banks would pass the higher cost of funding on to their customers. Thus, only general equilibrium analysis could tell what the net impact would eventually be on the economy's demand for credit, and hence on the aggregate volume of bank deposits in the economy. In any case, the higher cost of money would reflect the public's willingness to pay for being able to access a fully safe and liquid money such as CBDC, which more than nondigital cash would be easily available to them, convenient to use, and inexpensive to hold and administer. The very existence of such an instrument would make

explicit and transparent to the public the higher riskiness of bank money versus CBDC and force markets to assign a nonzero price to the former.

CBDC might thus affect the overall process of money supply, as a reflection of the portfolio preferences that the public would express for it. The stronger such preferences, the larger the substitution effect, and the stronger the impact. This would reduce the overall elasticity of the money supply in the economy (that is, the capacity of the money supply process to satisfy the dispersed demands for money), which the banking system typically ensures through its decentralized credit allocation decision process.

ANNEX 4. IMPACT OF CBDC ON FINANCIAL STABILITY

CBDC could affect financial stability. If CBDC proved very attractive and were to be highly preferred to bank deposits, banks would face competition from the central bank and, as discussed in the report, they would have to raise their deposit rates to remain competitive. This would reduce their profits and/or the demand for their loans. In turn, they might take on more risk. Banks could also increase their reliance on wholesale funding, but this might raise their cost of funding, with similar implications. Bank funding could also become more volatile, causing banks to hold more liquid assets and/or to cut back on lending.

CBDC might facilitate bank runs and accentuate financial crises. Considering that flight to safety has happened already twice within just over a decade (in 2008 as well as 2020) renders this issue far from just hypothetical. Although it is already possible for customers to switch to central bank money by having their bank deposits paid out in cash, they are in practice dissuaded by the costs and obstacles involved in handling and holding large amounts of cash (e.g., storage and insurance, transport, limitation to availability, etc.). All this could change with CBDC, and the flight to CBDC could be easy and virtually free of charge. CBDC could thus allow for “digital runs” towards the central bank with unprecedented speed and scale. The switch could indeed be large especially in times of stress, and the incentives to run could be sharper and more pervasive than is currently the case, if bank deposits were not insured or deposit insurance was limited. In fact, even in the presence of deposit insurance, limited coverage ratio and long claim settlement procedures in case of bank insolvencies might reduce the effectiveness of the insurance mechanism in dissuading runs. It should be noted that in cases of individual bank insolvency, immediate runs from the insolvent bank to other banks is already tech-

nically possible. In such case, therefore, CBDC is not likely to affect the likelihood of runs. However, introducing limitations to deposit convertibility into CBDC could increase the risk of generalized runs out of the banking sector. The consequences of introducing such limitations are not clear in terms of the issuing central bank’s ability to guarantee the one-to-one convertibility of CBDC into cash and reserves, under the given limitations.

Also, CBDC of reserve currency countries available across borders could increase currency substitution (“dollarization”) in other countries. In particular, the national currency of countries suffering from high inflation and exchange rate volatility might be supplanted by the CBDC of a reserve currency country. A reserve currency country is typically home to large digital networks that would facilitate such kind of currency substitution, and private networks could be created that would give access to new and specific units of account to people in many countries. In fact, if a reserve currency were available in CBDC form, even economies with stable currencies could be digitally dollarized if their citizens find themselves often transacting with users of a digital platform in that currency.

Finally, there are privacy concerns with giving the government—through the central banks—access to private transaction data. These are not straightforward to solve, even conceptually, as noted in a recent Bank of Canada note,⁵⁸ “Techniques to achieve cash-like privacy are immature (...) [and do not] comply with know-your-customer (KYC) and anti-money laundering (AML) regulations. Their risks include hidden vulnerabilities, a lack of scalability and complicated operations.”

ENDNOTES

- 1 Drafted by Biagio Bossone (Senior Payments Advisor, World Bank) and Oya Pinar Ardic (Senior Financial Sector Specialist, World Bank), with contributions by Ahmed Faragallah (Senior Financial Sector Specialist, World Bank), Sheirin Iravantchi (Financial Sector Specialist, World Bank), Maria Chiara Malaguti (Senior Legal Advisor, World Bank), Holti Banka (Financial Sector Specialist, World Bank). Harish Natarajan (Lead, Payments and Market Infrastructure, World Bank) provided overall guidance and co-ordination.
- 2 See “Digital Currencies,” report by the Committee on Payments and Market Infrastructures, Bank for International Settlements, Basel, 2015.
- 3 DLT refers to the processes and related technologies that enable nodes in a network (or arrangement) to securely propose, validate and record state changes (or updates) to a synchronized ledger that is distributed across the network’s nodes. A “node” refers to a computer participating in the operation of a DLT arrangement. See *Distributed ledger technology in payment, clearing and settlement: An analytical framework*, report by the Committee on Payments and Market Infrastructures, February 2017.
- 4 Annex 1 provides a glossary of relevant terms associated with CBDC.
- 5 They range from responding to a demand to a move to a cashless society to exploit the opportunity of negative interest rates for a more effective monetary policy. Financial inclusion, financial stability, monetary policy implementation, anti-money laundering (AML)/combating financing for terrorism (CFT), cost efficiency, cross-border transfers, reducing informality (and tax evasion), efficiency in clearing and settlement are among other reasons cited by various central banks that are interested in the idea of CBDC. See Barontini, C., and H. Holden (2019), “Proceeding with caution—a survey on central bank digital currency,” BIS Papers No: 101, Bank for International Settlement, Basel, Switzerland.
- 6 See *Digital currencies and the future of the monetary system*, remarks by Agustín Carstens, General Manager, Bank for International Settlements, Hoover Institution policy seminar, Basel, 27 January 2021.
- 7 While a review of this literature is beyond the scope of this report, a recent comprehensive review is reported in Brokke, G. O. J., and N. E. Engen (2019), *Central Bank Digital Currency (CBDC)—An Explorative Study on its Impact and Implications for Monetary Policy and the Banking Sector*, Norwegian School of Economics Bergen, Fall 2019. For a recent reflection on CBDC related issues from within the international central banking community, see *Central bank digital currencies: foundational principles and core features*, *Central bank digital currencies: foundational principles and core features*, Report no. 1 in a series of collaborations from a group of central banks (Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, and Bank for International Settlements), Bank for International Settlement, 2020, and the literature therein referred; and see also Carapella, F., and J. Flemming (2020), “Central Bank Digital Currency: A Literature Review,” FEDS Notes, 9 November.
- 8 See Barontini, C., and H. Holden (2019), “Proceeding with caution—a survey on central bank digital currency,” cit.
- 9 See Boar, C., H. Holden, and A. Wadsworth (2020), “Impending arrival—a sequel to the survey on central bank digital currency,” BIS Papers No: 107, BIS: Basel, Switzerland.
- 10 For an updated list of central bank initiatives and their current status, see *CBDC Tracker—Today’s Central Bank Digital Currencies Status*, available at <https://cbdctracker.org>.
- 11 This report does not analyze CBDC for cross-border payments. This issue is discussed in detail in a separate, companion report.
- 12 See *Central Bank Digital Currencies*, report by the Committee on Payments and Market Infrastructures and the Markets Committee, Bank for International Settlements, Basel, 2018; and Bech, M. and R. Garratt (2017). “Central Bank Cryptocurrencies,” BIS Quarterly Review, September 2017, p.55-70.
- 13 Token-based currency allows for peer-to-peer transactions, using private and public cryptographic keys to access and mobilize value, and without the transacting parties holding accounts with any entity.
- 14 Wholesale CBDC would provide a valid solution for settling transactions in tokenized digital securities, which are emerging due to innovations in financial and capital market infrastructures. On this issue, see *Wholesale digital tokens* report by the Committee on Payments and Market Infrastructures, Bank for International Settlements, December 2019.
- 15 Fung, B.S.C. and H. Halaburda (2016). “Central Bank Digital Currencies: A Framework for Assessing Why and How,” Staff Discussion Paper, 2016-22, Bank of Canada.
- 16 Adapted from Gouveia et al. (2017); and The Federal Council, 2019. “Central bank digital currency: Federal Council Report in response to the Postulate 18.3159, Wermuth, of 14.06.2018”, Swiss Federal Council, Bern.

- 17 Fung, B.S.C. and H. Halaburda, 2016. “Central Bank Digital Currencies: A Framework for Assessing Why and How,” Staff Discussion Paper, 2016-22, Bank of Canada.
- 18 The CPML defines fast payments as “payments in which the transmission of the payment message and the availability of final funds to the payee occur in real time or near-real time and on as near to a 24-hour and 7-day (24/7) basis as possible.” See *Fast payments—Enhancing the speed and availability of retail payments*, report by the Committee on Payments and Market Infrastructures, Bank for International Settlements, Basel, November 2016. Currently, over 60 countries across the globe have an FPS in place and several others have announced their plans to implement such systems. FPS help improve the efficiency of the financial system by unlocking funds, given the 24/7/365 operation, reduce systemic risk by providing instant access of funds to beneficiaries, help improve oversight by enabling the central bank to have instant access to PSP data, reduce costs for users, and help drive financial inclusion and reduce dependency on cash for retail payments.
- 19 Credit risk among FPS participants emerge if the FPS is based on a deferred settlement arrangement, unless a “deposit” model is used. In a deposit model, payments are executed based on deposits pre-accumulated by the participants and held on a dedicated account. Each participant has a defined limit of transactions, covered by the funds earlier deposited on the dedicated account. Transactions are executed only up to the level of the limit set for a given participant. If the limit for the sent orders of a given participant is exceeded, the payment is rejected. Participants manage the level of their liquidity on the settlement account of the system and, depending on the situation, may complement the required limit or transfer the surplus of funds collected over the limit to their account.
- 20 See *Overview of Saudi Arabia’s 2020 G20 Presidency—Realizing Opportunities of the 21st Century for All*, Riyadh, 1 December 2019, and *Enhancing Cross-border Payments Stage 3 roadmap*, report by the Financial Stability Board, 13 October 2020.
- 21 Often, the complexity of public funding programs slows down the speed at which businesses and citizens receive the money and raises uncertainty as to whether and when the money will actually be made available. Failure to address these challenges aggravates the macroeconomic effects of the crisis and diminishes people’s ability to weather them, increasing their frustration.
- 22 See *Payment Aspects of Financial Inclusion (PAFI)*, report by the Committee on Payments and Market Infrastructures World Bank Group, 11 April 2016.
- 23 See *Payment aspects of financial inclusion in the fintech era*, report by the Committee on Payments and Market Infrastructures World Bank Group, April 2020.
- 24 See *Payment aspects of financial inclusion in the fintech era*, cit.
- 25 This section draws on BIS *Annual Report*, June 2020, Ch. III, “Central banks and payments in the digital era,” Bank for International Settlements, Basel, pp.67-95.
- 26 An API [Application Programming Interface] is a set of protocols and tools that underlie application software programming. An API defines how software components communicate with one another. An open API enables external app-developers to establish communication between their own apps and the apps and information systems of the entity providing the open API. In the case of payment services, a credit institution that uses an open API will be providing a digital platform that allows third party providers access to the account data and services it provides to its clients, provided the client has given his consent. For example, when a client places a payment order through a mobile app developed by a fintech service provider, the client’s bank will be obliged to grant the fintech provider access to its client account data for the payment to be made. Also, APIs that allow non-financial organizations to connect to PSPs can facilitate automated payments in the Internet of Things context (e.g., cars automatically paying an insurance premium in a pay-as-you-go model, objects automatically paying for the energy they consume, refrigerators sending shopping lists along with payment credentials to an online grocery delivery store, or in pay-per-use object-sharing models. Finally, FMs and critical service providers generally publish API specifications to enable direct connections between their clients’ back office systems and their own information systems. These direct connections could lead to greater transaction processing efficiency, including enabling straight-through processing.
- 27 This issue has been extensively studied in the recent literature. This subsection provides a summary of the main arguments, and Annexes 3 and 4 offer additional elements.
- 28 See below the sub-section on financial integrity for further possible consequences of this.
- 29 In fact, the “effective” lower bound is less than zero considering storage, insurance and transport costs associated with cash and the loss of convenience associated with cashless payments. For further details, please see Kolcunova D. and T. Havranek, (2018). “Estimating the Effective Lower Bound on the Czech National Bank’s Policy Rate,” *Czech Journal of Economics and Finance*, Charles University Prague, Faculty of Social Sciences, vol. 68(6), pages 550-577.
- 30 On this issue, the Bank of England says that, “The appropriate degree of anonymity in a CBDC system is a political and social question, rather than a narrow technical question. As discussed above, CBDC would need to be compliant with AML regulations, which rules out truly anonymous payments. However, CBDC could be designed to protect privacy and give users control over who they share data with, even if CBDC payments are not truly anonymous (or secret). For example, a user may legitimately want to make a payment to a supermarket without sharing their identity with the supermarket, as this would allow the supermarket to build a picture of their shopping habits. In most cases, the payer should be able to pay without revealing their identity to the payee. In this sense, they could have anonymity with regards to other users, without having anonymity with regards to law enforcement.” See *Central Bank Digital Currency Opportunities, challenges and design*, Discussion Paper, Bank of England, March 2020.
- 31 See *Central Bank Digital Currency Opportunities, challenges and design*, cit.
- 32 See Khiaonarong, T., and D. Humphrey, “Cash Use Across Countries and the Demand for Central Bank Digital Currency,” IMF Working Paper No. 19/46, March 2019.
- 33 The seigniorage of money equals the value of the money minus the cost required to produce it.
- 34 Bank deposits are, in many jurisdictions, under the coverage of deposit insurance. The extent of deposit insurance (i.e., coverage limit) and the speed with which it takes effect are the two features that would likely make CBDC preferable as a default risk-free alternative.
- 35 See Davoodalhosseini, M., F. Rivadeneyra, and Y. Zhu (2020), “CBDC and Monetary Policy,” Staff Analytical Note 2020-4, Bank of Canada, February.
- 36 The ELB is the rate below which it becomes profitable for financial institutions to exchange central bank reserves for cash.

- The experience of many developed countries has shown that the lower bound for nominal interest rates is not zero (as it was previously assumed), but negative due to cash storage costs. This is the reason why “effective” is used in place of “zero” to qualify more rigorously the lower bound.
- lower bound (rather than the more traditional “zero” lower bound).
- 37 This would require removing cash or at least restricting cash holdings (for instance, by eliminating large-denomination notes).
- 38 See Bindseil, U., and F. Panetta (2020) “Central bank digital currency remuneration in a world with low or negative nominal interest rates,” VoxEU/CEPR, 5 October.
- 39 Regardless of how desirable helicopter drops could be from a monetary policy perspective, they remain debatable from the point of view of fiscal equity, specifically considering how selectively they would be used across different individuals and businesses. The main concern is whether this is fiscal policy under another name, and whether the central bank should be in charge of distributional decisions. There is a strong case, thus, for thinking of helicopter drops in the context of coordinated action between monetary and fiscal authorities. In this regard, see Balls, E., J. Howat, and A. Stansbury, *Central Bank Independence Revisited: After the financial crisis, what should a model central bank look like?*, M-RCBG Associate Working Paper Series, No. 87, Harvard Kennedy School, April 2018.
- 40 While anonymity in the use of money is appreciated by many, it might also be possible that users would accept for basic information to be kept with a trusted institution—be that their bank or public authorities. Users today are willing to leave a trace and share information with financial intermediaries in exchange for being able to work online and prevent losses.
- 41 See Auer, R. and R. Boehme (2020), *The technology of retail central bank digital currency*, BIS Quarterly Review, March, and from the same authors, “CBDC architectures, the financial system, and the central bank of the future,” VoxEu, 29 October 2020, available at <https://voxeu.org/article/cbdc-architectures-financial-system-and-central-bank-future>.
- 42 See Auer, R. (2019), “Embedded supervision: how to build regulation into blockchain finance,” BIS Working Papers No 811, Bank for International Settlements, Basel, September.
- 43 In October 2020, The Bahamas launched the Sand Dollar, making it the first country in the world to officially release CBDC beyond the testing phase. To that end, it amended the Central Bank of The Bahamas Act to enable the central bank to issue digital currency (electronic money) as legal tender. Sections 8 and 12 of the Act establish that the currency of The Bahamas may include electronic money issued by the central bank (“The currency of The Bahamas shall comprise notes, coins and electronic money issued by the Bank under the provisions of this Act”) and that electronic money issued by the central bank is legal tender in The Bahamas (“All notes and electronic money issued by the Bank are legal tender in The Bahamas at their face value for the payment of any amount”). Section 15 of the Act empowers the central bank to issue regulations for the purpose of prescribing the framework for the issue of electronic money (“The Bank shall make regulations for the purpose of prescribing the framework under which electronic money issued by the Bank as legal tender may be held or used by the public in keeping with best international practices for the development and functioning of the payment system”). Section 8(3) refers to the definition of ‘electronic money’ as contained in Section 29 of the Payment System Act 2012. Finally, Section 14 sanctions counterfeiting and reproduction of currency, including in the form of electronic money.
- 44 In the case of The Bahamas—apparently the first country that has introduced CBDC beyond a pilot phase—the fact that the Central Bank Act specifically mentions that currency comprises notes and coins has required amending the Act expressly to recognize that the digital currency (rectius: electronic money) issued by the Central Bank is indeed currency.
- 45 Consistently with this line of reasoning, the amended Central Bank of The Bahamas Act contains a specific section empowering the Central Bank to prescribe the framework under which electronic money issued by the Bank as legal tender may be held or used by the public in keeping with best international practices for the development and functioning of the payments system.
- 46 To that end, the mentioned amendment to the Central Bank of The Bahamas Act explicitly affirms that digital currency is legal tender. Although the relevant section (Section 12) establishes thresholds for coins as legal tender, no qualification is made for digital currency. On the opposite, it is affirmed that the central bank may issue notes and coins and electronic money simultaneously, or issue electronic money in the place of notes and coins.
- 47 Whilst the amended Central Bank of The Bahamas Act specifically refers to the definition of e-money contained in the Payment System Act, 2012, there is no specific reference to the requirements specifically established for e-money in such earlier Act. However, it is assumed that the central bank may govern these aspects, as well as any protection of customers for digital currency to be accepted as legal tender, by way of regulation.
- 48 See Rachel, L. and L. H. Summers (2019), “On Falling Neutral Real Rates, Fiscal Policy, and the Risk of Secular Stagnation,” BPEA Conference Drafts, Brookings papers on Economic Activity, March 7–8.
- 49 See Ha, J., M. Ayhan Kose, and F. Ohnsorge (eds.) (2019), *Inflation in Emerging and Developing Economies: Evolution, Drivers, and Policies*, The World Bank Group.
- 50 See Agarwal, R., and M. Kimball (2015), “Breaking Through the Zero Lower Bound,” IMF Working Paper WP/15/224, International Monetary Fund, October, and Bordo, M., and A. T. Levin (2017), “Central Bank Digital Currency and the Future of Monetary Policy,” NBER Working Paper 23711, National Bureau of Economic research, August.
- 51 See Selezneva, V., M. Schneider, and M. Doepke (2015), “Distributional Effects of Monetary Policy,” No 1099, 2015 Meeting Papers, Society for Economic Dynamics, and Lenza, M., and J. Slacalek (2018), “How does monetary policy affect income and wealth inequality? Evidence from quantitative easing in the euro area,” ECB Working Paper Series No 2190, European Central Bank, October.
- 52 Notice that the expression “helicopter drops” derives from the expression “helicopter money,” coined by Milton Friedman (in his *The Optimum Quantity of Money and Other Essays*, Chicago: Aldine, 1969), when he wrote about the parable of dropping money from a helicopter to indicate a large economic stimulus through the issuance and distribution of money directly to people. According to S. Grenville (“Helicopter money,” VoxEu, 24 February 2013), the image of the central-bank helicopter dropping currency onto the eager public below is misleading: only governments can giving away either cash or, more realistically, cheques, and—as he argues—this is fiscal policy, not monetary policy, while central banks have

no mandate to give money away (they can only exchange one asset for another, as they do in quantitative easing). Decisions like this are backed by the usual budget-approval process. Thus, Grenville concludes, it is a government helicopter that does the drop, and it is called fiscal policy.

53 See Bindseil, U., and F. Panetta (2020), cit.

54 This annex draws on Bossone, B. (2020), "Banks create money (but only to a point): The 'payments perspective'," *Journal of Payments Strategy & Systems* Volume 14 Number 3, 286-304.

55 See The role of central bank money in payment systems, report by the Committee on Payment and Settlement Systems, Basel: Bank of International Settlements, August 2003.

56 See Brunnermeier, M. K., and D. Niepelt (2019), 'Public versus private digital money: Macroeconomic (ir)relevance,' *VoxEU*, 20 March.

57 See Andolfatto, D. (2019), 'Central bank digital currencies and private banks,' *VoxEU*, 17 March.

58 See Darbha, S, and R. Arora (2020), Privacy in CBDC technology, Staff Analytical Note 2020-9, Bank of Canada, June.



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