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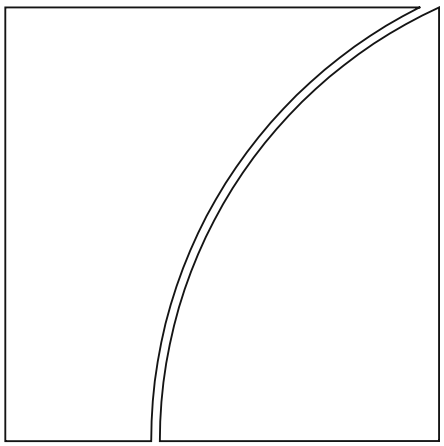

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Central bank digital currencies: a new tool in the financial inclusion toolkit?

By Raphael Auer, Holti Banka, Nana Yaa Boakye-Adjei, Ahmed Faragallah, Jon Frost, Harish Natarajan and Jermy Prenio

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Author contact information: Nana Yaa Boakye-Adjei (Nana.Boakye-Adjei@bis.org), Raphael Auer (raphael.auer@bis.org), Jon Frost (jon.frost@bis.org) and Jermy Prenio (jermy.prenio@bis.org), Bank for International Settlements (BIS), and Holti Banka (hbanka@worldbank.org), Ahmed Faragallah (afaragallah@worldbank.org) and Harish Natarajan (hnatarajan@worldbank.org), World Bank.

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Executive summary

Central banks are actively considering how retail central bank digital currencies (CBDCs) may fit with policy goals around financial inclusion. In the second half of 2021, authors at the BIS and the World Bank interviewed nine central banks at various stages of exploring retail CBDCs and financial inclusion. These are the Central Bank of The Bahamas, Bank of Canada, People's Bank of China, Eastern Caribbean Central Bank, Bank of Ghana, Central Bank of Malaysia, Bangko Sentral ng Pilipinas, National Bank of Ukraine and Central Bank of Uruguay. While a CBDC, like other forms of money, has different functions (eg means of payment, store of value, unit of account, settlement asset), its link to financial inclusion is in the context of its payment properties, and hence it is the lens through which CBDC is discussed in this paper.

The interviewed central banks take the view that, while CBDC is not a panacea, it can represent a further tool to promote financial inclusion if designed with this goal. The paper explores this theme, outlining findings in three main areas: (i) existing barriers to financial inclusion that could be addressed with the introduction of a CBDC; (ii) CBDC design features that many jurisdictions view as critical to addressing these barriers; and (iii) the challenges foreseen, along with legal and regulatory changes needed for CBDC implementation.

Barriers to financial inclusion differ across countries, but there were some common elements that came out in the interviews. These can be grouped into six main areas. First are geographic barriers related to vast territories and remote locations. Second are institutional and regulatory factors, such as a lack of public goods like identity credentials, as well as informality and a lack of consumer protection. Third are economic and market structure issues, including limited competition, inefficiency in the financial sector and a lack of profitability of serving excluded groups. Fourth are characteristics of vulnerability, such as barriers by age, gender, income or disability status like visual and hearing impairments. Fifth is a lack of education and financial literacy, and sixth is low trust in existing financial services.

Some central banks consider CBDCs as key to their mandate as a catalyst for innovation and economic development. While access to payment services has grown in recent years, it is still far from universal. Low-income populations and those living in remote locations continue to confront barriers to digital payments. Domestic retail payment services can be expensive, and payments across borders – particularly for low-value transfers like remittances – face even larger challenges. CBDCs can secure the continuous provision of public money to the general public. With CBDCs, central banks can help to speed up digital payment adoption, particularly when market size and profit potential are insufficient to motivate private sector innovation, or when established oligopolies prevent entry. Some central banks argued that they have a role to play in applying innovation to specific access challenges. As such, given the expanding yet uneven access to payment services, they recognise the importance of pursuing CBDC issuance.

Several central banks see CBDC more as a potential complement to existing financial inclusion initiatives. Many jurisdictions are tackling financial inclusion barriers today with dedicated strategies to improve the provision of transaction accounts and other payment products. The entry of non-banks and agent-based models, risk-based and proportionate customer enrolment processes, effective use of data and interoperability remain relevant. Authorities are already expanding the network of readily available access points and developing tools to improve awareness of transaction accounts and digital money, including by promoting financial and digital literacy. Central banks are also modernising existing

payment infrastructures with the introduction of fast payment systems and leveraging high-volume recurrent payment streams. Several central banks noted that these actions, if implemented effectively, would be the most direct means to tackle financial exclusion. These are in line with the Committee on Payments and Market Infrastructures and World Bank guiding principles of payment aspects of financial inclusion (PAFI).

The central banks that see greater potential for CBDCs to enhance financial inclusion noted several specific design features. These design features target four broad objectives that, in turn, address specific financial inclusion barriers.

- **Promoting innovation in the two-tiered payment system.** This can be achieved through architectures that involve private sector retail services (as in existing systems), including new (non-bank) actors, and by revisiting rules on authorised access.
- **Offering a robust and low-cost public sector technological basis and novel interfaces.** CBDCs can be designed as a public sector-led basis for private sector innovation. This may include providing low-cost CBDC payment services with fees set by the central bank. CBDCs may use open application programming interfaces to share data with appropriate safeguards, such as separating transaction and personal data. CBDCs could support technological solutions with offline functionality (ie when mobile connectivity or even electricity are unavailable).
- **Facilitating enrolment and education on CBDC.** This involves the application of simplified due diligence processes to enrol individuals and micro-enterprises, remote registration or electronic know your customer (e-KYC), integration with national digital ID systems, merchant acceptance of CBDC, enabling access to special groups with limitations and giving users control of their data to support the building of a financial record. These should be accompanied by targeted digital and financial literacy campaigns.
- **Fostering interoperability among multiple dimensions.** This entails integrating CBDC with existing payment instruments like credit transfers, payment cards and mobile money. It requires interoperability with other cross-border CBDC systems and with government payment and collection streams.

Obtaining buy-in from stakeholders and safeguarding data privacy were highlighted as two major challenges. Buy-in from all key stakeholders, including those currently not reached by formal financial services, must be achieved if CBDC issuance is to have the intended impact. The more individuals, merchants and financial intermediaries that can be onboarded and sustainably participate in the system, the more attractive the use of CBDC will be to further users. This will entail decisions on a number of key issues, including pricing of CBDC services. Moreover, complementary initiatives may need to address obstacles such as limited financial and digital literacy. Similarly, safeguarding data privacy and preventing the misuse of consumer data will be essential to ensuring the same level of public trust in the CBDC that other forms of central bank money, such as physical cash, enjoy. One promising approach is to separate individual transaction data from identity information, and to engineer privacy by design.

CBDC issuance may require new laws and regulations to be enacted, or existing laws to be revised. These include central bank laws to provide the appropriate powers to issue CBDC and oversee the CBDC ecosystem. Similarly, issuance may require introducing new, or revising existing, laws for effective oversight of relevant CBDC participants, whether existing or new players undertaking similar or novel roles under the CBDC system. Relevant thematic laws, such as those for data privacy and anti-money laundering / combating the financing of terrorism (AML/CFT), may need to be re-examined to assess their continued relevance in the context of CBDCs. In addition, other relevant laws may need to be changed to legally recognise CBDC as an asset, including laws pertaining to taxation, property foreclosure and disposal of electronic wallets in bankruptcy. There may need to be criminal laws that provide legal protection for the possession of CBDCs, as with cash today.

Section 1 – Introduction

1. **Inclusive financial services are a crucial prerequisite to economic growth and poverty reduction, in both emerging market and developing economies (EMDEs) and advanced economies (AEs)**.[1] Financial inclusion means that "individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way. Being able to have access to a transaction account is a first step toward broader financial inclusion since a transaction account allows people to store money and send and receive payments."[2] Digital payments are often the entry point for digital financial services and provide the infrastructure or "rails" through which additional products and use cases can be developed (eg credit, insurance, savings products). Digital payments therefore not only provide individuals and businesses with convenient and affordable channels by which to pay and be paid, but also benefit the financial health of individuals and businesses by facilitating access to other financial services beyond payments. Governments can use digital payments to increase efficiency and accountability in various payment streams, including for the receipt of tax payments and disbursement of social transfers.

2. **In the past several years, disruptive fintech innovations have driven impressive progress in financial inclusion, particularly in EMDEs**. According to the World Bank's Financial Inclusion Index (Findex), 1.2 billion adults gained access to a transaction account between 2011 and 2017.[3] Most of this progress was driven by new digital technologies, often supported by government and central bank policies.[4] In several markets across Sub-Saharan Africa and Asia, mobile money, agent-based distribution models, payment applications and quick response (QR) codes have significantly improved access to and use of digital payment channels, and as a result, digital transaction accounts. There is evidence that this has contributed to poverty reduction and greater resilience of households.[5] In India, the public sector-led transformation of the financial infrastructure has provided the foundations needed to significantly increase bank account penetration from 10% to 80% in just over a decade.[6]

3. **While digitalisation has resulted in material progress in financial inclusion globally, 1.7 billion people remain outside the formal financial system.**[7] Persistent barriers to inclusion, such as poor access point coverage, limited competition in the financial sector and low levels of financial literacy, continue to limit access to financial services for vulnerable groups. Many users also prefer cash. Yet the digitalisation of financial services, the decline of cash use and the closure of physical branches raise new risks that could exacerbate exclusion going forward**.**

4. **Central banks around the world are researching newer forms of innovation, such as CBDCs**. CBDCs could complement cash and reserve accounts that central banks currently provide. Formally, a "CBDC is central bank-issued digital money denominated in the national unit of account, and it represents a liability of the central bank. If the CBDC is intended to be a digital equivalent of cash for use by end users (households and businesses), it is referred to as a 'general purpose' or 'retail' CBDC".[8] As of January 2022, BIS research noted that 68 central banks had announced that they are actively engaging in some form of

1 See Demirgüç-Kunt et al (2017).

2 World Bank (2021a). See also Her Majesty Queen Máxima of the Netherlands, UNSGSA (2010), CPMI and World Bank (2016, 2020) and World Bank (2021b), accessed 1 December.

3 Ansar et al (2018).

4 See BIS (2020) and Auer, Frost, Lammer, Rice and Wadsworth (2020).

5 See eg Jack and Suri (2014), Munyegera and Matsumoto (2016) and Riley (2018).

6 D'Silva et al (2020); Frost, Gambacorta and Shin (2021).

7 Ansar et al (2018).

8 BIS (2021).

CBDC research or development work, with a significant share of these at an advanced stage in their exploration of the topic.[9] The focus of this paper is on retail CBDC, rather than wholesale CBDC.

5. **Financial inclusion is a key driver of such work, particularly in EMDEs.** While motivations for issuing a CBDC vary, interest in the potential impact of retail CBDCs on financial inclusion has risen in recent months, and there is some budding research (see Box 1 for an overview of publications exploring the topic). A BIS survey of 81 central banks found financial inclusion to be a top priority for CBDC development amongst EMDEs.[10] This paper aims to inform the public policy discussion and cooperation between central banks on these issues.

6. **To explore further the link between CBDC and financial inclusion, the authors chose to interview contacts at nine central banks that are undertaking work on CBDCs and/or financial inclusion.** The central banks were chosen to provide geographical variation and insights from different levels of financial inclusion; they thus provide a diversity of perspectives. The central banks are the Central Bank of The Bahamas (CBB), Bank of Canada (BoC), People's Bank of China (PBC), Eastern Caribbean Central Bank (ECCB), Bank of Ghana (BoG), Central Bank of Malaysia (BNM), Bangko Sentral ng Pilipinas (BSP), National Bank of Ukraine (NBU) and Central Bank of Uruguay (BCU). Interviews took place over June–October 2021. The counterparts were generally experts in CBDC, payment and financial inclusion teams. The interviews explored existing barriers to inclusion in their jurisdictions, and which aspects of their current or planned design for a CBDC would target these barriers. Understanding why a CBDC was being considered as a potential remedy to persistent financial inclusion challenges, relative to other payment instruments and/or system developments, was an important element of the research. The central banks interviewed also provided insights into the risks and/or challenges they had identified in their planned approaches, and the regulations and policies needed to effectively implement CBDC.

7. **The findings of this study show that there is great value in peer learning around CBDCs and financial inclusion.** Indeed, many central banks face similar challenges, and novel solutions developed in one jurisdiction are often relevant for others. While central banks hold different views on the relative promise of CBDCs versus other reforms, they generally agree that inclusive designs are important. Counterparts noted that to address financial inclusion challenges, CBDCs would need to have features such as offline capabilities, differentiated balance and transaction limits, low-cost transactions and data portability.

8. **This paper is organised as follows:** Section 2 analyses barriers to financial inclusion and existing policies to address them. Section 3 discuses CBDC design considerations to promote financial inclusion. In Section 4, we turn to challenges and risks of CBDC issuance and the legal and regulatory implications of implementing CBDC. Finally, Section 5 concludes with thoughts on how to support international policy dialogue going forward.

Section 2 – Barriers to financial inclusion and policies to address them

9. **Among most central banks interviewed for this study, financial inclusion is a key policy goal.** In some cases, financial inclusion is an explicit component of the central bank's mandate. In other cases, it is an implicit goal, understood as part of the central bank's mandate to ensure sound and efficient payment systems and promote economic growth. Several countries have explicit financial inclusion strategies, and some central banks have dedicated units supporting financial inclusion efforts (eg BSP's Financial Inclusion Office).

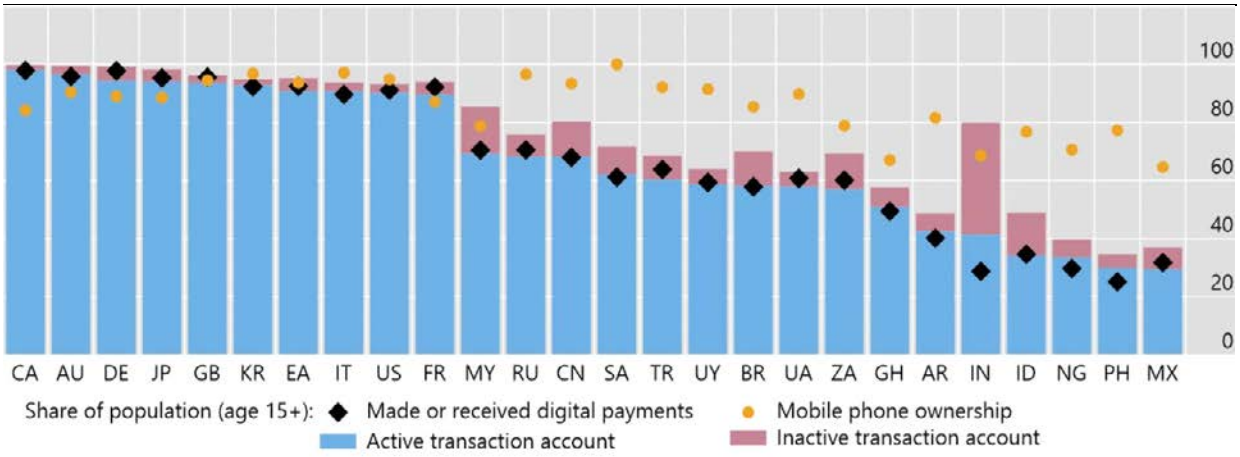
[9] Auer, Cornelli and Frost (2020), as updated through January 2022. See also Soderberg et al (2022).

[10] Kosse and Mattei (2022). See also Boar and Wehrli (2021).

10. **Access to transaction accounts, ie bank and e-money accounts, is a foundational aspect of financial inclusion, giving individuals the means to pay and save in the formal financial system.**[11] Such access has been improving over time, although it has not always translated into more use of the digital payment instruments and services that come with such accounts. In some of the countries discussed in this study, over half of adults lacked access to a transaction account.[12] Mobile phone ownership has risen rapidly in recent years and is often higher than transaction account ownership. Mobile phones (both smartphones and basic "feature phones") can help users to access payment services without visiting a physical bank branch, and mobile money has been an important driver of progress on transaction account access. Yet mobile ownership is also far from universal in most countries. Finally, the use of digital payments often lags transaction account coverage; due to high fees or limited usability, many accounts are inactive (Graph 1).

Account access, mobile phone ownership and use of digital payments vary widely

In per cent — Graph 1



For EA, simple average of the member countries. Data for 2017.

Sources: World Bank, *Findex*; authors' calculations.

11. **The barriers to financial inclusion differ across countries, but there are some common themes that came out clearly in our interviews.** These can be grouped as follows:

- **Geographic barriers:** many of the countries in our sample have vast territories (eg Canada or China) or a large number of islands (eg the Bahamas, Eastern Caribbean Currency Union or the Philippines). Especially for households and businesses in remote, rural areas and on islands, there may be severe challenges around data connectivity (fixed broadband or mobile data access), physical branches of financial institutions and even reliable access to electricity. For people in these areas, cash is often a much more convenient means of payment than bank money or digital applications that require a computer or mobile phone. This is reflected in lower access to and use of digital payments (Graph 2, left-hand panel). Account access and use are also highly correlated (centre panel). In many cases, the telecommunications service in remote geographic areas is inadequate for even feature phone-based mobile money services.
- **Institutional factors:** in many jurisdictions, basic public goods like identification (ID) are absent or not widespread. Some individuals lack an ID document or credentials to meet the basic know-

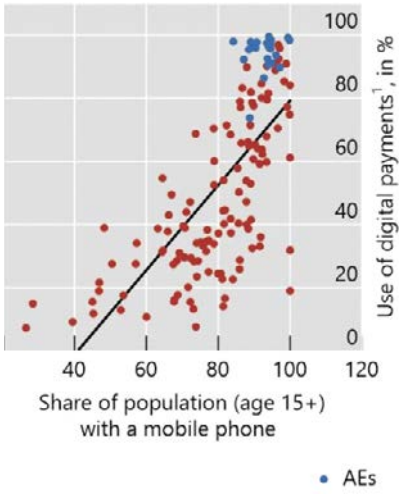
[11] See CPMI-World Bank Payment Aspects of Financial Inclusion (2016) and Arner et al (2018).

[12] Data derived from the 2017 World Bank Findex survey, which is the most recent iteration published. The 2021 iteration has been delayed due to Covid-19.

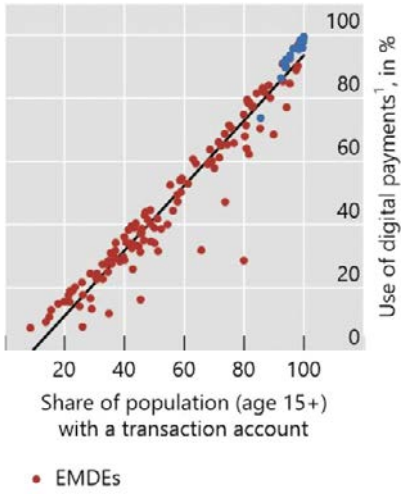
your-customer (KYC) requirements to open a transaction account (Graph 2, right-hand panel). In many cases, the large informal economy does not require formal ID credentials to transact, and households and firms often have concerns about the compliance costs associated with formalising such activities. In general, regulatory gaps or weak regulatory frameworks, particularly for non-bank financial institutions, also hinder financial inclusion. In particular, where consumer protection regulation is not well developed, individuals and businesses may not be willing to use transaction accounts even where they are available.

Mobile phones and ID credentials are fundamental to digital financial services — Graph 2

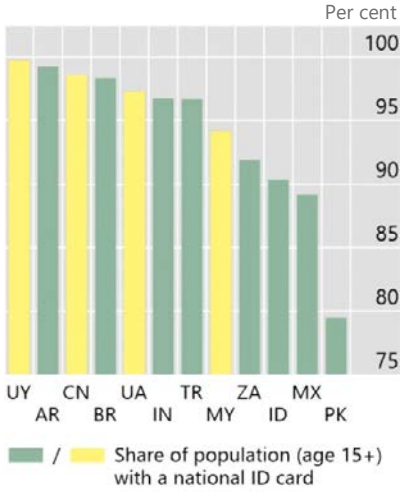
Use of digital payments rises with greater mobile ownership…



…and with greater access to transaction accounts



National identity cards are near-universal in many countries, but there are gaps in several others[2]



Data for 2017.

[1] Share of population (age 15+) that used the internet to buy something online in the past year. [2] Yellow bars correspond to countries that have been interviewed for this project.

Source: World Bank, *Findex*.

- **Economic and market structure barriers:** in many EMDEs and some AEs, there is limited competition in the financial sector. This results in high markups (margins) by banks and other financial institutions, visible in a high cost of executing payments and a large wedge between lending and deposit rates for households and businesses. In many cases, low efficiency may mean that it is not profitable to serve low-income users, and a lack of competition among incumbent financial institutions can mean high prices and poor services.[13] Even in a competitive landscape, banks may invest considerable resources in attracting high-income users, but very little to serving the lower end of the market. Competition from the entry of new types of providers or business models might be beneficial.
- **Characteristics of vulnerability:** many central bank counterparts emphasised gaps in inclusion by age (with older users and youth often excluded or underserved), gender (with women often excluded or underserved) or region (with rural users underserved relative to those in urban areas).[14] Individuals with lower incomes universally have lower access to transaction accounts,

[13] The ECCB pointed to complacency by the private sector, and a bank-centric model, which has resulted in lack of innovation, lack of competition and high end user prices.

[14] In many cases, these gaps are also present in new fintech services. See Doerr et al (2022) and Chen et al (2021). Unbanked users are also found to be less likely to have internet access; see Hayashi and Minhas (2018).

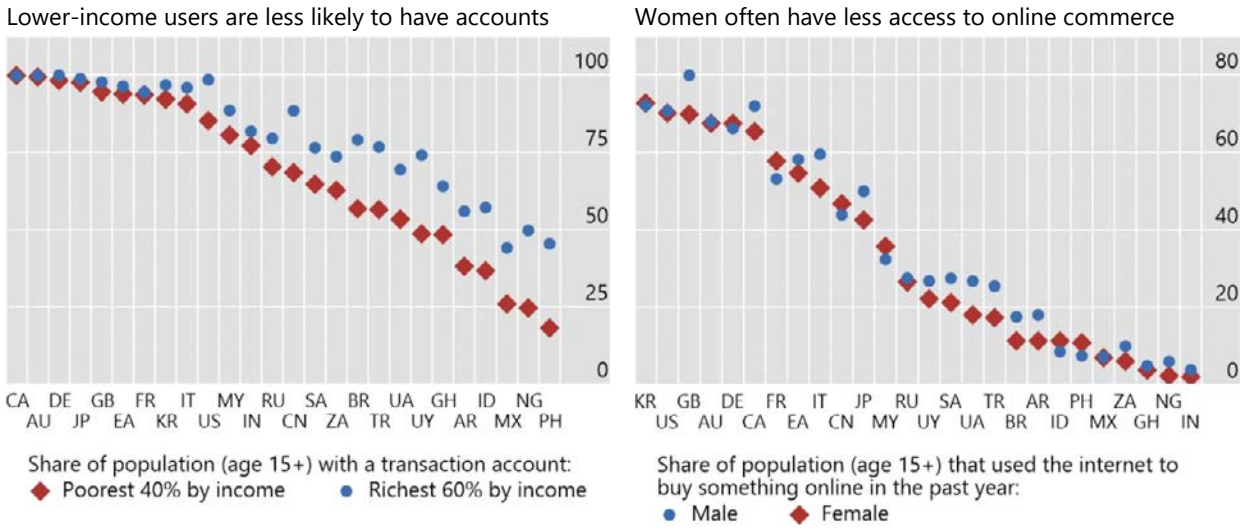
though the gap is larger for EMDEs than AEs (Graph 3, left-hand panel). Women are less likely to have used the internet to buy something in the past year (right-hand panel).[15] Some central banks discussed the challenges in accessing financial services for those with disabilities like visual and hearing impairments, or a lack of formal education.

- **Limited financial literacy:** in several cases, central banks emphasised a low level of financial and digital literacy, for instance around how to save and borrow, how to understand and compare financial offers or how to prepare for unexpected life events. Several referred to a "cash mindset" among households, who see cash as easy to use and helpful for budgeting or controlling spending.
- **Limited trust in financial institutions:** some central banks explicitly referred to low trust in existing financial services and institutions as a barrier to account access (see also Gjefle et al (2021)). Where users have experienced bank failures, fraud, hidden fees or discriminatory treatment, they may be particularly wary of using these institutions' services.

Account access and digital payments use vary by income and gender

In per cent

Graph 3



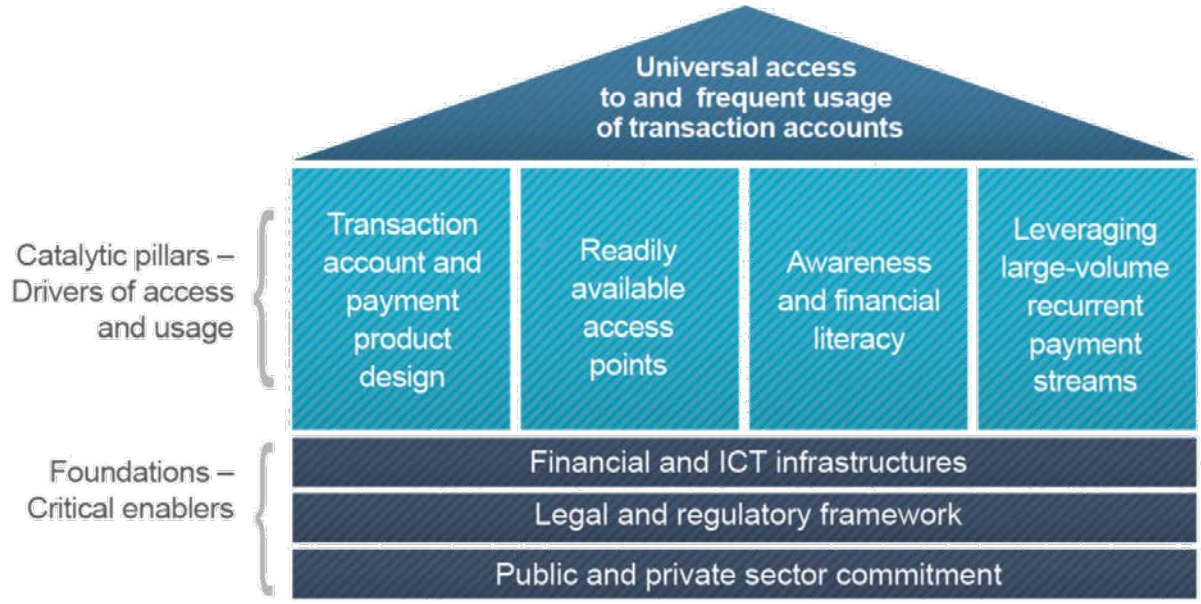
Data for 2017.

Source: World Bank, *Findex*.

12. **Public authorities are tackling these barriers with dedicated strategies and a range of policy tools.** In many cases, central banks are working with other public authorities and the private sector. These initiatives can be grouped into the foundational "critical enablers" and the subsequent "catalytic pillars" of the Committee on Payments and Market Infrastructures (CPMI)-World Bank (2016) PAFI framework (Graph 4). These aim to support universal access to and frequent use of transaction accounts, and thus to support overall financial inclusion and consumer welfare. We will start with the critical enablers, and then consider the catalytic pillars.

[15] In the global sample, 30.3% of men had made a purchase online, while only 27.7% of women had done so. Some countries show an exception to this pattern, including China, France, Germany, Indonesia, Malaysia and the Philippines.

Framework for the guidance on payment aspects of financial inclusion Graph 4



Source: CPMI and World Bank (2016).

- **Public and private sector commitment:** while the private sector typically drives payment innovation, central banks play an important role as regulators, overseers and catalysts. In many cases, central banks chair forums like national payment system councils, are (co-)operators of retail payment systems and define national payment strategies.[16] Efforts among public and private stakeholders have resulted in marked progress over time.
- **Legal and regulatory framework:** in many countries, the focus has been on the facilitation of basic transaction accounts, with simplified KYC, low-cost maintenance and no balance requirements (eg basic deposit accounts in the Philippines). Consumer protection has also received attention in many countries. For instance, in 2020 the NBU established a special department responsible for consumer protection issues, covering both banks and non-bank payment service providers (PSPs).
- **Financial and ICT infrastructures:** authorities in countries like China and the Philippines have implemented new generation payment systems (ie retail fast payment systems) in order to create an open payments ecosystem that would address the needs of the financially excluded.[17] Meanwhile, closed-loop retail payment models like AliPay and WeChat Pay in China have driven dramatic improvements in transaction account access, but such private infrastructures often lack interoperability between one another. (This is a key consideration for creating an open and interoperable CBDC system – see below). Some countries have tried to create a more level playing field by opening up payments clearing infrastructures, such as automated clearing houses (ACHs) to non-bank PSPs for direct access. These financial and digital infrastructures can allow for efficiency gains to promote inclusion. In addition, other supporting infrastructures such as ID systems are also beneficial to inclusion. The Philippines, for instance,

[16] For example, see Central Bank of Kenya (2022), which includes consideration of financial inclusion and CBDCs.

[17] Retail fast payment systems can be designed to allow free payments for individuals, interoperability between bank and non-bank PSPs and a wide range of interfaces. One example is the Pix instant payments system in Brazil. See Duarte et al (2022). These may also use DLT, such as the Bakong system in Cambodia. See NBC (2020).

has been working towards a universal digital ID system that would enable online and offline authentication and, in turn, facilitate digital payments such as disbursements to cash assistance beneficiaries.

- **Transaction account and payment product design:** various market initiatives have been put forward to foster easier access to transaction accounts. Some examples mentioned during the interviews include facilitating remote KYC for account opening, extensive use of e-money and the use of near-field communication (NFC) mobile wallets (like Apple Pay).
- **Readily available access points:** agent-based service points (particularly in rural areas) have been used in countries including China, Ghana and the Philippines to address the problem of last-mile financial inclusion. Moreover, the deployment of "light" digital payment infrastructure at the point of sale, such as QR codes like QRPH in the Philippines, was also mentioned during the interviews. The lack of widespread access points is still an issue in several of the interviewed countries, though.
- **Awareness and financial literacy:** public campaigns to enhance financial literacy are a common practice followed by almost all those interviewed. Central banks and other authorities target these campaigns to the needs of their jurisdiction, for example by paying special attention to the payment needs of people with disabilities.
- **Leveraging high-volume recurrent payment streams:** some central banks noted the importance of channelling government payments, such as public sector salaries, pensions and social protection grants, to transaction accounts to increase access and ultimately use of formal payment services.

13. **These measures have borne fruit, but gaps remain.** Overall, account access has improved across regions (Graph 5, left-hand panel). Yet financial and digital literacy remain low in many regions (centre panel). In many countries, households and businesses continue to rely on the informal ("shadow") economy, and estimates show that the share of informal activity has remained persistently high, particularly in Sub-Saharan Africa and Latin America and the Caribbean (right-hand panel).[18] Further reforms must grapple with these issues, helping users to access formal financial services and for such services to help meet their needs.

[18] See eg Alfonso et al (2022).

Box 1

CBDCs and financial inclusion: related literature

The potential of CBDCs to address financial inclusion barriers has been discussed in several publications.

A CPMI and World Bank (2020) paper, *Payment aspects of financial inclusion in the fintech era*, discusses the growing interest amongst EMDE authorities in CBDCs for financial inclusion purposes. The paper notes the importance of non-banks in this context. It outlines two potential transfer mechanisms that could be relevant to financial inclusion – account- or value-based, recognising that more research would be required to determine which features of a CBDC would best support financial inclusion objectives (see Section 3). The report also highlights the potential risk that CBDCs could crowd out private sector initiatives that could be equally or better suited to providing individuals with a basic means of payment, such as fast payment systems.

The World Bank (2021) paper *Central bank digital currency: a payments perspective* focuses on payments-related considerations for a CBDC, yet it also covers several considerations relevant to financial inclusion. The paper argues that CBDC may be help enhance payment system efficiency by promoting competition and innovation, but it should not be viewed as a panacea. The note provides a framework to support the decision-making process that central banks can undertake when considering a CBDC:

- Why? Refers to the reasons and objectives that motivate CBDC implementation.
- What? Refers to the type and model of CBDC to be eventually chosen.
- When? Refers to the timing for implementing a CBDC.
- Where? Refers to the system/infrastructure (existing or planned) from which a CBDC would be issued and circulated.
- Who? Refers to the stakeholders that should be involved in the process, their roles, and their cooperation and competition in the CBDC process.

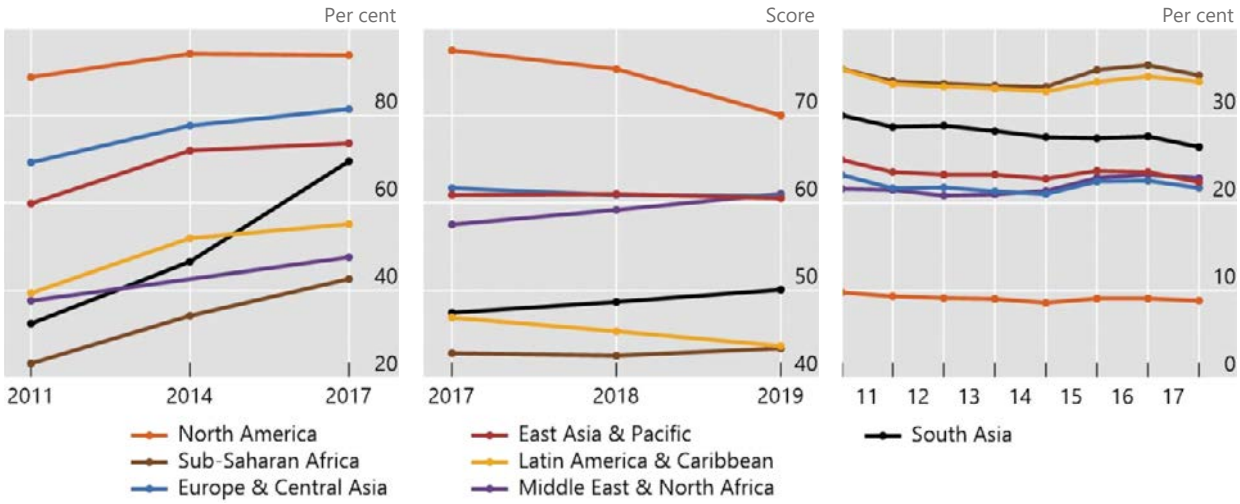
Given the growing interest in CBDCs, the G7 (2021) published a set of principles related to public policy implications to guide and inform the exploration of retail CBDCs within the G7 and other interested countries. On financial inclusion, the report argues that "CBDC ecosystems should avoid reinforcing barriers to financial access and should not introduce any unintended sources of exclusion". It also emphasises work on "a wider set of enabling policies, particularly on financial literacy, digital literacy and open and affordable access to digital infrastructure".

In her paper *Inclusion by design: crafting a central bank digital currency to reach all Americans*, Maniff (2020) outlines six design features that would allow universal access to a CBDC to be achieved in the United States. These are: (i) no minimum balances; (ii) the ability to transact at any time, at very low cost; (iii) achieving a balance between consumer privacy and AML/CFT requirements; (iv) a wide range of access points including retail stores; (v) conversion at parity with cash; and (vi) CBDC accounts being offered by both financial and non-financial service providers. The paper concludes that the six features are not exhaustive, recognising that a CBDC may not be able to reach those who wish to remain outside the financial system.

In a Cenfri paper, Allen et al (2019) investigate CBDCs and financial inclusion through the lens of mobile money. The paper builds on previous work done by Cenfri, exploring the benefits and potential risks of CBDC. Key findings from their work point to mobile money being a positive use case for CBDC. The paper argues that "the application of retail CBDC to mobile money has the potential to foster greater interoperability, improve payment efficiency, facilitate cost-saving gains by minimising reconciliation complexity and notional costs, as well as reduce the key payment risks that are typically associated with mobile money". The paper highlights the potential for CBDC to heighten the risk of cyber security for service providers, and also potentially to intensify the perceived complexity of mobile money services for those that already have a limited understanding of financial services.

In the paper *Centering users in the design of digital money*, Gjefle et al (2021) at the MIT Digital Currency Initiative (DCI) and Maiden Labs examine common assumptions by technologists and policymakers about likely CBDC users. In this light, they present findings from 91 qualitative interviews and a survey of 1,319 Americans to understand their experience with the US payment system. They show that user pain points for US consumers are especially uncertainty around the speed, cost and security of transactions; distrust of banks; poor user experiences; and privacy in the user's social circle. They argue that digital currencies should be designed to address these points, for instance by alleviating uncertainty, offering access through modes other than banks, improving speed and clarity of cross-border transactions, and addressing concerns about data use.

Account access is rising, but other indicators are more mixed[1] Graph 5



[1] Regional aggregates correspond to simple averages of the member countries. [2] The graph shows digital skills among the population from the World Economic Forum (WEF) Global Competitiveness Indicators (GCI) 4.0. The index measures the extent to which the active population possesses sufficient digital skills such as computer skills, basic coding and digital reading. Higher scores reflect better digital skills. [3] Estimates of the informal ("shadow") economy based on a multiple indicator–multiple cause approach.

Sources: Medina and Schneider (2019); World Bank; World Bank, *Findex*; authors' calculations.

14. **Several central banks see a CBDC as a potential complement to existing financial inclusion initiatives.** Yet their degree of optimism varies. For instance, the NBU notes that financial inclusion is not a key driver of its work on CBDCs; it sees programmability, usage of virtual asset markets and cross-border payments as more salient use cases. In the Philippines, the BSP argued that financial inclusion could also be supported by using already available products in the market and existing payment infrastructures and public policy tools.[19] By contrast, the central banks of the Bahamas, China, the Eastern Caribbean and Ghana noted a potential for CBDCs to enhance financial inclusion. In particular, the PBC referred to the potential of offline payments (see Section 3). The ECCB noted the potential to lower the cost of transactions. The exact scale of these effects will depend on a range of factors, particularly around the design of a CBDC.

Section 3 – Inclusive CBDC design

Do CBDCs have a unique proposition with respect to financial inclusion?

15. **Before drawing on central bank responses, it is useful to discuss whether and how CBDCs offer a unique value proposition for financial inclusion.** The CPMI-World Bank Guiding Principles for Payment Aspects of Financial Inclusion presented in Graph 4 can be a useful framework for this exercise.

[19] Bangko Sentral ng Pilipinas (2021).

Foundational enablers:

- A CBDC requires public authorities to be in the lead in the design and implementation, and as such is accompanied by a strong public sector commitment.
- As a liability of the central bank, a CBDC – like cash – would not be subject to credit risk and would thus provide greater safety to end users. Like cash, it can provide a tangible link between the central bank and the general public. As a central bank-operated system, CBDCs could allow for fees to be set and rules on data usage to be established in line with public interest rather than commercial considerations.
- A CBDC system could be made available to all licensed payment service providers – either developed from the ground up or by upgrading existing payment systems. This could provide an impetus to public authorities to institute necessary changes in the governance and access policies of payment systems and require a higher level of commitment to safety, reliability and efficiency.
- As regards the legal and regulatory framework, a CBDC could allow for a new type of intermediaries that offer payment services but do not handle customer funds – akin to payment initiation service providers (PISPs) under the Second Payment Services Directive (PSD2) in the EU, and similar frameworks in other jurisdictions. Such institutions pose a lower level of prudential risk and as such can have lower capital requirements and be subject to lower regulatory and supervisory intensity. This may incentivise a new set of players to enter the payment services market.
- New functions such as programmability can enable certain regulatory requirements to be programmed into the CBDC design, instead of relying on implementation of the regulations by the PSPs and other regulated intermediaries, and their validation through supervisory actions. For example, validation of the KYC status of a payer and payee can be made a pre-condition and enforced by the CBDC system for any transfer over a threshold amount. A CBDC system could also allow for simultaneous transfers from or to multiple users when certain conditions are met.[20]
- The offline capabilities of a CBDC could reduce dependence on the quality and availability of mobile and broadband networks, and round-the-clock availability of electricity.

Catalytic pillars:

- By enabling a new class of PSPs to enter the market, CBDCs could introduce more vibrancy and innovation, leading to more tailored and compelling value propositions for both payers and payees.
- As an open-loop system, CBDCs could engender more open innovation by a range of actors and provide an easier pathway for their introduction, as there would be a presumption of universal acceptance of any CBDC-based service.
- Particularly, token-based CBDCs can enable payments in newer contexts like the "internet of things", and programmability could allow payment services to be embedded into commercial and social interactions and enable their orchestration.
- CBDC design could enable approaches for giving users control over data generated by payment transactions, which might otherwise remain for exclusive use by a few players in concentrated markets. This gives consumers the ability to "port" their payment transaction histories and use them to obtain access to financial services beyond payments. This would necessarily need to be

[20] See FRB Boston and MIT DCI (2022), and Lovejoy et al (2022) for a discussion in the context of Project Hamilton.

accompanied by adequate data protection and privacy measures and be based on informed consent of the data owner – the payer or the payee.

16. **It needs to be noted that many of these features can, in isolation, be offered by other payment innovations, and many gaps could be addressed through regulation and sound oversight arrangements.** Combining different payment innovations – such as open application programming interfaces (APIs), fast payment services, contactless chips and QR codes – could achieve many of the same goals. This is particularly true when accompanied by robust regulatory and oversight arrangements that public authorities can use to catalyse private sector players, enforce sound governance arrangements and foster required coordination and collaboration. Adoption of relevant technologies for supervisory and regulatory compliance could also improve the efficiency and effectiveness of regulators and supervisors. What is truly different about CBDC is that it is a direct claim on the central bank. It is an open question for central banks whether CBDCs or other policy interventions are the best fit for their jurisdiction. Yet if a CBDC is to be issued (for financial inclusion or other motives), interviews with central banks clearly point to the importance of inclusive design elements to successfully promote inclusive outcomes. We discuss these elements in the next subsection.

Insights from the central bank interviews

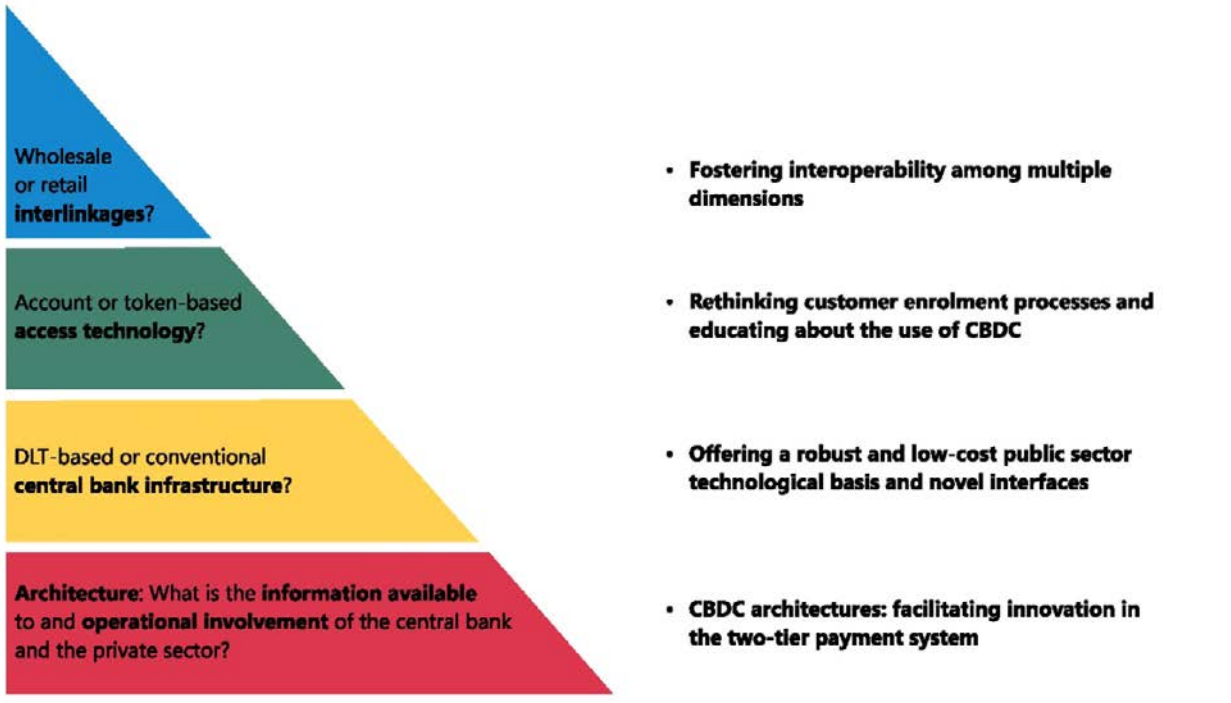
17. **The central banks interviewed for this study are at different stages of exploring how a CBDC might address specific challenges in their market.** The Bahamas is the first jurisdiction globally to move to full implementation of a CBDC. Nigeria also launched a CBDC, called the eNaira, in October 2021, but was not included in our interview sample. (See Box 2 for more on the eNaira). The CBU undertook a pilot between November 2017 and April 2018, concluding that more research was needed. The PBC has undertaken pilots across several provinces to test potential features of its CBDC. The Eastern Caribbean's DCash pilot was live at the time of interview, and the results of the pilot would inform subsequent plans for commercial deployment. The NBU completed a pilot in 2018 and, at the time of the interview, noted that it continues to explore features for its e-hryvnia, as well as actively engaging with stakeholders in preparation for a larger pilot. Canada is currently in the consultation phase, engaging with key stakeholders to define the parameters of any potential pilot or deployment. The central banks of the Philippines, Malaysia and Ghana are at varying stages of initially researching the potential of a CBDC, and its usefulness given their specific market contexts.

18. **For some central banks, such as those of the Bahamas, Eastern Caribbean, Ghana and China, addressing persistent barriers to financial inclusion has been cited as a major motivation for a CBDC.** This has factored into their thinking of how a CBDC should be designed. For other central banks, such as those of Uruguay and Ukraine, financial inclusion has been less of a driving force for exploring the potential of CBDCs, and as such less of a consideration when exploring potential design features. The central banks of the Philippines and Malaysia, despite still exploring the potential of CBDC for financial inclusion purposes, highlighted the use of existing innovations to address their specific issues. For Canada, the only advanced economy in our sample, most of the population has access to financial services. For those that do not, the issues are specific and may require very tailored solutions. So, while the BoC is exploring CBDC for much broader reasons than financial inclusion, it recognises CBDC's potential for addressing the country's particular access challenges (eg limited access to transaction accounts in very remote parts of the country).

19. **Several design features and supporting policies were mentioned as important to ensuring that CBDC can effectively address financial inclusion barriers.** The goal of CBDC issuance is generally to enhance the access of individuals and businesses to useful and affordable payment services and, to some extent, as a store of value – delivered in a responsible and sustainable way. Design features target four broad objectives that, in turn, address specific financial inclusion barriers discussed in Section 2.

- **Promoting innovation in the two-tiered payment system.** This can be done by designing architectures that involve the private sector and applying rules on authorised access.
- **Offering a robust and low-cost public sector technological basis and novel interfaces.** This can be done through public sector-led technology initiatives as the basis for private sector innovation. In particular, central banks discussed providing low-cost CBDC payment services with fees set by the central bank, using APIs to share data with appropriate safeguards, such as separating transaction and personal data, and technological solutions with offline functionality.
- **Facilitating enrolment and education on the use of CBDC** This includes applying simplified due diligence (SDD) processes to enrol individuals and micro-enterprises, allowing remote registration or electronic know your customer (e-KYC), integration with national digital ID systems, facilitating merchants' access to and acceptance of CBDC, enabling access to special groups with limitations and giving users control of their data to support the building of a financial record. These should be accompanied by targeted digital and financial literacy campaigns.
- **Fostering interoperability among multiple dimensions.** This entails integrating CBDC with existing payment instruments including credit transfers, payment cards and mobile money. It also requires interoperability with other cross-border CBDC systems and with government payment and collection streams.

CBDC design framework and stages — Graph 6



Sources: Auer and Böhme (2020); authors' elaboration.

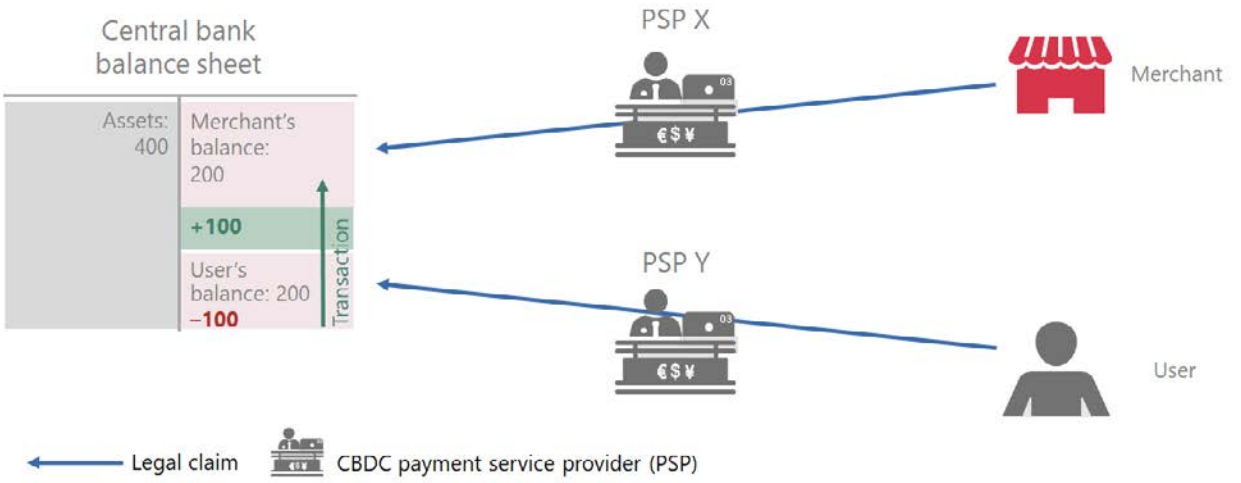
Graph 6 gives an overview of the main dimensions of the national CBDC design framework. Below we discuss these four objectives, structuring the discussion to reflect the inclusion-specific focus areas highlighted by those interviewed for this study.

Promoting innovation in a two-tiered payment system

20. **Most of the central banks interviewed are considering or implementing two-tiered CBDC designs that leverage on the existing system of regulated financial intermediaries, but also allow for new PSPs**. In the terminology of Auer and Böhme (2020, 2021), all jurisdictions were considering the so called "hybrid" CBDC model in which intermediaries handle retail payments, but the CBDC is a direct claim on the central bank, which also keeps a central ledger of all transactions.[21] A CBDC is issued by the central bank to the public via banks or non-bank PSPs. These intermediaries either rely on the retail infrastructure of the central bank or establish their own technology for getting CBDC into the public's hands. PSPs thus perform some or all the functions involved in a payment in a traditional payment system.

21. **A key distinction between a CBDC and existing payment instruments is that a CBDC is a liability of the central bank instead of that of a commercial bank or PSP**. In today's payment system, a payment must work its way through the balance sheet of intermediaries. In a CBDC, by contrast, only the information of who owns which claim on the central bank is exchanged (Graph 7). The absence of liquidity and solvency issues for the intermediaries and the associated need for prudential regulation for the CBDC issuer implies that new types of intermediaries could be licensed, thereby exerting competitive pressure on the national payment system.

CBDCs do not require transiting in PSPs' balance sheets and can reduce costs — Graph 7



Source: Carstens (2021).

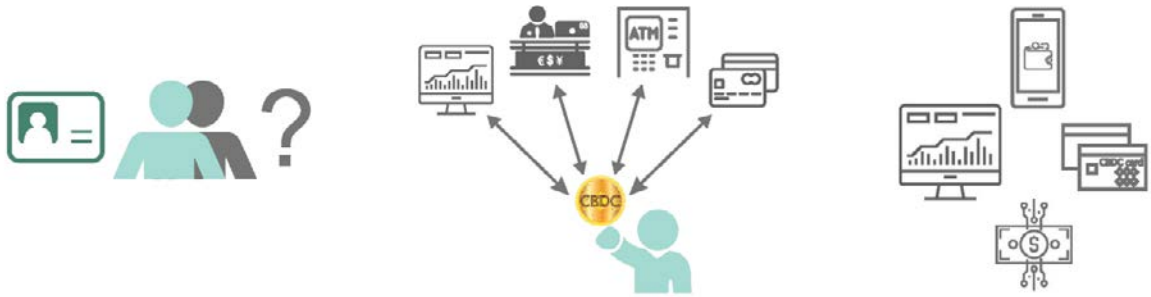
22. **The technical degree of intermediation in a CBDC arrangement could vary significantly with different players at every stage in the payments chain**. For example, the distribution of a CBDC could include commercial banks. The access providers could also include non-bank PSPs, technology companies and other non-banks. Settlement of transactions on the ledger could involve a range of stakeholders, depending on the design. Access channels, software and potentially also devices could be provided and operated by any number of non-bank service providers, adding complexity to the ecosystem. Furthermore, the channels and access devices would arguably need to be distinct from existing access channels and access providers for resiliency, for example in the form of novel payment apps that can run with low internet bandwidth, functionalities for feature phones (non-smartphones) and pre-paid cards. Despite these differences, the user experience should be broadly similar to existing digital payments (Graph 8).

[21] An exception is Canada (see Bank of Canada (2020), where in addition to a main hybrid CBDC option, consideration is being given to directly providing a "minimal viable service (supporting public-policy goals) that can be supplemented with value-added services from third parties for end-users (eg, targeted to small businesses)" (see Shah et al (2020)).

Gaining access to the CBDC system would still involve some form of identification (left-hand panel); there should be 1:1 convertibility with cash, bank accounts and other instruments (centre panel) and it should be possible to pay with a multitude of different methods, including computer or mobile apps, cards or even offline with dedicated devices (right-hand panel).

User experience with a CBDC — Graph 8

Identification and data protection | 1:1 convertibility with all other payment means | Multitude of private and public sector access options



Source: Authors' elaboration.

23. **For several of the central banks interviewed, both commercial banks and non-bank PSPs would distribute a CBDC and provide access channels**. For example, in the Bahamas, all supervised financial institutions can operate Sand Dollar wallets. This includes commercial banks, credit unions, money transmission businesses (MTBs) and other PSPs.[22] Sand Dollar wallets exist on customers' smartphones. To date, the main providers of Sand Dollar wallets are MTBs and other PSPs. At the time of interview, only one commercial bank and one credit union were participating in the Sand Dollar scheme.

24. **Non-banks are described as important to meeting financial inclusion objectives.** Many of the central banks interviewed outlined plans for non-bank participation in their CBDC schemes, alongside banks. In some instances, these were viewed as facilitating access to CBDC for excluded and underserved segments of the population. In the Bahamas, non-bank PSPs are playing a significant role already, operating as the custodians of almost all active customer wallets to date. For Ghana, existing mobile money and payment service providers are being viewed as the primary enablers of CBDC usage, should they launch.[23] This is based on the role they are already playing in the market as electronic money issuers, responsible for much of the financial inclusion gains seen throughout the country.[24] For China, where two big wallet providers (AliPay and WeChat Pay) currently dominate mobile payments, the e-CNY provides an opportunity for smaller PSPs to gain some traction in the market by offering CBDC-based services. Taking advantage of this opportunity will have the added benefit of driving inclusion amongst unbanked populations.

25. **Leveraging existing cash-in and cash-out networks is a priority for those aiming to drive greater inclusion with a CBDC**. Central banks outlined plans to develop rural agent networks and distribute merchant acceptance tools to facilitate offline transactions. For China, this included using existing branch networks of financial institutions, including the extensive rural networks of the Post Savings Bank.

22 CBB (2021a).

23 See also Bank of Ghana (2022).

24 See Mattern (2018).

Offering a robust and low-cost public sector technological basis and novel interfaces

26. **Some central banks interviewed consider CBDCs part of their mandate as a catalyst of innovation and development.** Counterparts in the Bahamas, China, the Eastern Caribbean and Ghana argued that technology can secure the continuous provision of central bank money to the general public. Central banks can help to speed up this transformation, particularly when market size and profit potential are insufficient to motivate private sector innovation, or when established oligopolies prevent entry. While access to payment services has grown in recent years, it is still far from universal. Low-income populations – or those living in remote locations – continue to confront barriers to digital payments. Domestic retail payment services can be expensive, and payments across borders – in particular for low-value transfers like remittances – face even greater challenges. These counterparts hence all argued that in their respective markets, the central bank had a role to play in applying innovation to specific access challenges. While access is being expanded through greater innovation to varying degrees across their respective markets, they argued that this is taking place unevenly and that, to ensure universal access, CBDC issuance may be required.

27. **Fee structures and pricing models are still being designed by many of the central banks interviewed.** Transaction fees to end users in any payment system are charged to recoup the costs associated with providing the service; in many cases, there is also a markup associated with rents to PSPs. In a CBDC system, the central bank has greater discretion to influence prices and reduce rents. While there are several options by which cost can be recovered, each comes with a trade-off. First, the cost of facilitating transactions on behalf of customers could be fully recovered from end users, but this might lead to an expensive and unattractive service, particularly for currently excluded users. Second, the costs could be absorbed by the service providers distributing a CBDC, including through cross-subsidisation of CBDCs by other payment and financial services, but this could lead to an unsustainable business model. Making CBDC services free to individuals, while having low (non-zero) costs for merchants could be one option (see next paragraph). The third option could be for the public sector to absorb (some) costs, for instance through the central bank's seigniorage income (as is currently the case with cash operations). Yet this could push out some current private sector providers, resulting in a lack of innovation and service development. CBDC systems need to find the right balance between service provision attractiveness, business sustainability and innovation, and this will probably be achieved by developing suitable and well balanced pricing policies. The use of existing infrastructure could minimise the investment and operational costs of developing CBDC systems, helping to achieve the right balance when needing to recoup costs. In instances where the central bank plans to set prices, the approach to pricing should be designed to be viable for all PSPs. The PBC offers a useful example where the fee-free infrastructure for PSPs and a streamlined value chain is expected to keep costs for PSPs minimal. The expectation is that these savings will then be passed on to consumers, creating an even lower-cost offering than what is currently available.

28. **Policy interventions to provide fee-free services are usually limited to person-to-person (P2P) payments, with pricing for business and merchant payments set by PSPs.** The provision of low-cost or free P2P solutions – akin to cash – was mentioned as an important feature of several CBDC initiatives. P2P transactions were free during the pilot phase of the Bahamas' Sand Dollar initiative, and this is planned to continue with the central bank mandating as a regulatory requirement "that no fees or services charges shall be levied by wallet providers in connection with the distribution or redemption of electronic Bahamian dollars".[25] The Bank of Ghana is also planning to offer free P2P transactions. The ECCB's DCash pilot goes further, requiring fee-free transactions for all actors (person and merchant) during the pilot phase of the project. The central bank website states that "… a huge motivation and big benefit of DCash is the significant reduction in the cost of financial transactions" for individuals and

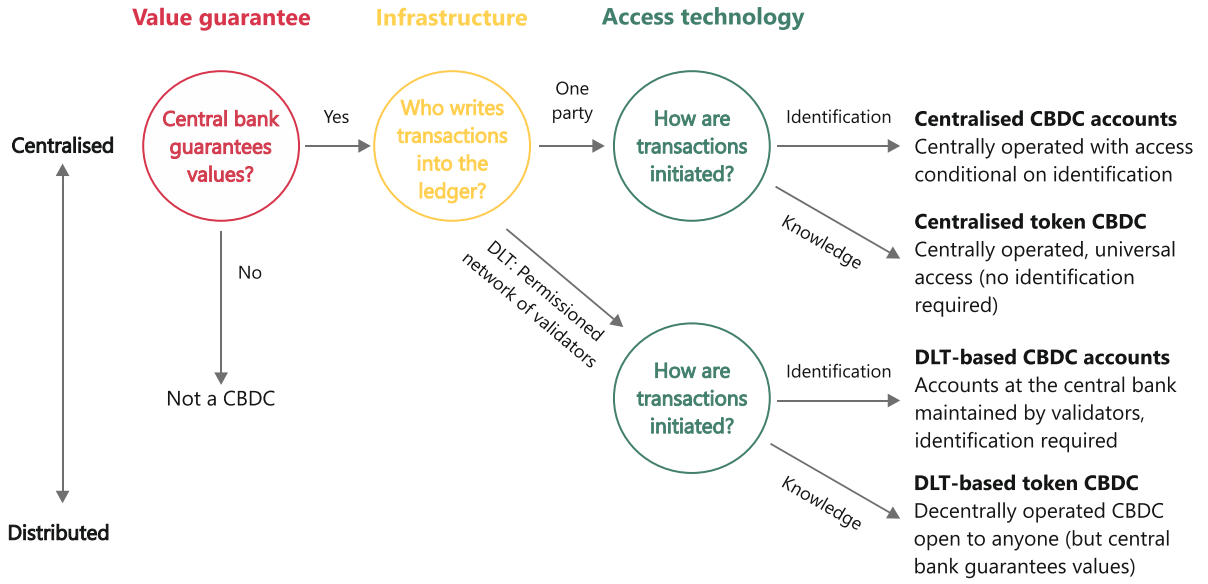
[25] CBB (2021a).

merchants".[26] How the central bank plans to keep costs free in subsequent phases of the project is still being explored.[27]

29. **APIs are being used to facilitate access to CBDC platforms for financial intermediaries**. APIs can play an important role in creating a level playing field for the various private sector intermediaries involved in the CBDC payment system. APIs are sets of definitions and protocols that allow different applications to securely communicate with each other. They can allow for PSPs to execute payments between clients with different payment service providers.[28] They can also enable data-sharing. For instance, APIs can be designed to provide selective access by different parties only to the data required for the execution of a specific transaction. This allows for interoperability between previously isolated payment systems. This ultimately benefits consumers through greater competition, lower costs and a broader range of services. For those at the pilot stage of their research, APIs have been the main interface for PSPs to access the CBDC platform.

30. **When it comes to determining the infrastructure, the range of options spans from a conventional centrally controlled database to novel digital banknotes based on distributed ledgers.** Graph 9 depicts how distributed ledger technology (DLT) factors might have a role in a CBDC. There are two primary design options, related to the infrastructure and access to a CBDC. The first DLT-related design decision is whether to centralise or delegate authority to a network of recognised and approved validators for database updates. A second – and independent – option is that even if DLT is not chosen as the backbone infrastructure of a CBDC, a closely related technology may still be useful: whether the infrastructure is DLT-based or not, access can still be based on cryptographic tokens rather than identity.

Elements of decentralisation: DLT and token-based access — Graph 9



This graph maps out the four possible combinations of whether a CBDC infrastructure is distributed or centralised and whether access is based on identification (accounts) or cryptographic knowledge (digital tokens). All four combinations are possible for any CBDC architecture (indirect, direct or hybrid), but in the different architectures, the central bank and the private sector operate different parts of the respective infrastructure.

Source: Auer and Böhme (2020).

[26] ECCB (2021).

[27] See CBB (2021a).

[28] As an example, an API enables a user who is using the mobile banking app of one bank to send money to a relative who is using another bank's mobile banking app.

31. **Some central banks observed an additional layer of data security when using a DLT-based infrastructure**. In the Eastern Caribbean, DCash is built on a private permissioned blockchain architecture. The central bank has access to the entire retail transaction record and can locate all information pertaining to a specific account. Personal information (ie the identity) of account holders is kept separate from the transaction record and is accessible only by the institution that established the account. None of the interviewed central banks anticipates a design where PSPs or commercial banks have access to personal and transaction information beyond that necessary for the execution of their clients' transactions.

32. **It is unclear whether DLT offers unconditional advantages for a CBDC, including those designed to address financial inclusion barriers.** Both traditional, centrally managed databases and DLT-based databases can store data multiple times in physically different locations. However, in DLT-based systems, the ledger is managed collaboratively and decentralised by several organisations. Each ledger's change must be synchronised between all entities' nodes, which takes time. As a result, transaction throughput in DLTs is lower than in traditional designs. For the central banks interviewed that are not considering a DLT-based infrastructure, decreased transaction throughput was the main reason given. In terms of generating robustness, neither a DLT-based nor a traditional system provides a clear advantage. The primary risk of a traditional design is the failure of the central access point, eg as a result of a targeted hacking attempt. The consensus mechanism is DLT's fundamental weakness, which can be harmed by a distributed denial of service (DDoS) attack, for example. The trade-offs between using a centralised or decentralised design are discussed in Auer and Böhme (2020) from a technological perspective and in Auer, Monnet and Shin (2021) from an economic perspective. A centralised market building on the traditional intermediary is typically superior unless it is difficult to enforce contracts. When the former is the case, DLT may have economic potential in payments due to its enhanced robustness and the potentially lower cost of achieving good governance in a decentralised network of validators versus a central intermediary.[29]

33. **Some central banks are providing "white-labelled wallets" that can be branded to specific service providers.** For example, in the Eastern Caribbean, participating financial institutions can use a client wallet module from the central bank that they then operate and manage. In the Bahamas, a basic wallet module is also available on the Sand Dollar platform. This can be integrated into existing electronic wallets of service providers, or re-branded to the specifications of the financial institution. In the case of the Bahamas, the main role of the central bank is to provide the infrastructure and the API specifications that PSPs use to interact with the CBDC system. PSPs then compete on the functions and user interface of the wallets. Looking forward, one could envision an environment where wallet providers could be independent of financial institutions and could integrate with any CBDC account or token opened and managed by different financial institutions.

34. **Many central banks interviewed are exploring how CBDC can be accessed via different user interfaces.** This includes the provision of both smartphone-based and non-smartphone-based services with various features. In China, distribution of a CBDC to more basic hardware devices will allow individuals to store their CBDC on e-ink display cards. In addition to smartphones, smart devices such as wearables will be able to hold CBDC wallets. In the Bahamas, customers can access the Sand Dollar through an iOS or Android mobile phone application, or by using a physical payment card.[30] In Ghana, app-based CBDC usage will be available through banks and fintech payment apps. It is also envisioned that CBDC will sit in wallets accessible via any phone. Customers will be able to check balances and initiate payments using unstructured supplementary service data (USSD), available on feature phones. This is similar to what is currently being used for private e-money services, such as mobile money.

35. **Offline functionality is considered critical if CBDCs are to adequately address financial inclusion barriers.** An offline payment functionality would allow CBDC transactions to continue in an

[29] See Auer, Monnet and Shin (2021) for a discussion of the merits of decentralisation in different contexts.

[30] CBB (2021c).

environment with no internet, no mobile network coverage and, in some instances, no electricity. This would enable distribution of a CBDC (eg by government agencies) to devices in rural areas with limited connectivity, or in disaster-hit areas. The BoG is exploring the potential of smart cards to function in locations with limited or no network coverage and an inconsistent supply of electricity. The proposed plan will have offline transactions operating in a similar manner to cash, whereby settlement onto cards is in real time, with tokens moving between cards and without the need for a back-end settlement system. Working with service providers to ensure the availability of Bluetooth and NFC point-of-sale devices, and facilitating the expansion of agent networks into currently underserved rural regions of the country, were described as important elements of the BoG's offline CBDC plans. While many jurisdictions highlighted offline functionality as important, the approach to providing it is still being explored, recognising that any solution would have to be a coherent package to provide access consistently. An important consideration with enabling an offline mode for CBDC is the risk of potential double-spending and the possible creation of fake tokens. For many of those that have piloted and/or launched services, offline functionality is yet to be provided, probably due to these potential challenges (although the e-CNY in China has already provided offline functions).

36. **Using a CBDC for disbursing government payments is seen as important for driving a critical mass of users and greater inclusion**. As outlined in Section 2, channelling public sector salaries, pensions and social protection grants to transaction accounts can increase access to and usage of them. Some of the central banks interviewed are already exploring this potential with specific government departments. The ECCB mentioned that it was exploring facilitating person-to-government payments for small taxes and other levies directly from CBDC wallets. The NBU mentioned working with the Ministry of Digital Transformation and other state bodies on programmable social disbursements. Similar pilots have also been undertaken in China, with various government departments.

37. **Some central banks interviewed are considering programmability features of CBDC to enforce rules or to apply conditions to payments.** Programmability refers to the ability to automate or to direct transactions, eg to make a payment contingent on certain pre-specified conditions. This can allow for a range of new features, including self-executing protocols ("smart contracts"). Programmable money features have already been used by some Chinese districts within the e-CNY pilot, where the CBDC, distributed through "red envelopes", would expire in a few days if not used by the recipient. In its CBDC research the NBU has assessed the potential of programmability for government payments and for likely new business models and products in the financial markets. Programmability using smart contracts is embedded within DLT systems. However, it can also feature in non-DLT-based CBDC. Central banks need to apply strict controls on how programmability is applied to avoid possible fraud and misuse of a CBDC.

Customer enrolment and education on the use of CBDC

38. **Central banks can map CBDC schemes to the existing AML/CFT legal and regulatory framework.** Where CBDC is considered a financial product such as a bank or e-money account, access to it would require the customer to pass a due diligence process. The process could be aligned with the standard, simplified or enhanced customer due diligence process. This can be based on the features of the CBDC account, their limits and use cases. Alternatively, if the CBDC is considered similar to cash, there might be a full exemption from customer due diligence (CDD), with anonymous access, but strict limits could apply to account and transaction values. For example, in a recent survey conducted by the NBU to assess key design features for a potential e-hryvnia, 80% of respondents favoured a system where customers remain anonymous within the existing limits set for cash-based transactions, recognising the need to identify users when these limits are exceeded.[31] All the interviewed central banks suggested they are likely to maintain their existing frameworks for CDD for their CBDC.

[31] NBU (2021).

39. **Several of the central banks interviewed already have some form of simplified due diligence to promote financial inclusion and plan to extend its application to include CBDC.** As shown in Table 1, wallets with higher balance or transaction limits are subject to the standard CDD, while those with lower limits will be subject to simplified rules. These "basic" wallets or accounts have been offered under the Eastern Caribbean's DCash and the Bahamas' Sand Dollar. The central banks of China and Ghana are also planning to offer a similar type of wallet class for their CBDCs.

CBDC account/wallet tiers

Table 1

Jurisdiction	Basic CBDC account			Standard CBDC account		
	ID requirements	Transaction limits	Linked to bank account?	ID requirements	Transaction limits	Linked to bank account?
Bahamas	Phone number verified with one-time password (OTP)	Wallets can hold up 500. Aggregate transaction value of 1,500 per month (Bahamian dollars)	No	Govt issued ID	Can hold up to 8,000. Aggregate transaction value of 100,000 annually (Bahamian dollars)	No
China	Phone number verified with OTP	Single payment limit 2,000, daily cumulative limit 5,000, balance limit of 10,000 (yuan)	No	Govt issued ID	Various categories: Category 1 has no limits but requires in-person identity verification; Categories 2 and 3 have the following limits, respectively: single payment limits of 5,000 and 50,000, daily cumulative payment limits of 10,000 and 100,000, balance limits of 20,000 and 500,000 (yuan)	Yes, but not for Category 3
Eastern Caribbean	Govt issued ID	1,000 EC per month	No	Govt issued ID	2,700 EC per month	Yes

Source: Authors' elaboration.

40. **For all the countries interviewed, the CDD process is being (or will be) performed by licensed financial institutions or their agents**. In most two-tiered CBDC systems, licensed financial institutions (banks, non-bank financial institutions and e-money issuers) would perform CDD to enrol users in the CBDC system. None of the central banks interviewed planned to perform the CDD process themselves. Using agents is a typical approach for SDD measures. For example, in the Eastern Caribbean, for value-based wallets not linked to a particular bank or credit union, agents will be paid a commission to onboard customers and complete KYC checks, while also facilitating exchanges between digital and physical currency.

41. **For some of the central banks interviewed, linking CBDC accounts/wallets to existing bank accounts is a design feature aimed at minimising the risk of disintermediation**. As shown in Table 1, accounts/wallets allowing for higher transaction and balance limits can also be linked to a bank account. While some central banks highlighted the opportunity to take advantage of existing CDD by doing this, others also described it as an effective way of mitigating potential disintermediation risks.

42. **Allowing for remote onboarding of customers, using e-KYC methods, was highlighted as an important CDD feature.** Social distancing requirements resulting from the Covid-19 pandemic, as well as other longer-term access barriers, have resulted in several jurisdictions adopting e-KYC techniques for onboarding customers. In the Bahamas, new customers can take a selfie with a government-issued ID and send this to their service provider to complete the onboarding process. The functionality for e-KYC exists at the service provider level, but the central bank recognises these methods as legitimate forms of CDD. In Ghana, the central bank highlighted the recently adjusted CDD framework to allow for remote onboarding for tier 1 mobile money accounts, in response to Covid-19. They plan to align access policies for any CBDC with those existing measures. Integration with existing or planned national digital ID systems was also mentioned as essential to facilitating remote onboarding.

43. **Most central banks interviewed described a system where privacy will be maintained, but without full anonymity.** The provision of CBDC with full anonymity is not being considered by any of the central banks that participated in the study, including those that described financial inclusion as a primary motivation for researching CBDCs. For example, in the Bahamas the CBB is taking a centralised approach to record-keeping, maintaining the ledger of all individual holdings of the Sand Dollar.[32] Individual transaction information will be maintained by the service provider managing the customer wallet.

44. **Data portability was described as especially important to achieving financial inclusion objectives.** Data portability refers to the ability of an individual to obtain their own transaction data from current data holders, such as financial service providers, and use ("port") this data for their own purposes, including with a variety of data users.[33] In the Eastern Caribbean and the Bahamas, this was described as an enabled feature within CBDC customer wallets. Transaction histories are provided in a structured, machine-readable format that can be downloaded by wallet users. This can then be shared with other financial institutions to obtain access to additional financial services, such as credit facilities.

45. **Some central banks are exploring novel ways to address geographical barriers to financial inclusion.** The CBB has also mandated that PSPs outline their strategies for distributing payment services to residents in the central, southeastern and northwestern Bahamas. Licensed providers are required to report financial inclusion data periodically, outlining the number of customers onboarded that reside in the target regions. Under the regulations, the central bank also has powers to demand that a specific licensed wallet provider extend services to regions, should they continue to be underserved.[34] The BoC is exploring the potential of offering CBDC transaction accounts directly to those residing in very remote, underserved regions of the country.

46. **Several of the central banks highlighted the importance of financial literacy campaigns and activities to encouraging uptake and usage of CBDC.** Lower levels of financial literacy continue to be a significant barrier to financial inclusion. Providing education and learning tools to improve understanding and usage of financial services is essential to greater financial inclusion. Many countries already undertake efforts in this regard, developing learning materials to demonstrate how to use certain payment instruments, as well as outlining the advantages of using electronic payment services. Raising awareness of the different financial services that are available in the market is also important to facilitating uptake

32 CBB (2021a).

33 See Plaitakis and Staschen (2020).

34 CBB (2021a).

and usage of services. Most of the central banks interviewed have some form of financial education initiatives under way to address financial inclusion challenges in their respective countries.

47. **Digital literacy was highlighted as a specific challenge for certain segments of society such as older users**.[35] Developing learning materials and campaigns that directly address these barriers was mentioned by several central banks as being critically important to the success of any CBDC launch. Providing consumers and merchants with information on how CBDCs work, why they are safe and why they can be trusted is an integral element of the planned outreach and stakeholder engagement activities. These were also seen as an important complement to design elements implemented (such as simple customer user interfaces and having access to wallets on more basic features phones) to address financial inclusion challenges.

Fostering interoperability among multiple dimensions

48. **Ensuring CBDC systems are interoperable with private sector digital payment systems and arrangements is important for financial inclusion.** Counterparts in the Bahamas and Ukraine emphasised that a CBDC system would be interoperable with existing financial market infrastructures. The central banks of China and Ghana noted that this included integrating CBDC with existing payment instruments that have already had an impact on financial inclusion, such as mobile money. More generally, back-end integration should take place among CBDCs and other existing payment systems. Integration could happen through direct interoperability between the systems, where systems could exchange transfer orders, or through a third party participating in both systems that can serve as a bridge between them. The third party would act as a counterpart for the sending and receiving parties in both systems. It could be a common role for the central bank to act as such a third party, providing liquidity to PSPs on both CBDC and other payment systems.

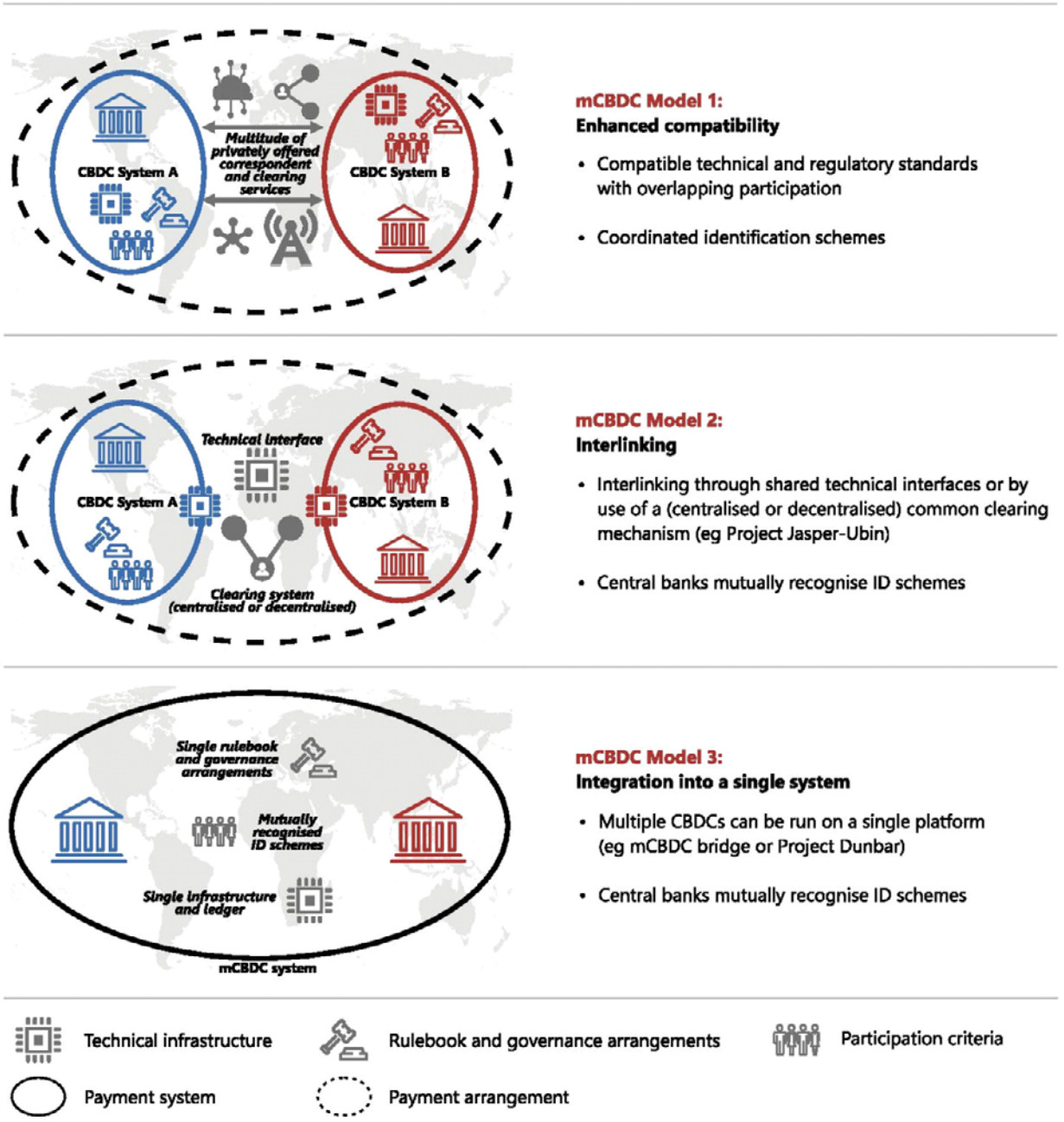
49. **Interoperability with other CBDC systems to facilitate cross-border payments is an objective in the context of so called "multi-CBDC" (mCBDC) arrangements**. A multi-CBDC arrangement is one that links two or more CBDCs for cross-border payments. These arrangements can be classified into three conceptual models (Graph 10). Model 1 (compatible) considers interoperability through common standards. Model 2 (interlinked) considers additional interlinkages through a shared technical interface or a common clearing mechanism. Model 3 (single system) considers higher-level cooperation with a single system, a single rulebook and a single participation set. Given the Eastern Caribbean's location and geography as a collection of independent islands, ensuring interoperability with CBDC systems of other islands not included in the regional bloc is important, with the potential for switching on this functionality at the appropriate time.

50. **Cross-border CBDC arrangements could be a tool to decrease the overall cost and time to receive remittances.** Because these arrangements involve central banks and commercial banks/PSPs from two or more jurisdictions, cross-border CBDC systems could bring immediate settlement, provide competitive exchange rates and make the best use of existing domestic payment rails. Being a claim on the central bank, CBDC would eliminate credit risks between financial institutions participating in a cross-border transaction. Reducing risks would decrease transaction fees. These arrangements would also enable a large number of possible counterparts and could replace the need for existing correspondent banking relationships. A number of the countries considered in this study are large net receivers of inbound remittances. Improving the integration of remittance systems into domestic payment systems is thus an important development objective, and it has been suggested that CBDCs could reduce remittance costs.[36]

[35] See Doerr et al (2022).

[36] See Didenko and Buckley (2022) for a discussion of CBDCs to support inclusion and remittances in Pacific Island countries and Rice et al (2020) for a discussion of challenges in the current correspondent banking system.

Multi-CBDC arrangements can facilitate cross-border payments Graph 10



Model 1 enhances compatibility for CBDCs via similar regulatory frameworks, market practices, messaging formats and data requirements. Model 2 involves interlinked CBDC systems. This could build on enhanced compatibility while offering additional safety, via payment-vs-payment (PvP) settlement. Further, common clearing mechanisms – potentially operated by central banks acting as super-correspondents in cross-currency settings – could enhance efficiency, especially when they are linked with FX trading. Model 3 involves a jointly operated mCBDC payment system hosting multiple CBDCs. All FX settlements would be PvP by default, rather than requiring routeing or settlement instructions through a specific entity acting as an interface. Trading venues could also be integrated into an mCBDC system, to reduce complexity, fragmentation and concentration.

Source: Auer, Haene and Holden (2021).

Box 2

The eNaira: the Central Bank of Nigeria's digital currency initiative

Overview

On 25 October 2021, the Central Bank of Nigeria (CBN) introduced a digital form of its currency: the eNaira. Key motivations for issuance were to enable households and businesses to make fast, efficient and reliable payments, while benefiting from a resilient, innovative, inclusive and competitive payment system. The objective clearly focuses on increasing individuals' and businesses' access to and usage of the financial system.

According to the World Bank Findex, only 39.7% of Nigerians have access to an account at a financial service provider, with the lowest levels of inclusion seen in the less developed northern parts of the country, amongst women and lower-income groups.

Inclusion-focused design elements

The CBN has adopted many inclusion-focused design elements for the eNaira that have been highlighted by other central banks interviewed for this study.

Involving existing payment providers:

- Like other (live and planned) CBDCs, the eNaira uses a two-tiered architecture, where the CBN acts as an issuer, and banks distribute the CBDC to the broader economy. Non-banks such as e-money issuers cannot distribute independently, but can work with banks to facilitate specific use cases.
- The eNaira infrastructure uses DLT, and account-based access (based on identification).

Low-cost public sector technological base and novel interfaces:

- CBDC accounts are available via the eNaira Speed Wallet app on smartphone devices. Transactions can be initiated using USSD on feature phones.
- While not yet live, the CBN is currently exploring approaches to facilitating offline functionality.

Rethinking access policies and educating the public about the use of CBDC:

- The CBN has implemented simplified due diligence, using national ID and verification tools to facilitate access. Table 1 provides an overview of the different tiers.
- The CBN plans to deliver ongoing digital literacy campaigns, targeting individuals and merchants.

Tier	Category	Requirement	Daily transaction limit (NGN)	Daily cumulative Balance (NGN)
0	Non-bank account	Phone number *Awaiting NIN verification*[1]	20,000	120,000
1	Non-bank account	Phone number *NIN verification*	50,000	300,000
2	Bank account	BVN[2]	200,000	500,000
3	Bank account	BVN	500,000	5,000,000

Fostering interoperability:

- The eNaira is interoperable with other major payment systems in the country, namely those operated by the Nigerian Interbank Settlement System.
- Given the motivation of addressing challenges with cross-border payments and international remittances, interoperability with other CBDC systems has been factored into the design.

[1] The National Identification Number (NIN) uses demographic and biometric information and ties all records about an individual in Nigeria in a national database that can be used to verify identity.
[2] The Biometric Verification Number (BVN) is a unique identification number that can be verified across all financial institutions in Nigeria. A customer's BVN is also mapped to the individual's biometric information.

Summary: mapping specific design elements to financial inclusion barriers

51. **CBDC design features outlined by counterparts interviewed aim to directly address the main barriers to financial inclusion that were highlighted.** As outlined in Table 2, the design features described by those interviewed map directly to the financial inclusion barriers categorised in Section 2.

CBDC design features can target financial inclusion barriers — Table 2

Specific design features to address financial inclusion barriers	Financial inclusion barriers					
	Geographic barriers	Institutional factors	Economic and market structure barriers	Characteristics of vulnerability	Limited financial literacy	Limited trust in financial institutions
CBDC architectures: facilitating innovation in a two-tiered system						
Participation of non-bank PSPs			■			
Direct provision of CBDC by the central bank	■		■			
Use of third-party agents	■	■	■	■	■	■
Offering a robust and low-cost public sector technological basis and novel interfaces						
Fee-free P2P payments		■	■	■		
Access for PSPs via APIs			■			
Provision of wallet modules			■			
Different user interfaces				■	■	■
Offline functionality	■	■		■	■	
Disbursement of government and social payments	■					
Rethinking customer enrolment processes and educating about the use of CBDC						
Tiered wallets		■				
Simplified KYC processes		■		■	■	
Electronic KYC (e-KYC)	■	■	■	■	■	
Customer data portability		■	■	■	■	
Fostering interoperability among multiple dimensions						
Domestic interoperability	■		■			
Cross-border interoperability		■	■	■		

[1] This table shows how individual design features map to the six financial inclusion barriers categorised in Section 2.

Source: Authors' elaboration.

52. **CBDCs provide a unique opportunity to apply a multipronged approach to financial inclusion challenges.** Most of the design features address multiple barriers to financial inclusion. For example, the use of third-party agents, fee-free P2P payments, different user interfaces and offline payments can address multiple barriers related to geography, institutional factors or market structure. Meanwhile, simplified KYC and e-KYC, the ability to port transaction records and cross-border interoperability can all address barriers for specific groups, such as those without ID credentials or international migrants. The majority of these have either been used independently as tools for addressing exclusion (eg the various approaches to KYC) or are being explored as solutions to financial exclusion

independent of CBDCs (eg offline functionality). While these features in and of themselves are not unique to CBDCs, the opportunity to deploy them through one public sector-led initiative may present a unique and novel approach for tackling financial exclusion going forward.

Section 4 – Challenges, risks and legal/regulatory implications

53. **The introduction of a CBDC poses some challenges and risks, and it may necessitate changes in laws and regulations.** The CBDC-related work of central banks covered in this paper, such as research, building proofs of concept or pilots and live CBDCs, provides insights into the challenges and risks of issuing a CBDC. Many of these challenges and risks apply to the issuance of CBDC in general and are not necessarily specific to financial inclusion. In addition, some central banks have already articulated their thoughts on new laws and regulations or adjustments to existing ones that may be necessary to effectively implement CBDCs in their jurisdictions. While these legal and regulatory changes may not be directly related to financial inclusion, they could help foster trust in CBDC thereby contributing to their wider acceptance and to the financial inclusion objective in general.

54. **The challenges highlight the importance of private sector involvement in a CBDC system and the inherent tension between the use of data and privacy risks.** If a CBDC were to have a meaningful impact on financial inclusion, involvement of the private sector (ie banks, other PSPs and merchants) is necessary to support the attractiveness of a CBDC to users and to ensure sufficient access points, even in remote areas. The value of data generated by CBDC payments is also clear and could help to open up other financial services to the unserved or underserved segments of the population (eg credit, insurance). However, using insights from these data could easily run into privacy issues if done without the necessary policy measures and safeguards, eg to ensure user control. The next subsections consider these points in turn.

Challenges and risks

55. **Developing an overall ecosystem is important for the effective implementation of CBDC but could be challenging to achieve.** A well developed ecosystem allows users to easily move into and out of CBDC, make transfers, pay merchants and send and receive payments to the government, among other things. This requires buy-in from both financial institutions and different enterprises including merchants, which in turn would make it more attractive for the public to use a CBDC. However, some central banks mentioned that achieving large-scale adoption by relevant parties could be a challenge. One potentially large challenge is whether financial intermediaries and merchants would have economic incentives to participate in the CBDC system. As mentioned in Section 3, pricing CBDC transactions is still an open question for the central banks interviewed.

56. **Financial institutions may have different reasons for not immediately participating in central banks' CBDC projects.** The requisite infrastructure to connect to the CBDC system might be too expensive to put in place. There might be a mismatch in expectations regarding incentives for providing intermediation services and the objective of central banks for CBDC transaction fees to approximate that of cash. Financial institutions' decisions may also be influenced by outside factors. For example, some commercial banks may prefer to take a "wait and see" approach when it comes to CBDC adoption or may prefer not to be one of the early adopters joining the project. This could be due to various reasons, such as foreign commercial banks implementing decisions made at their head offices. Typically, banks can link their core banking system to a CBDC, making it easy to move funds from wallet to bank accounts and vice versa. However, the non-participation of some banks could make it hard to facilitate this movement of funds. Central banks would need to engage commercial banks at early stages of the project and ensure

the business model is viable for commercial banks. Central banks would also need to be sure that the CBDC system would not lead to excessive crowding out of private sector services.

57. **One major concern for central banks could be end users' acceptance of a CBDC.** CBDC wallet design and features could influence the public's willingness to use a CBDC. Wallet design considerations such as ease of use, convenience, predictability, a user-friendly interface and the inclusion of key use cases could lead to a positive experience for individuals and (small) businesses – particularly those who are currently underserved. Security and data protection measures, which should be carefully designed and effectively communicated in consumer awareness campaigns, are also paramount for ensuring consumer trust. While central banks are (with the exception of cash) not used to designing products for end users, they can use collaborative forums to work with commercial banks and other PSPs on requirements and standards for CBDC wallets. CBDC wallets could be dedicated solely to the CBDC, or CBDC functions could be included in general wallets provided by PSPs, with the CBDC as a currency and payment instrument. CBDC wallets should be designed with due consideration of financially excluded groups through using a simple interface, in their language (including minority languages) and with appropriate information and support. End users should be shielded from having to deal with complex elements like cryptographic keys. Due consideration for the context of older users, children and people with disabilities is also required. Wallets that can provide voice guidance or commands to operate are important features to enable access of unserved or underserved users (eg the visually impaired) in the CBDC ecosystem.

58. **Wide acceptance by merchants is necessary for CBDCs to effectively support users' payment needs.** One central bank interviewed pointed to the need to undertake a massive campaign to onboard merchants in order to drive use of CBDC among consumers from the beginning.[37] Merchants will probably be concerned about the costs of accepting CBDC payments – both the one-off cost (eg putting in place new hardware) and ongoing costs. These costs must be as low or lower than those of merchant services offered by existing third-party payment rails (eg by payment card companies). A CBDC will be more attractive to merchants if it is integrated with existing payment instruments that are already widely used (eg payment cards, e-money). In remote areas of developing economies that are the target of financial inclusion efforts, most low-value commercial transactions happen in the informal sector. In achieving CBDC adoption in this part of the economy, there is a trade-off between the desire of some informal players for anonymity and the objective of creating a digital record of consumers' transactions that could be used for onboarding to other financial services. Other options including simplified customer due diligence for onboarding small merchants, akin to that followed for low-risk transaction accounts for individuals, could be considered.[38]

59. **Wide adoption of a CBDC by consumers brings with it the challenge of protecting their data privacy.** One attraction of CBDCs for financial inclusion is that they create digital records of transactions. This could be a useful source of information to expand financial services such as credit to the unserved or underserved. However, this information could also be subject to misuse or abuse – including by political authorities. The challenge for central banks, whether this information is kept by them or by private entities that are part of the CBDC ecosystem, is to keep this information safe in order to achieve the same level of public trust in the CBDC that physical cash enjoys. Separation between identity and transaction data could secure a better environment for protecting privacy and might lead to public confidence and trust in using CBDC. In China, for example, data protection is given more emphasis with the recent issuance of the personal data protection law. The e-CNY has a tiered wallet design where the lowest category wallets can be anonymous with only phone numbers required; the PBC has noted that users' personal information will not be shared with commercial banks or the central bank by the telecom operators. Moreover, payments can be done with tokenised "sub-wallets" pushed to e-commerce platforms and other online-to-offline platforms, while ensuring these platforms will have no access to the

[37] See also Group of central banks (2021a).

[38] See World Bank, *Electronic payment acceptance (EPA) innovations*, forthcoming.

personal information. In addition, the PBC states that it has set up an information firewall and strictly implements information security and privacy protocols. These include appointing responsible persons for maintenance, establishing internal barriers to data use, applying a tiered authorisation system, putting in place checks and balances and conducting internal audits. All these ensure that arbitrary information requests and use are prevented.

60. **However, very far-reaching data privacy and data protections could result in risks related to money laundering and terrorist financing.** One extreme would be to have total anonymity of CBDC ownership and transactions. This would be fertile ground for illicit actors, who could go about their activities unhindered. Central banks interviewed recognise this risk and the importance of AML/CFT measures without sacrificing their financial inclusion objectives. As explained in Section 3, they are planning to put in place differentiated limits on CBDC balances or transactions, with the lowest limit (ie those intended for financial inclusion purposes) subject to SDD requirements.

61. **Cyber security is another challenge that can affect data privacy.** A CBDC infrastructure is an attractive target for cyber criminals given both the funds and types of information it stores. As such, it should be subject to at least the same cyber resilience expectations as other critical financial market infrastructures. While the key vulnerability differs between a conventional and a DLT-based CBDC infrastructure,[39] all parties connected to this infrastructure – the central bank, financial intermediaries, mobile phone operators, merchants etc – should have effective cyber security safeguards and processes in place. Applying a cyber resilience framework such as that of the US National Institute of Standards and Technology (NIST) and regularly conducting penetration testing is important to shield the target information. This is similar to the work central banks already undertake for real-time gross settlement (RTGS) and other payment systems.

62. **CBDC implementation poses other operational challenges.** DLT-based CBDC infrastructures have lower transaction throughput, presenting impediments to widespread use except in small jurisdictions.[40] The current IT systems of financial institutions may also not be ready to implement CBDC. This might necessitate implementing CBDC in several stages. Offline transactions need to address the issue of double-spending, while allowing the central bank to redeem the CBDC holders, even in the cases when the holder loses the CBDC wallet or the PSP serving the holder faces operational or financial disruptions. Moreover, since CBDC will play an integral role in the economy once it achieves wide adoption, implementing safeguards and contingency plans are necessary to reduce risks of network failure or interruption.[41] More generally, for central banks in both AEs and EMDEs, the operational commitment of operating and overseeing the CBDC system can be substantial and would require appropriate resources and institutional capacity.

63. **Central banks interviewed recognise the potential financial stability risks associated with the issuance of a CBDC, but do not consider these material at this early stage given planned safeguards.** Interest-bearing CBDC could theoretically be another transmission channel for monetary policy.[42] However, this could also lead to disintermediation and destabilisation of existing financial institutions, for example via liquidity flows from commercial banks' deposits to CBDC. In general, central banks interviewed see this as a low-probability risk since they would only plan to issue non-interest bearing CBDCs. Some central banks are considering limits on CBDC holdings or transactions to mitigate

39 See Auer and Böhme (2020).

40 Ibid.

41 See WEF (2020). The need for contingency plans has been highlighted in a recent service interruption of the DCash platform (Region-Wide Service Interruption of DCash Platform | Eastern Caribbean Central Bank (eccb-centralbank.org)).

42 See Group of central banks (2020).

financial stability risks.[43] However, there may be challenges to implementing these price- and quantity-based safeguards, such as obstacles to public understanding that might affect wider acceptance.[44]

64. **In summary, the adoption of a CBDC hinges on whether it makes economic sense for different players to participate and on the trust that individuals and businesses have in the central bank.** Financial intermediaries and merchants will only participate in the CBDC system if there is a business case for them to do so. Individuals and businesses need to have the confidence that the central bank: can meet its obligations as represented by the issued CBDC; has put in place a resilient technology infrastructure for the smooth functioning of CBDC systems; has established safeguards to protect information from misuse and abuse, including by its own agents or agents of other government bodies; and has the ability to address risks to the soundness, stability and integrity of the financial system. Finally, central banks will have to assess the operational implications unique to their jurisdiction.

Legal and regulatory implications

65. **Central banks that are in more advanced stages of their projects have already outlined legal and regulatory implications of CBDC.** They have identified new laws and regulations that need to be issued or existing laws and regulations that need to be revised. There are three main categories:

- Central bank laws
- Laws and regulations for participants in the CBDC ecosystem
- Thematic laws and regulations

66. **All central banks interviewed recognise that they need to have appropriate powers to issue CBDC and oversee the CBDC system.** In some jurisdictions, the central bank law might need to be revised to define currency to include its digital version and to empower the central bank to issue such digital currency.[45] In addition, the central bank law might need to be revised to give the central bank oversight powers with respect to all participants in the CBDC ecosystem. In Ukraine, for example, the 2021 Law on Payment Services stipulates that digital money issued by the NBU is an electronic form of the currency of Ukraine. In addition, the NBU as the issuer is responsible for defining the rules related to its use.

67. **The legal considerations about issuing CBDC for some central banks would extend to the functions of CBDC as a currency.** While the currency would serve as a unit of account, medium of exchange and store of value, some central banks would not formally consider a CBDC as a store of value due to the fear of bank runs. For those central banks, CBDC would need to be defined legally as a medium of exchange. Another legal aspect would be the positioning of CBDC as legal tender to settle a private or public debt and meet a financial obligation. Introducing CBDC as legal tender would obligate the government and private parties to accept CBDC to discharge obligations. Consequently, it should be facilitated for all natural and legal persons to open CBDC accounts and accept CBDC from different payers.

68. **The introduction of a CBDC may entail re-examining which types of institutions or parties will have access to central bank accounts**. Central banks may need to apply changes to extend the scope of access to the central bank's accounts if the retail CBDC design entails opening accounts for end users or even to other stakeholders in the CBDC ecosystem. Regulatory changes can clarify the exact roles and responsibilities of the central bank and financial institutions for AML/CFT in CBDC systems where the holding and management of end users' accounts are shared. In cross-border CBDC systems, where central

[43] See eg CBB (2021b).

[44] See Group of central banks (2021b).

[45] Bossu et al (2020) note that out of the 171 central banks of the IMF membership, 61% of central bank laws limit the authority of issuance of currency to banknotes and coins and 85% limit the power to open cash current accounts to a limited category of institutions.

banks or trusted PSPs may need to hold accounts in currencies other than the one issued by the central bank, arrangements might be considered for such holding and management of foreign currencies.

69. **Laws and regulations need to be introduced or revised for effective oversight of relevant CBDC participants.** Payment system laws and regulations, including those relating to roles and responsibilities of different players in the system, need to be examined, including for whether they are applicable to CBDC. If they are not, appropriate adjustments would need to be identified and adopted. Regulations may also need to be put in place or strengthened for financial institutions and other players that have a role to play in the CBDC system. Two broad examples came out from the central bank interviews: regulations for existing financial institutions and regulations for new players.

70. **All central banks interviewed see a role for existing financial institutions in their CBDC system, but this may require strengthened regulations.** Regulations that may need to be strengthened include those related to IT requirements, security and safeguards; AML/CFT requirements; and data protection rules (eg rules on data management, access, privacy and custody). For example, the CBB proposed regulations for financial institutions that would serve as Sand Dollar wallet providers.[46] The proposed regulations include provisions on eligibility criteria, technical standards, consumer protection, financial inclusion (eg requirement to serve target areas), obligations such as record-keeping and reporting etc.[47]

71. **In some cases, central banks might envision a role for certain new entities that would require new regulations.** The ECCB, for example, uses non-bank regulated entities to do onboarding and KYC procedures for value-based CBDC wallet holders (ie holders of low-value CBDC wallets who do not have existing relationship with financial institutions). These entities are governed by existing legislation and regulations and are regulated by the local regulatory commissions. The results of the pilot would help determine whether any new regulations would be required for these operations.

72. **Central banks interviewed acknowledge that relevant thematic laws and regulations may need to be re-examined to assess their continued relevance in the context of CBDC.** The discussion above identifies risks to data privacy and AML/CFT objectives as the main ones associated with introducing CBDC. It is thus not surprising that central banks also name laws and regulations pertaining to these two areas as those that may need to be enhanced. In terms of data privacy, it is emphasised that the concept of use agency is extended to the use of CBDC. This means that users must be able to access and share their data arising from CBDC as they choose, and must be able to have them corrected, updated or deleted, if necessary.[48] In terms of AML/CFT, changes might relate to e-KYC regulations, such as use of digital ID and tiered KYC for individuals, agents and merchants.

73. **Concerns regarding end users' privacy within CBDC systems, and the trade-off with financial integrity, could be addressed with various legal, regulatory and technical choices.** In CBDC systems where personal information (eg identity) is separated from transaction information, it may be easier to promote privacy, but adjustments in AML/CFT requirements may be required. For instance, it is possible that information on user identities would be gathered and stored only by PSPs, and that the central bank would not have any information on the identity of users in any specific transaction. If there were a need to collect such information, for instance for law enforcement purposes, there would need to be clearly delineated processes for doing so, similar to today's bank secrecy laws.[49] These features could help to safeguard against abuse of user data for political purposes (state surveillance), and to protect the operational independence of central banks from pressure by political authorities. In the case of insolvency

[46] CBB (2021a).

[47] PBC (2021) also outlined the envisioned regulatory framework for e-CNY.

[48] See WEF (2020).

[49] This is already being explored in several jurisdictions. For instance, in the Bahamas the central bank does not hold identity information of users, and law enforcement authorities could only collect such information from PSPs with a court order.

of the financial institution with users' identity information, it would still be necessary to transfer this information and account balances to a different provider. Legal and regulatory reforms could help to further protect CBDC end users and to combat money laundering and the financing of terrorism by specifying the conditions under which information could be used.

74. **The use of DLT as the ledger for CBDC might raise some legal considerations that should be addressed by the authorities.** For DLT systems that use probabilistic consensus mechanisms, there would be concerns related to the legal finality of the transactions. Some DLT protocols might open access to account and transaction information to all participants, which needs to be either avoided or regulated so as to protect financial accounts. Government systems typically follow standard accounting protocols to record their assets and liabilities. Using DLT to record government transactions might require changes to regulations mandating the accounting protocols. Another concern could relate to insolvency laws, as enforcing the change of ownership under insolvency laws would require the central bank or one of the service providers to have custody of assets (CBDC), while the design of the ledgers might permit only the account or token holder to gain access to the private keys necessary to transfer the CBDC.

75. **In addition to the laws and regulations mentioned above, there may be other relevant laws that need to be changed to legally recognise CBDC as an asset.** These include laws pertaining to taxation, property foreclosure, disposal of electronic wallets in bankruptcy, and criminal laws that provide legal protection for the possession of CBDCs. It would be advisable for other jurisdictions planning to issue CBDC to consider potential laws that may need amending in the light of the introduction of a digital currency.[50]

Section 5 – Conclusion

76. **Central banks have different objectives for issuing a CBDC, but financial inclusion is one driver.** The barriers to exclusion differ starkly around the world and in the countries in our sample. It is therefore important to ensure a clear distinction between tackling pervasive exclusion problems, as seen in some EMDEs, and addressing pockets of exclusion, as observed in AEs. Possible solutions for each of these are distinct and separate. For more pervasive levels of exclusion, several foundational reforms identified in the CPMI-World Bank guiding principles of payment aspects of financial inclusion would rise to the level of being pre-requisites.

77. **A CBDC alone may not address financial inclusion challenges, but it could play a role as part of a broader suite of tools.** A CBDC and other policies have to grapple with the key reasons for financial exclusion. CBDCs have design features that can be tailored to specific barriers, but they would still need to be supported by further policies. The development of an acceptance ecosystem will be required, which will allow for the seamless exchange between digital and physical forms of currency. Significant and wide-reaching financial and digital literacy activities will also be required if a CBDC is to be afforded the same levels of trust currently enjoyed by other forms of central bank money. The fundamental reforms required to achieve financial inclusion, including the entry of non-banks and new business models, applying a tiered KYC approach and encouraging agent-based models, remain relevant. Further efforts to modernise the national payment system by introducing fast payment services, the use of open banking and APIs to enable efficient interfaces, and ensuring fair, transparent and risk-based access criteria for access to payment systems and financial infrastructures, are also relevant. As some central banks noted, this reform agenda could go a long way towards addressing the barriers to financial inclusion. In some

[50] For further discussion on legal aspects of CBDC, please refer to World Bank (2021a).

cases, these policies can pave the way for a smoother introduction of CBDC, if the country context requires that.[51]

78. **CBDCs could offer an opportunity for governments and central banks to promote universal access.** If adopted as legal tender, jurisdictions will strive to ensure CBDC is accessible and used by all residents. Where central bank and market forces have been unable to bring about interoperability so far, CBDC could provide the required interoperability and interlinkages with different payment rails. CBDC can also be used by the public authorities to establish a base level of service quality and put competitive pressure on private sector providers to improve upon their provision of financial services. As outlined in interviews, CBDCs – where they are being considered – are being designed to cover customer segments that cannot be reached by existing private sector-led solutions, functioning as a low-cost public good.

79. **Ultimately, many central banks see CBDC as a new tool to tackle some fundamental issues in the existing payments landscape.** CBDC systems could be designed in a way that involves all PSPs, banks and non-banks; offers a robust and low-cost public sector technological basis and novel interfaces; provides for low service fees; rethinks access policies to include all; allows for remote registration; facilitates access of merchants, micro and small enterprises; enables access to special groups with limitations; and fosters interoperability with domestic and cross-border systems, without the unintended consequence of new forms of exclusion. If designed with inclusion in mind, CBDCs form an addition to the policy toolbox to support access to payments and financial services for all.

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[51] See also Buckley et al (2021).

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