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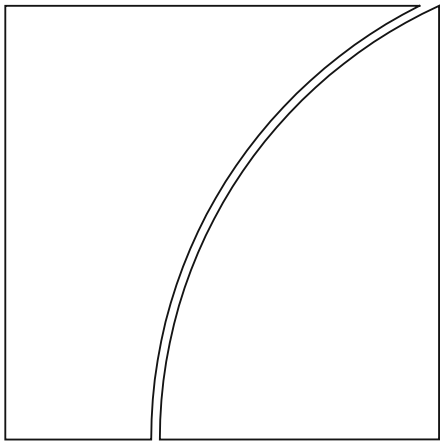

BIS Papers

No 123

CBDCs in emerging market economies

Monetary and Economic Department

April 2022

JEL classification: E42, E58, G21, L86, O32, O38.

Keywords: banking system, big tech, capital flows, central banks, central bank digital currencies, currency substitution, data privacy, digital currencies, financial inclusion. financial stability, intermediation, money.

Papers in this volume were prepared for a meeting of emerging market Deputy Governors organised by the Bank for International Settlements on 9–10 February 2022. The views expressed are those of the authors and do not necessarily reflect the views of the BIS or the central banks represented at the meeting. Individual papers (or excerpts thereof) may be reproduced or translated with the authorisation of the authors concerned.

This publication is available on the BIS website (www.bis.org).

ISSN 1682-7651 (online)
ISBN 978-92-9259-549-4 (online)

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CBDCs in emerging market economies

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Introduction

In recent years, in both advanced (AEs) and emerging market economies (EMEs), central banks have become increasingly engaged in projects related to central bank digital currencies (CBDCs) – ie digital money that is denominated in the national unit of account and is a liability of the central bank (BIS (2021)). However, the stage of engagement – research, pilot or launch – varies according to the country.

All 26 central banks participating in this meeting (Annex Table A1) are active in CBDC research. Several have progressed to the pilot or proof-of-concept stage (eg Hong Kong SAR, Saudi Arabia, Thailand, the United Arab Emiratis (UAE)). A few are close to launching (eg China's eCNY), while some do not see a pressing need for a CBDC in the near future (eg Poland, Singapore).

This paper begins by discussing the main motivations of EME central banks for CBDC engagement, focusing primarily on the rationale for retail CBDCs. A second section reviews central banks' main concerns regarding retail CBDCs, including data privacy and data governance. The third section discusses design choices for retail CBDCs that promote central bank objectives while addressing possible concerns. The fourth section discusses the implications of cross-border use of CBDCs and related design considerations. The paper concludes with high-level takeaways. Throughout, the paper draws on survey responses and background papers from the central banks participating in the meeting.

Motivations for CBDC issuance

The top motivations for CBDC issuance vary across EMEs, with no single factor dominating, as the survey shows (Graph 1). Providing a cash-like digital means of payment, in light of reduced cash usage and an increase in private digital payment services, is the most common consideration. Boosting financial inclusion also ranks high. Other significant considerations include strengthening competition among payments service providers (PSPs), increasing efficiency and reducing the costs of financial services. Background papers suggest that these motivations are not mutually exclusive. Indeed, a majority of central banks consider many of these motivations as jointly important (Annex Table A2 on central bank survey responses).

Provide cash in digital form

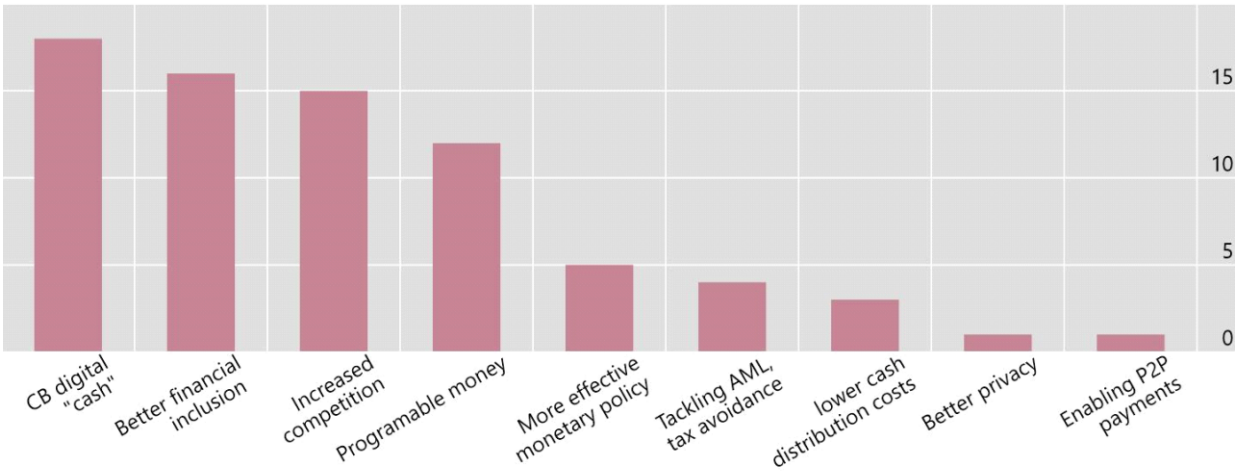
The digital revolution is changing the payments landscape. As big techs and fintech firms move into financial services, payments are no longer a commercial bank monopoly. New forms of digital asset such as cryptocurrencies and stablecoins are also emerging as a potential means of payment. In many EMEs – including India, Pakistan, Kenya and Tanzania – digital payments via mobile phone have gained ground. Meanwhile, the cash-to-GDP ratio – a proxy for the use of cash in payments

– has declined in a number of EMEs (CPMI (2021)). In China, for example, cash could lose its central role in the not-too-distant future.

Motivations for issuing CBDC

Number of central banks

Graph 1



Each bar indicates the number of central banks that choose a given motivation as one of its top three motivations.

Source: BIS EMDG survey 2022.

Against this backdrop, a CBDC could serve as a tangible marker of the trust in money, just as cash does today (BIS (2021)). In the same vein, central banks in Chile and Indonesia noted that CBDCs could also help central banks maintain their role as the issuer of the unit of account and as the anchor of the monetary system.

The Reserve Bank of India noted another possible motivation for issuing a CBDC – potential savings from reducing cash in circulation. Savings could stem from lower costs related to printing, transporting and storing banknotes and coins. The potential for savings is greater in economies where cash circulation remains high.

Enhance financial inclusion

Promoting financial inclusion is another common motivation. It is a top consideration for Peru, Mexico and South Africa and one of the main considerations for more than half of all central banks (Graph 1).

Financial inclusion, broadly defined, means that individuals and businesses can access and use financial services at a low cost. Inclusion across EMEs has improved over time but is still low in some regions. As of 2017, almost a third of adults in the world had no bank account; this number exceeded a half in Africa and was close to 40% in Latin America and the Caribbean.

Financial exclusion can stem from financial market features as well as broader structural factors (Graph 2, left-hand panel). Market features include lack of access points, insufficient ICT infrastructure, high costs and the private sector's unwillingness to serve some segments of the society (eg in rural areas). Peru, for example, stressed limited access to digital infrastructure as a barrier to inclusion. Broader structural factors include financial or digital illiteracy, lack of funds and limited trust in service providers (Demirgüç-Kunt (2018)). Financial illiteracy is a hurdle especially in low-

income countries (centre panel) while Hungary stressed digital illiteracy as a critical issue for financial inclusion in an increasingly digital world. Relatedly, there are "digital divides" across income, education and age groups, either because of lack of access or differences in preference for use of digital products. For example, in Peru, those in the informal sector – roughly 70% of the workforce – prefer the anonymity of cash. The use of digital payments by the elderly relative to the young is also low despite financial account ownership that is comparable with that of the young (right-hand panel).

While CBDCs might not be able to directly overcome structural barriers to inclusion, they can mitigate some of the market imperfections inhibiting inclusion. For instance, CBDC issuance can provide an open infrastructure that lays down "rules of the game" for payment service providers. In turn, this could promote effective competition through interoperability and deliver benefits to consumers (eg UPI in India). Private players could develop services with greater added value through CBDCs. In addition, as a publicly provided digital payment service, a CBDC could inspire greater trust and strengthen financial engagement, especially among those reluctant to use private digital payment services. Moreover, CBDCs could help cut the cost of payment services (eg a low-fee structure, such as that envisioned by the Bank of Russia for its digital ruble). Finally, CBDCs can facilitate fiscal policy implementation, such as targeted direct transfers to households. That said, CBDCs, by themselves, might not do much to increase deposits or encourage credit provision.

Improve efficiency of domestic payments

The potential of CBDCs as a new means of payment and the attendant increase in diversity and competition in payment services are a top motivation for a number of central banks. The Central Bank of Brazil, for example, noted its focus on technology to foster innovation and enhance financial markets efficiency. The Bank of Russia and the Bank of Thailand, meanwhile, indicated CBDC's potential to better serve customer needs as a key factor.

Payment service markets are often marked by oligopoly. This is because a few payment service providers (PSPs) can gain and maintain a substantial market share due to network effects (Gowrisankaran and Stavins (2004)). Concentrated market power has several undesirable implications. One is the high cost of services, as in the case of credit card network providers (eg Visa, MasterCard, Amex); even if costs remain low initially (say due to predatory pricing), oligopolists may seek rents later on. Another concern is information-hoarding in an increasingly digitalised world, akin to "walled gardens" where only a few players have access to detailed user transaction data (eg AliPay and WeChatPay in China, KakaoPay in Korea).

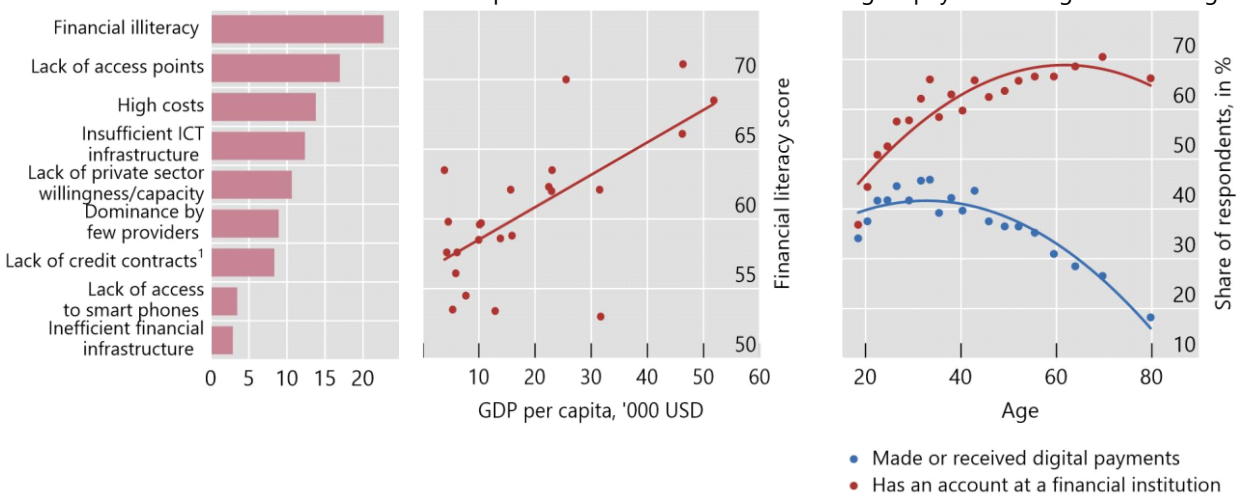
The introduction of a CBDC as an alternative means of payment can affect the competitive structure of the underlying payment system. Depending on design, it could improve competition and reduce costs; it could also help prevent "walled gardens" (Box A). The Central Bank of Israel raised one specific possibility – in economies where a functioning payment ecosystem already exists, a CBDC could benefit from the so-called late-mover advantage and build upon the latest innovations while addressing the weaknesses of existing services. CBDC issuance could also support new digital technologies and their integration with the broader economy such as integrated payment of electricity and phone bills via the CBDC wallet. In Brazil, for example, the Digital Real project is shaping up as the main element

of a platform for "smart payments" where the Digital Real system would connect current sources of liquidity to digital asset ecosystems.

Barriers to improving financial inclusion

In per cent

Graph 2



[1] Lack of credit contracts and procedures suitable for individuals and/or firms with erratic and/or undocumented cash flows. [2] Financial literacy score is a derived value that ranges between 1 and 100. It is calculated following the methodology described in the OECD/INFE Toolkit for Measuring Financial Literacy and Financial Inclusion and the data are from 26 economies.

Sources: BIS EMDG 2022 survey. OECD/INFE 2020 International Survey of Adult Financial Literacy. World Bank Global Findex Surveys 2011, 2014, and 2017; A Demirgüç-Kunt, L Klapper, D Singer, S Ansar and J Hess. *The Global Findex Database 2017: Measuring financial inclusion and the Fintech revolution*, World Bank, 2018. S Doerr, J Frost, L Gambacorta, H Qiu, "Population ageing and the digital divide", *SUERF Policy Note*, 2022.

Box A

Data privacy and governance

Data collected as part of the CBDC system and how they are managed can affect consumer privacy as well as the competitiveness of the new digital landscape.

Some level of identification is crucial for CBDC design (BIS (2021)). Currently payment systems rely on effective identification of users for access and system integrity; CBDCs are no different.[1]

A CBDC that is linked to a digital identification system can help standardise usage in a digital payment ecosystem, support the formal economy and help improve financial inclusion. Several countries have introduced digital ID schemes, with specific designs and different roles for the public and private sectors. In the Philippines, for example, the Philippine Identification System (PhiSys) Act in August 2018 provides consumers with a national ID and thus the means to establish a verifiable digital identity that enables them to open accounts and participate in the financial system more easily. Other have different setups for effective ID verification: in Sweden, for example, a consortium of banks developed the BankID Solution under a public-private partnership.

Regardless of the structure and the relative role of the public and private sectors in the digital ID system, a key question is the protection of consumer data. Indeed, payments data – eg from credit card usage, CBDCs or retail fast payment systems (FPS) – are revealing about consumer behaviour and preferences. Consumer privacy and data governance are, therefore, as the Reserve Bank of India noted, of "prime importance" for the success of a CDBC.

Credible privacy and data governance frameworks can engender greater trust in a CBDC and encourage its adoption (BIS (2021), Carrière-Swallow et al (2021)). Specifically, data collection and storage for CBDCs involve multiple participants, including consumers, financial service providers, data service providers and government entities. Data management would thus need to be interoperable across these participants. Moreover, rules related to storage, ownership and sharing, as well as the governance system would need to be defined and established (Tiwari et al (2022)). Such rules can help mitigate privacy and/or misuse risks associated with "walled gardens" (D'Silva et al (2019)).

Globally, many countries have privacy laws that recognise and define the rights individuals have over their data. These laws generally emphasise protecting personal data rights, in particular control over consent and data portability (see for example, the Personal Information Protection Law in China introduced in 2021 and the European General Data Protection Regulation introduced in 2018).

More concretely, CBDC designs can allow for privacy by separating payment services from control over the resulting data. Such designs could allow anonymity with respect to specific parties, such as PSPs, businesses or public agencies. Like some FPS, CBDCs could give users control over their payments data, which they need only share with PSPs or third parties as they decide (BIS (2021)). For example, with UPI, data ownership and control over their credentials are addressed through application programming interfaces (APIs) that use public key cryptography. For a system that relies on biometric digital ID systems, such as Aadhar in India, the safeguards are even more stringent and crucial. Thus, data and privacy management challenges under CBDCs are not new.

Concerns related to CBDC issuance

A number of macroeconomic, financial and operational concerns are raised by central bank survey respondents (Graph 3, left-hand panel). A key concern relates to greater operational burdens – including maintaining system stability and cyber security, particularly in an increasingly digitalised system that calls for new regulatory and supervisory initiatives for privacy protection and data management (Box A). A majority of survey respondents are also concerned about the possibility of CBDCs

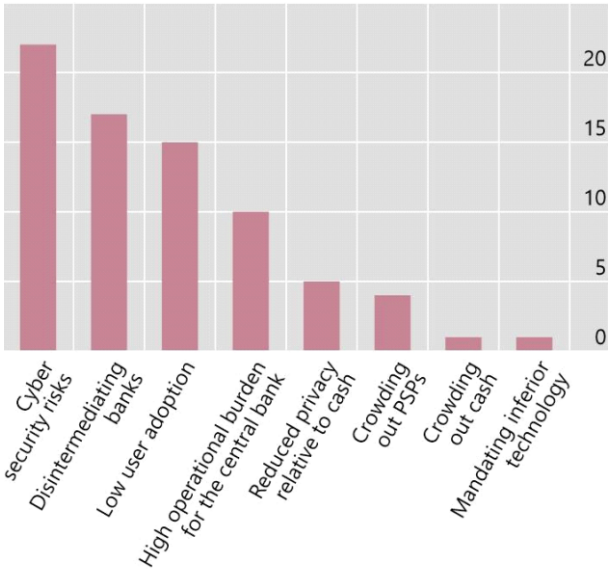
[1] Retail FPS, such as UPI and PIX, and CBDCs have a lot in common: both rest on digital ID and technical standards such as APIs that ensure data privacy.

disintermediating banks and the attendant impact on financial stability; these concerns are relevant especially if the take-up of CBDCs is large. At the same time, central banks are also concerned about possible low user adoption, suggesting some debate regarding the value added by CBDCs to consumers and businesses.

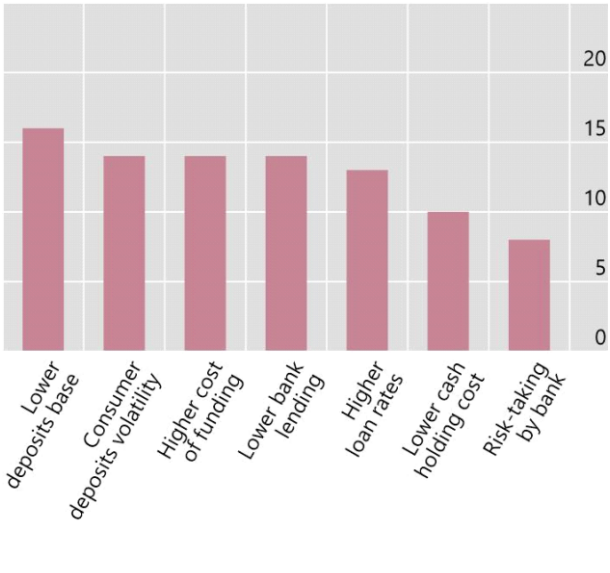
Concerns related to CBDC issuance

Number of central banks — Graph 3

Concerns related to CBDC issuance[1]



Channels and consequences of bank disintermediation[2]



[1] Each bar indicates the number of central banks that choose a given downside as one of its top three concerns. [2] Each bar indicates the number of central banks that choose a given item as one of its top five likely channels and implications of potential bank disintermediation.

Sources: BIS EMDG 2022 Survey; authors' calculations.

Operational concerns

A CBDC system must be stable, robust and able to recover from operational disruptions. It is equally important to mitigate any associated credit and liquidity risks. Such disruptions could also have reputational costs. Limiting these operational risks is a dominant consideration for EME central banks (Graph 3, left-hand panel). For instance, these risks materialised on 17 January 2022 for the Eastern Caribbean Central Bank (ECCB) when transactions using DCash – the digital currency pilot scheme for the ECCB launched in March 2021 – were interrupted by an outage at the service provider.

A key operational challenge is tackling cyber risk. Cash has sophisticated anti-counterfeiting features and has limited exposure to large-scale operational breakdowns. By contrast, a successful cyber attack on CBDCs could cause widespread and serious damage. Attacks on the financial system, such as hacks into credit card systems or databases containing consumer credit profiles, offer a glimpse of the threats involved. Defending against such attacks is far more difficult given the multiplicity of linkages with the broader financial and digital ecosystem.

Another challenge for central banks is the operational burden of maintaining a CBDC. The central banks surveyed highlighted several key issues, including network

resilience, the safety, cost and availability of technologies as well as the scalability and functionality of technologies considered (Graph A2, left-hand panel). The operational cost of a system with such complexity is high. Compared with a direct system where costs associated with user-facing activities rest squarely on the central bank, a two-tier system (see Box B) would reduce the operation burden on central banks and thus, the cost to the users (BIS (2021)). The Hong Kong Monetary Authority, for example, has noted considerations for the division of labour between the central bank and private sector intermediaries in its CBDC design.

Disintermediating banks

Roughly half of survey respondents indicated concerns for bank disintermediation under tranquil conditions or during crisis times.

The specific drivers behind bank disintermediation differ between tranquil and crisis times. During tranquil times, considerations such as remuneration of CBDCs, and possibly safety, could drive bank disintermediation. The safety of an account at the central bank might be attractive, at least for balances at commercial banks above the deposit insurance threshold. Even if there were limits on individual CBDC holdings, some reduction in commercial bank deposits could still ensue. An interest-bearing CBDC could reinforce such effects (eg Fernández-Villaverde et al (2021), Agur et al (2021)).

Any disintermediation effect is likely to be more marked and abrupt in a crisis, given CBDCs' status as a safe haven. Argentina highlighted this concern. Specifically, CBDCs could exacerbate a run on weak private banks, as consumers move deposits to CBDCs or to stronger banks.[2] This effect could be stronger in EMEs with less developed banking sectors or where private institutions have a weaker reputation than public ones.[3]

Thus, the conditions – tranquil or crisis times – under which CBDCs disintermediate banks present difficult policy trade-offs for central bank.[4] A CBDC could hasten disintermediation in a crisis, amplifying the liquidity stress on weaker banks. Yet, constraining CBDCs' convertibility to control volatile flows runs counter to the goal of proving a safe means of payment precisely when that safety is valued most.

In general, deposit disintermediation, from CBDC, stablecoins or big techs in financial services, for example, can induce affected banks to rely on less stable funding sources, such as wholesale or money markets. This, in turn, could potentially reduce credit provision from affected banks and raise loan rates (Graph 3, right-hand panel). Indeed, banks' funding costs – including their access to deposits – and their loan rates are highly correlated. Not surprisingly, a majority of survey respondents indicated concerns about the impact on credit provision (Graph 4, left-hand panel).

[2] Monnet et al (2021) use a historical French episode to illustrate the role of central bank money in exacerbating bank runs.

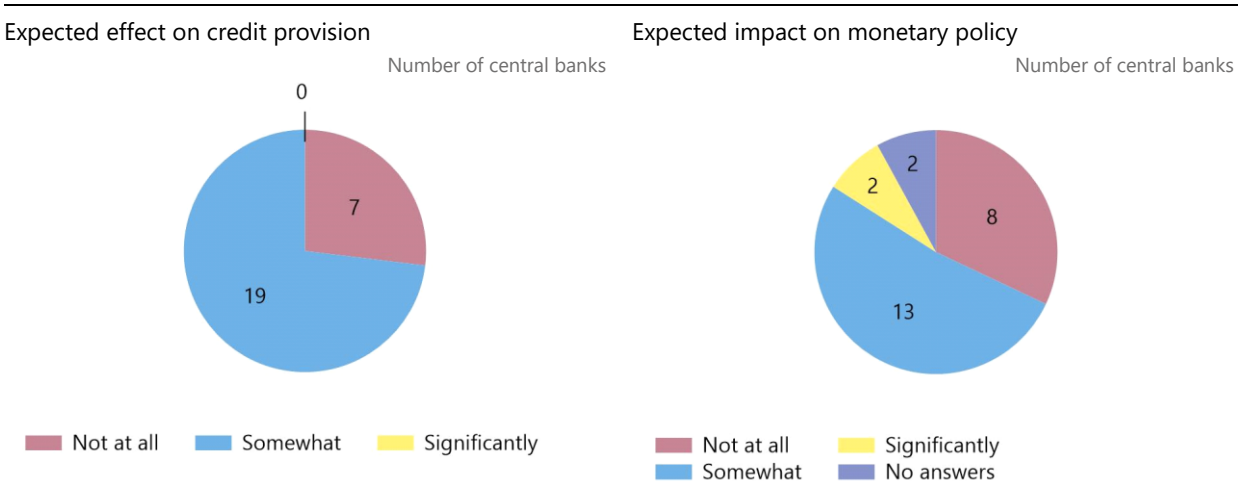
[3] The literature's verdict on this possibility, however, is not unanimous. Chiu et al (2019), for example, argue that a CBDC could inject greater discipline into banks in the imperfectly competitive deposit market, and not necessarily disintermediate banks. Rather, banks may compete away the rents.

[4] Indeed, as Table 1 suggests, roughly half of central banks surveyed are undecided on CBDC remuneration and a majority are undecided on the matter of imposing limits.

Bank disintermediation, if sufficiently large and broad-based, can affect central banks' balance sheets and the implementation of monetary policy. In fact, most central bank respondents expect CBDCs to have some impact on monetary policy (Graph 4, right-hand panel). One possibility is that deposit flights to CBDCs might expand central bank balance sheets. These increases would raise the question of how capital should flow back to the real economy – directly by the central bank, or via public sector or investment banks. The Bank of Russia indicated that it could offset the potential liquidity drain on the system via additional repo operations.

Monetary policy implications would be greater if the central bank were to use interest rates on the CBDC as another policy lever (eg a dual interest rate policy as discussed in Lonergan and Greene (2020)). Argentina and Thailand noted that tying retail CBDC remuneration to the central bank's policy rate might improve transmission to the interest rates of financial institutions. That said, across central banks respondents, the appetite for remunerated CBDC is low (Table 1).

Expected impact on credit creation and monetary policy — Graph 4



Source: BIS EMDG survey 2022.

Low user adoption

CBDC adoption is driven by its usefulness to consumers and merchants. Low CBDC adoption could hinder the policy objectives central banks hope to achieve.

In particular, CBDCs would need to satisfy unmet user needs for broad adoption; this would depend on country-specific conditions (Group of Central banks (2021a)). For many central banks, CBDCs do not offer significant advantages over FPS in terms of boosting financial inclusion (Graph A2, right-hand panel); systems such as UPI or PIX can confer more immediate improvements. In Brazil, for example, 45 million people made their first ever digital transfer via PIX in its first year of operation. Where there are successful implementations of new payment services – eg M-Pesa in Kenya or Swish in Sweden – broad adoption came from reducing frictions and providing incentives tailored to the targeted users. M-Pesa, for example, provided the unbanked population with access to basic banking-like facilities via SMS services and is currently used by 95% of the population.

For merchants and banks, the gains from CBDCs could come from a more efficient payment system. For example, a CBDC could lay the ground for an international system of CBDCs, such as the multiple currency CBDC bridge ("mCBDC") that could help broaden a bank or a merchant's reach. South Africa, for example, is exploring a multicurrency regional settlement system in a multilateral, multicurrency CBDC arrangement.

Box B

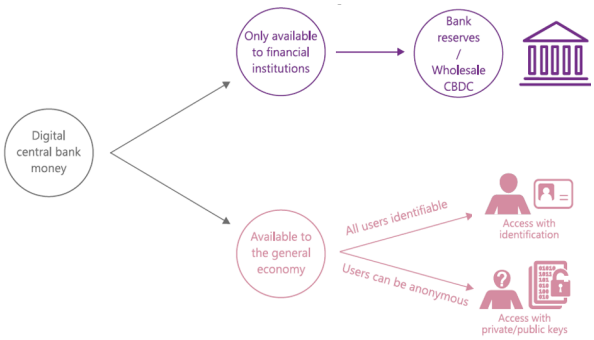
CBDC design elements

As in the case of cash (a physical liability) and reserves (a digital liability), the design of CBDCs entails several choices. There are two types of CBDC: one is universally accessible to the general public (like cash) – ie a **retail** or general purpose CBDC; the other is available only to select institutions (like reserves) – ie a **wholesale** CBDC (see Graph A, left-hand panel). Reserves have been digital for a long time – a wholesale CBDC differs in that it may be accessible to a wider set of counterparties than reserves, be interoperable with foreign systems, or feature "smart contracts" (eg security and currency payment and settlement within one framework). According to the survey, a majority of EMEs are investigating both retail and wholesale CBDCs, while about a third are focusing only on the retail version (right-hand panel).

A big question on CBDCs: retail, wholesale, or both?

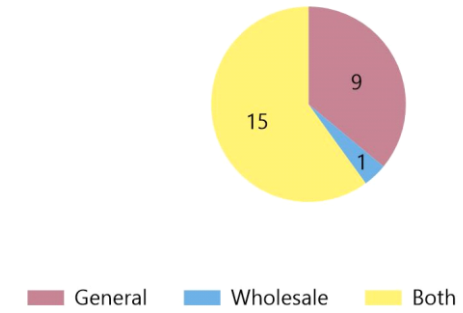
Graph A

Forms of digital central bank money



A majority of central banks envision both retail and wholesale CBDCs

Number of central banks



Sources: BIS, *Annual Economic Report*, 2021, Chapter 3; BIS EMDG 2022 survey.

The design of a retail or wholesale CBDC has many facets. Central banks' survey responses and background papers suggest the following six design features as being the more important ones (in no particular order). First is the **degree of interoperability** with the domestic payment system or with cross-border ones. A second choice is the **degree of central bank involvement** in the operation of a CBDC. Third is whether a retail CBDC pays **interest.** Fourth is whether there are **constraints** on the transaction amount, on the outstanding balance, on foreign users, or usage abroad by domestic users. Fifth is the **data governance policy**. Sixth is the underlying **technology**, ie whether a CBDC uses a distributed ledger technology (DLT), which can be permissionless or permissioned, or a central ledger technology (CLT).

From motivations and concerns to CBDC design

Central banks face trade-offs in CBDC design. As discussed above, CBDC issuance can advance policy objectives but also have undesirable effects. At the same time, how these effects can play out remains uncertain – due, for example, to the emergence of new technologies, novel use cases and broader risks – making their design analogous to a "moon landing", according to Magyar Nemzeti Bank (Hungary).

From motivations and concerns to design preferences[1]

Degrees of conviction for design features — Table 1

	(1) Domestic interoperable	(2) Two-tier	(3) Bears interest	(4) Limits	(5) CBDC-specific data policy	(6) Both DLT and CLT
Whole sample	0.90	0.79	0.27	0.62	0.44	0.77
Top three motivations						
Digital cash	0.88	0.88	0.35	0.62	0.50	0.73
Inclusion	1.00	0.67	0.00	0.83	0.17	0.67
Efficiency	1.00	0.80	0.10	0.60	0.50	0.90
Top three concerns						
Disintermediation	0.83	0.83	0.25	0.58	0.46	0.75
Operational concerns[2]	1.00	1.00	0.30	0.55	0.35	1.00
Low user adoption	1.00	0.58	0.33	0.75	0.58	0.58

[1] For each central bank and design feature, a "yes" is set to 1, a "no" is set to 0, and "not sure" or "no answer" is set to 0.5. The score of a design is then calculated as the average choice across central banks. The score is labelled with different colours: red (0-0.34) means central banks are on average "against" the design feature, yellow (0.34-0.67) means they are "uncertain", and green (0.68-1) means they are in "support". The top row shows the stance of the whole sample of central banks, rows two to seven show the score depending on central banks' top motivation or concern. [2] Operational concerns include operational burden as well as cyber risks.

Sources: BIS EMDG survey 2022; authors' calculations.

Central bank survey responses and background papers shed light on the six main design features (Box B) that can help satisfy CBDC issuance motivations while mitigating the attendant concerns. In Table 1, we report central banks' stance on these design features.

The stance of central banks regarding each design feature is obtained using an intuitive scoring system that goes from 0 to 1. A low value (red) means that central banks are on average "against" the design feature; an intermediate one (yellow) means they are "uncertain"; and a high value close to 1 (green) shows "support" for the design. For example, a value of 0.27 in the first row third column means that central banks are generally against a CBDC that "bears interest". A value of 0.44 in the first row of the second-to-last column means that central banks are uncertain regarding a "CBDC-specific data policy". By contrast, a value of 0.77 in the first row of the last column suggests that central banks are, on average, interested in both DLT and CLT architectures.

The rows in Table 1 are organised as follows. The first row shows the average stance across all participating central banks. The next three rows respectively show the stance within the three groups of central banks whose main motivation for CBDC issuance is (i) providing digital cash; (ii) improving financial inclusion; and (iii)

increasing efficiency. The final three rows show similar data depending on central banks' main concerns around CBDC issuance, namely, (i) bank disintermediation; (ii) operational concerns; and (iii) low user adoption.

(1) Domestic interoperability. Interoperability is a broad term, which generally denotes the ease with which funds can flow between CBDC and other payment systems (BIS (2021a)). For example, a less interoperable CBDC would be one where direct transfers between CBDC and private e-money solutions are not possible and instead need to go via, for example, a bank account.

There is broad support for a design that is interoperable domestically (Table 1, column 1). A more interoperable CBDC would contribute to the diversity of payment options (eg Poland) and relatedly serve as a backup for the payment system (eg Czech Republic). It can also create competition incentives (eg Mexico). In general, it would foster an open and dynamic system (eg Thailand). Some, however, noted that greater interoperability could be technically complex (eg Saudi Arabia) and that it is not clear if benefits could offset the costs (eg Chile).

(2) Architecture (direct vs two-tier). Most central banks are in favour of a two-tier system (Table 1, column 2) in which the central bank provides the core infrastructure while banks carry out the customer-facing activities as opposed to a direct model where the central bank handles all aspects of payments and keeps records of all transactions and balances (see Auer and Böhme (2021) for an in-depth discussion).

Such a design can reduce the central bank's operational burden (eg UAE). Indeed, as the second column of Table 1 shows, the preference for a two-tier model is strongest among central banks for which operational concerns matter most (sixth row with a value of "1"). A two-tier model would also facilitate collaboration and potentially draw on synergies with the private sector (eg China, HKMA). In general, central banks' preference for a two-tier model is consistent with their preference for greater interoperability.

(3) Remuneration. Central banks surveyed generally do not foresee offering interest on CBDCs (Table 1, column 3). That said, for around half of the central banks the choice remains open. For instance, while the draft model of Israel's CBDC would not bear interest to begin with, it will remain technically possible to change this in the future.

A non-interest bearing CBDC is consistent with the objectives of providing a cash-like digital means of payment. At the same time, it can help keep credit disintermediation (eg Chile) and the impact on monetary policy in check (eg Brazil and Hungary).

(4) Limits. A majority of central banks (20 out of 26) are uncertain about imposing limits on CBDC transactions or balances (also see Graph A1, left-hand panel). Among those that have a view, the preference is for some form of limits on CBDC transaction amounts and balances (Table 1, column 4). This could help ensure that retail CBDCs serve primarily as a medium of exchange and not as a major store of value (eg Singapore), prevent bank runs in stress period (eg Thailand) and help tackle AML/CFT (eg Argentina).

Imposing such limits, however, may not be straightforward. Limits on holdings may require changes to existing legal frameworks or be at odds with the general public's expectations from a CBDC (even though limits to cash payments for

security and fraud reasons do exist in some jurisdictions, such as the EU (Group of Central Banks (2021b)). More generally, the premise of imposing limits on a means of payment and thus constraining users' choices could raise broader public policy considerations.

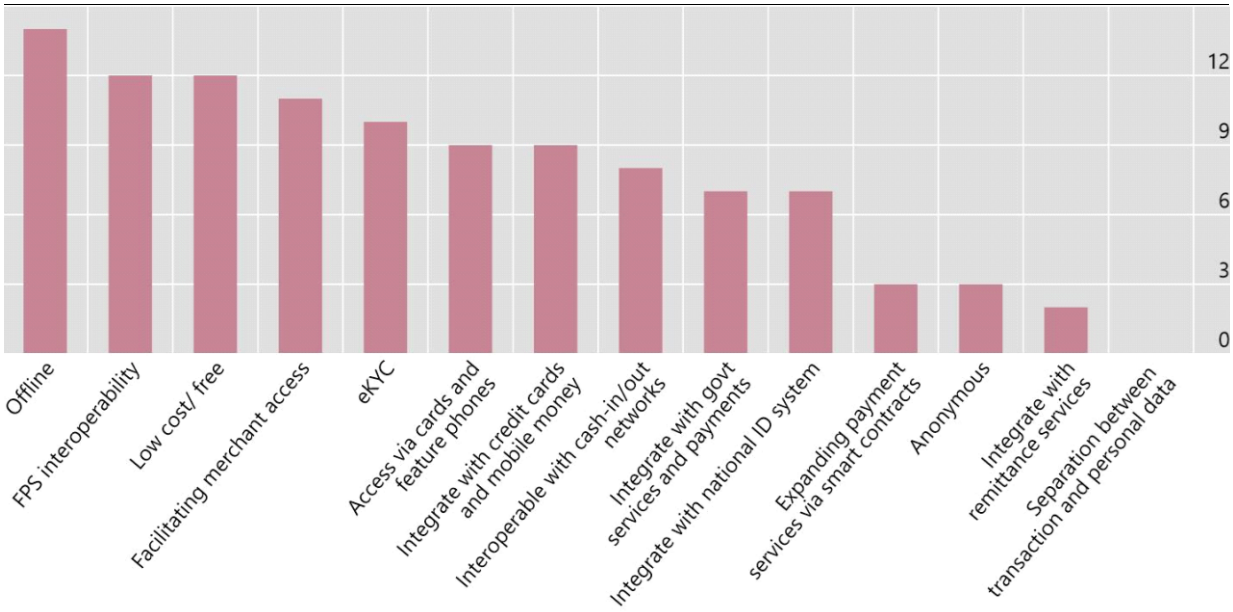
(5) Data governance. A majority of central banks (15 out of 26) are uncertain as to CBDC data governance policy. This high degree of uncertainty probably reflects the absence of a globally accepted standard on data governance, including for digital currencies (as noted in Box A). Yet, some central banks are adopting specific strategies. The CBDC in China, for instance, follows the principle of "anonymity for small value transactions and traceability for large value transactions".

(6) Technology (DLT vs CLT). Network resilience, speed, scalability, cyber security, and functionality are among the top technological considerations (see Graph A1, left-hand panel). The two main models, DLT and CLT, have relative advantages and disadvantages, and the current understanding in the literature seems to be that neither model (in its current incarnation) fully dominates the other (eg Auer et al (2021a)). For instance, in terms of resilience, the key vulnerability of a CLT system is the failure of the central entry point while that of a DLT system, which is based on the consensus mechanism, is a denial-of-service attack. In terms of functionality, a DLT may offer more programmable or smart features.

Most central banks are currently investigating both distributed and centralised arrangements (Table 1, column 6). This probably reflects efforts to identify the strengths and weaknesses of each model.

Financial inclusion hurdles and CBDC design

Graph 5



Each bar indicates the number of central banks that choose a given design as one of top five features that can help improve inclusion.

Source: BIS EMDG survey 2022.

Beyond the six main design features, the survey responses underscore several other features that could help promote financial access in particular. Not surprisingly, central banks with inclusion as the primary motivation do not envision any exclusions

to access or payment use cases (Graph A1, left-hand panel). Specific design features deemed most useful for improving access include offline availability, compatibility with feature (ie non-smart) phones, e-KYC, merchant access, and a low-cost design (Graph 5). At the same time, anonymity and the separation between transaction and personal data are perceived to be less relevant features in this respect.

Offline functionality, combined with CBDC access via feature phones, could rely on near-field-contact (NFC) technology, bluetooth or SMS. This could help users who have no smartphone, or are less familiar with digital products (eg a payment app) gain access to CBDC. Relatedly, interoperability with cash-in/cash-out networks (eg agents who can load prepaid CBDC cards upon receipt of physical cash) could provide an easy transition towards CBDC for cash-reliant users. Indeed, as the Magyar Nemzeti Bank notes, innovative solutions are needed for CBDC to make inroads among the digitally lagging or illiterate.

In addition, an eKYC-enabled CBDC that is integrated with the national ID scheme could greatly ease financial onboarding. Operationally, for example, an agent-based banking network model (such as in India and Indonesia) can get around the lack of physical bank branches (say due to limited incentives among private players to serve some markets). In this model, banking agents can complete KYC on a user's doorstep using a digital device and perform basic payment transactions. Another example is from Mexico, where mobile phone numbers are to be used as an initial CBDC account identifier for users without a bank account.

Finally, an interoperable and open CBDC system that drives competition could help to keep costs low. A CBDC with minimal fee, especially one with fees lower than PSPs, could help further reduce transaction costs (eg Russia). These features could be particularly attractive for those who find existing solutions prohibitively costly.

Cross-border CBDC: design considerations

CBDCs that can be used across-borders or are interoperable vis-à-vis foreign CBDCs – ie cross-border CBDCs – bring benefits as well as challenges.

Cross-border CBDCs can help improve the cross-border payments landscape. International payments such as remittances remain very costly, due in part to the decline in correspondent banking (CPMI (2019); Graph 6, left-hand panel). On average, making a $200 payment costs about $14 (World Bank (2019)). The time required is also long, generally ranging from three to five days. Cross-border CBDCs could help lower the dependency on intermediaries and thus reduce transaction costs and time. Of the central banks surveyed, 54% expect CBDCs to "significantly" lower the cost of cross-border transactions and another 31% expect "some" cost savings. These savings could yield substantial economic gains, especially for economies heavily reliant on remittances (centre panel). In the Philippines, for instance, inbound remittances totalled USD 2.7 billion in September 2021, or roughly 8% of GDP.

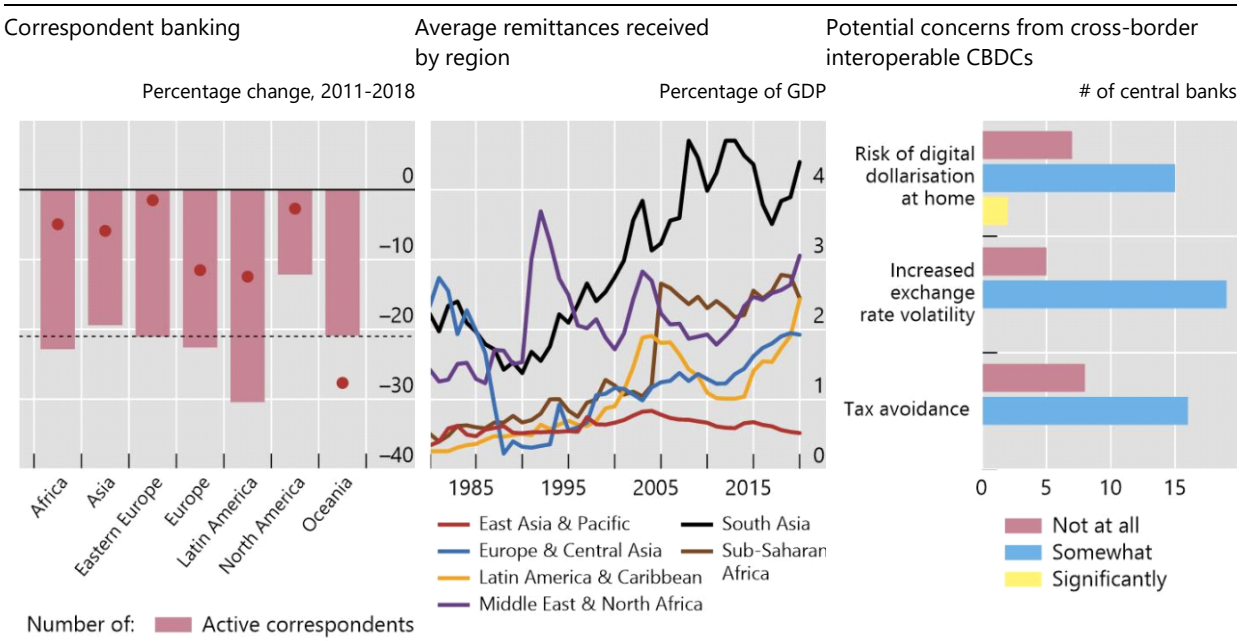
At the same time, more than half of the central banks believe that cross-border CBDCs, if not carefully managed, could spur currency substitution, exchange rate volatility and tax avoidance (Graph 6, right-hand panel).[5] The risk of currency substitution is higher for economies that face high inflation or domestic economic

[5] While cross-border CBDCs are a potential channel through which such risks could materialise, domestic and foreign private stablecoins are a bigger threat in this regard.

instability. Two central banks (Argentina and Chile) note that this risk could be "significant".

Cross-border remittance landscape

Graph 6



Sources: SWIFT BI Watch; BIS survey; E Feyen, J Frost, H Natarajan and T Rice, "What does digital money mean for emerging market and developing economies?", BIS Working Papers, no 973, October 2021; BIS EMDG 2022 survey.

Managing spillovers via design

On net, EME central banks are in favour of a cross-border interoperable CBDC (Graph A1, right-hand panel). They view the potential risks as manageable via design features such as limits on access and usage. For example, central banks could impose such restrictions on non-residents or foreign visitors based on digital IDs established as a part of mutual recognition of national ID schemes, alongside transaction limits on foreign users or use by residents abroad (BIS (2021)).[6]

Three CBDC arrangements for cross-border interoperability that incorporate digital IDs or usage limits are gaining traction (Boar et al (2021), Carstens (2021)).[7] The first model promotes greater compatibility between different national retail CBDC systems via harmonised regulatory frameworks, market practices and messaging formats that make it easier for systems to interoperate. The second model takes integration further by linking two domestic systems through technical interfaces (eg Project Jasper-Ubin). The third, most ambitious, establishes a single and jointly

[6] A recent survey indicates that few central banks are open to allowing non-residents abroad to use their CBDCs (Auer et al (2021)).

[7] An alternative approach to making cross-border transactions more efficient is via linking FPS across borders without using CBDCs. The Hong Kong Monetary Authority, for example, is currently building a local financial infrastructure to provide a multicurrency platform that aims to link up Hong Kong SAR's payment systems with those of the neighbouring regions and international systems to facilitate faster and safer cross-border payment (Yue (2020)).

operated wholesale multi-CBDC system (eg Project mBridge). In each of these models, users would be able to hold CBDCs from various jurisdictions in the CBDC "wallet" of their home jurisdiction, subject to some limits.

Cross-border coordination and cooperation are crucial, as stressed by Malaysia. In particular, the choices made by large-economy central banks could constrain the options available to smaller countries (as indicated by Israel). Efforts include common governance arrangements, which can be challenging (Auer et al (2021)). In addition, consistent technical standards, oversight framework, and adequate liquidity in several currencies would be necessary. South Africa emphasises several of these considerations based on its experience with a regional RTGS system.

Key takeaways

Central bank engagement with CBDCs has increased globally. The survey of EME central banks uncovers their key motivations for CBDC issuance as well as primary concerns. Like their AE counterparts, achieving greater payment system efficiency is at the heart of EME central banks' motivations (Boar et al (2021)). At the same time, EMEs place greater emphasis than AEs do on financial inclusion and are more concerned about cyber security risks, bank disintermediation, and cross-border spillovers.

Given differences in country circumstances, emphasis on motivations and perceived concerns, central banks are approaching their CBDC engagement differently. Indeed, the availability of digital infrastructure, mobile-phone and internet penetration, the level of competition in the payment system and data governance arrangements, are all factors that shape the objectives for CBDC issuance and determine the value added of CBDCs as well as their adoption.

While a handful of central banks are still uncertain about the need for CBDC issuance in the near term, others are of the view that careful design can keep risks to a minimum (and ensure "no harm" to the financial system, as discussed in Group of Central Banks (2020)) while still yield net benefits. The preference among those in this second group is for a "payment-focused CBDC" – one that seeks to improve payment system efficiency and steers away from serving as a store of value to avoid the risk of disintermediation and major monetary policy implications.

Accordingly, these central banks do not envision offering remuneration on their CBDCs and prefer some limits on balances and transaction values. There is also an inclination to keep the amount of CBDC outstanding small (Auer and Bohme (2021)). Operational considerations underpin a preference for a two-tier system, where the private sector has a major role to play and which draws upon the strengths of both distributed and central ledger-based network structures. More generally, central banks envision a framework where public and private entities "partner" together as forming the basis for efficient and stable financial and payment systems.

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Annex 1: Central banks participating in the survey

Twenty-six central banks participated in the 2022 EME Deputy Governors survey from the following jurisdictions:

Economies

Annex Table A1

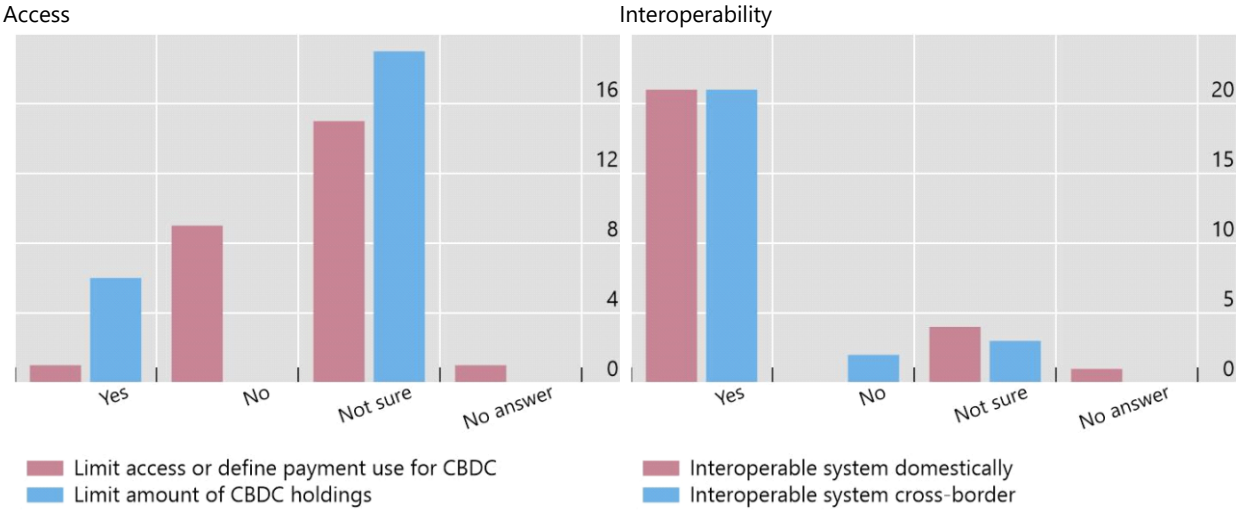
Algeria	India	Russia
Argentina	Indonesia	Saudi Arabia
Brazil	Israel	Singapore
Chile	Korea	South Africa
China	Malaysia	Thailand
Colombia	Mexico	Turkey
Czech Republic	Peru	United Arab Emirates
Hong Kong SAR	Philippines	Vietnam
Hungary	Poland	

Annex 2: Summary of survey responses

Use limits and interoperability

Number of central banks

Graph A1

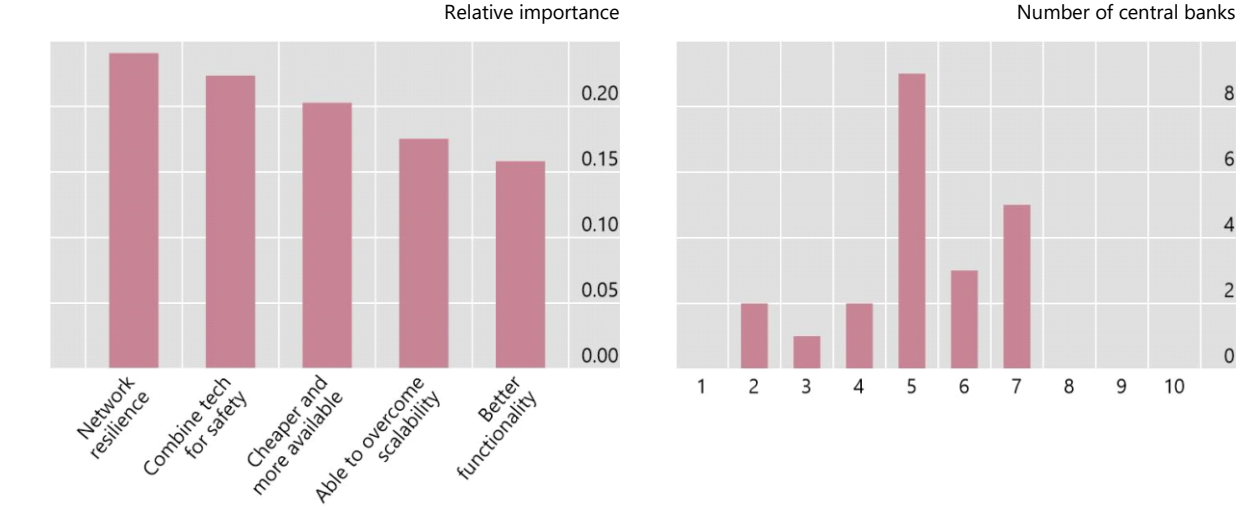


[1] Fraction of respondents that chose the design option as among the top five that can help improve inclusion.

Source: BIS EMDG 2022 survey.

Infrastructure design considerations

Graph A2



[1] Each central bank (CB) ranks the top five choices. For each choice, we compute the weighted importance as follows: 3 times the number of CBs that ranked a choice as first + 2 times the number of CBs that ranked a choice as second + the number of CBs that ranked a choice as third and so forth. This gives the relative importance of the choices. Finally, we normalise the sum by dividing by the total importance. [2] Scale of 1 (other solutions are vastly superior) to 10 (CBDC is vastly superior), with 5 meaning that they are equal.

Source: BIS EMDG 2022 survey.

Summary table of survey responses

Annex Table A2

	Top motivation	Top concern	Design						Impact				
			Architecture				Infra.	Remuneration	Domestic		Cross-border		
			Direct	Sharing	Dom	XB	CLT&DLT	IR offer?	Bk credit	MP op	Digital $	FX vol.	Tax
AE	CB digital "cash"	Cyber security risks	×		✓	✓	✓	×			×	×	×
AR	lower cash dist. costs	Disintermediating banks									✓		
BR	Increased competition	Disintermediating banks	×		✓	✓	✓	×		×			
CL	CB digital "cash"	Disintermediating banks	×	✓	✓	✓	✓	×			✓		
CN	CB digital "cash"	Cyber security risks	×	×	✓	✓	✓	×	×				
CO	Increased competition	Cyber security risks	×		✓	✓	✓						
CZ	CB digital "cash"	Crowding out PSPs								×			
DZ	CB digital "cash"	Low user adoption	✓		✓	×	✓	✓		×			
HK	CB digital "cash"	Cyber security risks	×		✓	✓	✓	×	×	×	×	×	×
HU	More eff. mon. policy	Low user adoption			✓	✓				✓			×
ID	CB digital "cash"	Disintermediating banks	×		✓	✓	✓						
IL	Increased competition	Disintermediating banks	×		✓	✓		×		×			
IN	CB digital "cash"	Low user adoption	×	✓	✓	✓	×	×	×		×		×
KR	CB digital "cash"	Low user adoption	×	×	✓	✓	✓		×		×		
MX	Better financial inclusion	Low user adoption	✓	✓	✓	×	×	×	×	×	×	×	×
MY	Programable money	Disintermediating banks			✓	✓	✓						
PE	Better financial inclusion	Disintermediating banks	×		✓	✓	✓	×	×				
PH	CB digital "cash"	High op. burden for the CB	×		✓	✓	✓				×		
PL	CB digital "cash"	Disintermediating banks	×										
RU	Increased competition	Disintermediating banks	✓	×	✓	✓	✓	×		×	×	×	×
SA	CB digital "cash"	Disintermediating banks	×			✓	×						
SG	CB digital "cash"	Disintermediating banks	×		✓	✓				×			×
TH	Increased competition	Low user adoption	×		✓	✓	✓	×					
TR					✓	✓	✓			✓			
VN	More eff. mon. policy	Disintermediating banks	×			✓	✓	×					
ZA	Better financial inclusion	Cyber security risks	×		✓	✓	✓	×	×			×	×

Note: ✓ indicates "yes" to the select features or question; × indicates "no". A grey bar indicates "not sure" in country response. A stripy bar indicates "No answer" in country response.

Summary table of survey responses (continued)

Annex Table A2

	Inclusion			Development focus	Issuance intention[1]
	Top challenge	Top feature	FPS?	General, retail or both	Unlikely near-term
AE	Financial illiteracy	Integration with national digital ID system	✓	Both	
AR	High costs of financial services		✓		✓
BR	Financial illiteracy	Expanding payment services through smart contracts	✓	General	
CL	Dominance of financial services by few providers	Integrating CBDC with existing payment instruments	✓	General	✓
CN	Lack of access points, especially in rural areas	Access to CBDC accounts via cards and feature phones	✓	General	
CO	High costs of financial services	Interoperability with existing payment systems	✓	Both	
CZ			✓	General	✓
DZ	Insufficient ICT infrastructure	Offline functionality	✓	Both	
HK			✓	Both	
HU	High costs of financial services	Low cost/ Access via cards and feature phones	✓	Both	✓
ID	Financial illiteracy	Integration with national digital ID system	✓	Both	
IL	Financial illiteracy	Integrating CBDC with government payments and services	×	General	
IN	Financial illiteracy	Access to CBDC accounts via cards and feature phones	✓	Both	
KR	Lack of credit contracts and procedures	Low cost/free CBDC service (subsidised by government)	✓	Both	✓
MX	Financial illiteracy	Interoperability with existing payment systems	✓	General	
MY	Financial illiteracy	Offline functionality	✓	Wholesale	
PE	Lack of access points, especially in rural areas	Low cost/free CBDC service (subsidised by government)	✓	Both	
PH	Lack of access points, especially in rural areas	Access to CBDC accounts via cards and feature phones	✓	Both	
PL	Financial illiteracy		✓	General	✓
RU	Lack of access points, especially in rural areas	Integrating CBDC with existing payment instruments	✓	General	
SA	Dominance of financial services by few providers	Offline functionality	✓	Both	
SG	Lack of private sector willingness or capacity	Low cost/free CBDC service (subsidised by government)	✓	Both	✓
TH	Lack of access points, especially in rural areas	Offline functionality	✓	Both	
TR			✓	Both	
VN	Lack of access points, especially in rural areas	Interoperability with existing payment systems	✓	General	
ZA	Lack of access points, especially in rural areas / Financial illiteracy/ Insufficient ICT infrastructure	Offline functionality	×	Both	

Note: ✓ indicates "yes" to the select features or question; × indicates "no". A grey bar indicates "not sure" in country response. A striped bar indicates "No answer" in country response.

[1] Based on information from country notes.

Central bank digital currencies in emerging market economies: a view from Latin America[1]

Central banks are increasingly considering the issuance of digital currencies, in response to fast and frequent payment market innovations. In this note, we weigh the benefits and costs of central bank digital currencies (CBDCs) and the main challenges posed by their possible implementation from the point of view of a Latin American country with a financial system which is underdeveloped as compared to more advanced regions, and basically bank-based. We argue that CBDCs and other technological innovations should be regarded as part of the central bank toolkit to improve means of payment – not as an end in themselves. Furthermore, we consider that the potential for lower conventional financial intermediation, currency substitution and capital flow volatility should be factored in, just as in the experience of previously issued CBDCs which did not become widely used.

New technologies and payments

The ongoing digital transformation is changing payment systems and may potentially change money as we know it. This is reflected, for instance, in growing holdings and use of cryptoassets as an alternative to traditional financial instruments and as a phenomenon that is rapidly expanding on a global scale, and that appears to have accelerated with the pandemic.

This process has a series of benefits, often related to the cost and speed of local and international financial transactions, and is based on distributed ledger technology (DLT), among other elements. But without adequate monitoring, regulation and supervision, these developments also pose potential risks for monetary policy, financial stability, consumer rights and the environment.

All these developments are better regarded as part of the evolution of the payment ecosystem. The Central Bank of Argentina (BCRA) has contributed to promoting the creation of new access points, facilitating the availability and opening of bank accounts, encouraging greater use of electronic means of payment and promoting the use of electronic channels for remote transactions.

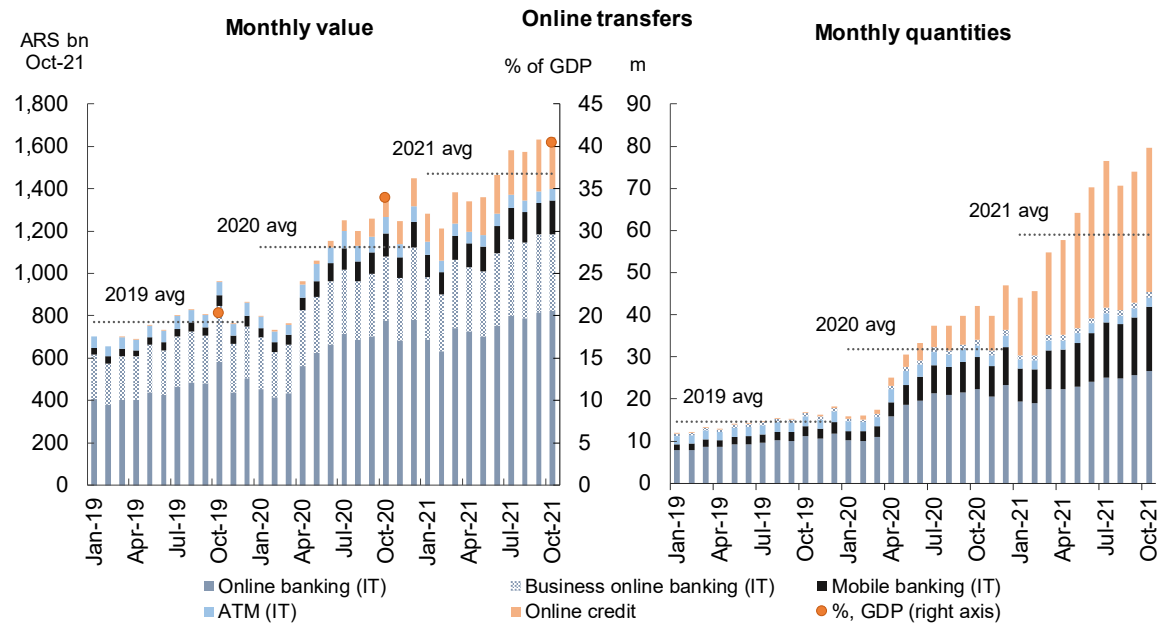
Recent initiatives include the Transferencias 3.0 programme, which was launched in December 2020 and completed by the end of November 2021. This scheme seeks to expand the reach of instant transfers and is based on an open payment ecosystem that is interoperable (between bank and non-bank accounts), immediate (automatic crediting of funds for retailers), and flexible (supports debit and credit cards, QR codes, payment requests, etc), just to name a few features. In keeping with these initiatives, banks in Argentina are also developing digital solutions, most notably the MODO digital wallet, launched by a consortium of public and private banks at the

[1] Central Bank of Argentina. Prepared for the BIS Emerging Market Deputy Governors meeting, 9–10 February 2022.

end of 2020 (in part as a response to strong competition from local fintech companies).

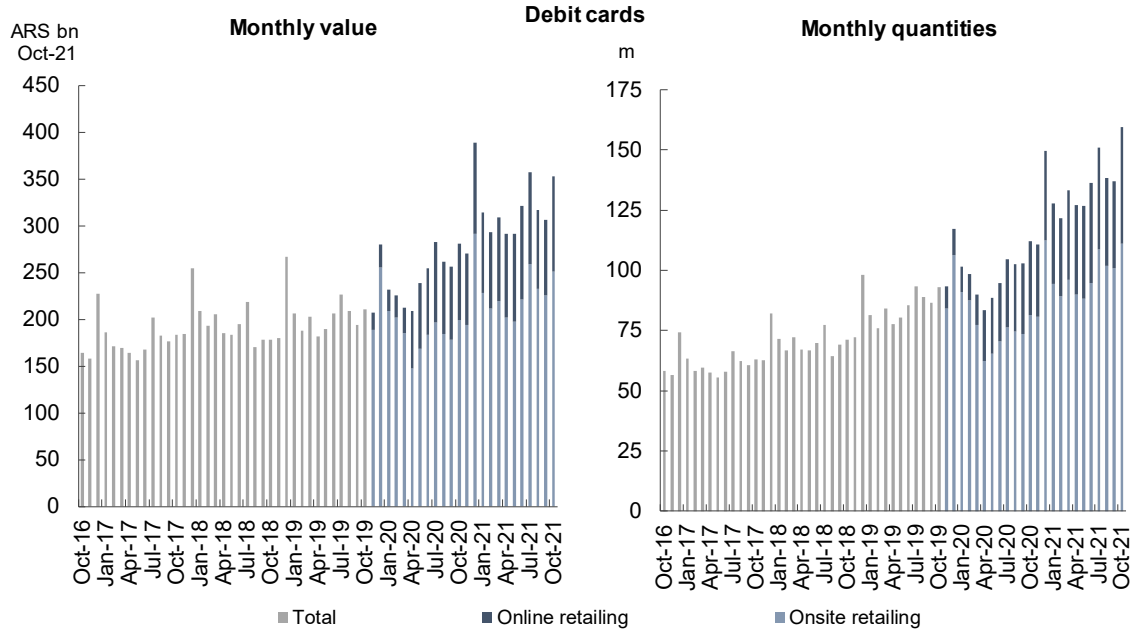
Digital means of payment in Argentina include online transfers through different means (online, mobile and home banking), the use of debit cards for payments and electronic cheques (ECHEQs). Online transfers have grown by almost 170% in real terms since early 2018, having doubled even before the pandemic broke out (see Figure 1). Debit card transactions have virtually doubled in the last three years, with a big push since the start of the pandemic; in this case, a significant contribution from online retailing can be detected (see Figure 2).

Argentina: online transfers (value and quantities) Figure 1



Immediate transfers (IT) through Link and Banelco. Online credit transfers (using a unique virtual key) through COELSA.
Source: BCRA.

Argentina: debit card transactions (value and quantities) Figure 2



Source: BCRA.

Compared to the digital means of payment just described, the information available reveals low levels of acceptance and use of cryptoassets among the general public in Argentina – although there are data gaps that limit the monitoring of the evolution of local cryptoasset markets. Furthermore, this activity is relatively concentrated on a few trading and custodial platforms, with limited connections to the financial system (mainly P2P transactions); and developments in "decentralised finance" (DeFi) are focused on certain niches.

Thus, financial stability risks from this source appear to be limited. However, high levels of volatility of certain types of cryptoassets, lack of safeguards, and operational issues, among other elements, could represent significant risks for consumers and investors. In this context, the BCRA and the Securities and Exchange Commission have issued a joint warning concerning the use of cryptocurrencies, covering the definition and characterisation of cryptoassets (pointing out the intrinsic risks associated with this type of digital asset), and highlighting that they: 1) are not legal tender; 2) involve high volatility; 3) can present operational disruptions and be subjected to cyberattacks; 4) lack safeguards; 5) are exposed to fraud, incomplete information and lack of transparency; 6) involve risks associated with money laundering and the financing of terrorism and potential non-compliance with exchange regulations; and 7) have potentially high costs in terms of defending the rights of users and investors. This situation might change rapidly depending on the speed of developments and the growing interest in cryptoassets, so it must be adequately monitored (Central Bank of Argentina and CNV (2021)).[2]

[2] As an example of the interest in these instruments, Google trend searches for October showed that Argentina is seventh in relative searches for Bitcoin in an international comparison.

Challenges in the implementation of CDBCs

Despite their initial claims, many of the cryptoasset initiatives have been a long way from establishing themselves as a suitable substitute for money. Central banks (CBs) have not considered these initial developments as a relevant threat to the current system of monetary creation at two levels (CB and fractional reserve commercial banks). However, CBs and financial regulators have tended to adopt a more positive attitude following the emergence of second-generation cryptoassets (for example, the so-called stablecoins) and new participants, such as large digital platforms (social networks, search engines, e-commerce sites) that compete actively in the creation of means of payment and, more generally, in the provision of financial services. Many CBs have thus accelerated the analysis of a possible implementation of digital currencies, especially after the announcements related to global stablecoins by big tech companies (Auer et al (2020)).

The issuing of digital currencies by CBs has potential benefits and costs, including its impact on monetary policy, on the provision of bank credit and on domestic and international financial stability.

The benefits include the following:

- **Efficiency and resilience of the payment system:** along with the provision of a stable money as a public good, ensuring a resilient, reliable and diverse payment system is an essential task of CBs. As part of this objective, the provision of banknotes and coins is one of the main responsibilities of CBs. Most CBs conceive the CBDC as a complement that could offer new opportunities to the public in an era of digital payments and provide the possibility of enjoying the unique attributes of a monetary liability issued by a CB: liquidity, integrity and power to cancel obligations in local currency (BIS (2021a)).
- **Higher potential for financial inclusion:** the emergence of new means of payment can overcome barriers to financial inclusion.[3] The pandemic – and the need to reach many households in the informal sector with state aid – highlighted the advantages of having public money with wide access and a digital nature. Finally, an area of special interest for the CBs of countries receiving international remittances is the possibility that a CBDC can be used as a vehicle for cross-border transactions, reducing their costs (BIS (2021b); FSB (2020)).
- **Improvement of the monetary policy transmission mechanism:** CDBCs that earn interest could transmit the monetary policy stance more effectively, widening the room for manoeuvre of monetary policy. By putting competitive pressure on commercial banks, a CBDC that earns the policy interest rate would transmit monetary policy decisions more quickly to the remaining interest rates. At the same time, the existence of a remunerated CBDC would, in principle, open up the possibility of dealing with the zero lower bound, freeing monetary policy from the current restrictions it faces and allowing it to aggressively combat deflationary contexts (Rogoff (2016); Bordo and Levin (2017)). Despite this, the majority of CBs seem for now to consider this as a mere "theoretical" possibility, difficult to implement in practice (BIS (2020); BoE (2020)).

[3] Although CBDCs could represent a disadvantage for vulnerable populations that are heavily dependent on cash for their transactions.

But these benefits should be weighed against risks:

- **Financial disintermediation:** if depositors move away from bank deposits to CBDCs (in their retail variety), banks will have fewer resources to intermediate, ultimately weighing on credit supply (Bindseil (2020); BIS (2020); BoE (2020)). This would have a more negative impact in less developed and bank-based financial systems. This kind of "digital bank run" could occur not only in periods of financial stress but also be related to potential financial disintermediation of a more "structural" nature (Mancini Griffoli et al (2018)).

Subject to this competitive pressure, banks might have to raise deposit interest rates and replace part of their deposits with new funding sources in the capital market – generally more expensive and volatile. There are at least two possibilities here, depending on the degree of competition. First, in an uncompetitive environment, with low elasticity of demand for credit due to the absence of alternative financing sources, banks will likely respond to the rise in deposit rates by trying to rebuild their profit margins. The consequence would be an increase in the cost of bank credit, which would especially affect companies that are more dependent on this financing, such as SMEs. Second, and on the contrary, in an environment characterised by alternative funding sources, banks would be forced to compress intermediation spreads, promoting efficiency if there are monopoly rents in the banking industry. However, in some cases that could generate financial fragility (Andolfatto (2021)).

Thus, the majority of CBs seem to favour a CBDC design that does not compete with bank deposits and assimilates it to cash, although without replacing it. In this framework, quantitative limits on CBDC holdings may be set, or a differential remuneration system may be introduced that limits their wholesale holdings (Bindseil (2020)). It may also be possible to re-channel disintermediated funds through rediscounts, although at the cost of inducing a centralisation of funding and increasing the participation of CBs in the credit allocation process (Brunnermeier and Niepelt (2019)).

- **International spillovers and capital flow volatility:** CBDCs introduced by central banks that issue global reserve currencies may easily be perceived as a new international "risk-free" asset. This could result in intense competition against countries which do not issue reserve currencies, for instance. This trend towards possible "digital dollarisation" could complicate the implementation of autonomous monetary policy in the case of many emerging market economies (EMEs) that are vulnerable to global financial shocks. In other words: this would affect not only countries where currency substitution is a concern, but more generally those countries that are subject to sudden stops in capital flows as, for instance, the US dollar appreciates globally.

Thus, it is very important that the main CBs internalise possible spillovers to the global economy in their analysis and design of digital currencies, including their impact on developing economies via capital flows and currency substitution. International cooperation on regulatory approaches and the design of these currencies is key (BIS (2021b); IMF (2020)). Analysis and possible implementation of CBDCs should be conducted in synergy with closely related initiatives, such as the G20 Roadmap to enhance Cross-Border Payments and the review of the IMF's Institutional View on Capital Flows.

CBDCs: design and implementation alternatives

In the context of this cost and benefit analysis, there are several design alternatives that are being actively explored by CBs. These alternatives will depend on the architecture, infrastructure and technology finally adopted (Auer and Böhme (2020)). A basic taxonomy can be defined depending on: a) whether access to CBDCs is widespread, without restrictions (like physical currency, this would be a retail CBDC) or restricted to certain actors (like banks, a wholesale CBDC); b) whether transactions are recorded in accounts or based on tokens (Bech and Garratt (2017)). Table 1 summarises the taxonomy along these two dimensions. CBDCs currently under discussion would be elements II, III and IV in the matrix (token-based retail and wholesale CBDCs, or retail account-based ones); while element I already exists as commercial banks' reserves held in accounts at the central bank for wholesale settlement purposes.

CBDCs: a taxonomy — Table 1

	Based on accounts	**Based on tokens**
Restricted access	Wholesale account-based CBDC (I)	Wholesale token-based CBDC (II)
Unrestricted access	General use account-based CBDC (III)	General use token-based CBDC (IV)

CBs could operate the CBDC directly or in hybrid form: that is, through intermediaries, which could be commercial banks themselves or other private payment service providers. This would be the decision to take between both rows of the matrix in the table. In the hybrid model, although the monetary obligation would remain with the CB itself, authorised operators could take care of all the operational matters, of interaction with the public and of keeping an up-to-date record of all transactions.

Indeed, the infrastructure related to the recording of transactions is a second aspect for which there are several options. These are summarised by the left- and right-hand columns of table 1. CBs could use a conventional centralised transaction recording infrastructure or use distributed ledger technology (DLT). A centralised registry structure would require the CB itself or an intermediary to handle and operate the transactions and take care of the security requirements of the system, whereas a DLT scheme would validate operations in a decentralised way, potentially making P2P and "offline" transactions easier.

Put simply, a CBDC system can be based on accounts (and, in that case, the authentication of the payments would depend on the validation of the identity of the holder of monetary balances) or consist of digital tokens (in which case the authentication of the transactions would depend exclusively on the validation of the "object" to be transferred). In the former case, the implementation, the volume of accounts and the direct relationship with the public would be key challenges for the central bank, as well as the impact on financial intermediation. In the case of tokens, a disadvantage that is usually pointed out is the complexity of emulating the characteristics of physical cash in a digital environment (integrity, availability and anonymity) and the desirability of doing so. Likewise, it implies challenges for the operation of the banking system and financial intermediation as it is currently conceived, mainly due to the competition between a CBDC of these characteristics and deposits in financial institutions.

There are many other related relevant characteristics that should be contemplated in the design of a CBDC, like the following:

- Degree of anonymity – a key feature of any CBDC akin to cash: Depending on the objectives of the issuer, this can range from absolute anonymity to its absence.
- Availability: 24x7 versus limited hours (another crucial aspect for any cash-like CBDC): possibility of using the system 24 hours a day, seven days a week or establishing a specific time of use to operate.
- Possibility of accruing interest: depending on the issuer's objective, the CBDC may accrue interest (positive or even negative, in the latter case to increase the effectiveness of monetary policy).
- Holding limits: in accordance with the objectives of the issuer and/or administrator of the CBDC, limits to the holding of the CBDC can be established. These could be related to different aims, such as: consumer protection, anti-money laundering/combating the financing of terrorism, foreign exchange regulation.

A large majority of CBs seem to favour a hybrid type of scheme, recognising the comparative advantages that the private sector has in terms of innovation and in the commercial relationship with the public. There seems to be a general consensus to promote a not fully decentralised transaction recording infrastructure and an account-based design.

Several economies in Latin America and the Caribbean have launched CBDC schemes or pilot tests. The Bahamas was the first country to officially launch a CBDC (the sand dollar), in October 2020; together with Nigeria, they are the two cases of CBDCs fully open to the public (Central Bank of The Bahamas (2020)). These experiences should be closely monitored, as well as the results of the pilot tests implemented by several countries, including Uruguay (with a pilot completed in 2017–18) and the countries of the Eastern Caribbean Currency Union. Finally, looking at the experience of countries that issued CBDCs that did not become widely used, such as Ecuador (2014–18), can shed light on the challenges ahead.

Concluding remarks

New technologies have changed the payment ecosystem at the global level. CBDCs, among other initiatives, have to be considered one of the many tools that central banks may use in order to improve means of payment and monetary policy implementation. In EMEs, these innovations must be carefully weighed against their impact on financial development and on currency substitution. Since this is a systemic and global issue, international cooperation is of the essence.

In Argentina, recent regulatory initiatives, such as Transferencias 3.0, have enabled the development of an efficient and secure infrastructure that could be leveraged to further improve access to and use of payment services by the public. In this context, the issuance of a CBDC is not a priority, at least in the short term. Nevertheless, recognising the fast evolution of the digital environment, the BCRA will continue studying the implications of CBDCs and the most appropriate CBDC design for Argentina.

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Initial steps towards a central bank digital currency by the Central Bank of Brazil

Fabio Araujo[1]

Abstract

This note shortly discusses the development of a central bank digital currency (CBDC) by the Central Bank of Brazil (BCB). Considering specific features of the Brazilian payment system, the digital Brazilian real is shaping up as the main element of a platform for smart payments, adding to the facilities composing the Brazilian payment system, such as a real-time gross settlement service (available since 2002), e-money mainly available through payment service providers (since 2013), and an instant payment service (since 2020).

Introduction

In the case of Brazil, gains may arise from the implementation of a CDBC as the foundation of a smart payment platform. This note discusses some aspects leading to this conclusion. Nonetheless, it is important to stress that the digital Brazilian real would not be the only means of liquidity available on this platform, promoted in an arrangement that would preserve the successful public-private partnership between central banks and commercial banks for providing liquidity that has been working for more than a century.

The power of creating money granted to central banks is already very extensive. Mixing that power directly with daily operations of families and businesses may tempt policymakers to mingle their actions with fiscal and credit provision policies, not always with the best interest of the population in mind.[2] Therefore, such a platform should be designed after careful consideration of the impact on the economy and also on the conduct of economic policy.

Main objectives of introducing a CBDC in Brazil

Brazilian payment systems are already quite modern. A solution for real-time gross settlement (RTGS) has already been available for 20 years. An e-money system, operated by a diverse ecosystem of payment service providers (PSPs) – or payment

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[2] An all-powerful benevolent policymaker would be able to implement first-best policies. But an all-powerful policymaker would not remain benevolent for long. The principle of separation of powers, a cornerstone of democratic regimes, allows for checks and balances and also seems to be important in the formulation of the economic policy.

institutions, as they are known in Brazil – has been operational for almost a decade. And, finally, an instant payment system – Pix – went live in November 2020 and has been very well received by the public, with more than 330 million individual keys (aliases) in operation.[3] In a period of 12 months, Pix was the channel for the first ever digital money transfer for 45 million people, an important step towards financial inclusion.

These modernising initiatives are part of a broader process of digital transformation in our society. Financial markets are getting reorganised to better deal with the flow of information generated by our daily routines. In this convergence of technologies and services, the use of payment information brings up potential for financial innovation, for the provision of new services, and for increasing the efficiency of currently available services.

In Brazil the main objective of the introduction of a CBDC is to provide entrepreneurs with a safe and reliable environment to innovate through the use of programmability technologies, such as programable money and smart contracts. In the context of a modern payment system, already available to the Brazilian population, a full-fledged CBDC must enable new functionalities, beyond those brought by an instant payment arrangement. Therefore, the innovation tool for which the BCB envisions the greatest potential is the development of a platform for smart payments.

Technologies available for smart payments, as seen in the cryptoassets ecosystem, open up space for new business models and are better suited to meeting the population's demand for natively digital means of settlement. Asset tokenisation and the issuance of digital assets is a reality. It is up to regulators to provide a safe environment so that entrepreneurs can propose innovations and a larger base of citizens can benefit from these technologies, without exposure to the uncertainties of an unregulated financial environment (as stated in BCB (2021c)).

The potential for financial inclusion of these technologies is clear when associated with other actions promoted by central banks. As discussed in Schär (2021), technological features available in the cryptoassets ecosystem, such as standardisation and interoperability, reusability of protocols, and composability of financial services, may result in new products that reach their target audience in a shorter period, are better suited to people's needs, and are able to operate at lower average tickets than currently possible. At the same time, such features allow for a high degree of auditability, traceability, and transparency, providing the necessary tools for supervision.

Nonetheless, a mature governance is a fundamental aspect of stable financial and payment systems. Although innovations based on smart payment technologies are being used in the decentralized finance ecosystem, their current governance devices fall short of the requirements compatible with the level of integrity essential to the operation of financial and payment systems. Thus, as observed in Aramonte and Schrimpf (2021), a fully decentralized environment is most likely not achievable under current integrity requirements. Therefore, incorporating

[3] The current arrangement in the Brazilian e-money market provides a synthetic CBDC (sCBDC) as defined in Soderberg (2022), and the instant payments system, Pix, can be seen as the final step in providing such an instrument to the general population.

such innovations into central banks' regulatory perimeter will imply important changes in the governance of these new technologies.

Guiding principles of CBDC design and architecture

Taking the time necessary to discuss possible CBDC designs is an important step towards a safe and stable financial environment. In general, implementation of CBDCs for wholesale purposes has implications that are easier to grasp, as countries where RTGS systems are in operation give a quite faithful guideline for the expected effects of such implementation. Retail applications, however, will lead to much broader and unmapped developments.

In BCB (2021a) and BCB (2021b), the BCB presented guidelines for the digital Brazilian real, in short:

- Focus on technology to foster innovative business models that can increase financial market efficiency;
- Use in retail, alongside bank accounts, payment accounts, cards and cash;
- Online operation with seamless integration to currently available payment systems;
- Offline payments are also under consideration, although not a mandatory initial feature;
- Two-tiered distribution model, with the BCB issuing the digital Brazilian real and with access provided through custodians in the payment system;
- Non-interest-bearing instrument, as the BCB does not intend to use a CBDC as an additional monetary policy tool;
- Compliance with bank secrecy, the General Data Protection Law (LGPD) and other applicable legal and regulatory provisions, which equates transactions with the digital Brazilian real to other transactions currently carried out by the payment system;
- Mechanisms to prevent money laundering, terrorist financing and the financing of the proliferation of weapons of mass destruction;
- For cross-border payments, it is essential to keep the local system open to the possibility of adopting internationally agreed standards, seeking interoperability solutions with other countries' central banks;
- Finally, resilience to cyber attacks must be comparable to that adopted in the critical infrastructures of Brazilian financial markets.

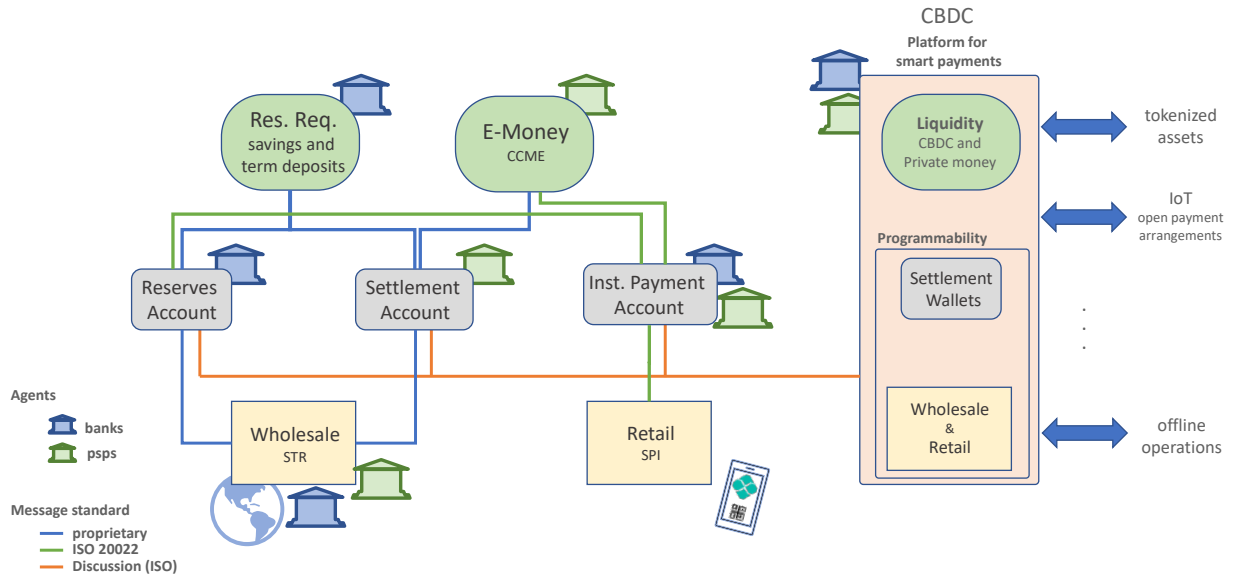
These features would qualify the digital Brazilian real as a hybrid CBDC, in the sense of Auer and Böhme (2021).

It is important for a CDBC platform to be interoperable with other available payment systems. As an infrastructure for smart payments, the digital Brazilian real system would connect conventional sources of liquidity, provided by authorised agents, to digital asset ecosystems, as illustrated by Figure 1. With the regulation of those spaces, new business models could be incorporated into the regulatory perimeter, with potential benefits for the population.

Moreover, the risk of currency substitution is larger if national central banks are not able to fulfil the demand of the population for digital financial and payment services. Improved efficiency in providing services demanded by the population, whether provided by a CBDC or by regulated stablecoins denominated in local currency, is likely to curb threats of currency substitution. On the other hand, privately issued unregulated stablecoins denominated in foreign currencies, which could be a threat in the absence of a CBDC, would remain used at the margin of society.

CBDC as a smart payment platform and interoperability

Figure 1



Another important aspect is that central banks should maintain the partnership with the private sector in providing liquidity to the market. Therefore, the BCB envisions coexistence between the digital Brazilian real and private money issued by institutions regulated by the BCB on the intended smart payments platform. Individuals could transform their deposits, with both banks and PSPs, into tokens[4] capable of accessing services provided on this new platform, under a commitment by banks and PSPs to convert such tokens into CBDC on demand.[5] Tokens of deposits with commercial banks would inherit all applicable regulation and features from their originating assets, such as fractional reserve requirements and backstops. In the same way, tokens of deposits with PSPs would inherit their features, such as the full reserve requirements.

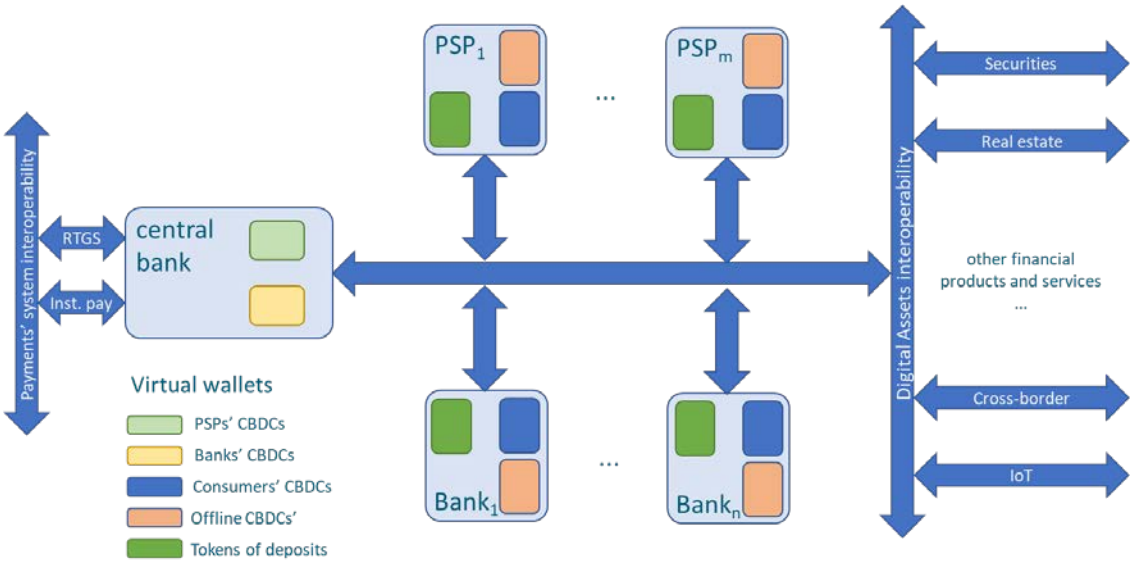
4 As the decision regarding the use of a token-based solution for the digital Brazilian real has not been reached yet, with other more centralised architectures still under consideration, the term token is used loosely here in order to simplify the presentation. Whatever the platform chosen for the issuance of a CBDC, private money issued by institutions regulated by the BCB will be available to the public, offering the same sort of technological functionality. This is similar to the environment proposed by McLaughlin (2021).

5 Here, the expression "on demand" needs qualification. In the next section, dealing with financial stability issues, it will become clear that this commitment should be fulfilled only under certain criteria.

This strategy would give rise to two kinds of regulated stablecoins in the Brazilian economy, and others could be added to the portfolio. Tokens issued by PSPs would fit the basic description of a stablecoin, with deposits fully backed by reserves held at the central bank. These tokens would play the important role of fostering innovation and contestability of financial markets. Fintechs willing to provide new products could opt for using a PSP token to reach their public, with a simplified regulation allowing them to focus efforts on the development of their business models.[6] On the other hand, incumbent banks could participate in the market by issuing their tokens. The regulatory constraints on liquidity, portfolio risk and backstops would render their stablecoins effectively stable – in the same way that such requirements make stable the parity between bank deposits and fiat currency.[7]

Avoiding regulatory asymmetry between existing platforms and the intended smart payments platform is an important guideline to curb inefficient flows between payment environments. One concern worth noting, raised by this architecture, is the fragmentation of reserves held by authorised agents. Currently, each agent has its reserves divided between two accounts: i) instant payment account; and ii) reserve account or settlement account in the case of banks and PSPs, respectively. With the creation of yet another payment platform, their resources would be divided into three accounts, with the requirement for CBDC holdings in order to assure liquidity in their operations on the CDBC platform.

Regulated liabilities network – coexistence between CBDC and private money Figure 2



[6] The PSP market in Brazil is very contestable, with a large number of active service providers and simplified authorisation processes.

[7] Concerns about financial instability and supervision would continue to be an important area for central banks. Suptech would become even more of a need given the possibility to assess, in real time, stability indicators of authorised entities operating in such an environment, rendering artificial intelligence indispensable.

Dealing with financial intermediation and financial stability

A regulated liabilities network could prevent forceful financial disintermediation. The architecture proposed in Figure 2 allows the coexistence of private money, provided by regulated entities, and a CBDC. One valid question in that context is whether people would demand a source of liquidity that carries credit or operational risk – such as a token issued by a bank or PSP – when a risk-free equivalent – such as a CBDC – is available. In the case of Brazil, where the CBDC held by the general public will not bear interest, if risk perception is limited, the preference for a CBDC can be offset by rewards offered by banks or PSPs in order to generate demand for their tokens. Such rewards could, for instance, be a small yield on those holdings.

Bank runs could be averted by backstops and constraints on conversion flow from and to CBDCs. Backstop mechanisms for deposits with banks and PSPs work to break coordination in bank runs. By inheriting these mechanisms, tokens issued on the regulated liabilities network would be stable. One source of concerns, though, is the speed at which private tokens could be converted into CBDCs, which could restore coordination mechanisms. To avoid such undesirable flows, large conversions could only be available if scheduled in advance and constraints on daily conversions could be set.[8] In addition to that, circuit breaker mechanisms could be automatically applicable when the continued draining of tokens from any specific institution would render it vulnerable.

CBDCs and financial inclusion

The main challenges for financial inclusion in Brazil stem from two sources: inadequate broadband coverage and financial illiteracy. In that sense, a CBDC would, most likely, lead to little improvement in financial inclusion of the unbanked population. The Brazilian instant payment system (Pix) and its use during the pandemic helped to reach what probably is the limit of inclusion of that population given the current level of broadband internet access in Brazil. Through Pix, in its first year of operation, more than 45 million people made their first digital transfer ever.

Nonetheless, the inclusion provided by Pix was mostly restricted to payment services, and that is only the first step towards deeper financial inclusion. An increase in operational efficiency could boost the offer of other financial services. Moreover, the ability to offer tailored solutions is very important in a country as diverse as Brazil, with such large income inequality among its citizens. Therefore, when allied to actions of financial education, smart contract capabilities may provide the gains in efficiency and composability needed to serve underbanked populations. An infrastructure making available standard financial product protocols would reduce the compliance burden on small financial enterprises, enabling niche markets to be reached.

[8] In analogy to what happens today with physical cash in Brazil. Apart from addressing financial stability concerns, these measures increase users' safety, prevent fraud, and work as AML devices.

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The Central Bank of Chile´s approach to retail CBDC

This document describes the current status of the analysis conducted by the Central Bank of Chile (BCCh) on the eventual issuance of a retail central bank digital currency (CBDC). Since this process is at an early stage, no formal policy decision has been made yet. An internal Working Group (WG) on CBDC is preparing a white paper scheduled for release in early 2022 which will assess and describe future steps on this matter.

The BCCh established the WG with the objective of exploring and proposing a medium- to long-term strategy on digital payments in Chile. Currently, the WG has scoped the internal discussion on retail CBDC. Its first duty is to understand whether there could be a compelling reason for a future issuance of CBDC in Chile. Thus, it has been relevant to assess the current situation of the Chilean retail payment system, looking for possible motivations for a retail CBDC and further designing principles for its eventual implementation.

1. Objectives and considerations for a retail CBDC issuance

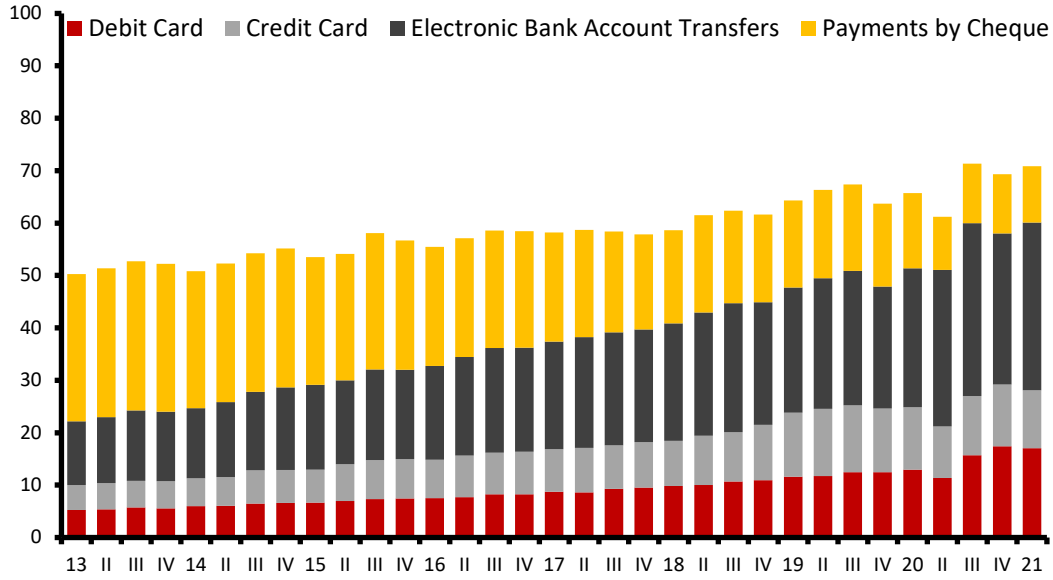
1.1 An overview of the Chilean retail payment system

- The Chilean retail payment system is performing adequately for the level of development of the economy. From the analysis performed, there are no relevant gaps that can be minimised with a CBDC solution.
- A broad view of the local retail payment system can be captured with the following figures:

Non-cash personal payments

As a percentage of GDP

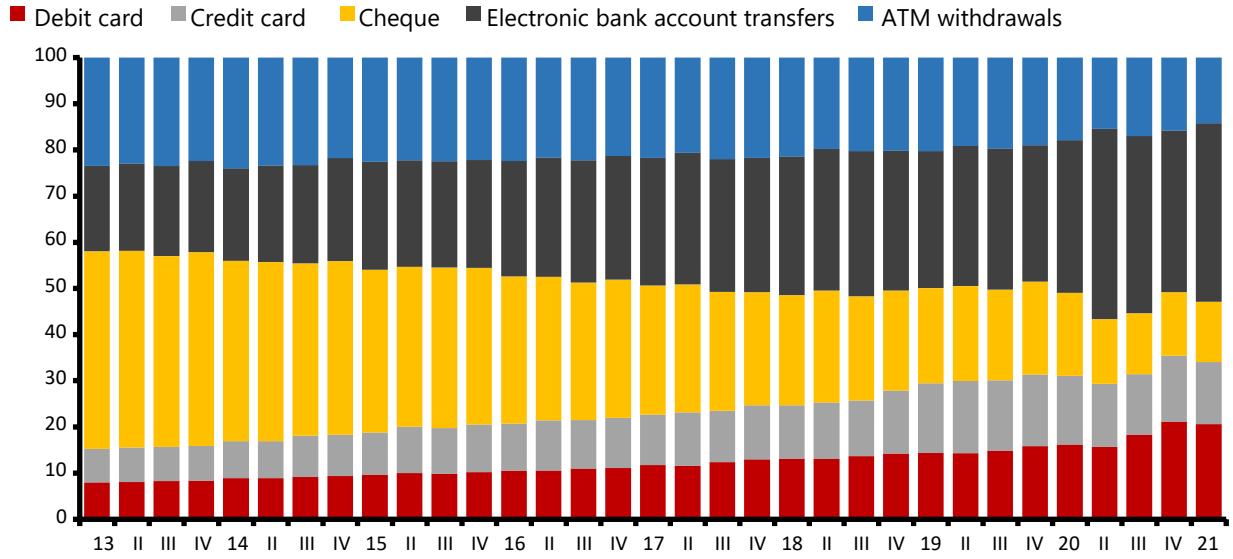
Figure 1



Source: BCCh, with Financial Market Commission data.

Distribution of personal payments

Figure 2



Source: BCCh, with Financial Market Commission data.

- According to the figures, the retail payment system has an adequate level of digitisation. There are several means of payment available to end users. Although an estimate of the use of cash for retailpayments cannot be made from the figures, it is manifest that cash withdrawals from ATMs are declining.
- Even if overall financial inclusion in Chile from a comprehensive perspective can be improved, there is a significant level of access to basic financial products and

digital payments. The Chilean state-owned bank, BancoEstado, offers a bank account with a debit card linked to each citizen's identification number. In 2020, there were 1.08 active credit and debit cards for each citizen and 45% of these cards were issued by BancoEstado, which represents 63% of the adult population. Historically, this type of bank account has been mainly used for withdrawals from ATMs, but in recent years BancoEstado has offered innovations to its users related to payment methods, which has increased their use for transactions. This view is consistent with various financial inclusion reports made by the Financial Market Commission in which this idiosyncratic bank account is declared as a relevant financial product for accessing the Chilean banking system.[1]

- With regard to fast payments, since 2008 payments by direct transfer from bank accounts have been seen by users as instant payment, 24x7, although there are some internal post-payment bank processes.
- In recent years, the regulatory framework for card issuers has been modified to open up access to the payment system to more and/or different participants. With these changes, non-bank financial institutions can issue prepaid cards and receive deposits from individuals for the exclusive purpose of completing payments.
- There are competition challenges within the payment system and some difficulties related to the implementation of the four-part model for payment card networks. A committee, with members including the Financial Market Commission and the BCCh, has been appointed by law to determine the maximum exchange fee to be paid from acquirers to issuers of payment cards, an innovation that is intended to boost competition, among other goals.
- The Government has sent a bill to Congress known as the "Fintech Law" that includes topics such as the introduction of open banking and regulation for stablecoins. In addition, the BCCh has issued a public consultation on a regulation to incorporate payment service providers and retail payment processors into the regulatory perimeter, endorsing the implementation of low-value payment clearing houses.

1.2 Drivers of CBDC issuance

The WG has been exploring whether there are relevant reasons that could incentivise a potential CBDC issuance in Chile. The WG is currently confident about the following motivations.

Homogeneity of public money and commercial bank money

- The main methods of payment are cash, physical money issued by a central bank, and demand deposits, digital money offered by banks. Both are denominated in the same unit of account and have a 1:1 guaranteed conversion.
- In the absence of demand for cash, there must exist another instrument issued by a central bank that should homogenise the value of any other commercial bank money. This gives a guarantee of the acceptance of all means of payment offered by the banking system.

[1] See www.cmfchile.cl/portal/estadisticas/617/articles-38692_doc_pdf.pdf.

- The central bank is the only agent that could ensure that there is an asset in the economy that links bank deposits and bank transactions to the value of the national fiat currency. Therefore, it could be a commitment from the public sector to provide this instrument to the local financial system and to the public. Currently, this instrument is cash. Then, in a scenario where the use of cash as means of payment decreases substantially, the BCCh would be prepared for this new reality.

Efficiency and resilience of the financial system

- If the CBDC issuance originates with the objective of developing a new payment infrastructure with redundancy as a criterion of resilience, the CBDC could strengthen the quality of the retail payment system.
- In addition, the new infrastructure of the CBDC system could stimulate more activity from private agents to innovate and offer new payment solutions.

CBDC as a platform for a digital economy

- The challenge of being prepared to act properly for future scenarios of disruptive changes in payments is a relevant driver for an eventual CBDC implementation. In these terms there is a case for CBDC as a new digital payment platform which could provide access to central bank digital money, becoming the basis for new – and hitherto unseen – payment solutions. In this case a CBDC could leverage future innovation in payments of private and public agents and enhance the system.
- The potential massive use of cryptocurrencies, even a foreign CBDC, as a local means of payment could severely impact financial stability and the transmission of monetary policy. In Chile there is public confidence in the local currency (it is used as a unit of account, store of value and means of payment), so currently this concern is not a priority. However, in conjunction with other measures a properly designed CBDC could help to mitigate this type of risk in the future.

2. Basic design principles for CBDC

- In CBDC, an appropriate design is relevant due to potential consequences for payment systems, financial policy, and monetary policy transmission. Therefore, it is important that design decisions are aligned with the BCCh mandate and authority, and the policy objectives derived from it.
- Furthermore, design considerations depend on the main objectives to be addressed and the associated costs. Hence, design considerations from jurisdictions with which Chile has commercial and financial relations are particularly relevant.
- The WG has been evaluating an initial list of principles for a potential CBDC issuance in Chile, having as a central principle "do no harm" to the financial system, as several central banks have already stated. Despite the BCCh being at an exploration stage, the following principles have been raised by the WG:

    a) **Enhance the payment system**. CBDC should be complementary to cash. It should be designed as a "good means of payment" and not as

a store of value per se. Some design decisions could include for CBDC holdings not to earn interest and/or limiting the amount of CBDC held in digital wallets, the underlying idea being not to disintermediate the banking system.

b) The WG is considering a **preference for an indirect model**, such as the hybrid model or the intermediated model, within the two-tier architecture options. Since a (retail) CBDC is registered as a liability for a central bank, a relevant design choice is defining whether the BCCh should interact directly with end users or not. In general terms, as it does today, the BCCh should exclusively manage the issuance of money, and it should not necessarily be responsible for the entire distribution process. In this scenario the BCCh would externalise all functions and responsibilities that the private sector and other authorities already perform. For instance, the private sector could manage the CBDC distribution to end users and all onboarding and compliance obligations such as know-your-customer (KYC) policies.

c) **Interoperability level**. As mentioned, a CBDC should improve the system; therefore, in achieving this goal, a Chilean CBDC should not create a segmented payment system outside of the current system. The challenge is that greater integration among different systems could be more costly and complex and it is not clear that potential benefits derived from full interoperability in the system would offset its cost. There is a trade-off on how much interoperability the BCCh should implement for a proper CBDC design.

E-CNY: main objectives, guiding principles and inclusion considerations

Ⅰ. Main objectives and vision of e-CNY

The development of China's e-CNY system aims to create a digital version of the renminbi that meets the public's demand for cash in the digital economy era. The e-CNY system will support the development of retail payment infrastructures and improve payment system efficiency in parallel with digital economy developments in China.

First, e-CNY aims to improve the efficiency of central bank payment systems. Technological innovation, especially the digital economy, is the key driver of economic development. More secure and inclusive retail payment infrastructures as public goods provided by central banks are needed. As an important financial infrastructure, the e-CNY system will further fulfil the diversified payment needs of the general public and improve efficiency of financial infrastructures. In addition, as e-CNY transactions are settled upon payment, it will allow businesses and related parties to improve their cash flow while enjoying more convenient payment services.

Second, e-CNY aims to provide a backup or redundancy to the retail system. Big tech companies have become important retail payment infrastructures, and any failure will dramatically impact payment system operation, and even introduce systemic risks. The e-CNY is a direct claim on the central bank, backed by sovereign credit, and has the status of legal tender. Therefore, it can provide a backup or redundancy to the retail system backed by commercial bank deposits, offer diversified payment products and improve payment efficiency and safety.

Third, e-CNY aims to support equal access to digital payment and financial inclusion. As digital technology and electronic payments develop, the use of cash in retail payments has been declining. However, it is the mandate of the central bank to ensure the public's direct access to cash, and to make sure the unit of account is consistent in the digital economy era by digitalising cash. The e-CNY system will make financial services more accessible, providing fiat money for a large population in various scenarios.

Fourth, e-CNY aims to echo international initiatives and explore ways to improve cross-border payments. First of all, cross-border payment involves various contentious issues such as monetary sovereignty, foreign exchange policies and arrangements, as well as regulatory and compliance requirements. Though technically ready for cross-border use, e-CNY is still designed mainly for domestic retail payments at present. Looking ahead, the People's Bank of China (PBoC) will actively respond to initiatives of the G20 and other international organisations to improve cross-border payments, and explore the applicability of CBDC in cross-border scenarios. Based on experiences of domestic trials and international demand, and on the premise of mutual respect for monetary sovereignty and compliance, the PBoC will explore pilot cross-border payment programmes and work with relevant central banks and monetary authorities to set up exchange arrangements and regulatory

cooperation mechanisms on digital fiat currency in line with the principles of "no disruption", "compliance" and "interconnectivity".

Ⅱ. Guiding principles of e-CNY design and data governance

1. Guiding principles

Compliance with laws and regulations. The institutional design of the e-CNY system strictly complies with regulations on the administration of the renminbi, anti-money laundering and combating the financing of terrorism (AML/CFT), the administration of foreign exchange, and data and privacy protection. The operation of e-CNY should be included in the regulatory framework.

Safety and convenience. The e-CNY is a value-based, quasi-account-based and account-based hybrid payment instrument, with legal tender status and loosely-coupled account linkage. This makes it adaptive to various online and offline payments. It minimizes difficulties resulting from limited technological literacy and telecommunications coverage to meet people's demand for safe and convenient payment instruments. The e-CNY operational system is highly secure, highly usable, and highly scalable and concurrent, helping to ensure business continuity.

Openness and compatibility. The PBoC leverages the advantages and professional experience of authorised operators and aspires to keep technology up to date by promoting technological competition and upgrading in line with the principle of evolving with the times, so as to avoid an excessive concentration of system operational risk. The e-CNY system supports interoperability with traditional electronic payment systems. It makes full use of existing financial infrastructures to connect digital wallets of different operators as well as connecting e-CNY wallets with bank accounts, thus improving the interoperability of payment instruments.

2. E-CNY design

The e-CNY system is built on a two-tier architecture whereby the PBoC is responsible for issuance and disposal, inter-institution connections and wallet ecosystem management. Additionally, it prudently selects commercial banks with certain strengths in capital and technology as authorised operators to provide e-CNY exchange services. Other commercial banks and institutions, under the PBoC's centralised management, give full play to their creativity, and collectively provide services for e-CNY circulation. The PBoC will try to maintain a level playing field and ensure that the market plays a decisive role in resource allocation. This will incentivise all participants and unleash their creativity, and also maintain financial stability. The two-tier system can fully tap authorised operators' advantages in terms of resources, talents and technology to build a market-driven system that promotes innovation and competition. On top of that, since the public is used to accessing financial services via commercial banks, this two-tier architecture may increase public acceptance of e-CNY.

3. Data governance

The e-CNY system follows the principle of "anonymity for small-value and trace ability for high-value transactions", and attaches great importance to protecting personal information and privacy. It aims to meet the public demand for anonymous small-value payment services based on the risk features and information processing logic of current electronic payment systems. Meanwhile, it is necessary to guard against misuse of e-CNY in illegal and criminal activities, such as tele-fraud, internet gambling, money laundering and tax evasion, by making sure that transactions comply with AML/CFT requirements. The e-CNY system collects less transaction information than traditional electronic payment systems and does not provide information to third parties or other government agencies unless stipulated otherwise in laws and regulations.

Ⅲ. Relationship between e-CNY and financial inclusion

There is still a "digital gap" in the field of payment services. In remote areas with poor coverage by telecommunications networks, it is difficult for some people to enjoy the benefits of digital financial technology. Illiteracy and underdeveloped ability to use smart phones have discouraged people from reaping the benefits of digital financial services, especially in the case of disadvantaged people. Meanwhile, some small and medium-sized banks and micro-finance institutions that focus on local businesses are having difficulties with digital transformation due to their technological capabilities.

Issued by the PBoC and mainly meeting the need for domestic retail payments, the e-CNY is a public good that improves financial inclusion. First, the design of the e-CNY system will broaden the accessibility of payment services. Thanks to the design of loosely-coupled account linkage, the underbanked population in poor and remote areas could apply for digital wallets without opening a bank account, which could expand the coverage of financial services. The offline payment function of e-CNY will enable people in areas with poor network coverage to enjoy basic financial services, improving financial inclusion. Second, e-CNY will lower costs and improve affordability. The PBoC does not charge authorised operators or individual users, and the operators do not charge individual users for the exchange services either. This will reduce the burden on the real economy and optimise the business environment. Third, e-CNY will make payments more efficient. As e-CNY transactions are settled upon payment, it will greatly enhance payment efficiency, and also allow businesses and related parties to improve their liquidity. The programmability of e-CNY could be realised by deploying smart contracts, enabling conditional payments, guaranteed payments and other complex use cases, so as to facilitate financial inclusion and innovation. Fourth, e-CNY will support fair competition on the retail payment market. On the one hand, e-CNY will provide a level playing field for accessibility and infrastructure that promotes innovation and competition among different payment service providers. On the other, the e-CNY is a claim on the central bank and can break down barriers – institutional and platform alike – in the payment market, enabling payments in all use cases, broadening the accessibility of retail payment services and improving social welfare.

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Some thoughts about the issuance of a retail CBDC in Colombia

Hernando Vargas[1]

1. Introduction

This note presents some thoughts on the issuance of a retail central bank digital currency (CBDC) in Colombia. To provide some context, it first describes some relevant features of low-value payments in Colombia. Then it discusses the implications of a retail CBDC for financial intermediation, financial stability and the transmission of monetary policy in the country, based on some results from the specialised literature and the characteristics of the Colombian financial and payment systems. Next, it provides some ideas regarding the implications of the issuance of foreign CBDCs by advanced economies for the risk of digital dollarisation and capital mobility. Finally, some preliminary policy implications are offered.

2. Some features of low-value payments in Colombia

Cash is the preferred instrument for low-value payments in Colombia. According to a survey conducted by the central bank in 2019, 88.1% of adults use cash as their main payment instrument for monthly purchases of non-durable consumer goods and services (Central Bank of Colombia (2021a, p 94)). Likewise, cash is widely used by businesses in the retail and service sectors. A central bank survey of these firms in 2020 found that 77% of their expenses were paid in cash (mostly payroll payments; see Arango et al (2021)). Despite this, cash holdings as a percentage of GDP in Colombia (7.1% in 2019) are close to the average of a sample of emerging market and advanced economies (Arango et al (2020, p 12) and Central Bank of Colombia (2021a, p 82)).

The use of electronic payment instruments (credit cards, debit cards and electronic funds transfers) has been growing in the country in the last decade, but is still comparatively small (see Graph 1 and Central Bank of Colombia (2021a, pp 79-81)), even after controlling for differences in per capita income (Arango et al (2020, p 11)).

The country's lag in the use of these payment instruments for low-value transactions has been attributed to several factors. To begin with, it has been shown that the speed and "steady state" level of adoption positively depend on per capita income (Arango et al (2020, pp 18–20)). Since a significant fraction of the population

[1] Technical Deputy Governor, Central Bank of Colombia. The opinions and ideas expressed in this note are mine and do not necessarily represent those of the Central Bank of Colombia or its Board of Directors. I am grateful to Viviana Alfonso, Carlos Arango, Wilmar Cabrera, Pamela Cardozo, Clara Machado, Ana Constanza Martínez, Daniel Osorio and Leonardo Villar for valuable comments and corrections to an earlier version of this note.

is poor, it is natural to expect a low penetration of these instruments. In fact, substantial differences between the use of payment instruments across income strata are observed (Graph 2). Furthermore, there are factors affecting both sides of the payment markets in a way that mutes the cross externalities that characterise them (acceptance by businesses depends on use by consumers, and vice versa; see Arango et al (2020, pp 28–34)). On the customer side, cost of access to electronic payment instruments is high relative to cash. Informality and low income reduce the ability to pay those costs. On the side of the merchants (especially the small ones), high installation and service costs, tax avoidance and mistrust of financial institutions are determinants of low acceptance of electronic payment instruments. Of course, lack of access to internet and telecommunication services also limits the adoption and use of these payment instruments. Nevertheless, internet access has increased over time, reaching 80% of the population in 2020 (Arango et al (2021)).

The Covid-19 shock brought about some remarkable changes. Government transfers to the vulnerable segments of the population were channelled through the financial system (mostly by means of electronic simplified deposit accounts, also called "electronic wallets"), pushing financial inclusion. The probability of opening an account increased by 14 percentage points for the beneficiary households vis-à-vis non-eligible similar households, while the probability of using it for payments or transfers rose by 7.5% with respect to the same benchmark (Gallego et al (2021)). Similarly, a central bank survey found that after the Covid-19 shock, the acceptance of electronic payment instruments in retail and service businesses rose and reached 50% of the firms surveyed, with one in two informal businesses now accepting at least one such instrument (Arango et al (2021)).

However, the use of those payment instruments is still lagging. The results provided by Gallego et al (2021) suggest that cash transfer beneficiary households did not increase use of electronic payment methods on a par with electronic account opening. Likewise, Arango et al (2021) report that, despite wider acceptance of electronic payment instruments by retail establishments, their use has been limited. In fact, cash demand rose significantly in 2020 (19.4% in real terms), while overall electronic payments remained stable in nominal terms, with electronic funds transfer increases being compensated by a decrease in debit and credit card payments (Central Bank of Colombia (2021b, p 65)). These observations are compatible with an increase in the demand for cash as a store of value and a decline in consumption during the pandemic (Central Bank of Colombia (2021a, pp 92–3)).

Colombia is also lagging in the development of an instant payment system. There are two automated clearing houses (ACHs), one managed by the central bank that handles government transfers and payments, and the other managed by a firm owned by banks that handles virtually all private transfers and online payments. The latter offers an instant payment service limited to person-to-person transfers that includes only 11 financial institutions. Transfers and payments between banks outside this service are not instantaneous and are subject to fees paid by the end users that vary from bank to bank and can be very expensive in some cases. The central bank currently offers real-time gross settlement (RTGS) for wholesale payments in its deposit accounts, but its services are not available 24/7.

In this setting, the development of the low-value payment system has been driven by proprietary networks mostly provided by large banks. These networks are based on traditional deposit accounts and the more recently created simplified electronic deposit accounts or "electronic wallets" that manage small amounts of

receipts and payments. Within these networks, the cost of payments and transfers for the consumer is lower but, while they are interoperable, incentives are set so that consumers prefer to remain in one network. In 2020 *intrabank* transfers were 87% larger than *interbank* transfers and this difference has been growing since 2011 (Central Bank of Colombia (2021a, p 67)).

Individual banks benefit from this arrangement by gathering valuable information about potential customers of some of their products. This is compatible with financial inclusion within each individual network, but hinders the development of a fast, inexpensive low-value payment system and limits competition in financial services. Thus, a key and complex issue under discussion among policymakers is whether a stronger regulation of the incumbent private ACH, coupled (or not) with public provision of an infrastructure (eg an enhancement of the central bank's ACH), are necessary to significantly improve low-value payments in the country (Arango et al (2022)). Recently, the government changed the regulation pertaining to the credit and debit card payment process (issuance, acquiring, processing, compensation and settlement) to increase competition in each of its phases and enhance transparency about costs and tariffs (Decree 1692 of 2020, Central Bank of Colombia (2021a, pp 68–71)). The results of this change remain to be seen.

Meanwhile, Colombia lags other advanced and emerging market economies that have successfully implemented widely accessible, inexpensive and interoperable low-value payment systems. In Latin America, Brazil, Mexico and Costa Rica already have such systems in place. In this context, a line of defence against a widespread use of cryptocurrencies and stablecoins is weaker in Colombia than in other jurisdictions and the discussion about the adoption of a retail CBDC becomes particularly interesting.

The country's credible, low-inflation environment and strong financial system are factors that reduce the risk of currency substitution by a cryptoasset or a stablecoin, especially one that is not linked to the Colombian peso. As a matter of fact, financial and transactional dollarisation is virtually non-existent in Colombia and exchange rate pass-through is among the lowest in Latin America (IMF (2016)). However, the absence of an inexpensive, accessible and fast low-value payment system might give an advantage to a stablecoin. Although the development of such a system within the current technological framework is feasible and may be socially efficient, the persistence of institutional and market structure obstacles could support the case in favour of a retail CBDC.

Similarly, the low speed and high costs of cross-border remittances in the traditional financial system provides an additional motivation for an arrangement of CBDCs (BIS (2021)), particularly if no cross-border connection of inexpensive and fast low-value payment systems is possible. This is an important consideration for Colombia, where worker remittances are approximately 3.3% of GDP. The central bank has explored the concept of a CBDC. In 2017 it experimented with a direct CBDC and during 2019 it did so with a hybrid, account-based model in which five banks participated (DSIF (2021)).

3. Implications of a CBDC for financial intermediation, financial stability and the transmission of monetary policy

Financial intermediation

A CBDC, especially a retail one, would primarily be aimed at substituting cash. Arango et al (2020) show that the expansion of electronic payment networks significantly reduces the demand for cash for a panel of countries, affecting in particular the demand for high-denomination bills. A similar impact could be expected from the development of a CBDC. Of course, this effect depends on the design aspects of the CBDC and, specifically, on its remuneration and associated convenience services. Also, depending on these design aspects, a CBDC may compete with sight and short-term deposits offered by banks and other financial institutions. Therefore, a natural question is whether the issuance of a CBDC would reduce financial intermediation and hamper credit supply.

Andolfatto (2020) shows that if the CBDC interest rate is below the policy rate, then a monopolist bank will optimally link its lending rate to the policy interest rate and not to the CBDC rate. As a result, equilibrium loans will not change after the introduction of a CBDC. On the deposit side, if the CBDC interest rate is above the initial deposit rate, the monopolist bank will optimally match the CBDC yield. Consequently, bank profits will be lower and the CBDC will substitute only cash in equilibrium.

In the Colombian financial system total deposits exceed loans (Graph 3). A significant fraction of deposits are in either savings accounts (sight deposits) or current accounts, and this fraction jumped up after the Covid-19 shock (Graph 4). Within savings accounts, three categories may be distinguished: accounts held by corporates, accounts held by public institutions and accounts held by households and small firms (Graph 5). As expected, certificate of deposit (CD) and bond interest rates are generally greater than or equal to the policy interest rate (Graph 6). By contrast, there are differences between the interest rates paid on the different categories of savings accounts, with the returns on the households' and small firms' accounts being generally lower than the policy interest rate and rather insensitive to its shifts (Graph 7). In addition, several current and savings accounts are subject to fees and commissions that reduce their yields and might even imply negative rates of return.[2]

In this setting, a CBDC that earns a zero or low interest rate (certainly lower than the policy rate), and provides wide-ranging and inexpensive transactional services would directly compete with current accounts and savings accounts currently demanded by households and small firms, including the above-mentioned "electronic wallets", which accounted for 39% of total deposits and 30% of total loans in 2021. According to Andolfatto's (2020) argument, banks with market power would match the return and payment convenience of the CBDC, which would imply lower fees and commissions on deposits and transactions, and even higher deposit interest rates.

[2] See, for example, this table of deposit costs published by the Financial Superintendence of Colombia: https://www.superfinanciera.gov.co/descargas/institucional/pubFile1057845/ctasahorro1221.xlsx.

Importantly, loan supply would be only slightly affected, since the CBDC interest rate is lower than the policy rate, which is the opportunity cost for bank loans.[3]

This would be a desirable outcome from the point of view of payments in the country, but could have an impact on bank profitability. The latter might be an issue in the short run if banks faced substantial risks to their solvency. However, despite the challenge posed by the Covid-19 shock, Colombian banks have remained solid and profitability has recovered (Graph 8). In the long run, lower profitability would reflect reduced market power of banks, which is convenient from an efficiency standpoint.[4]

A key assumption of the previous analysis is that banks have market power on the deposit side and the CBDC interest rate is low enough to make deposits profitable for the commercial bank. But, what if deposit markets are more competitive or deposits and transactions are costlier than assumed? In this case, the CBDC could crowd out some current accounts or households' and small firms' saving accounts, since banks would not find it worth their while to match the CBDC's return and services. Loan supply could be affected if banks are unable to substitute central bank credit for deposits, which might happen because central bank financing facilities are concentrated in short maturities or banks face collateral constraints to access central bank funding.

Although sustaining financial intermediation through a permanent expansion of central bank financing of banks is possible (see eg Brunnermeier and Niepelt (2019) and Fernandez-Villaverde et al (2020)), it might not be desirable. It implies that the central bank must permanently get involved in the selection of maturity transformation for the economy (which is different from setting regulatory limits to privately chosen maturity transformation). As stated by Fernandez-Villaverde et al (2020), enlarged central bank power in the deposit market may reduce the central bank's incentives to deliver the socially optimal deposit contract (one that supports efficient maturity transformation) and exposes it to political pressure. Also, increased exposure to credit risk may imply greater reputational risk and interference with central bank autonomy, especially in an institutional framework in which central bank losses must be absorbed in the government's budget, as in Colombia.

However, setting the CBDC features appropriately could avoid the need for a significant substitution of central bank funding for bank deposits. In particular, the return on the CBDC could be set so that it does not exceed the marginal (average) net benefit of a deposit for an efficient price-taking bank. As an illustration of this calculation for Colombia, consider that, with a 3% inflation target, a long term natural real interest rate around 2% and an 8% reserve requirement on sight deposits, the gross marginal (average) benefit from a COP 1 deposit would be (3% + 2%)x(1–0.08) = 4.6%. Hence, a zero-nominal return, central bank balance sheet preserving CBDC would be feasible if an efficient bank's deposit and transaction marginal (average)

[3] In fact, Andolfatto (2020) argues that if banks match a higher return on the CBDC, total deposits would increase (at the expense of cash holdings). This could end up raising loan supply if the additional deposits relax binding liquidity regulation constraints.

[4] Torres and Castaño (2020) report an increasingly non-competitive market structure for financial intermediation after the 1998–99 financial crisis in Colombia using the Lerner index and Boone indicator. They also show increasing Herfindahl-Hirschman (HH) concentration indices for loans and deposits in the same period. Likewise, Rodríguez and Cabrera (2020) claim that loan markets exhibit a non-competitive structure based on the Panzar-Rosse measure, and show an increasing (although still moderate) concentration in the loan, savings deposit and current account deposit markets since 2008, according to HH indices.

costs are equal to or lower than 4.6%. Notice that in this calculation the gross benefit of a COP 1 deposit is limited to the after-reserve requirement policy interest rate (over the cycle), and that it does not include the benefit associated with the information gathered on potential new customers of the banks' products. Notice also that reducing the reserve requirement would expand the set of "feasible" CBDC nominal returns.

A related issue is whether a CBDC would support or hinder financial inclusion. Financial inclusion will increase if banks match a higher CBDC return and, consequently, deposits rise. If deposits remain constant, but cash holdings are reduced in favour of CBDC, there is the potential for increased financial inclusion, provided that the information on CBDC transactions is voluntarily shared with financial intermediaries that might offer their products to new customers or expand their supply to existing ones.[5] On the other hand, if the CBDC crowds out some bank deposits, then some information could be lost and financial inclusion may be hindered, unless CBDC transaction information is voluntarily shared with financial intermediaries. Therefore, according to the discussion above, the design and features of the CBDC would influence the outcome regarding financial inclusion.

Financial stability

It has been argued that the existence of a retail CBDC could threaten financial stability by making it easier for households and firms to run against bank deposits, especially those that are uninsured (Cecchetti and Schoenholtz (2017)). In assessing this risk, it is important to acknowledge that runs on deposits may vary in their extent and nature. In some runs, funds are withdrawn from some intermediaries to be deposited in others (eg public and large banks), so that aggregate deposits are not substantially reduced. In this case, the central bank's task is to ensure that liquidity from surplus intermediaries flows to those that need it, especially when the interbank markets have probably seized up as part of the stress episode that includes the run. Typically, the central bank ends up substituting for the market for a while.

In other runs, certain types of deposits are withdrawn to be replaced by other types of deposits within the system. For example, after the Covid-19 shock, term deposit demand fell in Colombia, as bond prices collapsed and money market funds faced large withdrawals. However, the money returned to the system in the form of sight deposits (Graph 4). In this case, financial authorities had to deal with an instantaneous increase in term mismatches (possibly requiring longer-term central bank financing) and ensure that sufficient liquidity was available for those institutions that did not rely on sight deposits.

So long as the CBDC design provides for a sufficiently low interest rate, it is possible that these types of runs would not substantially reduce total deposits and, therefore, that the described central bank responses would remain adequate. However, despite a low interest rate, by construction the liquidity and safety of a CBDC make it a natural alternative to flee to during a run. In this case, aggregate deposits may be affected and a more active role of the central bank as lender of last resort (LOLR) may be in order. Of course, a systemic run typical of a full-blown

[5] Following Andolfatto (2020), if banks match a higher return of the CBDC, total deposits will increase at the expense of cash holdings.

financial or currency crisis requires a complete macro-financial policy response to stabilise the system that would include a very active LOLR component as well.

In sum, the introduction of a retail CBDC requires a strengthening of the LOLR facilities to deal with potentially larger effects of bank runs on aggregate deposits and credit. This has been acknowledged in the literature (Brunnermeier and Niepelt (2019)),[6] but in practice it means that the readiness of central bank LOLR facilities and financial intermediaries' access requirements must be adequately and frequently verified, including legal and operational aspects. For the same reason, on the prudential policy side, the introduction of a CBDC would require an even more watchful eye to ensure that liquidity and capital buffers remain adequate and, consequently, runs on banks have low probability.[7]

Monetary policy transmission

The effect of the introduction of a CBDC on the transmission of policy interest rate movements to deposit and lending interest rates depends on the features of the CBDC, namely its rate of return and the convenience services that it provides. If the return on the CBDC is lower than the interest rate on the existing deposits, then the CBDC will only substitute cash holdings, leaving unchanged the deposit and lending interest rates, as well as their response to policy interest rate shifts.

Otherwise, if banks match a return on the CBDC that is higher than the initial interest rate on deposits, but lower than the policy rate (as in one of the cases covered by Andolfatto (2020)), then the transmission from policy rates to deposit interest rates could be weakened, since the latter would be fixed at the CBDC yield and only for relatively high policy rates would the link between them be re-established (see eg Garratt and Zhu (2021)). This assumes that the interest on the CBDC is *not* changed along with the policy interest rate. If the CBDC substituted part of the deposits (for which banks find matching the return on the CBDC not worth their while), then the central bank would have to expand its financing of intermediaries and a larger fraction of bank funding would be directly linked to the policy interest rate. In either case, transmission from policy rates to lending interest rates would not be significantly affected, since the introduction of a CBDC does not change the fact that the policy rate is the opportunity cost for bank loans (Andolfatto (2020)).

Based on the foregoing arguments, it is likely that the issuance of a zero or low interest rate CBDC in Colombia would have only a limited impact on the transmission of monetary policy. If banks match the CBDC return on the fraction of their sight deposits that currently yield a low interest rate, then the latter's interest rate would become decoupled from the policy interest rate. However, as shown in Graph 7, the interest rate on these deposits already exhibits low sensitivity to policy rate shifts.

Interestingly, a CBDC that delivers a wide array of payment services may reduce the advantage that large banks have over smaller ones on account of their greater payment network and services. In this case, the CBDC would "level the playing field"

[6] Interestingly, Brunnermeier and Niepelt (2019) and Fernandez-Villaverde et al (2020) state that an equilibrium in which deposits are substituted for by CBDC exhibits greater financial stability, since there will be no runs on the CBDC and the central bank funding to banks is stable.

[7] This is especially relevant if, as a consequence of the introduction of the retail CBDC, banks' deposit and transaction fees are cut, and bank profitability is consequently reduced. In this case, capital buffer build-up becomes harder and incentives for risk-taking on banks' asset side increase.

and produce a convergence of deposit interest rates across banks, which would restore their link to the policy rate (Garratt and Zhu (2021)).

4. Foreign CBDC and the threat of digital dollarisation

From an emerging market economy point of view, access of residents to a foreign CBDC (especially an advanced economy CBDC) may be a concern on two accounts: the possibility of "digital dollarisation" and increased capital mobility. As mentioned above, a credible, low-inflation environment and a solid financial system have prevented transactional or financial dollarisation in Colombia. If these conditions persist, it seems unlikely that transactional digital dollarisation would become an issue, especially if an inexpensive and fast low-value payment system is implemented locally either within the existing framework or through the adoption of a domestic CBDC. Access to the foreign CBDC would have to be very easy and its transaction cost advantage substantial to overcome the costs and difficulties associated with currency conversion in daily payments with a currency as volatile as the Colombian peso.

Would access to a foreign CBDC increase capital mobility and facilitate asset reallocation across currencies? The answer to this question depends on the design of and ease of access to the foreign CBDC. Today, Colombians may hold assets abroad, including current and savings accounts. They can also shift their exposure to foreign currency-denominated assets through local investment funds. Hence, the impact of a foreign CBDC on capital mobility and the sensitivity of capital flows to domestic and foreign financial conditions depend on whether the cost of acquiring or trading it is lower than doing so with the currently available foreign assets. For example, if purchasing a foreign CBDC requires a foreign bank account, the advantage of the CBDC would be reduced. On the other hand, if this purchase can be made through an intermediary in Colombia, then the system would work as it does today with USD bills and could increase capital flows and capital flow sensitivity to their determinants.

The previous discussion has policy implications on two fronts. First, developing an inexpensive low-value payment system would contribute to fending off the threat of transactional digital dollarisation. Second, maintaining a credible regime of low inflation and a flexible exchange rate is key to minimise the risk of both transactional and financial digital dollarisation. Exchange rate volatility and low inflation reduce residents' incentives to make payments in a digital foreign currency. At the same time, nominal stability and a flexible exchange rate could discourage large holdings of foreign currency assets as a store of value and introduce uncertainty about the local currency return on them.

5. Conclusion and policy implications

In a context of an underdeveloped low-value payment system and institutional and market structure obstacles to its improvement, the introduction of a retail CBDC is an

option worth considering in Colombia.[8] Its design aspects (return, convenience attributes) can be set so that it substitutes mostly cash holdings, with a moderate impact on bank deposits and financial intermediation. In particular, the return on the CBDC could be calibrated for that purpose. The adoption of a CBDC could augment the effects of a run on bank deposits, requiring a strengthening of the LOLR facilities and processes. For the same reason, maintaining a solid prudential framework is essential to minimise the probability of a run.

Issuance of a low-return CBDC would not significantly affect the transmission of policy rate movements to deposit and loan interest rates in Colombia, since policy rates would remain the opportunity cost of bank loans and a stable CBDC yield would probably influence the interest rates of a fraction of deposits that already exhibit low sensitivity to policy rate shifts.

The threat of "digital dollarisation" from a foreign CBDC or a stablecoin does not seem significant, as long as the credible low-inflation regime with exchange rate flexibility and a solid financial system is maintained. The development of an inexpensive and fast low-value payment system would further reduce such a threat.

Looking ahead, Colombia could adopt a strategy along the lines of Japan's, in which further progress is made in understanding and developing different aspects of a CBDC (DSIF (2021)), and Canada's (Auer et al (2020)), in which a contingent plan is designed to introduce it. However, the contingency plan in Colombia would consider the impossibility of developing an inexpensive instant payment system as a criterion for adoption, in addition to a scenario in which a cryptocurrency or a stablecoin substantially gain in popularity in the country as a means of payment. If a CBDC is seriously considered, issues on cross-border interoperability and insertion in multi-CBDC arrangements must be taken into account in order to expand its benefits to remittances and other cross-border payments (Auer et al (2021)).

These aspects could be considered in an evaluation of benefits and risks of issuing a CBDC that the central bank will perform in accordance with its new Strategic Plan.

[8] Further analysis is required to determine the structure of the CBDC. Most likely, it would be a hybrid or intermediated digital currency to facilitate the management of operational risk and anti-money laundering and combating the financing of terrorism (AML/CFT) activities.

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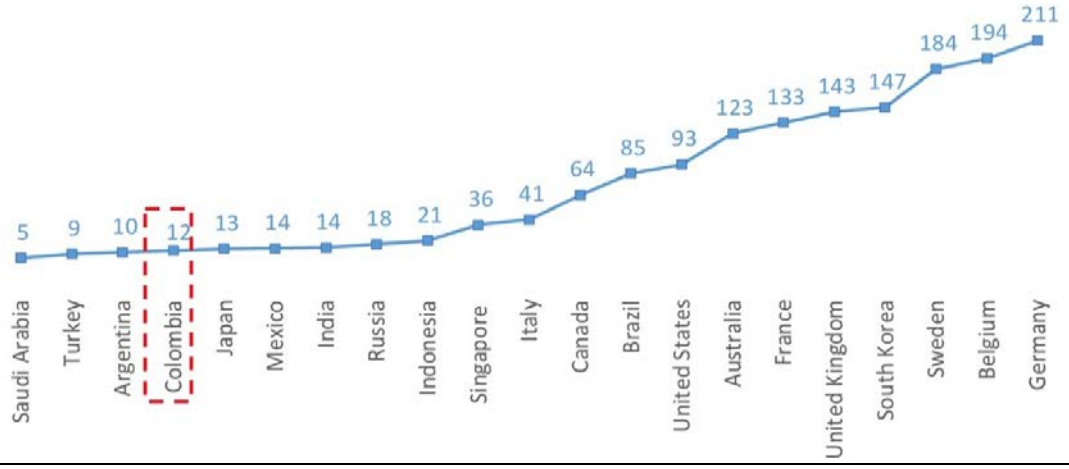
Electronic funds transfers

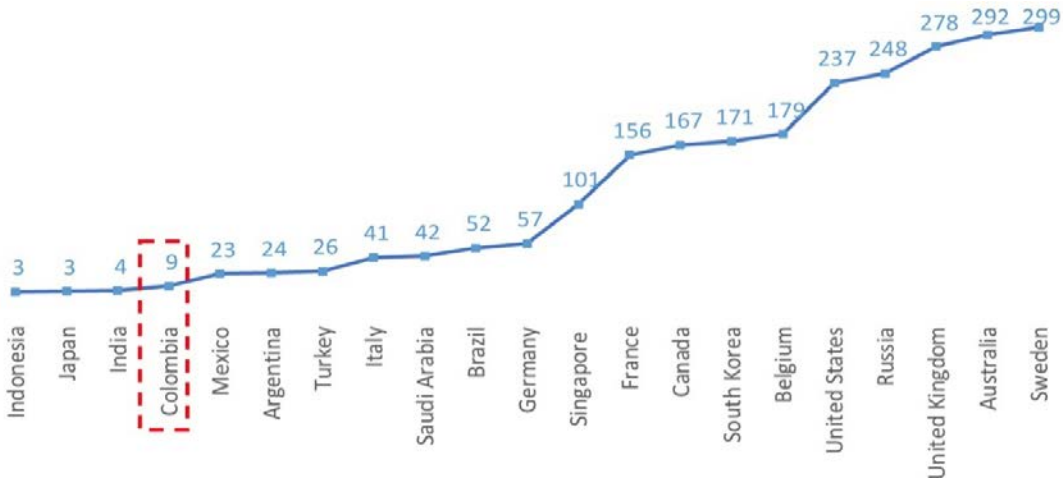
Number of transactions per capita

Graph 1



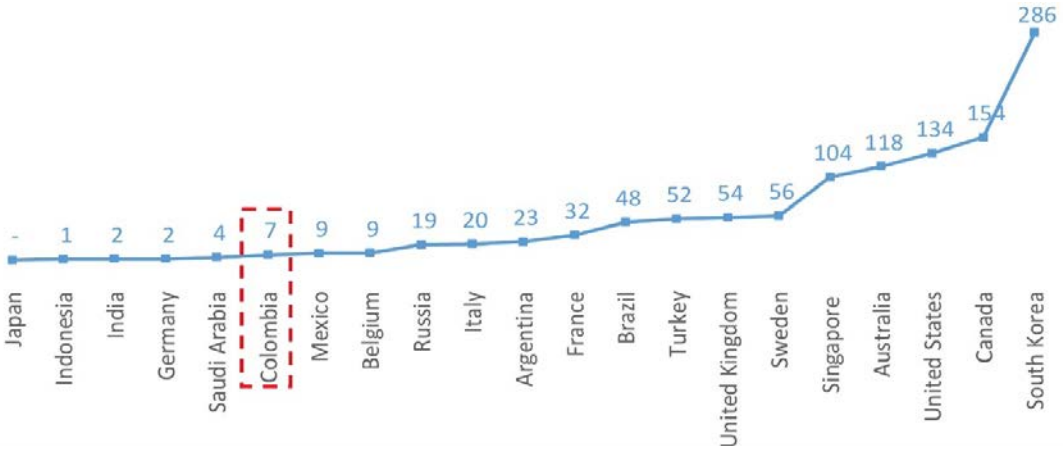
Debit cards

Number of transactions per capita



Credit cards

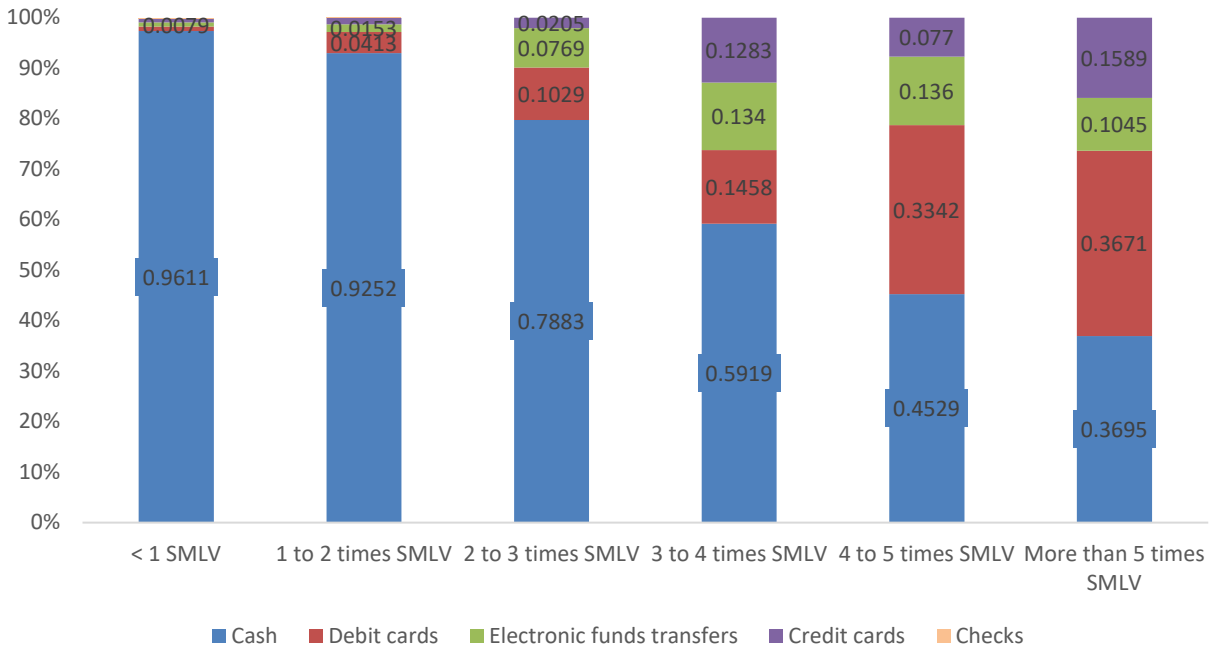
Number of transactions per capita



Source: Central Bank of Colombia (2021a).

Preferred payment instrument

Number of transactions by income bracket — Graph 2

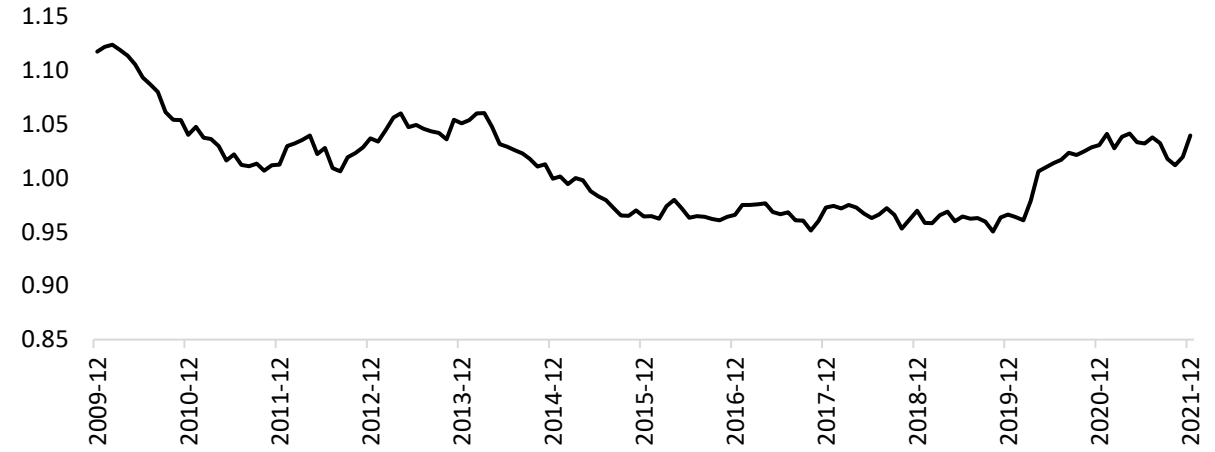


SMLV: legal minimum wage.

Source: Central Bank of Colombia (2020).

Ratio of deposits[1]/loans[2]

Graph 3



[1] Includes CD and bond holdings by the Central Bank of Colombia.

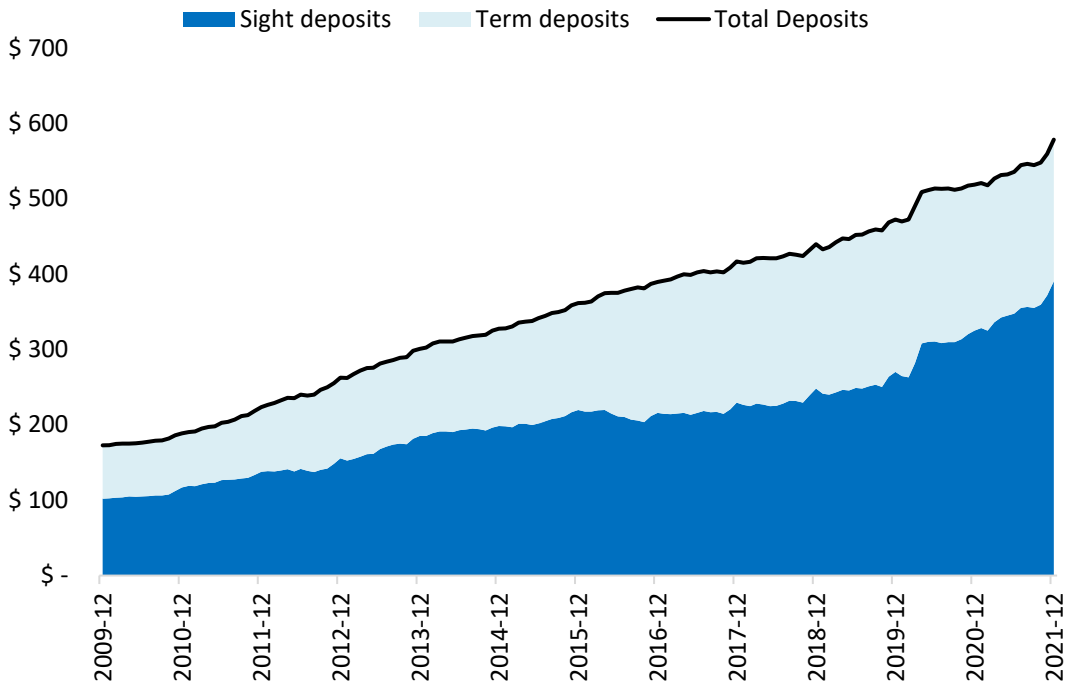
[2] Loans in local and foreign currency.

Source: Calculations by the Central Bank of Colombia with information from the Financial Superintendence of Colombia (weekly balance sheets).

Deposits by term[1]

In trillions of Colombian pesos

Graph 4

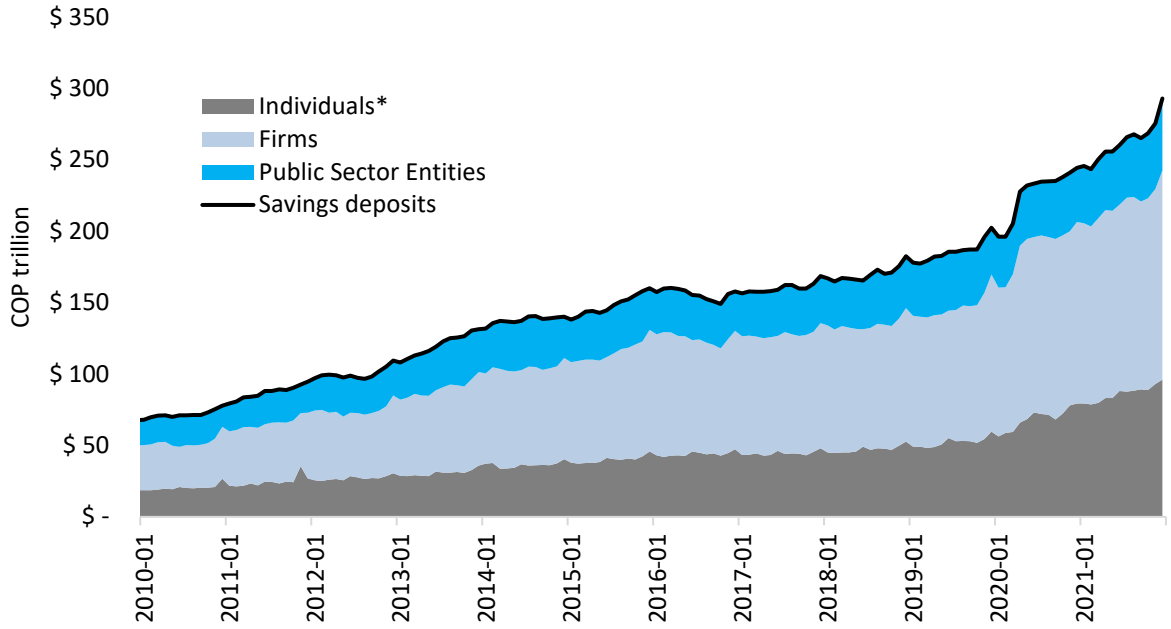


[1] Excludes CD and bond holdings by the Central Bank of Colombia and the National Treasury.

Source: Calculations by the Central Bank of Colombia with information from the Financial Superintendence of Colombia (weekly balance sheets).

Savings deposits by holder

Graph 5

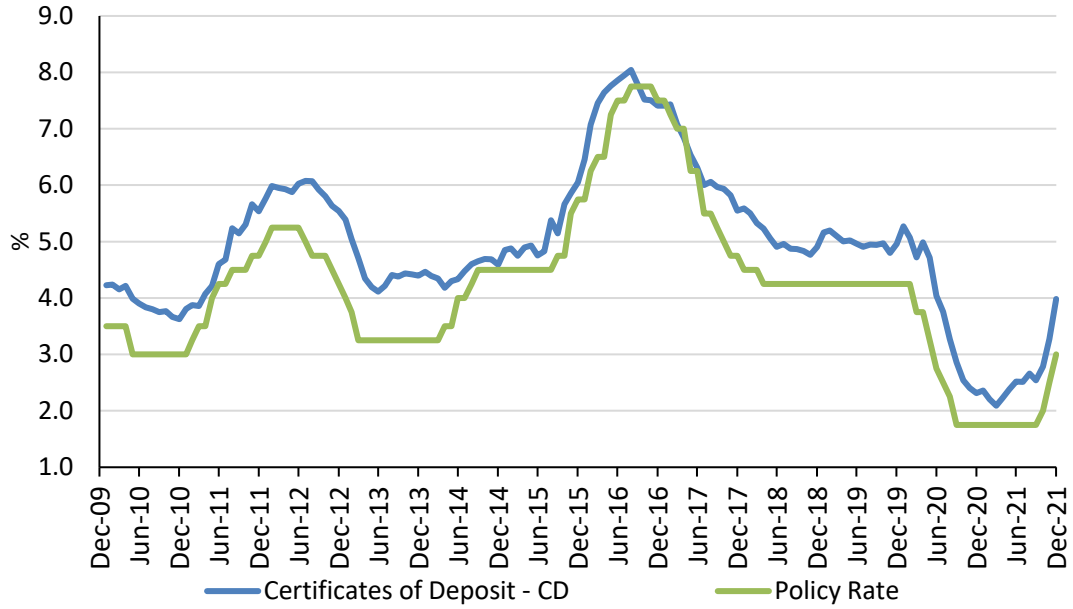


* Includes electronic deposits.

Source: Calculations by the Central Bank of Colombia with information from the Financial Superintendence of Colombia (weekly balance sheets). Sectoral breakdown based on Form 441 of the Financial Superintendence of Colombia.

Certificate of deposit interest rate[1] and monetary policy rate[2]

Graph 6

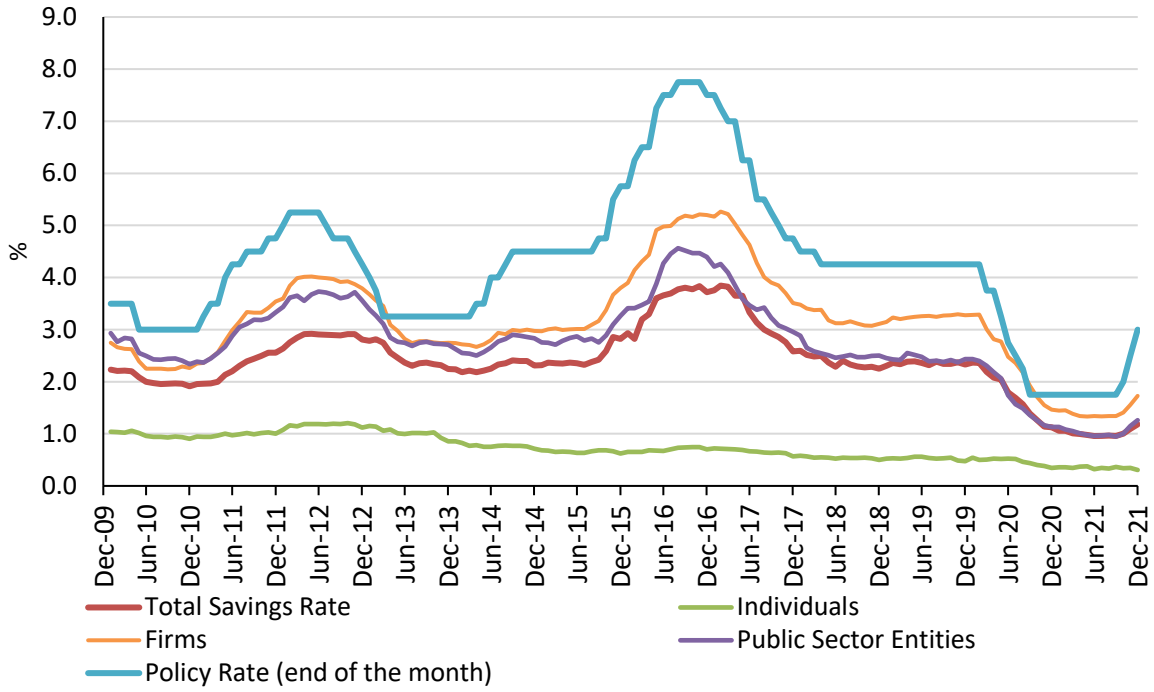


[1] Monthly average. [2] End of the month.

Source: Calculations by the Central Bank of Colombia with information from the Financial Superintendence of Colombia (Form 441).

Savings interest rates[1] by holder and monetary policy rate[2]

Graph 7



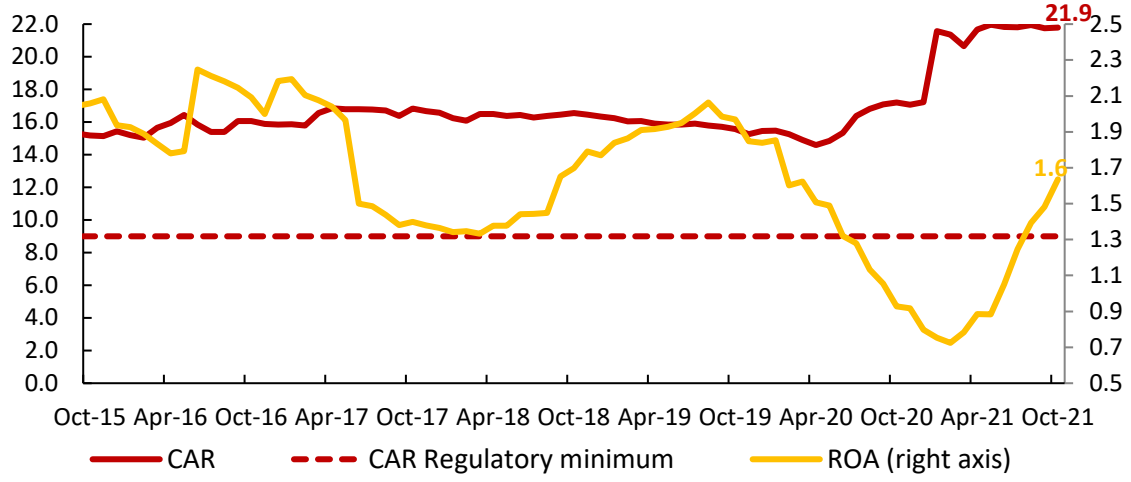
[1] Monthly average. [2] End of the month.

Source: Calculations by the Central Bank of Colombia with information from the Financial Superintendence of Colombia (Form 441).

Capital adequacy ratio (CAR) and return on assets (ROA) for the Colombian banking sector

In per cent

Graph 8



Source: Calculations by the Central Bank of Colombia based on data from the Financial Superintendence of Colombia.

Are there relevant reasons to introduce a retail CBDC in the Czech Republic from the perspective of the payment system?

Michal Vodrážka, Tomáš Bízek, Martin Vojta[1]

Many central banks are currently intensively considering questions related to the possible introduction of a central bank digital currency (CBDC),[2] examining the need for it, its benefits and risks, as well as technical solutions and legal aspects. The Czech National Bank (CNB) is also examining the issue of the possible introduction of a CBDC available to the general public – a retail CBDC. For this purpose, an internal working group was established in February 2021 whose task is to monitor and analyse trends abroad, in particular in jurisdictions with similar characteristics to the Czech Republic, and to discuss the reasons for the issue of a Czech CBDC and the impact of such step on the central bank, the domestic financial sector and the wider Czech economy.

Our analysis is built on the premise that the introduction of a CBDC in the Czech Republic should be preceded by a thorough assessment of its need and added value in our specific conditions, and that the central bank should consider issuing a CBDC only if it can identify the existence of a serious shortcoming (market failure); a problem or risk that the CBDC could effectively resolve; or room for a material improvement for users or for increasing market efficiency that for some reason is not already realised by the private sector. At the same time, the present two-tier banking system should be retained. The CNB has not taken any decision on the issue of its own CBDC or its possible parameters. At the working level, however, analytical work is continuing to examine the topic from a number of perspectives, including assessment of legal and monetary policy aspects, impacts on financial stability, currency circulation, risk management, etc.

In this article[3] we will concentrate on assessing the need for a CBDC for the Czech Republic from the perspective of the domestic payment system. For this assessment, we used a joint report of seven developed economy central banks[4] and the BIS from October 2020,[5] which, in Section 2.1 *Payment motivations and challenges*, states a total of seven motivations for investigating the introduction of a CBDC relating to payments. These are stated below (the text of the report in italics, without notes) and

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[2] 68 central banks have communicated publicly about their retail CBDC work as of January 2022, including the CNB. Most are in the research phase. See Raphael Auer, Giulio Cornelli and Jon Frost, *Rise of the central bank digital currencies: drivers, approaches and technologies*, BIS Working Papers No 880, August 2020.

[3] This article expresses its authors' opinions and may not fully reflect the CNB's official position.

[4] The central banks of Canada, Japan, Sweden, Switzerland, the United Kingdom and the United States, as well as the ECB.

[5] See Group of Central Banks, *Central bank digital currencies: foundational principles and core features*, October 2020.

there is a subsequent analysis of the extent to which each is relevant, currently and in the near future, for the CNB and the Czech Republic.

1. Continued access to central bank money

In jurisdictions where access to cash is in decline, there is a danger that households and businesses will no longer have access to risk-free central bank money. Some central banks consider it an obligation to provide public access and that this access could be crucial for confidence in a currency. A CBDC could act like a "digital banknote" and could fulfil this obligation.

In some developed, in particular Scandinavian, countries, there has been a gradual increase in the use of electronic payment methods at the expense of cash payments to such an extent that the volume and importance of cash is falling. In such cases, there is a relevant debate about whether and how to replace the functions of cash, and what role a central bank should play in this.[6]

As far as this relates to the Czech Republic, it can be said that the trend of decreasing cash usage in some countries is going in the opposite direction in the Czech Republic (where cash in circulation is still rising both in absolute terms and relative to GDP), despite the Covid-19 pandemic crisis. Trends in currency in circulation in the Czech Republic are comparable to those in the euro area, Poland, the United Kingdom and United States.[7] The problem of public access to cash is therefore not relevant in the Czech Republic, even after the first waves of the pandemic. Although it seems that the ratio of electronic to cash payments has increased, this has not affected the volume of cash in circulation.

2. Resilience

Cash serves as a backup payment method to electronic systems if those networks cease to function.[8] However, if access to cash is marginalised, it will be less useful as a backup method if the need arises. A CBDC system could act as an additional payment method, improving operational resilience. Compared to cash, a CBDC system might provide a better means to distribute and use funds in geographically remote locations or during natural disasters. However, significant offline capabilities would need to be developed, both for the CBDC system and any dependencies (eg some availability of electricity for mobile devices).

Counterfeiting and cyber risk present a challenge. Cash has sophisticated anti-counterfeiting features and large-scale issues rarely occur. Theoretically, a successful

[6] A related sub-question is then whether cash should be retained in parallel to a CBDC or if it should be replaced completely. Based on statements by central banks until now, the complete replacement of cash is not assumed anywhere.

[7] See also J Duchacek, "What about cash or the Czech Republic with banknotes and coins", 3 August 2020, www.cnb.cz/cs/o_cnb/cnblog/Jak-je-to-s-hotovosti-aneb-Cesko-s-bankovkami-a-mincemi/.

[8] One example is the outage of Visa systems in the summer of 2018: see "The recent outage of Visa card systems affected five million transactions", *Aktuálně.cz*, 20 June 2018.

cyber attack on a digital CBDC system could quickly threaten a significant number of users and their confidence in the wider system (as it could for a large bank or payment service provider). Defending against cyber attacks will be made more difficult as the number of endpoints in a general purpose CBDC system will be significantly larger than those of current wholesale central bank systems.

The functionality of a CBDC as a backup payment variant, eg in the event of natural disasters, terrorist attacks, cyber attacks on payment systems or on leading banks, or in connection with the Covid-19 pandemic and possible unwillingness of the public to pay in cash for hygiene reasons, has recently been examined by the ECB.[9] A CBDC could always perform a backup role at least for card systems, which currently dominate retail payments in bricks-and-mortar stores and also predominate in internet payments, because it would operate on a different, non-card infrastructure. If a CBDC's infrastructure were parallel to the existing Czech system of interbank payments (CERTIS) operated by the CNB, it could be a backup for outages of this system or problems on the part of participating banks. A CBDC would be able to perform a much more important role in offline payments, as it would not be influenced by internet outages and would better handle partial electricity outages. In the event of natural disasters, such as the flooding in the Czech Republic in 2002, a CBDC supporting offline payments could, in addition, work as a backup for cash payments.

We are, however, of the opinion that a CBDC as a reserve means of payment would become relevant in the Czech Republic only in the event that cash stops performing this function. Nothing indicates that this will happen and the current legal provisions on cash as legal tender in the Czech Republic should prevent us getting into, for example, the Swedish situation in the near future.[10] Although it can be assumed that the share of cash payments will fall, the number of retailers accepting payments in cash should not fall, so the infrastructure for cash payments (banks accepting cash at branches, the wide postal branch network and the ATM network) should be retained, albeit to a smaller extent.

As regards the offline payments functionality for a CBDC, based on available information it seems that sufficiently secure solutions are not sufficiently user-friendly and require the use of eg special chip cards.[11] The standard of comfort and speed to which the population of the Czech Republic is accustomed (contactless payments by a plastic payment card or its digital version in a mobile phone) is not currently provided by these solutions. In order for it to work during unforeseen events, it would have to be an ordinary method of payment to which the population is accustomed and for which retailers are prepared (ie appropriately equipped). For the near future we therefore think that for resilience in the Czech Republic it is more important to concentrate on maintaining the role of cash and reducing the costs of its infrastructure. If needed in the future it could be possible to adopt a sufficiently user-

[9] See European Central Bank, *Report on a digital euro*, October 2020, p 13.

[10] In the Czech Republic the laws establish a general duty to accept cash with narrowly stipulated exceptions (over 50 coins in one payment, payment using damaged money). Refusing domestic money without a lawful reason is potentially criminally punishable as endangering the circulation of domestic money. At present, the Government Council for Human Rights is proposing that the rejection of cash could also be punished by an administrative fine.

[11] See, for example, Bank of Japan, "Bank of Japan research: offline payments for central bank digital currency", 3 July 2020.

friendly offline-capable CBDC solution, should one be developed and implemented abroad.

3. Increased payments diversity

Payment systems, like other infrastructure, benefit from strong network effects, potentially leading to concentration and monopolies or fragmentation. Payment service providers have the incentive to organise their platforms as closed-loop systems. When a small number of systems dominate, high barriers to entry and high costs (especially for merchants) can occur. Where more systems exist, fragmentation may still occur as systems often have proprietary messaging standards, increasing the cost and complexity of interoperability. Fragmentation of payment systems means that users and merchants may face costs and difficulties paying users of other systems. This is inconvenient and socially inefficient. CBDC could provide a common means to transfer between fragmented closed-loop systems (although an accessible fast payment system can also achieve the same end).

The current payment infrastructure in the Czech Republic seems to be sufficient for the provision of electronic payments. The only system for interbank payments in Czech koruna (CZK) in the Czech Republic is the CNB's CERTIS system. A certain limit on its use stems from the fact that the group of CERTIS participants is limited by European legislation (the Directive on Settlement Finality[12]) to credit institutions only. Other providers of payment services, such as payment institutions and electronic money institutions, must make CZK payments through CERTIS participants, which could put up barriers to their business (eg the absence of access to instant payments) and increase their costs. The introduction of a CBDC in the Czech Republic could make electronic payments in CZK available to non-bank payment service providers as well. The current CERTIS restrictions could, nevertheless, be resolved legislatively, in the form of an amendment to the Directive on Settlement Finality, which is currently being considered by the European Commission.

For a number of years, the Czech Republic has been among the global leaders in contactless card payments[13] and in 2018 the CNB supplemented the card infrastructure with instant payments. At the time of writing, they are used by the majority of leading domestic banks and from June 2021 there has been an increase in the maximum limit on one instant payment from the original CZK 400,000 to CZK 2,500,000, which should enable their use among businesses. The CNB has also recently offered banks the opportunity to maintain a register for the use of a mobile number as an identifier for payment as an alternative to an account number (ie mobile proxy).

In can be concluded that the Czech Republic has an available system of instant payments that, together with cash, ensures sufficient competition for card payments. Rather than thinking about a CBDC, we think it is more appropriate to focus on supplementing functions in CERTIS for the purpose of improving the current

[12] See Directive 98/26/EC of the European Parliament and of the Council on settlement finality in payment and securities settlement systems, May 1998.

[13] See, for example, "The rise of contactless payments around the globe", Visa, www.visa.com.bs/visa-everywhere/innovation/contactless-payments-around-the-globe.html.

infrastructure for domestic and cross-border payments, which will enable payment service providers to come up with useful innovations and increase the security of payments (it is possible to think, in particular, about the functionality of a request for payment by the beneficiary[14] or checking the name of the intended beneficiary/account owner; the topic of connecting payment systems is also topical).[15] On balance, compared to a well functioning instant payment system, and in cases in which there are no doubts about the use of the data it generates or anti-money laundering (AML) risks, our view is that a retail CBDC does not provide any material advantages.

4. Encouraging financial inclusion

For the central banks contributing to this report, most of the adult population in their jurisdictions can conveniently access electronic payments. However, increasing digitalisation could leave some sections of society behind as potential barriers around trust, digital literacy, access to IT and data privacy concerns create a digital divide. For central banks in many emerging market economies, a key driver for researching CBDC is the opportunity to improve financial inclusion.

Yet for a CBDC to increase financial inclusion, it must address the causes of exclusion, which vary by jurisdiction and are often complex. Given the complexity of this issue and possible underlying obstacles to digital inclusion (eg illiteracy), any CBDC initiative would likely need to be embedded in a wider set of reforms.

Financial inclusion is not generally a problem for the Czech Republic, as a developed economy and a member of the European Union (EU). Access to bank accounts with basic features is a guaranteed right in the EU.[16] An analysis of publicly available data shows that the level of account ownership in the Czech Republic is stable at around 80% of the population. An informative overview published by the European Commission[17] shows that most Czechs who do not have a payment account do not have it because they neither need nor want it. In terms of financial inclusion, the Czech Republic is at an advanced level also according to many studies.[18] The solution to probably the only significant problem in the Czech Republic in the area of financial inclusion, ie making electronic payments available to a substantial number of persons whose bank accounts are garnished due to debt enforcement, should,

[14] A "request to pay". This is a more modern form of direct debit, where the beneficiary sends the payer for confirmation a request for the transfer of a certain amount. In the event this is confirmed by the payer it is executed in the form of an instant payment. In contrast to direct debit, there is no need to obtain the payer's prior consent to the setting up of the account from which the direct debit is to be taken and its limits.

[15] In 2021, the Monetary Authority of Singapore (MAS) was the first in the world to connect the instant payment system it operates in Singapore dollars with the Thai baht instant payment system, and in 2022 it plans to connect it to the systems in Malaysia and India.

[16] Directive 2014/92/EU of the European Parliament and of the Council on the comparability of fees related to payment accounts, payment accounts switching and access to payment accounts with basic features.

[17] See European Commission, Directive on payment accounts - Factsheet 3: Access to payment accounts.

[18] The most detailed analysis is by the World Bank from 2017: https://globalfindex.worldbank.org/.

after a number of years, be provided by the newly introduced provisions on a garnishment protection account valid from July 2021.[19] The motive for introducing a CBDC of potentially increasing financial inclusion is thus irrelevant in the Czech Republic.

5. Improving cross-border payments

Cross-border payments are inherently more complex than purely domestic ones. They involve more, and in some cases numerous, players, time zones, jurisdictions and regulations. As a result, they are often slow, opaque and expensive. An interoperable CBDC (ie one that is broadly compatible with others) could play a role in improving cross-border payments.

We do not see any reasons to consider a domestic CBDC in this regard either. Most Czech foreign trade is realised with the euro area and therefore in euros; otherwise the US dollar is used for international trade. Both the euro area and US central banks are only just beginning to think about CBDC issuance, and an interoperable Czech CBDC would have to be developed reactively in response to a digital euro or dollar.

In any case, payments in euros, which are the most important for the Czech economy, are relatively transparent and cheap thanks to the Single Euro Payments Area (SEPA) and related European regulation (including price regulation that sets forth that payments in euros must cost the same as corresponding CZK payments).[20] We thus think it is more appropriate to concentrate on the question of transaction speed (ie to support domestic banks in offering instant payments in euros – Sepa Instant Credit Transfer). An interesting possibility which merits a more detailed discussion is the alternative of connecting CERTIS to the ECB's Target2 system. The Swedish[21] and Danish central banks[22] are going even further in this regard, as they are preparing to completely replace the payment systems they operate with the Target2 system. A material improvement in cross-border payments in the medium term should, regardless of a CBDC, be ensured by the activities of the G20 and the Financial Stability Board (FSB), whose plan to strengthen cross-border payments assumes the achievement of the majority of aims set out by 2027.[23]

[19] In practice debtors make use of CZK accounts in other countries, for example using Revolut.

[20] Regulation (EU) 260/2012 of the European Parliament and of the Council establishing technical and business requirements for credit transfers and direct debits in euros, and Regulation (EU) 2021/1230 of the European Parliament and of the Council on cross-border payments in the Union.

[21] See Sveriges Riskbank, "The Riksbank wants to use the Eurosystem's T2 and TARGET2-Securities platforms", 23 September 2021.

[22] By 2025; see Danmarks Nationalbank, "Migration of Danish kroner to Target Services", 16 December 2020.

[23] See Financial Stability Board, *Targets for addressing the four challenges of cross-border payments: consultative document*, May 2021.

6. Supporting public privacy

A key feature of cash is that no centralised records of holdings or transactions exist. Some have argued that the main benefit a CBDC could bring would be some level of anonymity for electronic payments.

Full anonymity is not plausible. While anti-money laundering and combating the financing of terrorism (AML/CFT) requirements are not a core central bank objective and will not be the primary motivation to issue a CBDC, central banks are expected to design CBDCs that conform to these requirements (along with any other regulatory expectations or disclosure laws).

For a CBDC and its system, payments data will exist, and a key national policy question will be deciding who can access which parts of it and under what circumstances. Striking this balance between public privacy (especially as data protection legislation continues to evolve) and reducing illegal activity will require strong coordination with relevant domestic government agencies (eg tax authorities).

After the terrorist attacks in France in 2015, European AML legislation greatly limited the option of making anonymous electronic payments – up to a maximum of EUR 150 for goods and services in bricks-and-mortar stores and EUR 50 on the internet. Anonymous electronic payments between users are not possible at all. An anonymous CBDC is therefore hard to imagine in the EU. We also think that it would be a marked reputational risk if the central bank wanted lighter AML regulation than that governing commercial banks' digital money for its new digital money, whose issue could be fairly controversial by itself. For the same reasons, we do not think it is realistic to create a CBDC that copies cash in the aspect of user and transaction anonymity. In any case, we do not regard ensuring a certain degree of anonymity as relevant or sufficient motivation for the Czech Republic to consider CBDC issuance.

On the contrary, as regards the question of users' privacy when making payments, it is appropriate to state, in agreement with the BIS,[24] that public digital money could protect users' privacy in an increasingly digital economy better than is the case currently for private digital money. It should be possible to develop a CBDC in such a manner that neither private entities nor public authorities (obviously with the exception of authorities active in criminal proceedings), including the central bank, have access to individual payers' and beneficiaries' data. By itself, however, this does not justify issuing a CBDC, if there are no other reasons for it. Also, the data footprint of payments, albeit important,[25] is certainly neither the only nor the greatest one that users leave in a digital economy. Users are aware that data generated about their behaviour, interests and forthcoming purchases are consideration for digital services used "for free", as well as discounts in bricks-and-mortar stores or on the internet. Despite this, most of society makes use of such services. In addition to this, data about goods or services purchased can be obtained in other ways than directly

[24] See Bank for International Settlements: "CBDCs: an opportunity for the monetary system", *Annual Economic Report 2021*, June. This report deals with the question of privacy and gathering, administration and use of payment data. See the part on *Identification and privacy in CBDC design* and the discussion on "data-network-activities" ("DNA" loop).

[25] For example, but not only from the viewpoint of monitoring the success of digital marketing.

from transactional data,[26] so a CBDC could only increase privacy partially, but we cannot rule out the possibility that it would not increase it at all (if it created motivation to obtain the data in other ways).

7. Facilitating fiscal transfers

For some jurisdictions, the Covid-19 pandemic illustrates the benefits of having efficient facilities for the government to quickly transfer funds to the public and businesses in a crisis. A CBDC system with identified users (eg a system linked to a national digital identity scheme) could be used for these payments.

Although a CBDC could play a role in making fiscal transfers more efficient (especially in jurisdictions with greater unbanked populations), on its own, it would not be necessary or sufficient. A linked digital identity system would be a necessity to realise real improvement. If such a system were in place, the incremental benefit of CBDC over transfers to (eg) commercial accounts, etc could be small, depending on designs. Additionally, if fiscal transfers were made with CBDC there is a risk of blurring the division between monetary and fiscal policy and a potential reduction in monetary policy independence.

We are of the opinion that the topic of how CBDC could make fiscal transfers more effective is one for countries with larger unbanked populations, which is not the Czech Republic's case. Fiscal transfers can be performed through existing bank accounts or using postal services.

Conclusion

In this document we assessed the need for the introduction of a CBDC for the Czech Republic based on seven key payment system viewpoints and arguments that are often stated in this area as possible benefits of CBDC issuance and reasons for its introduction. In the Czech Republic, the quantity of cash in circulation is growing and its acceptance is ensured by relatively strict legal tender provisions. Therefore, it is possible to state that the problem of public access to cash is not relevant. Cash also performs the function of a fallback means of payment and the current payment infrastructure seems to be sufficient for the provision of electronic payments. The Czech Republic has a high-quality and well functioning instant payment system and, at the moment, it is more sensible to concentrate on additional improvements to the current infrastructure than on creating a brand-new system for a CBDC. In addition, residents have a legally guaranteed right to a basic payment account, and improvements in access to electronic payments are achievable not only through the introduction of a CBDC, but also through legal provisions on garnishments. The financial inclusion motive for CBDC introduction is therefore absent as well. The question of use of a CBDC for the facilitation of cross-border payments is not topical, as it would have to be developed reactively, in connection with the establishment of

[26] Google obtains these data automatically, eg from emails in the Gmail service: see J Winston, "Google keeps an eye on what you buy, and it's not alone", Fast Company, 8 June 2019, www.fastcompany.com/90349518/google-keeps-an-eye-on-what-you-buy-and-its-not-alone.

a digital euro or US dollar. With regard to existing EU legislation on combating money laundering and terrorism financing, the introduction of an anonymous CBDC in the Czech Republic is inconceivable. In contrast to this, it is true that central bank digital money could protect private users more than digital money at present, but there is the question of whether this would, in practice, be a sufficient reason for the introduction of a CBDC. We can conclude that from the perspective of payments in the Czech Republic there are currently no convincing reasons for the issuance of a retail CBDC. With regard to dynamic trends in this area, it is nevertheless appropriate to continue to carefully monitor further activities by central banks and their CBDC projects and to be prepared, if necessary, to increase the attention paid to considerations about a possible future CBDC issuance in the Czech Republic.

Three principles guiding the design of the HKMA's proposed retail central bank digital currency architecture

Hong Kong Monetary Authority (HKMA)

About this paper

This paper aims to offer meeting participants an overview of the HKMA's retail central bank digital currency (rCBDC) study as well as to highlight three selected principles that guided our design of the proposed architecture. The first section of the paper provides a background of the e-Hong Kong dollar (e-HKD) study being conducted by the HKMA, in which an architecture for distributing and circulating rCBDC was proposed. The second section briefly discusses the model adopted, explains why it was chosen, and describes how the architecture works. The third and final section delves into three of the design principles that were considered by the HKMA over the course of devising the proposed architecture, namely flexibility, privacy-preserving ability and interoperability.

1. Background of the HKMA's e-HKD study

In June 2021, the HKMA commenced Project e-HKD, a feasibility study on rCBDC and digitisation of the Hong Kong dollar to increase the city's readiness for issuing rCBDC if it decides to do so in the future. The project consists of two parts. The first part is a technology experimentation study which investigates the infrastructure needed for issuing and distributing rCBDC. Specifically, it examines how certain commonly recognised issues relating to rCBDC can be addressed or mitigated through suitable architectures and designs. The second part is a comprehensive study of other issues pertaining to the feasibility of issuing e-HKD, covering use cases, benefits, legal and monetary considerations, and risks related to data privacy, anti-money laundering (AML) and cyber security.

As part of the technology experimentation study, in October 2021 the HKMA published a technical white paper which reports the initial thoughts and findings on the potential architectures and design options that could be applied to the construction of the e-HKD distribution infrastructure. An architecture was proposed in the white paper, and comments and suggestions from the industry and academia were solicited.

While a conclusion regarding issuing e-HKD has not been reached, the HKMA remains open-minded on the matter, and aims to formulate a stance and offer its initial thoughts in the middle of 2022.

2. Overview of the proposed architecture

The two-tier model, in contrast to the one-tier/direct model, was adopted in the HKMA's proposed architecture. The rationale behind this decision will be discussed only briefly given that the merits (as well as drawbacks) of the two-tier model have already been discussed at length in various papers published by the BIS.

In brief, the two-tier model was chosen for the proposed design because it could preserve the division of labour between the central bank and private sector intermediaries, ie commercial banks and payment service providers (PSPs), implying that the central bank can focus on providing the core infrastructure, and delegate the majority of customer-facing activities and operational tasks to the intermediaries. Another particular strength of a two-tier model is its capability to decouple the wholesale and retail layer, ensuring that cyber attacks originating in the retail layer will not be cascaded into the wholesale one, resulting in a more cyber-resilient CBDC system overall.

The HKMA's proposed architecture consists of two layers. The first layer, which is the wholesale system, is where wholesale CBDC (wCBDC) issuance and redemption take place, and is only accessible to the central bank and intermediaries. Its distributed ledger technology (DLT)-based nature enables intermediaries to settle interbank payments among themselves without involving the central bank. The second layer is a retail system for distributing and circulating rCBDC. It is operated by the intermediaries and is accessible to general users who are equipped with mobile wallet applications. Between the wholesale and retail system are the intermediaries who act as a bridge to facilitate communication and synchronisation between the two systems. Most importantly, a mechanism is present in the architecture to ensure that every rCBDC distributed in the retail system is backed by wCBDC in the wholesale system in a verifiable manner at all times. This mechanism eliminates the problem of over-issuance of rCBDC.

In the retail system, the distribution and circulation of rCBDC is based on the unspent transaction outputs (UTXO) model. By nature, UTXO enables traceability of transactions by embedding a chain of records of previous transactions. Features to address the privacy concerns of UTXO will be discussed in Section 3.2. Another notable feature is the presence of the validator infrastructure.[1] It is responsible for verifying every retail payment transaction so as to prevent the problem of double-spending, ie spending the same rCBDC more than once.

3. Three principles guiding the design of the proposed architecture

Over the course of devising the proposed architecture, the HKMA considered a number of design principles. With reference to the meeting agenda, three of these

[1] For details about the validator infrastructure, such as its design and implementation, please refer to the HKMA's technical white paper, e-HKD: A technical perspective (www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/e-HKD_A_technical_perspective.pdf).

principles, namely **flexibility**, **privacy-preserving ability** and **interoperability**, were selected and will be discussed below.

3.1 Flexibility

The HKMA is of the view that, to maximise the usability of any design of CBDC issuance and distribution infrastructure, the infrastructure should ideally be based on a flexible architecture, so that central banks are allowed a certain degree of flexibility to implement different two-tier models according to their respective jurisdictional contexts, and to accommodate changes as informed by new policy research findings. Ideally, the design should be reconfigurable so that by configuring different components of the system, different two-tier distribution models can be achieved.

The HKMA's proposed architecture is designed with flexibility in mind. First of all, the adoption of the two-tier model implies that the design of the wholesale and retail systems could be made independent. For example, currently the wholesale system is based on DLT. In the event that a centralised database similar to the real-time gross settlement (RTGS) system is preferred to suit the local context, this change in preference in the wholesale system would have minimum impact on the design of the retail system.

The design of the retail system further demonstrates the flexibility of the proposed architecture. For instance, the validator infrastructure can be configured to achieve different two-tier models. If the host of the validator infrastructure is the central bank, a hybrid CBDC model can be achieved. If the validator infrastructure is hosted by a designated joint venture of all the intermediaries, an intermediated CBDC model can be achieved. The usability of an infrastructure based on such a flexible architecture would be greatly maximised.

3.2 Privacy-preserving ability

User privacy is commonly regarded as one of the most valued properties and key success factors that determine whether an rCBDC would be generally accepted and used by the general public. Thus it is natural to include privacy-preserving elements in the design of the proposed architecture. This section briefly explains how the HKMA's proposal could preserve a user's privacy on two fronts: first, by limiting the central bank's access to retail payment data; and second, by restricting access to a user's information to that user's bank only, ie not allowing other users, or intermediaries of which the user is not a client ("non-client intermediaries"), to access the user's information.

First, limiting the central bank's access to retail payment data is made possible by the flexible nature of the proposed architecture. As pointed out in Section 3.1, in the proposed architecture, the validator infrastructure can be configured to achieve different two-tier models. If the validator infrastructure in the retail system is operated by intermediaries, the role of verifying the retail payment transactions and maintaining the retail balances is assumed by the intermediaries, not the central bank. As the central bank is not present in the retail system at all, it has no access to individual users' retail payment data, thus users' privacy can be preserved.

Second, preservation of user privacy vis-à-vis other users and non-client intermediaries could be made possible by a pseudonym system. While the natural transaction traceability of a UTXO model allows intermediaries and users to know who

held the rCBDC in the past, such traceability would have privacy implications. To address this issue, the proposed architecture explores the possibility of creating pseudonyms, similar to "nicknames", to represent the transacting parties during each and every transaction. Only a user's bank has access to the mapping between the pseudonyms and the user's real identity, which means that only a user's bank, not other users or intermediaries, knows the real identity of an rCBDC owner.

3.3 Interoperability

In the context of a two-tier model, a CBDC infrastructure should ideally be designed in a manner that allows interoperability between systems of different banks and PSPs. In other words, customers of different banks and PSPs should be allowed to make CBDC payments freely between themselves, in contrast to only permitting CBDC payments between customers of the same provider, ie a closed-loop payment system. In the HKMA's proposed architecture, intermediaries would use the same set of standards for communication in the retail system, allowing banks, PSPs, and their systems to better interconnect with each other. This arrangement would enable rCBDC retail payments to flow across different intermediaries seamlessly.

In addition, to support overseas users or wallets, ie cross-border transactions, the CBDC infrastructure should preferably be designed in a way that allows extension of services and functionalities in order to support interoperability with other jurisdictions' CBDC systems in the future. In the proposed architecture, due to cyber security and resilience considerations, by design users would need to initiate transactions through their banks or PSPs, instead of accessing the validator infrastructure directly; and the same principle applies to overseas users. To support cross-border interoperability, there is a dedicated structure in the proposed architecture with a role similar to that of a service provider, for overseas users to connect to the validator infrastructure and make CBDC payments.

Closing

This paper has briefly discussed three design principles considered by the HKMA during the course of devising the proposed architecture, namely flexibility, privacy-preserving ability and interoperability; but they are by no means the only principles examined. The HKMA hopes that the principles highlighted in the paper will spark an exchange of views and facilitate a fruitful discussion among participating central banks. More in-depth explanation of the proposed architecture is provided in the HKMA's technical white paper *e-HKD: A technical perspective*, downloadable from the HKMA website.

CBDC – an opportunity to support digital financial inclusion: Digital Student Safe in Hungary

Péter Fáykiss, Ádám Nyikes and Anikó Szombati[1]

Abstract

CBDC has huge potential to improve the quality of and access to digital financial services, but it is also uncharted territory, a „moon landing" for central banks, where a decision requires great care. Therefore, when no urgent need is identified for a general use CBDC, careful but definite steps can help guide central banks to gain first-hand experience with targeted pilot projects having additional objectives. Hungary's central bank, the Magyar Nemzeti Bank (MNB), launched its first retail CBDC pilot project in September 2020 with a dual purpose: (i) to support digital financial inclusion of students; (ii) to gain hands-on experience on a potential operational model of a future CBDC system. When designing the Digital Student Safe pilot, we applied a seven-step decision-making structure that ensures a consistent conceptual framework appropriate to help design any future successful CBDC pilots or projects. In this case study we demonstrate how the framework was applied in practice and how the Digital Student Safe 1.0 programme was delivered for the benefit of both the general public and the central bank. Based on its success, further expansion is also being considered in the form of Digital Student Safe 2.0.

JEL classification: A11, A20, D14, E58, G53, I20.

Key words: Central bank digital currency, CBDC, digital financial inclusion, digitalisation, Hungary, education, financial and digital literacy.

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1. Introduction: CBDC, an uncharted territory

The introduction of a central bank digital currency (CBDC) can support the achievement of several economic, policy and social goals. The theoretical literature on CBDC is already extensive, and several studies address the potential benefits and risks of issuing a CBDC (eg Group of Central Banks (2020)). Wholesale CBDC could reform interbank and cross-border payment and settlement, while retail CBDC could lead to the renewal of financial services and monetary policy. Motivations for some countries may differ depending on whether they are emerging or developed economies or based on other factors such as social or geographic characteristics.

One of the most prevalent motivating factors among central banks is the promotion of financial inclusion. This was one of the main motivations behind the issuance of one of the world's first general retail CBDCs, the sand dollar of the Bahamas (CBoB (2020)). It is also an important motivating factor to the People's Bank of China, which has a remarkably advanced pilot programme (PBoC (2021)).

In Hungary, the instant payment system was successfully introduced for the banking sector in 2020, and overall, currently we cannot identify an urgent need for launching a generally accessible, fully fledged retail CBDC. However, Hungary's central bank, the Magyar Nemzeti Bank (MNB) is keen to be at the forefront of CBDC research, and therefore, it needs to experiment with all possible dimensions of a CBDC project on a small, controllable scale. To serve this goal, the MNB has chosen a special programme which has two parallel objectives: (1) to facilitate digital financial inclusion of a special age group of 8–14-year-old students; and (2) to serve as a real-life CBDC pilot project for the MNB.

Financial inclusion can be defined in several ways. Simply put, it is the access to and use of formal financial services by households and firms (Sahay et al (2015)). There are several reasons why financial inclusion has come to the attention of central banks. Studies have shown that increasing financial inclusion can have a positive impact on economic growth and, with properly supervised financial services, can also enhance financial stability (Sahay et al (2015)). A deeper understanding of the overall level of a country's financial inclusion can be gained by examining three components: (i) access to financial services; (ii) usage of financial services; and (iii) the quality and cost of financial services (Jahan et al (2019)). All three components are equally important, which is why financial inclusion is a challenge even in developed economies. In the United States, despite the advanced financial infrastructure and wide-ranging access to financial services, 5.4% of households were unbanked in 2019 (Kutzbach et al (2019)). This shows that even in one of the most developed economies in the world, there is still considerable room for improvement in the field of financial inclusion.

Although the digitalisation of the economy and society has long been an identifiable process, the Covid-19 epidemic has unexpectedly accelerated it. The digitalisation of finances poses a new challenge to everyday users. It carries the danger that people will be unable to keep up with the constant technological change, digital knowledge will lag behind, and in addition to financial inclusion, societies will have to cope with digital exclusion as well. That is why not only financial inclusion alone, but digital financial inclusion is the new challenge.

Digital financial inclusion is also an opportunity to create a more inclusive and equal financial ecosystem. It is associated with higher economic growth, compared to

traditional financial inclusion (Sahay et al (2020)). The digital revolution can provide a more effective response to all three components of financial inclusion. Digital financial services can increase access to formal financial services by overcoming physical infrastructure barriers and providing a first entry point to the financially excluded (OECD (2017)). Digital solutions can also improve the quality and reduce the cost of financial services. New fintech players increase competition, forcing all players in the financial sector to continually improve the quality of their services and reduce the cost of use. The improvement in the use of financial services depends on the ability of customers to keep up with the ever changing technological innovations. That is why financial and digital literacy is a critical issue for digital financial inclusion.

2. Financial inclusion in Hungary

According to the Word Bank's Global Findex survey, in 2017, 75% of the population aged 15 and over had a bank account in Hungary. Based on data observed in previous years, an upward trend can be detected, and this number is expected to increase further. It is a matter of concern that among young adults (ages 15–24) this figure was only 60%, although in terms of online payment use, young adults are ahead of the general population. This means that a significant part of future generations uses financial services less, and a higher unbanked rate was also observed among the lower educated or rural population. The most important reason given by unbanked for their condition was the high costs of financial services, insufficient funds, or lack of trust in financial institutions. Overall, the data suggest that all three components of financial inclusion have room for improvement in Hungary (World Bank (2018)). An OECD survey conducted in 2019 examined the level of financial literacy of countries based on three components: (i) financial knowledge; (ii) financial behaviour (ie planning and acting with a conscious financial mindset); and (iii) financial attitude (ie having long-term financial safeguards and higher resilience to shocks). Based on the results, the overall level of financial literacy in Hungary is below OECD average. The best result received was in financial knowledge, while Hungary was one of the worst performers in terms of financial behaviour (OECD (2020)).

The results of the presented surveys show that progress is needed in Hungary on all components of financial inclusion, but the main challenge is to improve the active and frequent use of financial and especially digital financial services. This clearly suggests that practical routines and confidence in the online space and basic financial practices need to start at as early an age as possible.

3. The MNB's approach to financial inclusion in the digital age

We have previously shown that an appropriate level of financial and digital literacy and its continuous improvement is essential to promote digital financial inclusion. This can be achieved through comprehensive and modern educational programmes for all social groups. The MNB's consumer protection mandate involves the strengthening and raising of financial awareness and supporting the spread of

financial culture.[2] To achieve this, the MNB has several educational programmes through which it seeks to strengthen financial awareness among a wide range of individuals. The aim is to reduce the financial insecurity of the population and to encourage them to use financial services that meet their own needs.

In addition, as described in the previous chapter, the digitalisation of the financial system and the emergence of fintech services can further facilitate digital financial inclusion. To support the spread of innovative financial solutions and create a vibrant fintech ecosystem, the MNB launched the MNB Innovation Hub and Regulatory Sandbox in 2018, followed by the establishment of the Digitalization Directorate and the appointment of the Chief Digital Officer in 2019. Furthermore, the digitalisation of the existing financial system is also a strategic goal of the MNB. The launch of the instant payment system in 2020 was a milestone in the digitalisation of the Hungarian financial system. Unlike international examples, the MNB made joining the instant payment system mandatory for all domestic banks, in order to deploy the full potential of network effects. In 2021, the publication of the Recommendation on the digital transformation of credit institutions also served the purpose of accelerating the digitalisation of the financial sector in Hungary and widening the offer of end-to-end digital, widely accessible financial services to customers.

The MNB has recognised that CBDC experimenting may also create an opportunity to launch a special pilot programme on digital financial inclusion. Therefore, the central bank decided to launch its first retail CBDC pilot project, which: (i) is in line with the MNB's objectives set out in the MNB Act; (ii) promotes digital financial inclusion; and (iii) supports the MNB's intention to join the leading central banks in the field of CBDC research.

4. Digital Student Safe: a targeted retail CBDC pilot

For the moment, the MNB does not see any urgent need to set up an implementation project for a large-scale retail CBDC. Still, it wants to develop capabilities, build market and implementation knowledge, and get to know technologies in order to shorten the time to issue a CBDC when economic or policy need arises. It has therefore issued a pilot project combining the two policy goals of building a running CBDC pilot and supporting the digital financial inclusion of a special group, 8–14-year-old students.

Savings stamps have a long history in Hungary. Their first appearance dates back to the 19th century. The early savings stamp was a financial instrument that allowed people to have microsavings. Later, in the 1970s and 1980s, collecting savings stamps became popular in primary schools in Hungary. Collecting stamps with different designs and colours was a playful form of saving for students. At the end of the school year, students were able to redeem the savings stamps through their teachers. However, in the past three decades, this playful form of microsaving has disappeared from schools.

The Digital Student Safe mobile application is an attempt to make the once so popular financial inclusion format available to students again, while adapting it to the expectations of the modern, digital age. The mobile application has been available to students since September 2020. With the help of targeted communication and a

[2] Article 44 (3) of the Act CXXXIX of 2013 on the Magyar Nemzeti Bank.

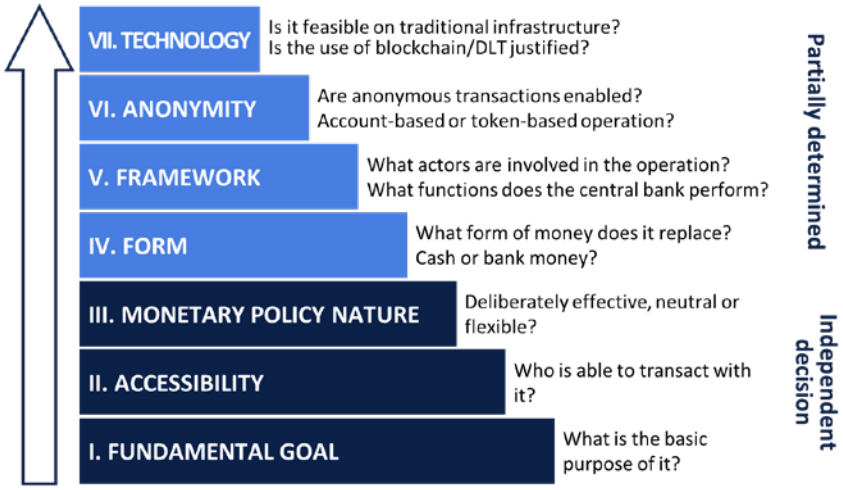
direct marketing campaign, the central bank first selected 45 schools to invite for participation. With a step-by-step extension of the programme, now students from more than 100 schools are actively using the application. Based on their experiences and feedback, the further expansion of the Digital Student Safe project is now under development.

The Digital Student Safe is a publicly available mobile application, where students can set savings goals, exchange and collect digital assets (digital medals, digital stamps) by answering quiz questions about finance, digitalisation, and environmental awareness. Additional digital medals can be earned from parents as a gift or in return for the completion of some predetermined tasks/activities, all registered in the app. The digital medals or stamps are forming special series, eg on famous Hungarian kings or Hungarian castles. Therefore, the collection of the specific series of digital assets and the exchange of excess copies has an intrinsic value for the young collectors. The digital assets also represent a specific value expressed in so-called Student Tallér, and can be redeemed for material gifts like toys or sports equipment at the end of the savings period at a specific webshop. Several redemption periods have taken place since launch, and thousands of students registered, who completed more than 700,000 quizzes. According to development plans, in the next phase (Digital Student Safe 2.0) a more direct connection to real money is to be attained, while the targeted user base continues to provide a secure base for testing. As a result, additional CBDC-related functions can be tested as well, and valuable experience gained.

As part of its CBDC research the MNB has also published a comprehensive study volume entitled *At the dawn of a new age – money in the 21st century*. The volume summarises the theoretical considerations, the most important practical issues, the motives behind the potential creation of and the opportunities offered by this new form of money. As referred to in the study volume, seven distinct, consecutive decision steps can be identified that should be considered while designing a successful CBDC project (Graph 1). Below, we are going to demonstrate how the MNB's first retail CBDC pilot project, the Digital Student Safe, was designed using this seven-step decision framework.

Decision "steps" in designing a CBDC

Graph 1



Source: Fáykiss and Szombati (2021).

1. Fundamental goal

In this step, it should be clearly defined what is the motivation for the introduction of CBDC, what kind of market failure or shortcoming it aims to alleviate. The MNB's approach is unique in a way because it decided to closely link the first retail CBDC pilot project with the MNB's financial education objectives. The aim was to promote the adoption of certain forms of financial behaviour that can be established in childhood, such as setting financial goals and plans, exchange of digital assets and forming a regular saving habit. On top of that, with the constantly updated quizzes the central bank can help students and families acquire up-to-date financial, digital and sustainability knowledge. Through the widely supported and well targeted educative programme, valuable live testing experience with real-time customer feedback was also achievable, as an input to the retail CBDC project.

2. Accessibility

In this step, accessibility should be determined, ie which economic and social players will have access to the CBDC. The MNB is the first and so far only central bank to design its retail CBDC pilot programme around a specific social group not based on geographical location. The Digital Student Safe is targeting primary school students and their parents. The MNB chose the 8–14 age group because: (i) at this age group regular pocket money appears, and occasional or even regular spending occurs; (ii) however, the saving and spending usually takes place exclusively in cash; and (iii) children at this age already have smartphones, while they are legally deprived of having individual bank cards. Therefore, the programme targets both the students in this specific age group and their parents, who are primarily controlling and overseeing their children's activity in the app. Designed for students, the CBDC pilot is a unique opportunity for the central bank to improve the financial awareness of young people who are currently not having any bank relationship, but who in the future are expected to spend more and more and later also to have their own income. The programme first targeted 45 primary schools all around the country, and, in two consecutive steps, has now been extended to directly contacting more than 100 schools.

3. Monetary policy nature

In this step, the monetary policy framework should be defined, ie whether the CBDC would be an active, neutral or possibly flexible instrument for monetary policy, as well as any restrictions (eg on the amount that can be held in the account, transaction size or number). Digital Student Safe is a neutral instrument for monetary policy; it is not intended to be interest-bearing.

4. Form

In this step, the form of the CBDC should be determined, ie whether it would be account- or token-based and what kind of functions it might thus have. In the current phase, the use of the Digital Student Safe mobile application is subject to registration and it can be described as an account-based form.

5. Framework

In this step, the operational framework should be defined, ie which players are involved in the operation of the CBDC and what functions the central bank performs. One of the biggest challenges for central banks in CBDC operations is that they might need to perform functions that they traditionally do not. In order to be able to respond flexibly to this decision-making step in the future, the MNB has decided to

use a framework in the pilot programme in which the central bank provides a wide range of functions directly. This gives the MNB valuable experience in the field of customer relations, and it also implies dealing with legal challenges such as know-your-customer (KYC) or anti-money laundering (AML). The main purpose of the (still limited) framework is to test the operability of the possible functionalities of an actual retail CBDC pilot and to gain experience. However, CBDC being a completely new, innovative initiative at the society level, the MNB deems the involvement of commercial banks as well as other innovative players like fintechs as inevitable in some form for the future.

6. Anonymity

In this step, the issue of anonymity should be defined, ie whether it would be possible to carry out anonymous transactions and within what framework. In the current phase, the system operates in a pseudonymous manner, allowing users to register with a username, email address, and age. In addition, it implicitly uses "KYC": when the student wants to purchase gifts, additional information is required to complete the delivery by their school teacher.

7. Technology

In this step, the technology used should be defined, where it can be determined whether the system would work on the traditional infrastructure or whether it would be necessary to develop a new system (eg based on distributed ledger technology (DLT)). A potential CBDC project may require significant infrastructure development. In order to achieve the main goals of the Digital Student Safe, the development or implementation of a completely new technology was not a priority in the short term, but it is worthwhile to build the system in such a way that it is modular. One of the advantages of the Digital Student Safe CBDC project is that it can be flexibly developed according to different future needs.

Conclusion

Digital financial inclusion is one of the key challenges of the coming decades and needs to be improved to ensure a stable, secure and accessible financial ecosystem. The MNB's Digital Student Safe initiative is a unique innovation in its retail CBDC pilot nature, and aims to improve digital and financial literacy and, ultimately, digital financial inclusion. The seven-step decision framework proved to be a helpful tool in practice, facilitating the successful design of the Digital Student Safe pilot project. The most important takeaway is to use the framework step by step, starting with the most important step, defining the fundamental goal, and then deciding on further issues. CBDC projects can only be truly successful if the central bank sets clearly defined policy goals, and these goals also serve the interests of the users.

On top of serving as an effective tool to support digital financial inclusion, the Digital Student Safe pilot programme was invaluable as a retail CBDC experiment for the central bank as well. Primary registration and complaints handling processes were developed, proper front- and back-end functions started to be operated, flexibility and scalability have been tested, peer-to-peer transactions and webshop transaction functions have been developed and tested. Overall UX, UI and conceptual ideas were introduced to real-life customers, and their feedback was highly appreciated. As it has been so effective in delivering on both objectives, it is planned to maintain and

develop the Digital Student Safe programme further. With expanded reach, widened functionality and real money involvement, while maintaining the gamification and the family focus, we believe that the Digital Student Safe pilot programme can continue to both support digital financial inclusion and provide an opportunity for the MNB to gain hands-on experience on a potential operational model of a future CBDC system. According to plans, these extended functionalities under the Student Safe 2.0 programme will already be available in the 2022–23 school year.

The MNB is committed to continuing its research on CBDC and to successfully implementing its ongoing pilot initiatives, although no significant market failure or specific public policy goal can be identified that would make the widespread introduction of a retail CBDC in Hungary urgent. The MNB's current CBDC activities are a good basis to enable the issuance of a retail CBDC with sufficient conceptual, technological and practical readiness if economic or policy demand arises. The MNB is committed to actively involving market participants in the process and is actively seeking the opportunity to cooperate with the players of the domestic banking and fintech ecosystem in order to prepare them for the digital transformation and for the potential introduction of any form of CBDC.

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Central bank digital currencies (CBDCs) in emerging market economies (EMEs) – India

Central banks the world over have been providing trusted money to the public for centuries as part of their key roles and responsibilities. Trusted money issued by the central bank is a vital public good that underpins the modern financial system. Other than currency notes, most aspects of this financial system have been replaced or supplemented with digital and electronic versions of their paper counterparts. Evidence also suggests that the use of physical cash has declined in recent years – a trend that has been further reinforced by the Covid-19 pandemic. With rapid and profound changes taking place in payment systems, most central banks have started considering the benefits and challenges of issuing a digital version of fiat currency (ie a central bank digital currency (CBDC)).

Main objectives and key considerations

Before delving into the potential benefits of CBDCs, it is worthwhile to clarify the definition and nature of modern money and currency. Money has, historically, taken the form of either commodities with intrinsic value or debt instruments. When money does not have intrinsic value, it must represent title to commodities that have intrinsic value or title to other debt instruments. Paper currency is such a representative money, and it is essentially a debt instrument. The owner of the currency knows who owes them or who has the underlying liability. There is always an "issuer" of representative money. Typically, in modern economies, this "issuer" is the sovereign. While private issuance of money did exist in the past, it has given way over time to sovereign issuance for two reasons. First, being a debt issuance, private money is only as good as the credit of the issuer. With multiple issuers in the system, private currency therefore entails some intrinsic instability. Understanding currency as defined here, it is important to note that private virtual currencies are at substantial odds to the historical concept of money. They are not commodities or claims on commodities as they have no intrinsic value, and neither do they represent any person/institution's debt or liabilities. In the absence of fundamental intrinsic worth or trust, private currencies carry substantial risks, and financial stability risks from private digital currencies are likely to pose significant regulatory and supervisory challenges. We also note that if private digital currencies were given regulatory mandates, competitive forces could engender fragmentation in the payments ecosystem resulting in excessive market power and eventual deposit disintermediation. Currency backed by the sovereign, on the other hand, is more stable since the issuer in this case has better credit standing. Second, paper currency involves *seignorage* – the difference between the intrinsic value and the representative value which accrues to the issuer. If currency is to serve the role of a public good, this seignorage should ideally not accrue to any private individual to avoid problems of adverse selection.

Therefore, in modern economies, currency is a form of money that is issued exclusively by the sovereign (or a central bank as its representative). It is a liability of the issuing central bank (and sovereign) and an asset of the holding public. Currency

issued by the sovereign is fiat money. Hence, fiat money is government-issued currency that is not backed by a physical commodity such as gold or silver, but rather by the government that issued it. It is legal tender. Currency is usually issued in paper (or polymer) form. In the case of CBDC, it will be issued in digital form. Thus, a CBDC is simply legal tender issued by a central bank in digital form. It is the same as a fiat currency and is exchangeable one-to-one with the fiat currency.

There is now widespread interest in CBDCs for various reasons. In countries with high physical cash usage, CBDCs may provide a more efficient issuance channel. There also appears to be substantial public demand for digital currency that has manifested in the mushrooming of an array of private digital currencies. Issuing a CBDC may help provide a more stable alternative to such private currencies. Other potential benefits of CBDCs include better financial inclusion, and tackling money laundering and tax avoidance.

India is leading the world in terms of digital payments innovations. Our payment systems are available 24/7, to both retail and wholesale customers, they are largely real-time, the cost of transactions is low, users have a large menu of options for making transactions and digital payments have grown at an impressive compound annual growth rate (CAGR) of 55% (over the last five years).[1] However, a pilot survey conducted by the Reserve Bank of India (RBI) on retail payment habits of individuals in six cities between December 2018 and January 2019 indicates that cash remains the preferred mode of payment and for receiving money for regular expenses, particularly for small-value transactions.[2] CBDC could target digitisation of these cash preferences. But preference for cash, for instance for its anonymity, can be redirected to acceptance of CBDC as long as anonymity is assured. India's high currency-to-GDP ratio holds another motivation for introducing CBDC. To the extent large cash usage can be replaced by CBDCs, the cost of printing, transporting, storing and distributing currency can be reduced. Another important consideration is related to satiating the public demand for virtual currency while preserving financial stability. CBDCs could provide the public with some of the uses that private virtual currencies provide – such as greater security and viability of holding currency. At the same time, it could also protect the public from the abnormal level of volatility some of these virtual currencies experience.

The RBI is currently working towards a phased implementation strategy and examining use cases which could be implemented with little or no disruption. Some key issues under examination include, inter alia: (i) the scope of CBDCs – whether they should be used only in retail payments or also in wholesale payments; (ii) the underlying technology – whether it should be a distributed or centralised ledger, for instance, and whether the choice of technology should vary according to use cases; (iii) the validation mechanism – whether token-based or account-based; (iv) the distribution architecture – whether direct issuance by the RBI or through banks; and (v) the degree of anonymity. The RBI has been considering pilot projects in CBDC in the wholesale as well as retail segments. Across both segments, the introduction of CBDC has the potential to provide significant benefits, such as reduced dependency on cash, higher seigniorage due to lower transaction costs and reduced settlement

[1] See RBI (2021a).

[2] See RBI (2021b).

risk. Going forward, CBDCs would also potentially enable a more real-time and cost-effective globalisation of payment systems.

Guiding principles of CBDC design and data governance

Various design choices for introduction of CBDCs are under active consideration at the RBI. The direct CBDC model would comprise accounts managed by the central bank, and the central bank itself would be responsible for managing all the payment services. The indirect model is identical to the arrangement for paper currency – the central bank issues CBDC through intermediaries, ie banks whose details are maintained in the central bank, and the public obtains CBDCs from the banks, as required. It is also possible to have a hybrid architecture with two components, ie central bank and intermediaries. It is understood that the direct model is attractive for its simplicity as it eliminates the need for an intermediary. However, this architecture is considered to require massive technological capabilities and may compromise the reliability, speed and efficiency of payment systems as the central bank would be the only entity handling payment services. It is the RBI's objective to work towards a phased implementation strategy for introduction of CBDCs and the related architecture shall be chosen accordingly. While designing CBDCs, aspects of consumer protection and data privacy need to be of prime importance as robust privacy safeguards would be necessary for ensuring high acceptance. To this end, legislative as well as technological protections need to be put in place and continuously adapted alongside the introduction of CBDCs. Ensuring adequate internet infrastructure and improving digital literacy of the large populace would also be key. Other important considerations relate to the country's large geographical expanse and the reach of the banking system. Ensuring high standards of cyber security and parallel efforts on financial literacy is, therefore, essential for any country dealing with CBDC.

Further, CBDCs are expected to coexist with other forms of currency and payment systems. Ensuring interoperability across different systems would be necessary for enhanced consumer experience and ease of transactions. Each jurisdiction will have to take a view on the model that is relevant and that can facilitate integration of CBDCs into its economy in a smooth and non-disruptive manner. A nuanced and balanced view has to be taken and a careful sequencing and learning from proofs of concept, pilots and other modalities are essential for this purpose.

Challenges of CBDCs for monetary policy, financial intermediation and financial stability

CBDCs may bring about a change in the behaviour of the holding public. The nature of that change cannot be gauged a priori given that there is little real-world evidence of CBDC use as of now. If there is overwhelming demand for CBDCs, and these are issued largely through the banking system, as is likely, more liquidity may need to be injected to offset the currency leakage from the banking system. The impact of CBDC on monetary transmission would clearly depend on the design and the degree of use. Further, CBDCs shall provide the public with the option to hold a sovereign-backed

and secure instrument as compared to privately issued digital currencies that operate outside the purview of authorities. By making available a risk-free and stable alternative to the public, some central banks expect to tap into the increased interest in privately issued currencies, which are often associated with huge risks at multiple levels. Substitution of private currencies with CBDCs is expected to also make monetary policy more effective.

CBDCs could be non-interest bearing like cash or they may carry positive interest rates, depending on the design choice of the issuing central bank. Even if they are non-interest yielding, still they are risk-free on account of being a central bank liability. Theoretically, a remunerated CBDC could pass on policy rate changes immediately to CBDC holders. However, beyond the theory, there are challenges and risks. To be effective in transmitting policy rates, a remunerated CBDC would need to pay competitive rates and allow the public to hold significant amounts. This could exacerbate financial stability risks associated with disintermediating banks and making fund flows more volatile.[3] Also, if banks were to lose a significant volume of transaction deposits, which are typically low-cost sources of funds, their interest margin might come under stress leading to an increase in cost of credit. Availability of CBDC provides depositors with an easily accessible choice that can be quickly mobilised at a very low cost. If a bank comes under stress, flight of deposits could be much faster compared to cash withdrawal. A prospective flight of deposits would impact the financial system and possibly the wider economy. On the other hand, the simple availability of low-risk CBDCs might reduce panic "runs" since depositors would possess the assurance that they could withdraw their money quickly. However, in many jurisdictions, credible deposit insurance should continue to dissuade runs.

Finally, securing monetary sovereignty is also one of the motivations behind introduction of CBDC in many countries. A risk of "cryptocurrencies" and foreign CBDCs is that domestic users adopt them in significant numbers and the use of the domestic sovereign currency dwindles, eventually compromising the domestic central bank's control over monetary matters ((Brunnermeier et al (2019); G7 Working Group on Stablecoins (2019)). By offering an efficient and convenient CBDC itself, a central bank may reduce the risk of domination by alternative units of account.

CBDCs and financial inclusion

Despite various measures that have been undertaken to strengthen financial inclusion in India, there are still certain gaps in the usage of financial services that require attention from policymakers through necessary coordination and effective monitoring.

With suitable design choice, CBDC may provide a safe and liquid government-backed means of payment to the public Some central banks view this as essential in a digital world in which cash use is progressively diminishing, especially in developing countries with low banking penetration. Since CBDC is a digital form of fiat currency, the government, and central banks, shall facilitate and strive to ensure its universal access and shall reach out to those customer segments that cannot be reached by existing private sector-led solutions.

[3] See Group of central banks (2020).

In a nutshell, the introduction of CBDCs has the potential to provide significant benefits, such as reduced dependency on cash, higher seigniorage due to lower transaction costs and reduced settlement risk. Introduction of CBDC is expected to lead to a more robust, efficient, trusted, regulated and legal tender-based payments option. There are associated risks, no doubt, but they need to be carefully evaluated against the potential benefits. It would be RBI's endeavour to take the necessary steps which would reiterate the leadership position of India in payment systems. It is important to acknowledge that the introduction of CBDCs is neither a compulsion nor a "business as usual" decision. However, CBDC is likely to be in the arsenal of every central bank going forward. Whatever the decision taken or the model of CBDC adopted, it has to be well calibrated, properly structured, and nuanced in implementation, if the concomitant benefits are to be realised.

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CBDCs in emerging market economies – a short note by Bank Indonesia

Question 2: Objectives and considerations for CBDC issuance

- Objectives and considerations for CBDC issuance are country-specific and dependent on factors such as each jurisdiction's financial system, economic, and legal structures.
- What are your policy objectives for issuing CBDC? Are you considering general purpose (retail) CBDC for day-to-day payments or CBDC restricted to wholesale, financial market payments, given your policy objectives? What are the costs/benefits of each?

Key drivers and policy objectives of CBDC in Indonesia

The advancement of technology over the past years has reshaped many aspects of customer behaviour, including how transactions are made. To effectively deal with the evolution towards digitalisation, fast, cost-effective, easy to use, secure, and reliable digital payment solutions are required to provide better integration and capability to meet demand in the digital era. Below, we discuss some observed domestic considerations in Indonesian digital payments that have led to a discourse on the importance of central bank digital currency (CBDC) issuance.

Since the declaration of the National Cashless Movement (GNNT) by Bank Indonesia in 2014, which was further supported by Bank Indonesia Payment System Blueprint initiatives, there has been tremendous growth in the use of digital payments for purchasing goods and services in Indonesia. In October 2021, Indonesia's digital economy and finance development was still exhibiting an upward trend, as indicated by the respective year-on-year (YoY) growth of 36.9% in e-commerce and 52.6% in fintech lending transactions. In addition, the expansion of digital banking has proven the agility of the banking industry and its ability to provide digital services that meet the changing demands of its users. The adoption of the Quick Response Indonesia Standard (QRIS) system to enhance cashless payment has also doubled. Similarly, through credit and debit transfers and e-money and the amount of money in circulation, retail payments show an upward trend with a noticeable rise of 28% (YoY) in credit card transactions. E-money usage has also increased by 51.6% during the same period. There was 16.9% (YoY) growth in volume and 17.5% (YoY) growth in value of BI-RTGS (Bank Indonesia real-time gross settlement) transactions for wholesale payments, with customer transactions contributing a significant proportion of the growth in wholesale transactions (22.3% (YoY) growth in value and 14.6% (YoY) in volume). In the same period, the Bank Indonesia national clearing system (SKNBI) dedicated to retail transactions also displayed positive trends. It increased in both the value and volume of transactions by 29% (YoY) and 19% (YoY), respectively.

Bank Indonesia continues to expedite the digitalisation of the payment system to support the acceleration of the national digital financial economy. To that end, various payment system digitalisation programs that have been implemented include the expansion of QRIS, the National Open API Payment

Standard (SNAP) and regulatory reform, as well as the implementation plan for the Bank Indonesia Fast Payment (BI-FAST) system. Digital economic and financial transactions are proliferating along with increasing acceptance and people's preferences for online shopping, expansion, and convenience of digital payment systems, as well as digital banking acceleration.

The rapid changes in the payment landscape, coupled with other digital disruptions such as the emergence of private digital currency, the internet of things (IoT), big data, blockchain, artificial intelligence (AI), decentralised finance (DeFi) and machine-to-machine (MtM) communication, have a significant impact on central banking practices. These have triggered central banks to adopt a more proactive stance to anticipate the uncertainty in the future, including the issuance of CBDC.

Central banks consider issuing a CBDC for various reasons shaped by local circumstances and at a different pace across jurisdictions and types of economy. As such, the objectives of CBDC issuance in different countries converge into six main objectives: (i) to provide risk-free digital payment using central bank money compared to the services provided by private entities; (ii) to mitigate risk to currency sovereignty and monetary stability from non-sovereign digital currency; (iii) to enhance payment system competition, efficiency and resilience, including for cross-border payments; (iv) to provide a new instrument for monetary and financial stability policy; (v) to facilitate fiscal transfers/subsidy distribution directly to the recipient's account/wallet; and (vi) to support financial inclusion with the digitalisation of payment data, offline functionality, and cost-effective transactions.

To ensure the smooth implementation of CBDC, the majority of central banks follow three common foundational principles. First, the CBDC should be implemented based on a strong legal basis which serves as a consensus from several stakeholders. Second, CBDC should support the objectives of the central bank on monetary, payment system and financial system stability. Third, CBDC should promote financial inclusion, innovation, and efficiency of the financial system in the digital era.

The use of CBDC as a form of central bank money that could act as both a liquid, safe settlement asset and an anchor for the payment system will improve the payment system's efficiency by increasing competition in the domestic and global payment systems markets. The issuance of CBDC can provide benefits for the wholesale and retail payment rails. For wholesale payment systems, wholesale CBDC (wCBDC) could increase settlement efficiency for transactions regarding securities, derivatives and cross-border payments. As a digital service, CBDC can be designed to support 24/7 operation and allow easier asset exchange. In addition, it could enable simplified payment data streams and better traceability of illicit transactions. Lastly, certain models of CBDC might increase trust between counterparties. Besides this, CBDC can also potentially benefit retail payment systems. A retail CBDC (rCBDC) could reduce the cost of managing cash for central banks as well as enabling fast, cost-effective and secure payments. This might result in a more efficient payment system. Moreover, CBDC could promote central banks' ability to monitor economic activities in real-time and support innovation by private entities, including enhancing financial inclusion. A domestic CBDC might also function as the requirement for better cross-border arrangements.

Despite the potential benefits of CBDC, there are several challenges that central banks should assess. Wholesale CBDC might disrupt the innovation already

flourishing in the existing financial system. Additionally, the implementation of wCBDC might be hindered by a lack of proper infrastructure and potential incompatibility with other financial infrastructure. The adoption of distributed ledger technology (DLT) for wCBDC may raise several issues, namely privacy, settlement finality, scalability, performance, and resiliency. On the rCBDC side, the implementation of rCBDC might entail cyber security and technology risks. Other challenges for rCBDC include the adoption and inclusion issue: it should be possible to distribute rCBDC to a broader user group, including residents in remote areas, with the ability to meet the service level agreement requirements. Other potential risks include disintermediation and bank run since CBDC would play a substantial role in facilitating the conversion of assets from commercial bank money to central bank money.

The challenges faced by Bank Indonesia in achieving its policy objectives are influenced by global and domestic issues that arise due to the dynamics in its strategic environment. Digital disruptions have compelled Bank Indonesia to adapt to the changing situation quickly and precisely. **Bank Indonesia plans to issue CBDC as a response to three key drivers**: first, "to emphasise BI's role as the country's sole authority for currency issuance, including in digital form, to maintain monetary sovereignty"; second, to take part in international initiatives among central banks or international organisations related to the issuance of CBDCs; and third, to spur on the integration of the national digital economy and financial system.

In response to the aforementioned key drivers, Bank Indonesia has formulated the main goal of CBDC in Indonesia, which is to provide a legal digital payment instrument in the Republic of Indonesia to support the performance of the central bank's duties, as well as supporting financial system stability and integration of the digital economy and financial system. Based on the main goal, three main objectives of CBDC issuance are being developed and will be discussed further below.

The first objective is to provide *sovereign public goods*. The core responsibility of central banks is providing currency to the public. The constitution, central bank act and currency law, mandates Bank Indonesia as the sole institution with the role to manage currency as a sovereign public good in Indonesia, represented by the rupiah in various forms, to support economic activities. As the rapid innovation of technology has enabled the digital economy to flourish in Indonesia, the rupiah needs to evolve into the form of sovereign digital money to support transactions in the digital era. Unlike private or foreign digital currency, sovereign CBDC would provide the public with a direct claim on the central bank, which would ensure trust and improve the functioning of the monetary system.

The second objective is to support the mandate and objectives of the central bank in the digital era. CBDC issuance may entail several threats that may hinder monetary and financial system stability, such as the risks of disintermediation and bank runs, which would lead to the obstruction of monetary and macroprudential policy exercised by the central bank. The implementation of CBDC should not be counterproductive to the central bank fulfilling its existing mandate by addressing the aforementioned issues with appropriate policy. In addition, it would be essential to identify the potential area of CBDC utilisation to sustain monetary, macroprudential and payment system policy in the digital era. CBDC has the potential to support the fulfillment of central bank objectives and, to some extent, could potentially be an essential tool for central banks in the future to enhance monetary and financial stability through leveraging new technologies.

The third objective is to encourage inclusion, innovation, and efficiency on an end-to-end basis. Considering the rapid growth of financial and payment instruments in Indonesia, CBDC must deliver added value to businesses and consumers with new innovative ways to pay, which contribute to the development of faster, cheaper, more inclusive, convenient, and efficient payment solutions in support of dynamic trends and innovations. CBDC ecosystems should avoid reinforcing barriers to financial access for those excluded from or underserved by the existing financial system while at the same time harnessing innovation to deliver a resilient and efficient payment landscape.

Design choices for CBDC in Indonesia

To achieve the objectives mentioned above, Indonesia's CBDC should support both retail and large-value and financial market transactions. Therefore, Bank Indonesia will develop wCBDC to support large-value and financial market transactions, including monetary operations and government transactions, and rCBDC to support retail transactions in the digital era.

A proper CBDC design is fundamental to ensure its objectives are met. Currently, Bank Indonesia is still researching and assessing the potential design of a CBDC which will be able to support Indonesia's economy while minimising risks. CBDC should provide more convenience in digital transactions without further disrupting the current payment system, such as fiat money, money held in accounts, digital banking, electronic money, and electronic wallets. This consideration will affect the technology and architecture used in Indonesian CBDC.

In 2022, Bank Indonesia will continue its exploration on CBDC by publishing a conceptual design for the digital rupiah to support the digital payment system and accelerate international cooperation on CBDC in the G20 forum. The CBDC issuance plan is designed to be integrated with existing infrastructure developments based on Indonesia's payment and financial system blueprint, including the foundation of end-to-end integration that has been built between the financial and payment infrastructures. This will add complexity to the design and require stronger governance to ensure all of the objectives are met.

What is an optimal CBDC strategy for small economies?

Yoav Soffer, CBDC Project Manager, and Andrew Abir, Deputy Governor, Bank of Israel[1]

Introduction

Central banks in most countries of the world are looking into the potential issuance of CBDC. However, they differ in many elements. Not only do the economic circumstances, the state of the payments system and the preferences of policymakers differ from country to country; countries also stand at different stages of their explorations – some have been studying the topic for several years and have invested significant resources into the explorations, whereas others have only recently started looking into the issue seriously. Moreover, looking forward, central banks in the larger economies can afford to invest extensive resources into technological research and development, resources that might be harder to be allocate for smaller central banks. Another basic element that distinguishes between larger and smaller central banks is interdependency: while decisions taken by smaller central banks are unlikely to impact the former, the path that central banks of large economies will take will have a significant effect on the space of choices in which smaller countries will need to navigate. For example, while the launch of the sand dollar in The Bahamas was an interesting case study to learn from, it will probably hardly have any effect on decision-making and economic developments in the United States. One cannot say the same regarding the effect of the e-CNY pilot on countries in Southeast Asia.

After an initial update on the preparations being made by the Bank of Israel for the examination of a shekel CBDC, or "digital shekel", this paper will discuss three aspects through which decisions made by large economies could affect smaller ones: (1) **monetary sovereignty and financial stability**; (2) **design choices**; and (3) **technology**. On each aspect, we will try to analyse what could be the optimal strategies for the small economies, and what decisions large economies could make in order to mitigate negative effects and increase positive externalities for the smaller countries.

Digital shekel – a progress update

Like central banks of all other advanced economies, the Bank of Israel has not made a decision regarding issuing a CBDC. The Bank is preparing an action plan (Bank of Israel (2021)), so that if conditions develop in the future that would lead to a Bank of Israel assessment that the benefits of issuing a digital shekel outweigh the costs and potential risks, the Bank will be prepared to put such a plan into action. For this

[1] We are grateful to the members of the Bank of Israel Steering Committee on the Potential Issuance of a Digital Shekel for their useful comments on the first draft of this paper.

purpose, and as part of the Bank of Israel's strategic plan, at the end of 2020 the Bank of Israel Governor established a Steering Committee on the Potential Issuance of a Digital Shekel. The Steering Committee appointed a number of working groups from among professionals in various fields within the Bank, through which it is mapping the potential advantages, various issues, and risks involved in a potential issuance of a digital shekel. Although a small proof of concept (PoC) experiment was carried out on an ethereum platform, most of the efforts of the Bank have been directed to research analysis, examining the potential benefits and risks deriving from the adoption of CBDC for the Israeli economy, and how these should affect its design.

The payment system in Israel is stable and reliable. The public has no doubt in its ability to make payment transactions or that the transactions will be made properly and in a timely manner. In discussing a potential project of issuing a CBDC, the foremost question is – Why? What benefits would the Israeli economy derive from the existence of a digital shekel, and what needs would it answer? Is it important that the Israeli public be able to hold a digital means of payment that would constitute a liability of the central bank, in addition to the central bank's physical liability held by the public – cash?

The Bank of Israel's Steering Committee has mapped the advantages that a Bank of Israel digital currency may generate for the Israeli economy if it is issued in the future. **The main motivations that may lead to a decision to issue a Bank of Israel digital currency are**:

- Creating another efficient, advanced and secure alternative to the existing and new means of payment in the digital age;
- Creating an innovative technology that will ensure the adaptation of the payment system to the needs of the future digital economy;
- Ensuring adequate redundancy of the payment system and its proper functioning during emergencies or breakdowns;
- Creating an efficient and inexpensive infrastructure for cross-border payments;
- Maintaining the public's ability to use digital means of payment while ensuring a certain level of privacy;
- Supporting government policy to reduce the use of cash in the struggle against the "shadow economy".

It is important to note that some – if not all – of these benefits may be obtainable through the improvement and upgrading of the existing payment systems, and not necessarily through the issuance of a Bank of Israel digital currency. In addition, the issuance of a CBDC may involve risks. A large part of the Steering Committee's work is focused on research on these topics and on an examination of the added value that a Bank of Israel digital currency could general for the Israeli economy over existing and future payment systems.

In order to examine the various implications of a potential issuance of a Bank of Israel digital shekel, and in order to analyse the business and technological challenges and opportunities, the Steering Committee has set out, in general terms only, a draft model for a Bank of Israel digital currency. The draft model forms the basis for a discussion and examination of alternatives by the working groups dealing with the matter at the Bank of Israel. It also serves as the basis for a discussion in the professional and academic communities in Israel regarding the necessary characteristics of a digital shekel.

The structure of the draft model assumes a partnership between the public sector (the Bank of Israel) and the private sector (banks, credit card companies, and technology and/or finance companies from Israel and abroad) – a "two-tier" approach. In terms of the technology to be adopted, the model does not at this stage determine whether the system will be based on distributed ledger technologies or on central registry technology, but it does set out that the Bank of Israel will provide the basic infrastructure to enable the private sector to develop innovative applications on it. Full and immediate conversion will be enabled between a digital shekel and existing means of payment and the system will support conversions to and from foreign currency. Payment will be enabled not only through mobile phones, but also through a variety of other means, including simple devices, and offline payments will also be enabled, at least in a limited form.

In terms of privacy, the digital shekel will be designed in keeping with anti-money laundering (AML) rules, and in a way that will not interfere with the government's efforts to collect taxes. As such, absolute privacy will not be possible. However, various levels of privacy vis-à-vis payment providers and commercial entities will be possible.

In terms of economic characteristics, according to the draft model the digital shekel will carry a zero interest rate, but it will remain technologically possible to change this in the future. The infrastructure should allow for the authorities to be able to define restrictions on the volume of holding and use of the digital shekel. The cost of making a payment should be very low or near zero, and its use will also be made possible for those that do not have a bank account in Israel (children, tourists and so forth).

While a dialogue between the central bank and key local players and technology vendors is ongoing, the deliberations are clearly affected by what other countries are doing and we will explore some of their impacts.

How are small economies affected by the decisions of large economies in the preparations for a CBDC?

1. Monetary sovereignty and financial stability

There is substantial theoretical literature showing that CBDC issuance by large economies could have significant implications for the monetary sovereignty and financial stability of neighbouring and trade partner countries. For example, Ferrari et al (2020) develop a theoretical model and show that the presence of a CBDC amplifies the international spillovers of shocks to a significant extent, thereby increasing international linkages, and that domestic issuance of a CBDC increases asymmetries in the international monetary system by reducing monetary policy autonomy in foreign economies. They note that the magnitude of these effects depends crucially on CBDC design, and can be significantly mitigated if the CBDC possesses specific technical features. This theoretical literature is yet to feed into practical policy decisions. It is not clear whether those who drafted the principle that CBDC should "do no harm" (Group of Central Banks (2020)) also meant for it to refer to the implications of CBDC for other countries. But a year later, the G7 document on retail CBDCs stated that "*CBDCs should be designed to avoid risks of harm to the international monetary and financial system, including the monetary sovereignty and*

financial stability of other countries" (G7 (2021)). The importance of this statement made jointly by policymakers from G7 countries cannot be exaggerated, nor can the importance of their emphasis that "*Where overseas access to a jurisdiction's CBDC could leave other countries vulnerable to currency substitution or other spillovers, collaborative work to design and implement safeguards, particularly through relevant international organisations, can help mitigate negative effects*".

From the perspective of a small economy, a decision by a large neighbouring country or a significant trading partner to issue a CBDC could raise several policy questions.[2] First, how probable is it that the citizens of the small country would want to widely adopt the foreign CBDC for domestic use? Theoretically, "dollarisation" can take place even without a CBDC; this has happened in the past, but mainly in economies that suffered hyperinflation and/or financial or political instability. If a country's currency and financial system are stable, there is no upfront reason for citizens to "run" to a foreign CBDC, as holding a foreign currency exposes the local consumer to exchange rate risks. However, there could be specific characteristics that attract local citizens to hold and use a foreign CBDC. Technological features of a foreign CBDC might be so attractive that the benefit they carry could outweigh the exchange rate risk: for example, if the foreign CBDC features innovative programmable capabilities that enable making use of payments for goods and services in ways that the local "standard" currency does not. Other drivers could be regulatory arbitrages: for example, if the foreign CBDC allows you to pay digitally while maintaining privacy, or if the AML restrictions are softer than those that apply in the local economy. Cost and efficiency could also be an important parameter: if the foreign CBDC enables payments with smaller (or even zero) fees compared to high fees associated with available digital means of payment in the local economy, and specifically if it makes cross-border payments easier, people may prefer the foreign CBDC over the local currency. This effect may be even stronger if the two economies trade a lot, or are correlated in a manner that mitigates exchange rate risks.

When small economies are contemplating issuing a CBDC, they first and foremost try to weigh the benefits and risks in the context of local conditions. Nonetheless, considerations such as those mentioned above may have an impact on the balance of benefits and risks, and may force countries to make decisions resulting from decisions of other countries. The path that leading economies take may affect the decision space for other countries. For example, if large economies restrict the use of their CBDCs by foreigners to only minor transactions associated with tourism or retail cross-border trade, that would mitigate the risk of digital dollarisation for smaller countries and decrease regulatory arbitrages. However, this could be complicated to implement, as FX flows resulting from retail trade need to be met by opposite capital flows in the FX markets.

2. Design choices

As CBDCs are developing from a theoretical concept which resides mainly in academic articles to practical systems that would be implemented on the ground, central banks need to get into the nitty gritty and decide on the specific properties – from the core system all the way to the end user interface, the legal framework, and the use cases

[2] Similar questions could arise as a result of the emergence of a global, foreign exchange-denominated, widely used stablecoin.

that CBDC would support. This could be a lengthy and time-consuming process for policymakers, who might also need to take into account political pressures, to consider preferences of different parts of society, etc. Perhaps a "wait and see" approach may be an optimal one?

When small countries make their choices regarding design, it is worth discussing to what extent they can actually make sovereign decisions. If CBDCs are to be used in cross-border transactions, they need to be compatible with one another at least to a minimal extent (Auer et al (2021)), and while there is substantial cooperation, bilateral as well as multilateral work coordinated by the international institutions, it is probably more reasonable to expect that small countries would need to adapt their designs to those of larger countries. If, for example, the standard set in the major economies regarding anonymity would require that authorities are able to obtain information regarding a specific transaction if such information is needed for law enforcement, it may not be possible for smaller countries to execute policies that give a greater weight to privacy concerns, if they want their CBDCs to be more similar to cash in this regard. Decisions regarding limitations on holding may also have an effect on cross-border compatibility: if a large economy sets a strict limit regarding who can hold a CBDC and in what amount, smaller countries might not have the liberty to set more flexible policies if they wish to allow mutual holding of CBDCs by each country's citizens.

Even without cross-border transactions being considered, if small countries hurry to design and launch their CBDCs due to local considerations, they may be designing relatively basic systems. These may end up being inferior to systems that are in the research phase today and may be launched within several years, and that may support advanced features such as offline payments, programmable money and smart contracts, micropayments, AI and the like. Adapting the early launched systems to advanced standards down the road may be very expensive.

3. Technology

The exploration of CBDCs is pushing central banks out into the frontiers of financial technology. While in the past technology was perceived mainly as an enabler for achieving the goals set by policy, CBDCs are an example of a policy issue where technology, design, and economic considerations go hand in hand through the exploration process. While the jury is still out on whether CBDCs would end up being built using technologies that are completely new to central banking, such as distributed ledger technology (DLT), or whether they would be based on familiar, centralised technologies, it is clear that either way, if CBDCs are to live up to the promise of fast, convenient, cheap, accessible and innovative means of payment, they would need to present significant technological improvements as compared to the technologies that have been used to build the current payment systems.

In 2020, nearly 60% of central banks were conducting experiments or PoCs on CBDCs, and another 14% had moved forward to development and pilot arrangements (Boar and Wehrli (2021)). However, not all central banks are at the same level of technological research. Some of the PoCs are a small-scale, internal exercise, and focus on trying to understand the basics of the technological alternatives.[3] On the other hand, some central banks have for several years now been deploying substantial

[3] We can testify that the experimental work done at the Bank of Israel is of this nature.

resources, working together with important players from academia and the private sector, and are looking to solve some of the core issues related to the potential future uses of CBDCs. While some central banks of smaller countries have been among the pioneers in technological CBDC experimentation,[4] clearly the bigger countries are better staged in terms of the resources they can deploy into the research, and the ability to move the research from pure theory to applied conclusions.[5]

Central banks of smaller countries, and especially those that have only recently started to examine the issue, may face a dilemma. As the pioneers and large central banks advance with their work, publish the results and share the insights with the global central banking community, how reasonable is it for the smaller countries to invest substantial resources in technological explorations? And given that small countries may want to ensure that they design their CBDCs in a manner that ensures compatibility with those of larger countries, perhaps here too a "wait and see" strategy would be optimal? Moreover, at the end of the day, the situation may be that there will be several large corporations that have built CBDC infrastructures for several front-running central banks. If this turns out to be the case, later adopters could rely on the services of these corporations with some necessary local adaptations, thus making redundant any intensive local technological research.

Small countries may want to invest in their own technological research for several reasons. It is a common understanding that there would not be a "one size fits all" CBDC (Group of Central Banks (2020)). Local characteristics and policy preferences may warrant different technologies for different countries. Central banks may also want to execute technological research in order to gradually increase the public interest in the CBDC project: getting the private sector involved, and gradually moving from research to PoCs to pilots that involve the general public, could turn out to be a useful strategy in terms of managing the public aspects of a CBDC project. Moreover, even if global corporations indeed end up offering custom-made products that central banks could acquire, it may be important for the central banks' IT departments to be acquainted with these different technologies, so that they can provide their managements with skilled advice regarding the pros and cons of each product on the shelf. Another interesting motivation for conducting your own technological experiments programme was raised by the Central Bank of Norway's CBDC Working Group: their impression was that although a lot of the work central banks are doing is being published, the publications rarely go deep into the technical details, and central banks that are conducting technological experimentations would be more willing to share their findings in detail with other central banks if the latter are conducting their own testing, and generate experience that can make the dialogue mutually beneficial (Central Bank of Norway (2021)).

In any case, increased knowledge-sharing between central banks is a win-win strategy. It may also be the case that while large countries focus on the bigger technological challenges, research conducted in small countries regarding country-specific issues could contribute to the general knowledge of the central banking community.

[4] Singapore and Thailand are good examples, although some of the earlier work focused on wholesale CBDCs.

[5] For example, the Federal Reserve Bank of Boston's Project Hamilton and the ECB's technological work on the digital euro.

Technological research on CBDCs is being done not only by central banks, but also by many technological companies around the world. So what are the particular needs for small economies from technology vendors, assuming they are not going to develop their own bespoke solution? In a word – **flexibility, as it was put by the Group of Central Banks (2020): "*A CBDC system should be flexible and adaptable to changing conditions and policy imperatives*".** Since the future requirements for a CBDC may vary between countries and change over time, it is important that the platforms developed by vendors allow considerable flexibility to define the setup for a CBDC. Let us take the example of privacy requirements – any future platform should allow for different privacy levels, even between existing consumers, who may have different requirements regarding privacy. Some may be willing to allow some access to their data in return for, say, lower commissions. Another relevant example is remuneration. For a country like Israel, paying interest on CBDC does not seem to be a desired feature in the near future. However, if we do build a CBDC, we will be building it for decades, and it is impossible to foresee the economic circumstances and monetary policy challenges of the future, Therefore, from a technological perspective the platform should allow for the potential of paying interest, even if at the beginning it may not be needed.

Conclusion

The way countries approach their deliberations regarding whether to introduce a CBDC and what will be the characterisation of that CBDC will clearly differ, according to each country's needs and resources. The most important element of the initial stage of the work is defining as clearly as possible what benefits you wish to derive from a CBDC and how these will impact the design of the CBDC for your particular country.

Small countries will be impacted by the progress and choices the larger countries will make. It may be possible to choose an independent, go-it-alone approach, but this risks losing the benefits that may accrue from the work being done by other countries or from the ability to interact with other countries' CBDCs. There will be trade-offs – a bespoke product allows you to design something very specific to a country's needs, but is likely to require far more resources, and may limit the interoperability of a specific country's CBDC with that of others'. It may in the end be a question of to what extent there are similarities between each country's requirements for their own CBDC.

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The Bank of Korea's CBDC research: current status and key considerations

Joonsuk Bae[1]

Abstract

In this paper, we present the current status of the Bank of Korea's (BOK's) research on central bank digital currency (CBDC) research, and explain our perspectives on how our potential CBDC could help address future challenges posed by rapid digital transformation of the economy.

Section 1 assesses whether we need to introduce CBDC in Korea. Currently, the BOK doesn't see an urgent need to issue CBDC, since, in Korea, bank account ownership is among the highest in the world, and we already have a sophisticated fast payment system. However, taking the recent acceleration of innovation in the payment and settlement sector into consideration, we also believe that the need to introduce CBDC in Korea will increase significantly in the future, and thus, there is a strong case for being prepared.

Section 2 explains the BOK's perspective on the design principles of CBDCs to respond effectively to rapid changes in financial and economic conditions, including: i) a continuous decrease in cash use; ii) the threat of big tech's market and data dominance and iii) the growing possibility of greater interest in global stablecoins in Korea. We believe that potential CBDC should be a reliable, low-cost, universal payment method on a daily basis, but at the same time be positioned as an open and universal public currency infrastructure that will support innovation and competition in the payment industry.

Section 3 concludes with the introduction of the BOK's CBDC-related research and a brief description of the Bank's current CBDC experiment.

Keywords: CBDC, financial access, digital transformation, big tech, market dominance, stablecoins, anonymity, privacy, CBDC experiment.

JEL code: E42, E58, O33.

1. Do we need to introduce CBDC in Korea?

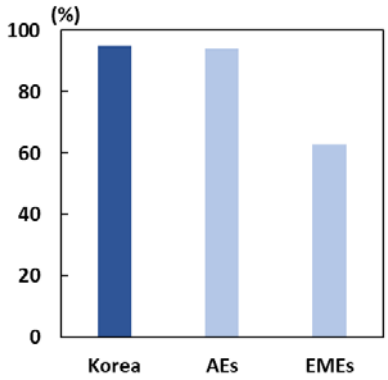
Financial and economic conditions

With a high level of financial accessibility and well developed digital payment systems, financial inclusion and efficiency of payment services are sufficiently advanced in

[1] Deputy Governor, Bank of Korea.

Korea.[2] The account ownership currently stands at 95%, which is one of the highest even among advanced economies. Korea also has a sophisticated fast payment system. In 2001, Korea became the first nation to launch a retail fast payment system, the "Electronic Banking System," which allows real-time transfers of funds 24/7. The transition to digitalised finance is progressing smoothly as well, with a high smartphone penetration rate (95%) and a steady increase in the number of both internet and mobile banking users.

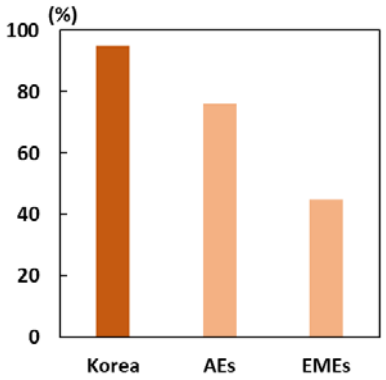
Account ownership[1)]



[1)] Ages 15 years and older

Source: Demirgüç-Kunt et al. (2017)

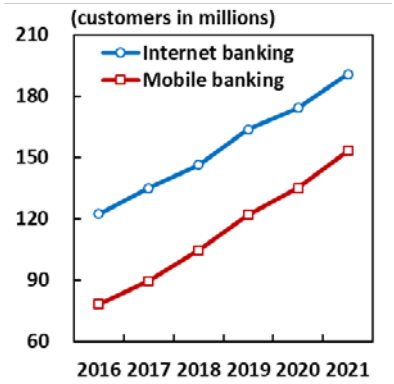
Smartphone penetration rate[1)]



[1)] Ages 18 years and older

Source: Pew Research Center (2018)

Number of registered internet and mobile banking users in Korea[1)]



[1)] Based on the number of registered accounts

Source: BOK (2021a)

Recently, financial institutions such as banks and credit card companies, and non-financial companies such as big techs have been introducing various kinds of digital payment services that are more convenient. Use of "easy payment services" and "easy transfer services"[3] has steadily increased. After Covid-19, consumers' adoption and usage of digital payment services offered by fintech platforms has been further accelerating.

2 Discussions about financial inclusion in Korea are focused on the fairness of credit provision. People with low credit and no collateral cannot borrow from the institutional financial sector and so have to turn to predatory lending with high-interest rates. The Korean government has been seeking various policy measures to address these problems, such as the introduction of internet-only banks specialized in extending moderate interest rate loans and supporting fintech companies that use big data in their credit rating.

3 "Easy payment services" refer to allowing consumers to pay for goods or services based on payment card information pre-stored in a mobile app, using a fast authentication method (password, fingerprint, etc). "Easy transfer services" refer to services that remit a prepaid amount charged through a mobile device, such as an account transfer, to a recipient using a phone number or social media.

Usage of "easy payment" and "easy transfer" services in Korea[1]

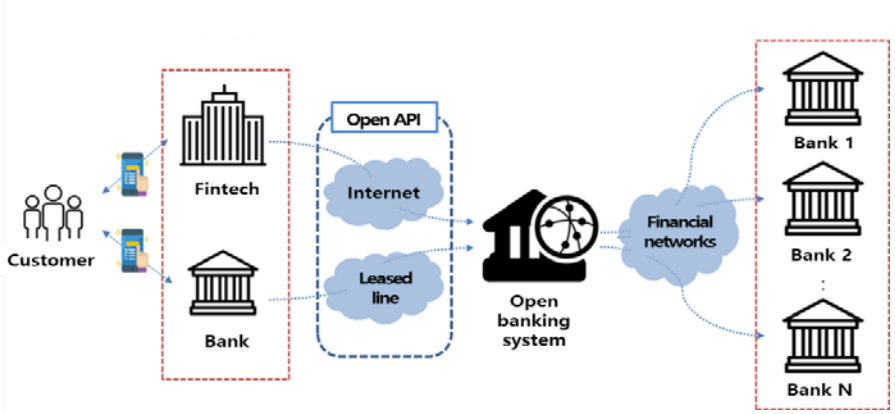
	2016	2017	2018	2019	2020
Easy payment	64.5	132.2	222.8	317.1	449.2
Easy transfer	7.1	35.5	104.6	234.6	356.6

[1)] In billions of won, based on daily average.

Source: BOK (2021b)

In addition, the Bank of Korea (BOK) and the Korean government have been supportive of fintechs and facilitated the introduction of an Open Banking System in 2019, so that new innovative entrants can operate and compete more freely within the current bank-based payment and settlement systems. As a result, in Korea there is not much concern that fintechs and stablecoins might establish their own ecosystem outside the boundary of the financial system governed by the central bank.

Structure of open banking system in Korea



Source: Bank of Korea.

In sum, BOK, like many other central banks, doesn't see an urgent need to issue central bank digital currency (CBDC). At this point, it is difficult to assess whether and when to introduce CBDC since further research and discussion are still needed, particularly with respect to the detailed design model and operation method.

The necessity of introducing CBDC

While there is no immediate need to issue CBDC in Korea, we believe that there is a strong case for us to be prepared for the potential introduction of CBDC in the future. Recently, innovation in the payment and settlement sector has been accelerating rapidly and discussions on the CBDC are in full swing in most economies including the US, Euro area, China, and Japan to name a few.[4] As such, the need to introduce

[4] See, e.g., FRS (2022), BOE (2021), ECB (2020), BOJ (2020), PBOC (2021).

CBDC in Korea is very likely to grow in the future. Therefore, the BOK is actively engaging in research and preparations so that if a decision is made in the future regarding the introduction of CBDC, it can be issued without any delay.

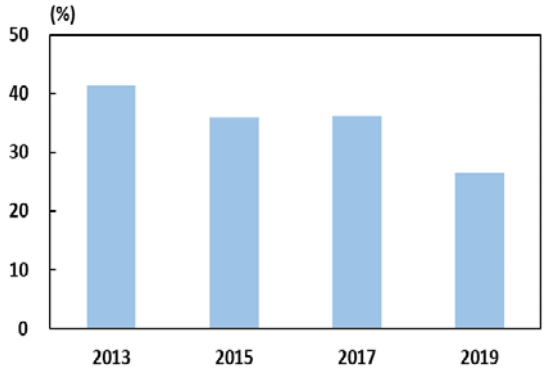
2. Key considerations in the BOK's CBDC research

In Korea, financial and economic landscape is expected to be rapidly transformed in the future due to: i) a continuous decrease in cash use, ii) growing concern about big tech's market power and data concentration and iii) potential domestic use of global stablecoins. To address the challenges posed by these shifts in the payment and settlement environment, in-depth research on the design of CBDC is called for so that it can be positioned as a universal public currency infrastructure that can support the smooth operation of the digitalised economy in the future.

The decline in the use of cash

As in many other countries, the proportion of cash use in retail transactions continues to decrease in Korea while that of credit card use remains very high (53.8%),[5] leading to high social costs in the form of transaction fees and credit risk management.

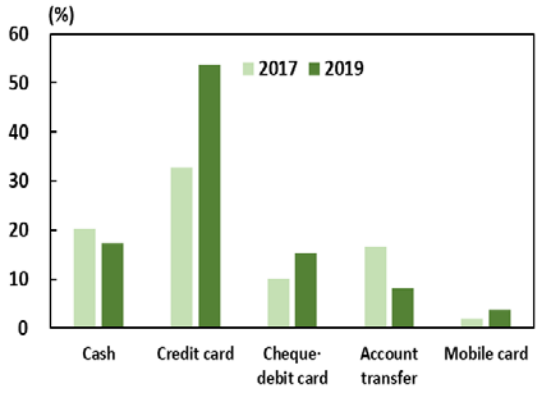
Proportions of cash use in retail transactions[1)]



[1)] Based on a number of cases, face-to-face survey results.

Source: BOK (2013, 2015, 2017, 2019).

Proportions by payment instruments[1)]



[1)] Based on the amount, face-to-face survey results.

Source: BOK (2017, 2019).

[5] The high proportion of credit card use in Korea is attributable to policies promoting credit card transactions after the 1997 Asian financial crisis. These policies sought to stimulate consumption and broaden the tax base by requiring merchants that meet certain criteria to accept credit card payment (Corporate Tax Act, Article 117) and allowing income tax refunds based on amount of credit card use.

If the decrease in cash use continues, the distribution channel will deteriorate and access to cash will weaken. As a result, those who lack access to cash alternatives will suffer the significant inconvenience. In Korea, some restaurants, cafes, and retail stores have begun to refuse to accept cash, and the numbers of ATMs and bank branches have been declining as well. In the long run, if cash is no longer regarded as a universal means of payment,[6] it may even impair the functioning of the monetary system.

Thus, we believe that, just like cash, CBDC should be positioned as a reliable, low-cost, universal payment method that can be conveniently and safely used in a digital environment by all economic entities, including individuals and businesses. Meanwhile, the issue of whether CBDC should have the same level of anonymity as cash requires further discussion and social consensus. CBDC issued by central banks must not be allowed to facilitate money laundering or tax evasion. At the same time, to ensure the protection of privacy for CBDC, albeit not on the same level as cash, the BOK has been investigating technological solutions and institutional safeguards such as privacy enhancement technology and data management governance to protect personal information.

Big tech's market dominance and concentration of personal information

The influence of big tech in Korea's financial sector has been growing.[7] While not as big as traditional players at the moment, big techs' market share has steadily been increasing in the e-commerce and retail payment services sector, and there is a growing concern about big tech abusing its dominant position in the platform business.

To tackle the potentially harmful effects induced by big tech's market power and data concentration, establishing an effective regulatory and supervisory framework should be a top priority.[8] At the same time, however, as a recent BIS report[9] suggested, we believe that CBDC could play a role by introducing a virtuous cycle of competition, innovation, and service improvement. As an open platform, CBDC would leave less room for big tech to exercise its market power over individuals and businesses by imposing excessive fees or creating barriers to entry. CBDC can also help protect privacy since central banks have no incentive to exploit personal information for profit-making and do not possess other personal data that can be combined with CBDC transaction data to identify individuals.

[6] Cash is a common unit of account in an economy and is the basis of the monetary system that connects bank deposits and retail payment systems. Public trust in financial products, such as bank deposits, relies on the belief and experience of ordinary people that they can always convert those products to cash on demand.

[7] The share of domestic big techs, such as Naver, Kakao, and Toss, in Korea's "easy payment" market increased from 55.7% in 2019 to 65.3% in 2020.

[8] In September 2021, Korea became the first country in the world to enact a bill prohibiting global platform companies such as Google and Apple from engaging in the anti-competitive practice of forcing exclusive payment methods (in-app payments).

[9] See BIS (2021).

For a CBDC to effectively respond to the threat of big tech, it should be designed and operated as an open public currency infrastructure. For this, participation of a broad range of stakeholders and interoperability will be important and an effective division of roles between the central bank and the private sector is required. In this sense, a *direct* CBDC model may not be a good choice since the central bank will end up being solely responsible for CBDC operation. With the *hybrid* or *intermediated* model, participating institutions, such as banks and fintechs, will have more room to creatively combine CBDC with their customer platforms and financial products to provide innovative services.

The proliferation of global stablecoins

Despite the growing global popularity of cryptocurrency trading,[10] stablecoins are not widely used in Korea. While the transaction volume of major cryptoasset exchanges in Korea has increased rapidly,[11] unlike in other countries, cryptoasset trades on Korean exchanges are settled by bank deposits rather than by stablecoins. However, considering the heightened interest in digital innovations such as non-fungible tokens (NFTs), decentralised finance (DeFi), and the metaverse, the demand for digital asset-related payment may further expand beyond cryptoasset trading in the future.[12] In particular, if big tech firms issue a global stablecoin in the near future, it is highly likely to spread rapidly into financial sector and the real economy.

In line with global discussions led by international organisations such as the G7, Financial Stability Board (FSB) and Committee on Payments and Market Infrastructures (CPMI), and among major countries including EU members, the United States and the United Kingdom,[13] discussions about a regulatory framework for stablecoins are beginning to take place in Korea as well. However, if stablecoins spread widely amid the current absence of a regulatory framework, they could not only cause problems in terms of consumer protection and financial stability but also, with deepening global economic integration, raise the risk of currency substitution similar to dollarisation in some emerging market economies. Nevertheless, in the case of Korea, it seems unlikely that global stablecoins or CBDCs issued by large foreign countries would cause currency substitution.[14]

Other issues

Some argue that a DLT-based CBDC may be more efficient at supporting new payment and settlement demands such as DeFi, the proliferation of NFTs, and the internet of things (IoT). On the other hand, some take the view that it will be possible

[10] More than $150 billion of stablecoins such as Tether (USDT) and USD Coin (USDC) have been issued worldwide and used as payment instruments for cryptoasset trading and DeFi (IMF, 2021).

[11] Daily cryptoasset transaction volume at major domestic exchanges (Upbit, Bithumb, Korbit, Coinone, and Gopax) increased two-fold from KRW 2.7 trillion in January 2021 to KRW 5.4 trillion in October 2021.

[12] Though in the early stages, Korea is seeing increased interest and investment in digital innovation, such as IoT supported by the high penetration of 5G, NFTs, and DeFi utilising distributed ledger technology (DLT), and augmented reality.

[13] See, e.g., FSB (2020), G7 (2019), CPIM-IOSCO (2021), PWG (2021).

[14] Currency substitution usually occurs in a situation where high inflation continues thanks to large fiscal deficits, impaired central bank independence, and a lack of public trust in monetary and fiscal policy.

to respond to new payment and settlement needs in the future, such as programmable payments, with current technology, for example using APIs. It must also be noted that DLT is still in the early development stage and has shown few cases of real-world application beyond cryptoasset trading.

Currently, the inefficiency of the cross-border remittance networks that rely on correspondent banks has been placing an additional economic burden on EMEs and vulnerable groups such as immigrant workers. Among various ideas for improving cross-border payments that are being discussed, using CBDC, in particular, has its perks, in that a new system could be built from scratch on a clean slate. However, in order to use CBDCs in cross-border payments and settlements, we should have sufficient discussions and coordination at the global level, not only on technological aspects, such as interoperability among related systems but also on regulatory framework, including sharing of identity information among jurisdictions.

3. The BOK's CBDC experiment study

The BOK has been continuously expanding its professional workforce since 2017 and launched a dedicated CBDC unit in early 2020. It has researched on CBDC-related systems and run a proof of concept (PoC) test on the feasibility of DLT to serve as the technological foundation of CBDC.

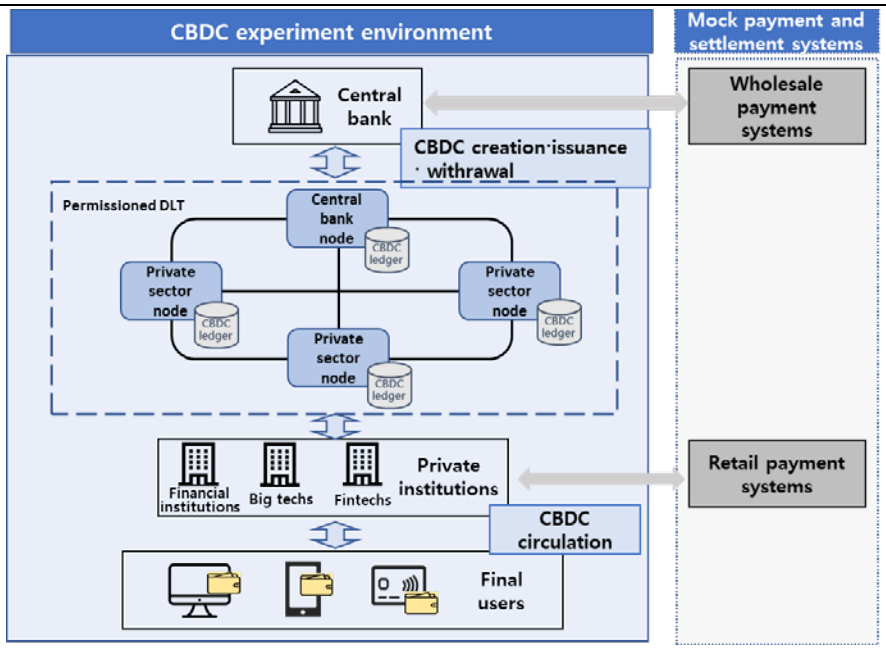
Currently, the BOK is working on a CBDC experiment, which will be conducted in two phases from August 2021 to June 2022.[15] In the experiment, virtual CBDC systems will be set up in a cloud environment, where the technological feasibility of CBDC's basic (issuance, distribution, redemption, etc) and advanced (offline payments, etc) functions will be examined.

This experiment adopts and examines: (i) hybrid architecture; and (ii) DLT-method ledger management as a basic model, following recommendations of international organisations such as the BIS and cases of central banks of major countries.[16] However, the experiment is not determinative of the CBDC design, and the BOK plans to continue researching and reviewing other alternative designs.

[15] The first stage of the experiment, completed in December 2021, reviewed the technological feasibility of basic issuance, distribution, and redemption in a distributed ledger-based CBDC experiment environment. The main goal of the second stage is to expand the central bank's CBDC distribution operations; support for cross-border remittance, digital asset purchases, offline payments, and new technologies to strengthen personal information protection will be reviewed.

[16] In a hybrid architecture, the creation, issuance, and redemption of CBDC is performed by the central bank, while distribution is carried out jointly with private financial institutions. A distributed ledger is used by a number of participating institutions (including the central bank) that confirm changes in CBDC-related information through a predefined consensus algorithm, and then distribute them to the ledgers owned by each institution to record and manage.

Korea's CBDC experiment environment architecture (example)



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CBDCs in emerging market economies (EMEs) – Malaysia's perspective

Motivation for CBDC work

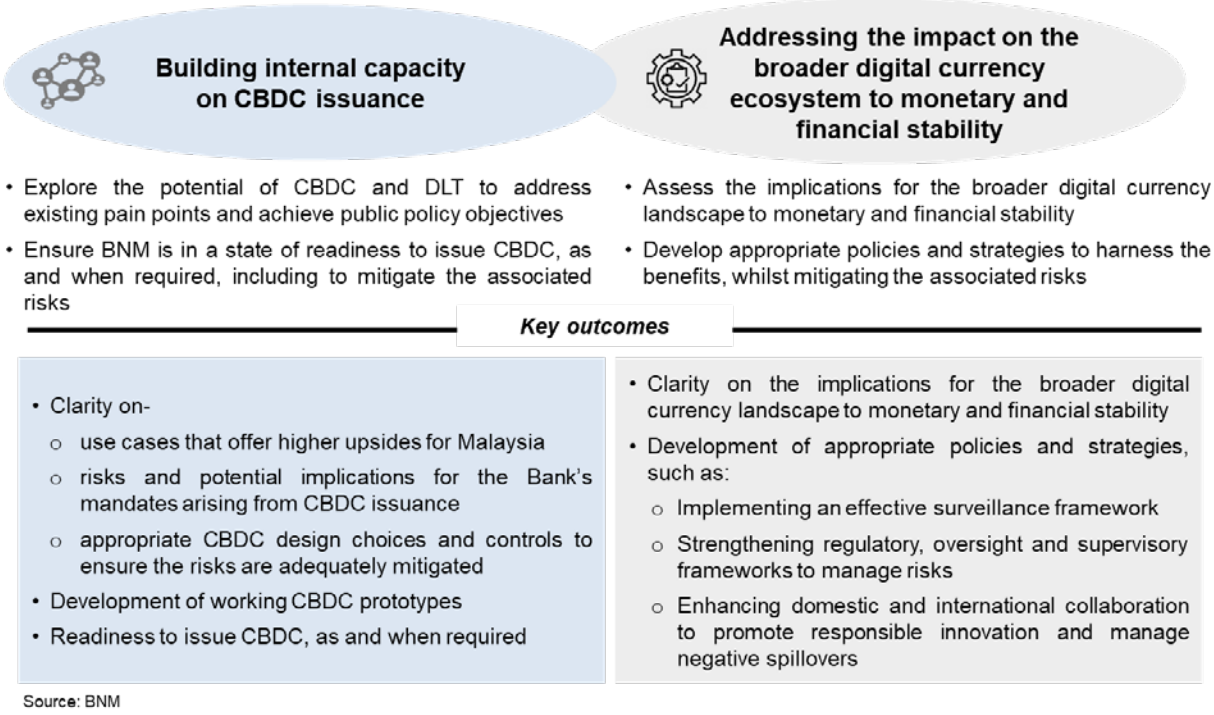
With rapid technological innovation and developments in the broader payment space, central banks have intensified efforts to explore the merits and feasibility of issuing central bank digital currencies (CBDCs). The motivation for CBDC work is largely shaped by local circumstances given CBDC's strong potential to be an effective tool to achieve public policy objectives. Such objectives may include improving domestic and cross-border payments, enhancing financial inclusion, ensuring continued access to central bank money, and strengthening monetary policy transmission. Additionally, CBDC is also seen as a potential measure to preserve monetary sovereignty against the risk of currency substitution posed by privately issued digital assets such as crypto-assets and stablecoins.

The first part of the paper will focus on Malaysia's approach to CBDC and the broader digital currency ecosystem. The subsequent part will outline the views of the Central Bank of Malaysia (Bank Negara Malaysia, BNM) on how to harness the benefits while mitigating the risks associated with the cross-border aspects of CBDCs.

1. Malaysia's approach to CBDC and the broader digital currency ecosystem

Developments in the digital currency space (eg CBDC and privately issued digital assets such as crypto-assets and stablecoins) may offer benefits to Malaysia. This, however, comes with some attendant risks. In the case of CBDC, for instance, the CBDC platform may provide a key foundational infrastructure upon which the private sector may innovate to promote a more efficient, inclusive and vibrant payments landscape. However, there are also consequent risks that need to be managed. Depending on how it is designed, CBDC issuance may impact monetary policy operations, amplify operational and cyber risks for BNM and disintermediate the banking system. This calls for a deeper understanding and careful evaluation of the opportunities and risks to make informed decisions. To this end, BNM is pursuing a two-pronged approach, as illustrated in Diagram 1.

Two-pronged approach on CBDC and digital currency work Diagram 1

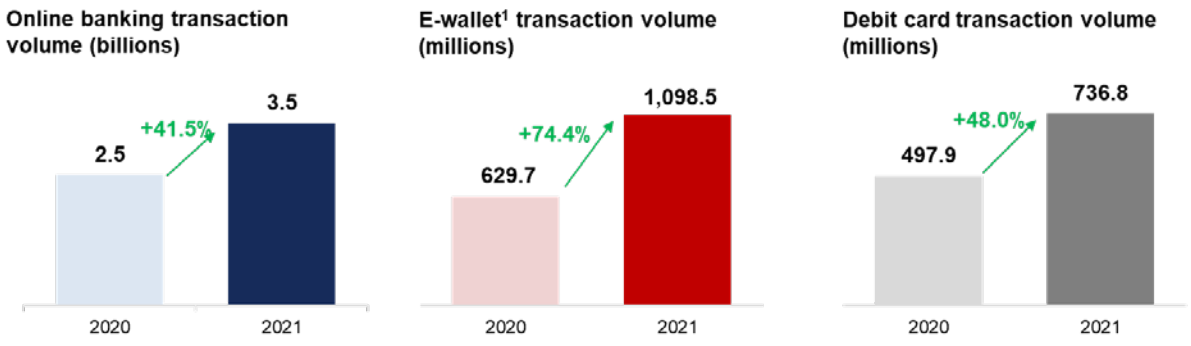


Source: BNM

Building internal capacity on CBDC issuance

At the present time, BNM does not have any immediate plans to issue CBDC. In Malaysia, domestic payment systems continue to operate safely and efficiently to support the needs of individuals and businesses and facilitate migration to digital payments (Diagram 2). Moreover, the existing monetary and financial policy tools continue to be effective in safeguarding monetary and financial stability.

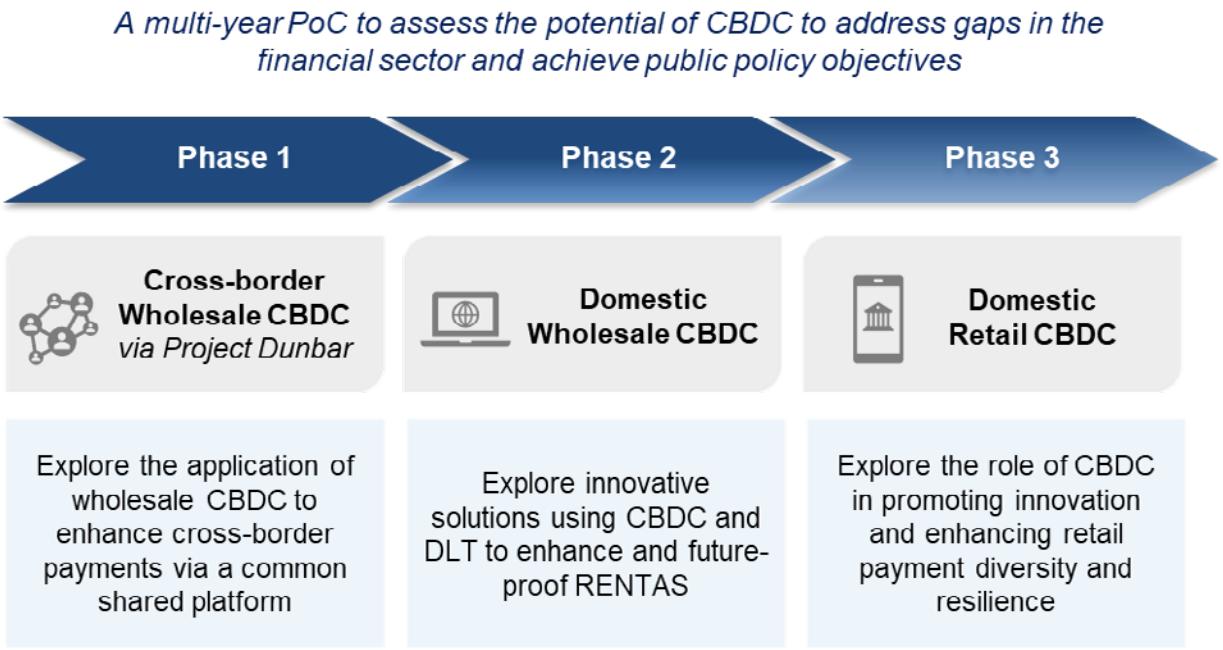
Highlights on the key trends of digital payments adoption in Malaysia Diagram 2



[1] Network-based e-money
Source: BNM

Nevertheless, BNM has commenced exploratory CBDC work to enhance our technical and policy capabilities, should the need to issue CBDC arise in the future. This is a multi-year exploration of CBDC via a proof of concept (PoC) in three phases (Diagram 3), with priority given to use cases with higher upsides for Malaysia. The PoC will be implemented in partnership with the industry to facilitate knowledge exchange and capacity-building.

BNM's CBDC PoC roadmap Diagram 3



Source: BNM

- Commencing with Project Dunbar,[1] the first phase of the PoC aims to explore the potential of cross-border wholesale CBDCs to address pre-existing frictions in the cross-border payment space (such as low speed, high cost, insufficient transparency and limited access) via a shared platform. As an open economy with a trade-to-GDP ratio averaging over 130% since 2010, Malaysia stands to benefit from substantial cost savings and productivity gains. A detailed report on the findings of Project Dunbar is expected to be published in March 2022.
- The second phase of the CBDC exploration will focus on domestic wholesale CBDC, and its potential to future-proof our domestic wholesale payment system, ie the Real-time Electronic Transfer of Funds and Securities System (RENTAS). The application of wholesale CBDC and distributed ledger technology (DLT) has the potential to reduce the "single point of failure" risk, enhance liquidity management, simplify compliance processes, and enable new use cases such as the settlement of tokenised assets.
- In the third phase of the PoC, BNM will explore the potential of domestic retail CBDC to complement the existing retail payment systems, in particular the Real-

[1] Project Dunbar, a collaboration between the Reserve Bank of Australia, Bank Negara Malaysia, Monetary Authority of Singapore, South African Reserve Bank and BIS Innovation Hub, aims to test the use of wholesale CBDC for international settlements via a shared platform.

time Retail Payments Platform (RPP), to enhance payment diversity and resilience, besides serving as a catalyst to spur greater innovation in the financial sector. Notably, it could support new use cases through its programmable features. For instance, CBDC can be programmed to streamline compliance processes and facilitate automatic payment to beneficiaries upon meeting certain predefined conditions.[2]

Addressing the impact of the broader digital currency landscape on monetary and financial stability

Apart from evaluating the potential impact of any CBDC issued by BNM (domestic CBDC), BNM will also undertake a holistic assessment of the implications of CBDCs issued by other central banks (foreign CBDCs) as well as privately issued digital assets such as cryptoassets and stablecoins. For instance, widespread usage of foreign CBDCs and stablecoins for domestic payments could have implications for BNM's monetary policy, credit intermediation by banks and capital flow volatility.

Besides assessing the implications for monetary and financial stability, this workstream also aims to develop an effective surveillance framework and identify appropriate policies and strategies to harness the benefits and mitigate the risks of digital currencies. This may include measures to strengthen regulatory and supervisory frameworks, and proposals for international collaboration to promote responsible innovation, facilitate interoperability and mitigate any negative spillovers. BNM will also actively monitor the trend of key indicators with direct impact on our mandates, which may provide useful data points for us to evaluate the merits of CBDC issuance. These include, among others, the level of physical cash usage in Malaysia, the extent to which privately issued digital assets are used for payments in Malaysia,[3] and the extent to which CBDC is being used to facilitate cross-border trade.

2. Harnessing the benefits while mitigating the risks associated with cross-border aspects of CBDCs

Cross-border payments are typically more costly, slower and less transparent compared to domestic payments.[4] This is due primarily to the higher level of risks and complexity as well as regulatory and compliance requirements often associated with cross-border payments. Today, most cross-border payments are settled through

[2] Some examples include automated coupon payment upon bond maturity, automatic routing of tax payments to the authorities at point of sale (Group of central banks (2021); Bank of England (2020)) and automated settlement of vehicle or real estate purchases upon confirmation of the transfer of legal title.

[3] In Malaysia, privately issued digital assets such as crypto-assets are not recognised as legal tender and are not a payment instrument regulated by BNM. They are generally not suitable to be used as a payment instrument due to various limitations, including price volatility, vulnerability to cyber threats and scalability issues. Accordingly, BNM has issued cautionary statements from time to time to advise the public to carefully evaluate the risks when dealing in digital assets.

[4] FSB (2020, p1).

correspondent banking arrangements. The associated long transaction chains,[5] multiple compliance checks and cost of trapped liquidity (due to prefunding of correspondent banking accounts across different currencies) add to the cost and time of completing a cross-border payment.

CBDCs could serve as a tool to enhance the efficiency of cross-border payments. For instance, a shared platform that facilitates international settlement using multiple CBDCs (mCBDC network) such as that envisaged under Project Dunbar could enable financial institutions to transact directly with each other. This has the potential to eliminate the need for intermediaries and enable real-time settlement. By leveraging on smart contracts and liquidity saving mechanisms, an mCBDC network could streamline compliance checks and enhance liquidity management, thus resulting in faster and cheaper cross-border payments. Based on a study by Oliver Wyman and JPMorgan, a full-scale mCBDC network which facilitates 24/7, real-time cross-border payments could reduce the cost of cross-border transactions by approximately USD 100 billion annually.[6]

Notwithstanding these efficiency gains, BNM has identified the following attendant risks as key risks that need to be managed. These risks can be analysed from two dimensions:

- **First, the risks arising from domestic CBDC being used offshore to facilitate cross-border payments.** According to a paper by the IMF,[7] expanding access to domestic CBDC for non-resident entities, including non-resident financial institutions,[8] may increase a country's exposure to global shocks. Swings in external demand for domestic CBDC could drive large movements in capital flows. The extent to which such swings pose challenges to an issuer country of a domestic CBDC would largely depend on the size and depth of the country's financial markets. Overall, the IMF paper finds that although CBDCs do not qualitatively change the economic forces that lead to the international use of currencies, quantitatively they could reinforce the incentives behind currency substitution and currency internationalisation. This poses a paramount concern to a highly open economy like Malaysia.
- **Second, the risks arising from foreign CBDCs being used onshore to facilitate domestic payments.** Widespread usage of foreign CBDCs for domestic transactions may heighten currency substitution (eg digital dollarisation) risk. This could undermine the effectiveness of domestic monetary policy, and if left unchecked could threaten a country's monetary sovereignty. While currency substitution risk is not new, technology can amplify the pace of such substitution by facilitating rapid and scalable adoption of foreign CBDCs. To the extent that foreign CBDCs are perceived as a safer store of value, this may exacerbate financial disintermediation risk by accelerating the flight of bank

[5] The length of correspondent banking transaction chains can range from just over one intermediary on average for cross-border payments via SWIFT (Bouther et al (forthcoming)) to five or more intermediary banks for 20% of euro-denominated cross-border payments (ECB (2020)).

[6] Ekberg et al (2021).

[7] IMF (2020).

[8] Financial institutions that are not licensed or regulated in the country in which the domestic CBDC is issued.

deposits to foreign CBDCs. Such "digital runs" on the banking sector could worsen at the times of stress with adverse impacts on financial stability.

To balance the trade-off between harnessing the efficiency gains and mitigating the risks to monetary and financial stability arising from the cross-border usage of CBDCs, BNM views the following measures to be important:

- **To ensure CBDCs are designed appropriately to mitigate risks**
  - If designed appropriately, some of the risks associated with the cross-border usage of CBDCs can be mitigated from the onset. The programmable features of CBDCs allow regulatory requirements, including foreign exchange measures[9] to be programmed through smart contracts. For instance, by integrating digital identity information with the CBDC infrastructure, a CBDC can be programmed to restrict access and usage by non-residents. Coupled with geolocation data, a CBDC can also be programmed to restrict usage by residents across borders. If implemented by an issuer of foreign CBDC representing a major reserve currency, such controls may be useful to mitigate the risk of currency substitution in other jurisdictions.
  - Likewise, compliance parameters are built into the design of the mCBDC network explored under Project Dunbar. The payments process flow was separated into settlement and non-settlement processes. The settlement process is governed by a common set of platform-level rules. The non-settlement processes (eg know-your-customer (KYC), anti-money laundering/combating the financing of terrorism (AML/CFT), foreign exchange compliance) on the other hand are separated and allowed to be processed in-country subject to the local jurisdiction requirements. Such separation helps streamline settlement processes, whilst ensuring clear delineation of jurisdictional boundaries.[10]
- **To enhance the effectiveness of foreign exchange measures to cover new transmission channels for digital currencies**
  - To mitigate the risks of currency substitution and financial disintermediation, regulators could technically prohibit or restrict the use of foreign CBDCs for domestic payments. For instance, in Malaysia, payments between residents in foreign currency are subject to BNM's prior approval except for certain permitted transactions.[11] However, the effectiveness of such measures would depend, among others, on whether foreign CBDCs are able to bypass

[9] IMF (2020, p 30) – for example, the transfer of value gets rejected if the metadata for the transaction to succeed do not meet certain compliance parameters.

[10] See how Project Dunbar attempts to address the challenge of regulations and jurisdictional boundaries at www.bis.org/about/bisih/topics/cbdc/dunbar.htm.

[11] Such permitted transactions include payments between immediate family members, payments for the purpose of education, employment or migration outside Malaysia, transactions between a resident and a licensed onshore bank in the conduct of the latter's business involving foreign currency, and settlement of a domestic trade in goods and services between a resident exporter and resident entities involved in global supply chain operations in Malaysia, subject to specified conditions. The full list of the permitted transactions are set out in paragraph 4 of BNM's Foreign Exchange Notice 4 (Payment and Receipt).

traditional intermediaries through which foreign exchange measures are typically enforced.

  - To mitigate potential circumvention, foreign exchange measures should be extended to new channels through which digital currencies such as foreign CBDCs may be transmitted. This may include new digital intermediaries such as digital asset wallet providers and exchanges. In this regard, BNM has collaborated with the Securities Commission Malaysia which regulate digital asset activities[12] to ensure the digital asset intermediaries comply with all relevant regulatory requirements including foreign exchange measures.
  - It is recognised that the implementation of foreign exchange measures by itself is not sufficient to address the risks of currency substitution and financial disintermediation brought about by foreign CBDCs. To reduce the incentives for households and businesses to hold foreign CBDCs, strengthening monetary policy credibility, safeguarding the independence of the central bank, maintaining a sound fiscal position and fostering efficient payment systems[13] remain key.

- **To advocate for principles of responsible innovation at the international level**
  - Efforts by a single country alone may not be sufficient to counter the risks posed by foreign CBDCs. Beyond what can be done domestically, international collaboration and coordination would be key to define a set of principles to govern the design and usage of CBDCs across borders.
  - Besides promoting responsible innovation, such principles may help mitigate potential negative spillovers to other jurisdictions. This is consistent with the core principle of "Do no harm", whereby a CBDC issued in an individual jurisdiction should not undermine monetary and financial stability in other jurisdictions and should support international macroeconomic stability.[14]

Deep international collaboration is key moving forward

In view of the pace and complexity in the development of the digital currency space, BNM aims to deliver a proactive and collaborative approach to CBDCs that will ensure that the central bank and the financial sector can effectively harness the benefits and mitigate the associated risks. In view of the interlinkages and potential spillover effects, we will also continue to support public-private partnerships and the broader international collaborative efforts to advance the principles of responsible innovation in the digital currency space.

[12] These comprise trading of digital assets via digital asset exchanges (DAX), issuance of digital assets for fundraising via Initial Equity Offering (IEO), and provision of digital asset custody services (DAC).

[13] IMF (2021, p 55).

[14] Group of central banks (2020).

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Policy considerations on central bank digital currencies for emerging market economies – Mexico

1. Digital innovation and the payment ecosystem

Technological advances and innovation are changing payment and financial services, causing a structural transformation in the ecosystem. Retail payments have been and continue to be one of the activities most influenced by this process. Innovation has focused on increasing convenience by improving the front end and introducing new ways to initiate payments and improve customer interfaces.[1] In this context, technology evolution and its adoption for retail payment solutions can contribute to improve financial inclusion and become the cornerstone of improved forms of digital money.

Nowadays, mobile devices with high processing capabilities are widely available to the population and continuous connectivity to the Internet has improved consistently. This generates multiple access channels for the development of more and better financial services, which are provided in a secure and efficient manner; in addition to creating possibilities for collecting information that in the past was difficult or even impossible to gather. Therefore, the current technological evolution that allows a constant improvement of the services offered in the market, results in new products and services with enhanced capabilities.

Safety and efficiency are imperative for new payment solutions and in this context, financial authorities – in particular, central banks – play a critical role in promoting state-of-the-art financial infrastructures in their roles of regulators and supervisors, and, in some cases, as operators of payment infrastructures. Consequently, central banks play an integral role in the provision of means of payment, whether digital or physical. Thus, leveraging the latest technology and developing fast retail payments and central bank digital currencies (CBDCs) are of the utmost importance.

The trust currently placed in the monetary and financial architectures and their institutions is an invaluable asset for society. Central banks should not look at this technological change as a need to redefine the public functions they serve: the provision of money and financial market infrastructure. Instead, central banks' challenge is to find how recent advances in technology and innovation can amplify the payment and financial services provided under the current monetary and financial architectures and to improve their resilience and quality for the benefit of users.

Concrete short-term steps and deliverables should focus on extending currency functions towards fully operable CBDCs, with a solution compatible with banks' intermediation role and delivering more efficient payment services, while keeping the current financial and monetary architectures that have supported financial intermediation and monetary policy implementation. This perspective would put

[1] See Bank for International Settlements, Monetary and Economic Department, March 2020, BIS Quarterly Review, International banking and financial market developments. Available at https://www.bis.org/publ/qtrpdf/r_qt2003.pdf

central bankers' role in providing money at the centre of the development of digital innovation for payment systems.

This process involves the development of an open finance ecosystem, and authorities should be careful to avoid market failures associated with concentration, vertical integration and lack of interoperability. Also, the inclusion of new network-based participants – so-called fintechs and big techs – in the financial ecosystems of emerging market economies (EMEs) raises key issues for public policy in terms of competition, consumer protection and financial stability.

An open finance ecosystem without adequate regulation and incentives will not deliver the desired public goods. In this context, payment networks of big techs and fintechs cannot be left to evolve outside our financial ecosystem. We must work on the necessary regulatory and technological conditions to ensure these are part of our financial systems. Under this approach, gains in efficiency would translate into improved financial services and inclusion with a firm footing.

We should be careful and avoid any potential sub-optimal result when developing a strategy to adopt innovative technologies. Materializing the objectives will require global coordination, sustained political support and investment in systems, processes and technologies. Success will also require a commitment to work together with the private sector in order to ensure the implementation of any services designed for the general population.

2. Payments vision and the public policy principles to promote innovation

Having a clear vision regarding the financial and payment ecosystem we aim for in our society guides the authorities' steps in this process. In order to ensure the proper functioning of payment systems, as mandated in its law, Banco de Mexico has developed a long-term vision of payments, whose guideline is that all Mexicans should have the possibility of sending and receiving secure, immediate, low cost, efficient and available at any time electronic payments. The goal is that any citizen can make their payments in a transparent and secure way, at any time, from any place and under different modalities.

Banco de México 's vision also requires to move fast on this effort, with the right strategies and approaches to develop the best digital payment ecosystems and a more inclusive and efficient financial system, and make good use of the opportunities offered by new technologies. We have identified seven public policy anchors essential to this process:

i. **Same risk/same regulation**. This policy approach aims to promote regulation according to the services and risks that a financial actor represents for the system, regardless of the actor's type of authorisation, concession, or figure. It focuses on aligning incentives to achieve maximum social benefits, addressing market failures, and promoting an environment for competition. It should be based on a level playing field to mitigate risks associated with the payment service provided, such as anti-money laundering/combating the financing of terrorism (AML/CFT) requirements, legal, financial and operational risks.

ii. **Interoperability and network neutrality.** Incentives are set for developing private networks against the public interest of expanding and exploiting network externalities and economies of scale. Large existing networks may want to use their condition as a competitive advantage to carry out financial transactions exclusively through their networks. To avoid this condition, promoting interoperability and neutrality becomes a crucial objective.

iii. **Fostering competition to avoid kingmakers**. The inclusion of new network-based participants– ie fintechs and big techs – in financial ecosystems raises key issues for public policy in terms of competition, consumer protection and financial stability. When developing an open finance ecosystem, authorities should encourage payment networks to evolve inside our financial ecosystem by promoting the necessary regulatory and technological conditions to avoid concentration, vertical integration and lack of interoperability. Under this approach, efficiency gains would translate into improved financial services and inclusion on a sound footing.

iv. **Ensuring business continuity with large foreign providers.** The failure or interruption of payment or financial market infrastructures with systemic operations could have substantial financial stability implications with significant spillovers. Operational risks are observed throughout all the building blocks necessary to provide clearing and settlement payment services. For that reason, infrastructures should implement robust business continuity plans to provide a very high availability level.

v. **Global coordination to address jurisdictional gaps.** Operational disruption could have substantial spillovers for both the domestic economy and other jurisdictions. The source of such risks – particularly those related to legal or operational issues – could also be in a jurisdiction different from the one affected by said issues. For example, big tech firms operating across multiple jurisdictions could increase the risk of gaps in supervisory oversight. For effective monitoring of big tech financial services activities, efficient cooperation between regulators across jurisdictions is extremely important to ensure that new risks are regulated equally. Also, new frameworks and standards need to be developed.

vi. **Client protection.** Risks concerning consumer protection may be larger in the case of big tech firms' activities, as once these firms have access to the whole set of data, it will be difficult to constrain its use. Thus, authorities must regulate the use of financial data to avoid its continued misuse. It is just as relevant to promote robust and transparent data governance frameworks to provide clarity regarding the use of consumer data, thus enhancing consumer confidence.

vii. **Cyber security**. Since the number and severity of cyber security incidents affecting the operation of all types of companies have been increasing, information technology security is a priority across industries and for the entire financial system. Setting minimum standards is crucial to avoid contagion and risks to the systems. Thus, cyber and operational security should be addressed on three levels: i) the owner(s) of the infrastructure(s); ii) the participants (by setting minimum requirements); and iii) the users. Even though all levels require the implementation of measures to make cyber security robust, the users' level could be the weakest link of the chain and addressing their inherent problems would require creative solutions depending on their needs.

Banco de México' payments strategy to achieve our vision is based on four pillars. This strategy implies an architecture that may contribute to integrate payment and financial services and ecosystem for innovation.

i. A robust **infrastructure for clearing and settlement** for low-, medium- and large-value payments. 24/7 services, extremely high levels of availability, and the capability to act as a hub for the innovation of payment services are means to address payment demands to the final users. This infrastructure should be fully scalable, and where exists a technological leveled-playing field in benefit of clearing and settlement practices, preserving expeditious processing.

ii. Strong **authentication and validation infrastructures** to achieve a smooth implementation of digital identity that also allows linking of digital information such as biometrics and transactional data from clients. Such a procedure would imply having a clear characterisation of clients' payment performance and risk profile to allow them to climb on the financial inclusion pyramid. This identification infrastructure will contribute to make know-your-customer and authentication processes more efficient and secure; enabling sheltered and regulated exchanges of information to strengthen the prevention of illicit activities, prioritizing users' personal data protection.

iii. **Open finance arrangements ready to provide network access to new participants**, including big techs. In this context, the development of application programming interfaces (APIs) for payment initiation would set the capacity to connect to the payment networks (ie the real-time gross settlement system) through direct or tiered participation. Standardised APIs would also contribute to setting a level playing field in terms of security standards and technological requirements as well as robust procedures for validation. Open finance would ease the provision of secure and interoperable financial services through third-parties. The above-metioned in order to have certainty about the security of the ecosystem and integrity of the connections between participants, working on the necessary regulatory and technological conditions that ensure private payment networks are part of the financial systems.

iv. **Capacity to operate ledger services for a CBDC infrastructure.** It represents an innovation within the central banks and its development must be consistent with promoting the proper functioning of the payment system. From a retail perspective, in particular, that could be used to implement a digital payment solution to address financial inclusion challenges.

3. Key features for an architecture to develop a CBDC in Mexico

The cornerstone for a healthy ecosystem is a safe and robust infrastructure capable of addressing the challenges of extending the payment and financial ecosystem to CBDCs' alternatives. Reaping the benefits of CBDCs and digital payments in Mexico comes with the implicit requirement of fostering public payments infrastructure.

The project for the implementation of a CBDC in Mexico is under a definition phase, as initial analysis, explorations and the design of possible functionalities and capabilities for the CBDC are taking place.

The key features for the CBDC project are proposed as follows:

- The design is focused on a solution for retail payments, looking for its use to be concentrated on individuals and businesses.
- The specific implementation must be flexible, so it is envisioned that an account-based system can work in parallel to a token-based system, in order to meet the particular needs of the users.
- An architecture where the liability remains at the Central bank is proposed, as well as an Open Finance ecosystem in which financial and non-financial intermediaries can participate into the CBDC scheme including activities such as the initiation of transfers and administration of balances.
- It will seek to leverage the cybersecurity, resilience and operational continuity measures that have already been tested and have proven their efficiency in other systems, transferring their advantages to the scheme itself.

Our CBDC proposal is designed to have an incremental development, where the functionalities of the infrastructures currently operating in the market are extended and improved in order to mount CBDC solutions on them.

The fist enhancement envisaged is the possibility to make transfers by indicating a beneficiary's identifier, such as the cell phone number; where an intermediate settlement element could be used, in which a record of the resources associated with the mentioned beneficiary's identifier is kept. The above to build a relational database that can facilitate the delivery of resources to a given beneficiary with only one element of its information, which can be strengthened with the implementation of a digital identity scheme.

Also, the generation of tokenized payment orders is expected to be allowed, in order to generate a secure cryptographic information element to represent a liability in Banco de México’s balance sheet. This tokenized payments' scheme requires both new message architecture for the transmission of value and a ledger to avoid double spending. Therefore, improvements in payment settlement infrastructures are being considered to allow immediate operations.

Lastly, the incorporation of the previous enhancements with the development of instances to instruct operations by users will allow the development of CBDC registers; where the adoption by users and merchants will rely on third-party developments in which they can offer products and services as accessories to the CBDC functions that solve the specific needs of their clients and users. Also, financial institutions will have a key role on the conversion and reconversion of available balances within deposit accounts to the central bank's digital currency.

Assessing CBDC potential for developing payment systems and promoting financial inclusion in Peru[1]

Adrián Armas[2], Lucero Ruiz[3], and José Luis Vásquez[4]

Abstract

In many countries, research on central bank digital currencies (CBDCs) has gained traction. At the Central Reserve Bank of Peru (BCRP) there is an ongoing exploratory assessment of the potential benefits and challenges of CBDC issuance. In particular, we explore the potential role of CBDC implementation in promoting financial inclusion, the lack of which is a significant obstacle to further development of domestic payment systems in Peru. From a policy standpoint, we discuss domestic idiosyncratic factors such as the preference for cash, and potential impacts on monetary policy

JEL Codes: E42, E58, G21, O32, L86.

Keywords: CBDC, digital currency, cash, financial intermediation, financial stability, monetary policy, payment system, financial inclusion.

[1] We would like to thank Paul Castillo, Carlos Montoro, Fernando Pérez, and Milton Vega for their excellent comments and support. The views expressed in this article are those of the authors and do not necessarily represents the view of the Central Reserve Bank of Peru.

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Assessing CBDC potential for developing payment systems and promoting financial inclusion in Peru

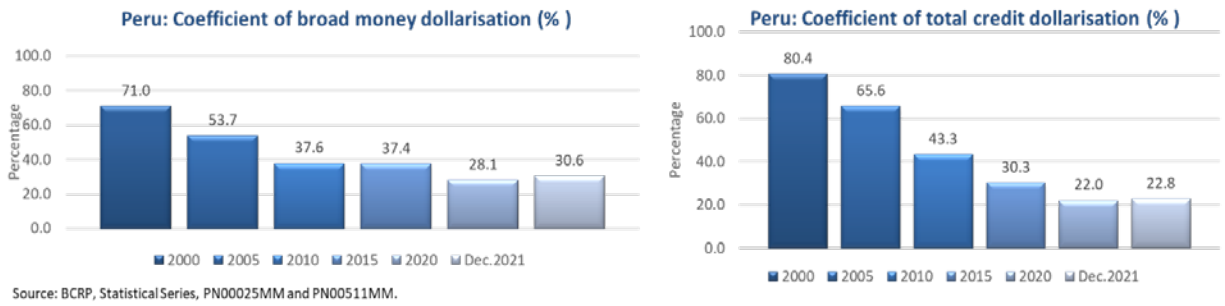
1. Initial conditions

The Central Reserve Bank of Peru (BCRP) is currently assessing the potential benefits and risks of issuing a domestic central bank digital currency (CBDC). In particular, we explore the potential role of CBDC implementation in promoting financial inclusion and improving the payment system in Peru.

In recent decades, the Peruvian economy has faced two main challenges, namely a bi-monetary financial system and a sizeable unbanked population. As an outcome of the inflation targeting regime and other policies, dollarisation has diminished. For instance, dollarisation of credit to the private sector has fallen sharply from around 80% in 2000 to 23% in 2021(Graph 1). In the same period, total credit to the private sector increased from around 28% to 47% of GDP, and broad money from 25% to 51% of GDP[5].

Aside from this progress in de-dollarisation, in Peru some transactions can still be invoiced in US dollars (USD). Additionally, residents can freely open bank accounts and make ATM withdrawals in either soles (PEN) or USD (although to a lesser extent in the latter case). Such practice aligns with the dual currency settlement system of the national real-time gross settlement (RTGS) system, which was created in 2000 and is managed by the BCRP. In brief, Peru is a dual currency economy that, in the last decades, has achieved a downtrend in financial dollarisation with low levels of inflation.

Evolution of financial dollarisation — Graph 1



Source: BCRP, Statistical Series, PN00025MM and PN00511MM.

Currency in circulation (CiC) also increased from a relatively low level of 2.5 % of GDP in 2000 to 9.5 % of GDP in 2021(with a print of 6.8 % of GDP in 2019 before the pandemic). While the de-dollarization process contributed to a higher CiC, a key structural factor is that, with more access to roads, the population of rural areas reduced significantly the share of production for self-consumption during this century.

All in all, there is still an important gap in terms of financial inclusion, as it greatly depends on structural factors such as a preference for cash and a low penetration of financial services in remote rural areas. Based on the Global Findex statistics, the

[5] Correspond to the BCRP statistical series PN03500MQ and PN03497MQ, respectively.

implied unbanked population was 80% in 2011 and had fallen to 57% in 2017. Based on local data from Peru's national statistics institute (INEI), it is comforting to see that financial inclusion has advanced, as the share of the adult population with a savings account was 53% as of the third quarter of 2021, implying a proxy unbanked population of 47% in 2021. However, further progress is required in promoting access to financial services, thereby reinforcing the transmission mechanisms of monetary policy.

Worldwide, there is an increasing debate on the impact of CBDC issuance on cross-border payments,[6] especially the potential savings from less costly and faster international transactions. In a similar vein, Brunnermeier et al (2019) point out the possibility that digital networks could strengthen the internationalisation of some invoicing currencies. In particular, Adrian (2019) suggests that e-dollarisation can arise because digital money avoids some of the standard entry barriers facing physical money (eg conversion premiums, storage costs, capital controls, etc.). According to Levy Yeyati (2021), there are three kinds of dollarisation in the LAC region: (1) financial dollarisation resulting from limited space for funding in domestic currency, so that liability dollarisation becomes entrenched; (2) real dollarisation, where FX volatility passes through prices via transactions and wages; (3) official dollarisation, where the US dollar is adopted as legal tender. The e-dollarization could arrive under the form of currency and asset substitution. In turn, the IMF (2020) envisions a scenario where a foreign fiat CBDC could accelerate the domestic use of a foreign digital currency, thereby intensifying currency substitution effects. Regarding the international use of CBDCs, the 2021 BIS Survey shows that the main potential risks reviewed by some central banks relate to currency substitution, tax avoidance and heightened foreign exchange volatility.[7]

In this context of ongoing consensus-building, it is relevant to reflect on each country's initial conditions before establishing design and strategic issues.

Enhancing the payment system

In 1997, and in close coordination with the participating financial institutions, the BCRP led an initiative to modernise the payment system, aiming to enhance the safety and efficiency of domestic wholesale transactions. As a result, in 2000, the dual currency RTGS system began operations under BCRP management. In 2009, legislation was enacted to provide a legal structure for addressing the systemic relevance of payment systems as a means to reinforce financial stability. To date, the BCRP plays three essential roles related to the payment system: (1) a regulatory function; (2) a managerial role for the dual currency RTGS system;[8] and (3) a user role

[6] CPMI (2021) defines cross-border payments as those in which the parties involved reside in different jurisdictions. For instance, a remittance is a type of cross-border payment, which can be invoiced in the same or different currencies (cross-currency). Other examples of cross-border payments are related to tourism and e-commerce transactions.

[7] The *BIS Annual Economic Report 2021* refers to Auer et al (2021a), which is based on a survey conducted on a sample of 50 central banks (from 18 advanced economies and 32 emerging market economies). Although matching potential risks to each central bank is not possible, it can be approximated via cross-border cases, such as non-residents using a domestic CBDC (eg tourists); digital dollarisation (e-dollarisation), where a foreign CBDC is used in the domestic market, replacing the recipient's currency in some transactions; or tax avoidance, where residents make transactions using foreign token-based CBDCs.

[8] RTGS settles one-to-one transactions, mainly transfers of interbank loans and FX transactions, as well as CAVALI (Settlement and Custody Institution of bonds and stocks) and CCE (electronic clearing house) transactions.

in settling BCRP monetary and FX instruments, as well as intraday operations.[9] By 2014, a multi-institution commission had been created to oversee progress in the national financial inclusion strategy.[10] In this high-level group, the BCRP is responsible for policies to promote the development of retail payments, including digitalisation.[11] While the high-level group has been replaced for national-level financial inclusion policies, the BCRP is working to enhance the domestic payment system, as a large part of the population does not have access to digital payment instruments, and so continues to live within a cash ecosystem.

In this sense, the BCRP articulates efforts to promote a proper ecosystem for electronic payments. For instance, since 2013, a national law provided BCRP with the powers for regulating the private working group on digital payments, whose participants include banks and microfinance entities[12]. BCRP is also involved in the regulation of customer to business payments done through QR codes. Accordingly, the digital payments have registered an uptrend in both value and number of transactions.

In 2021, the growth of digital payments was led by two innovations in the retail sector, namely, digital wallets and immediate payments. The former is already well-established as the preferred channel to transfer money within a financial institution, with a 270% growth in number of transactions. Due to the new service of immediate payments, fund transfers can be performed in real-time, available 24 hours, seven days a week. As of end-2021, the number of immediate transfers has grown more than 350%. While the immediate payment service is not as comprehensive as a FPS, this experience has shed lights on how to approach the technological change and to internalize the fact central banks play a key role in the early stages of adoption

In the medium to long term, another venue of progress might stem from CBDC issuance. In that scenario, design features such as interoperability and scalability will play vital role to improve the efficiency of the payment system and promote financial inclusion. For instance, CBDC interoperability could reduce interconnection costs among private payment infrastructures that otherwise would not be profitable to operate. In this regard, it is relevant to explore the demand and supply side issues that could arise in the process.

Further development of the domestic payment system is limited by low financial inclusion. In the context of Peru's large informal sector (engaging around 70% of the workforce), the Global Findex report indicated that 57% of the adult population did not hold a bank account[13] as of 2017. That survey-based source also reported the main reasons why the unbanked population refuse to open a bank account, which in

[9] Intraday operations include overdrafts in PEN against USD; and those in PEN or USD against BCRP's instruments (eg certificates of deposit).

[10] The commission is formed by the Ministry of Economy and Finance (MEF), the Ministry of Education (MINEDU), the Ministry of Development and Social Inclusion (MIDIS), the banking authority (SBS), the state-run national bank (BN) and the BCRP.

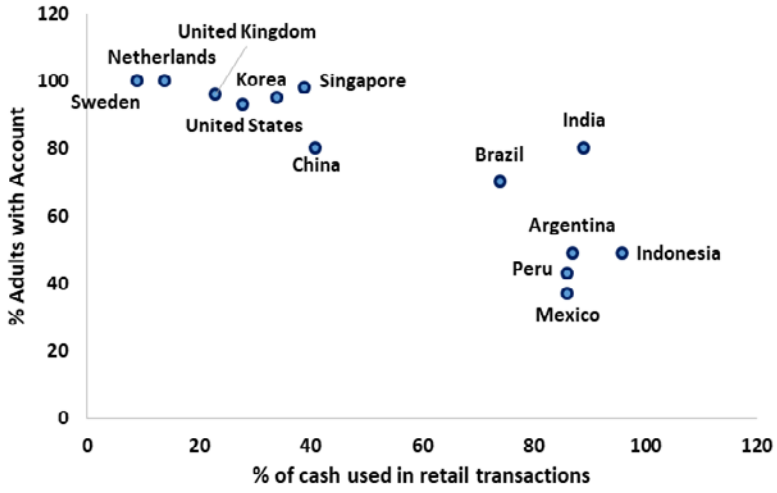
[11] See www.bcrp.gob.pe/sistema-financiero/inclusion-financiera.html.

[12] The national-level law Nº 29985, regulates the basic traits of electronic money as an instrument of financial inclusion. Moreover, this law establishes the regulatory and supervisory for issuers of electronic money.

[13] The unbanked percentage is inferred from Global Findex statistics as one minus the percentage of accounts held by people 15 years of age or older (including those with a financial institution or a mobile-money service provider). In Peru, the latter metric has increased from 20% in 2011, to 29% in 2014 and 43% in 2017.

the case of Peru related to high costs, low income, and distrust of the financial system (Table 1). At different degrees, other LAC countries also have sizeable shares of unbanked population (Mexico 63%, Colombia 54%, Brazil 30%, and Chile 26% as of 2017). Currently, there is still a share of the population that cannot access digital payments and remains confined to a cash ecosystem (Graph 2).

Use of cash and financial inclusion Graph 2



Sources: McKinsey (2020); World Bank (2017).

Reasons for not having a bank account Table 1

As a percentage of the unbanked

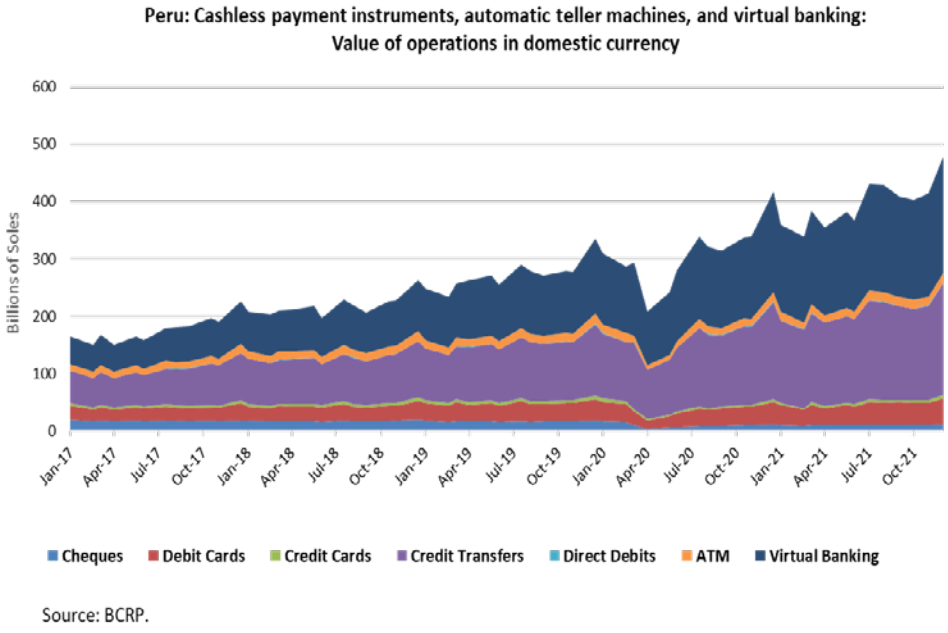
Country	Chile	Brazil	Colombia	Peru	Mexico
High costs	55	52	59	59	51
Lack of money	58	58	66	48	57
Distrust	41	26	28	38	36
Does not need	40	37	34	35	35
Distance	18	32	20	32	30
Required documentation	25	18	29	30	27
A relative has	22	52	20	23	22
Religion	5	5	6	14	6

Source: World Bank (2017).

However, data published by the INEI shows progress on this front, as 53% of the population had a savings account as of late 2021, compared to 43% as of mid-2020. To explain this progress, it is relevant to recall that demand for liquidity, including the currency stock, surged during the Covid-19 crisis. According to Alfonso et al (2020), a common household response in LAC countries was to reduce cash withdrawals and

POS usage in favour of mobile and internet banking. In Peru, the sudden lockout reduced the use of digital payments in April 2020, at a time in which economic activity fell by almost 40% against April 2019; however, as soon as the digital offer increased and the economy started to recover, so did the use of digital instruments (Graph 3). This wave of innovation stemmed from the urgent need to make online and contactless payments and, in some cases, to receive monetary subsidies targeted to vulnerable families. In particular, the government faced the challenge of how to make cash transfers to impoverished families, which were mostly unbanked and lived in remote rural areas. In this context, Covid-19-driven digitalisation was visible in both the private sector (via increased virtual banking transactions and digital payment offerings) and the public sector (via a digital account initiative based on the national identification number). In the public sector, the national bank (BN) launched a savings account related to an ID number ("Cuenta DNI") for making government cash transfers to vulnerable segments of the population. This facility allows users to withdraw cash from ATMs, affiliated retail stores, and BIM (BN's e-wallet). However, it is not accessible to the general public. It is not comparable to a domestic CBDC, as it is only distributed through BN and therefore lacks interoperability (a main CBDC feature). This digitalisation process was supported by the SBS's flexible regulatory approach. By the end of 2021, the ratio between the value of digital payments to GDP is almost twice that of 2015[14].

Digitalisation through the Covid-19 crisis — Graph 3



Source: BCRP.

Although even banked people used to prefer cash instead of digital payments, in the last five years the trend towards greater use of digital payment instruments has increased steadily. The latter was enhanced by the Covid-19 pandemic, as the need for digital payment instruments increased substantially in response to mobility restriction measures.

[14] The ratio increased from 3.5 times in 2015 to 6.3 times in 2021. In the same period, the number of digital transactions per capita per year increased from 28 to 94.

From a business perspective, many small merchants are unable to accommodate the plethora of payment systems that have been introduced into Peru's National Payment System (NPS). This involves different technologies and devices, as well as difficulties in fully understanding them or keeping up with updates, resulting in very patchy acceptance levels for digital payments (Table 2). Sometimes the costs, relative to the low transaction volumes involved, are considered too high. Therefore, the default option is falling back to cash. A drawback of the latter is its lack of traceability (ie its anonymity), meaning that it might be used for tax evasion purposes. As Peru has a bi-monetary financial system, USD bills are accepted as a means of payment and can also be held in bank accounts.

Payment instruments by entity — Table 2

(Participation in per cent, calculated from value of operations in domestic currency, last 12 months to September 2021)

Value	Transfers	Debit cards	Credit cards
Banks	99.7%	99.1%	99.1%
- BCP	68.8%	48.8%	21.5%
- Banco de la Nación (BN)	7.9%	24.3%	26.0%
- Interbank	3.8%	13.3%	18.3%
- BBVA	9.1%	6.1%	10.5%
- Scotiabank	9.5%	4.6%	13.9%
- Other banks	0.5%	1.9%	8.9%
Microfinance entities	0.3%	0.9%	0.9%
Total	**100.0%**	**100.0%**	**100%**

Source: Financial entities.

On the supply side, payment services are mainly represented by banks and other payment infrastructure providers. Although there are several banks operating in Peru, the industry is highly concentrated in the four largest private banks. Cooperation to achieve full interoperability between payment systems has not been completed. Recent innovations in the retail payments market do not facilitate interoperability. For instance, some private digital wallets issued by main banks have emerged as closed loops. Another example is electronic money,[15] which works as a closed loop and does not have interconnection with other payment systems. In this context, most funds transfers are made among clients of the same financial entity; and card payment networks are used by prepaid card issuers.

Other challenges to greater use of digital payment instruments include:

1. The ability to use payment instruments requires opening a bank account, which needs time and documentation.
2. Points of access would need to serve clients across the country, but tend to be geographically restricted to certain areas.
3. Some reputational fears remain among the unbanked population due to a lack of financial literacy.

[15] Implemented to promote financial inclusion, although its use is very low.

4. Most payment instruments do not work 24/7.
5. Most people working in the informal sector seek to avoid traceability.
6. The cost of digital payments among financial institutions increases substantially for transfers to other regions within the country.
7. Limited access to digital infrastructure. According to the National Household Survey (ENAHO) for Q1 2021, internet access reaches around 67% of the population over six years of age at the national level, but declines dramatically in rural areas (34%). However, home internet connectivity reaches only 13% of households in remote areas, given that 91% of internet access occurs though mobile phones.

2. Analysis

2.1. The role of CBDC issuance in facilitating financial inclusion

CBDC issuance can play a key role in allowing the unbanked population to access digital payment instruments. In this regard, the payment flows that CBDC implementation should focus on are the ones that are used in the cash ecosystem or on the margin where prepaid cards are used. The design of a retail CBDC must be consumer-centred and based on the needs of the ecosystem; therefore, CBDC issuance is not intended to replace other digital payment instruments currently used by the financially included population. CBDC design must assure wide use, ie acceptance by the unbanked population as a means of payment via a cash-like solution. It is important to highlight that consumers are unlikely to adopt a CBDC if it is less convenient to use than cash. Other features to be considered in CBDC design are security, accessibility, real-time payment, and privacy.

From an operational perspective, a CBDC unveils the trade-off between data management and supervisory intensity. To schematise this situation, Auer and Böhme (2021c) recall that a technical architecture model depends on the roles and controls of each component within the distributed record-keeping systems, as well as on the communication interplay. As such, in their view, there are four types of CBDC models:

1. Direct: a central bank runs the retail CBDC system itself, and intermediaries might only participate in the onboarding process.
2. Indirect: a non-retail CBDC in which a central bank only handles wholesale payments. Intermediaries issue fully-backed claims to the public, against CBDC held at the central bank.
3. Hybrid: a two-tier retail model where CBDC represent a direct claim on the central bank which records periodically retail balances. Real-time payments are executed by intermediaries.
4. Intermediated: a two-tier retail model that resembles the hybrid one, except for the fact that the central bank would record wholesale balances only. As central banks record aggregated balances, intermediaries would need close supervision to avoid misstatements of accounts.

In Peru, the exploratory assessment is still an ongoing process, so that no choice has been made regarding the type of CBDC model. The decision would also evaluate the experience gathered by other CBDC projects and the evolution of the literature. Besides that, it is essential to evaluate two key design choices: (1) whether the CBDC should function at a wholesale or retail level; and (2) whether an account- or token-based CBDC is congruent with the expected use and availability of data. Indeed, it is key to envision the feasibility of user cases at both the wholesale (central bank and third parties) and retail (third parties and final users) levels. This choice also implies identifying authorized third parties, which operations would be recorded at the central bank and who would be responsible for user onboarding. Only in the direct model is there no room for third party CBDC distributors, as users have a direct claim on the central bank.

As mentioned above, either model can be account- or token-based. In a wholesale CBDC, the former relates to an ID system and the latter to cryptographic schemes that do not require identification. Whether a system is account- or token-based depends on the legal claim on, and recording at, the central bank. In the case of retail CBDC, a token-based CBDC satisfies the anonymity feature of physical cash. In turn, an account-based retail CBDC brings the advantage of programmability. For instance, Usher et al (2021) assert that programmable payments enhance development of smart contracts, whose features vary depending on identifiable characteristics of the holder to allow for automated execution. If an account-based CBDC were to be successful in fostering competition around this type of technology, Usher et al anticipate that it could enhance market competition and efficiency in payment systems.

Beyond theoretical models, it is key to define the critical issues that CBDC issuance should address in order to be accepted by unbanked people in Peru. Basically, it is important to identify why existing payment instruments do not fulfil people's needs. From a payment efficiency perspective, the potential benefits of CBDC issuance in the realm of financial inclusion relate to the types of payment flows that can be digitalised using this innovation:

a. **Accelerate financial inclusion (person to person)**: There are digital wallets distributing prepaid cards among unbanked people. However, prepaid cards are a closed loop solution restricted to vendors within a network.[16] Hence, this innovation tends to fragment rather than centralise payment solutions. CBDC may provide the unbanked with strong authentication, some level of anonymity, and full interoperability.

b. **Funds transfers where the banking network is not present (person to person)**: Rural migrants moving into the capital city typically send money back to their relatives. Those transactions bear higher costs than those conducted within urban areas.[17] CBDC may allow relatives in both locations to

[16] A closed loop resembles a gift card, while an open loop is akin to a credit card. Hence, prepaid cards bring the benefit of anonymity, balance top-up, and timely check-out.

[17] The available instrument is *giro* (bank draft), a service provided by BN, which charges PEN 5–25 (depending on the amount transferred). Alternatively, some people prefer to give cash to a family member or friend travelling to the family's area of residence in order to avoid additional costs.

have a CBDC wallet for making funds transfers at a low (or zero) cost.

c. **Payments on public transportation (person to business)**: Currently 80% of Lima's population travel by bus.[18] In this user case, bus lines should take CBDC payments along with other digital payments. In offline cases, embedding the CBDC in a chip would make it possible to transfer funds from wallet to chip.

d. **Payment of wages in the informal sector and in rural areas (business to person)**: With their anonymity and digital features, CBDCs have the potential to replace cash due to lower robbery exposure and transportation costs.

e. **Payments to small merchants' suppliers (business to business)**: There are around half a million retail stores nationwide, which are usually small, single-person, or family businesses. These businesses pay their suppliers in cash.[19] Merchants that receive CBDC payments from their customers may pay suppliers without using cash; and delivery costs may decrease if suppliers do not need to collect cash payments. In addition, a CBDC can make it possible to extend working capital loans to merchants located far from the main cities.

f. **Programmes to promote social inclusion among the unbanked population (government to person)**: Peru's Ministry of Development and Social Inclusion (MIDIS) is responsible for managing the government's social programmes.[20] CBDC may solve the problem of handling cash and the need to travel to a different location to withdraw cash from ATMs. A wide network of small merchants using CBDC, or other interoperable means of payment, must be implemented.

g. **Extend accessibility of digital payments to the government (person to government)**: Currently, online payments to the government are made through a proprietary website[21] that settles transactions through credit cards. CBDC has the potential to be accepted as an additional means of

Moreover, it is common for rural inhabitants to have to commute long distances to withdraw the transfers.

18 The population of Lima City is nearly a third of Peru's total population (33 million). Cash is used to buy prepaid bus cards at stations, where long queues form. Another problem is related to the lack of interoperability among transport lines, as not all buses accept the same prepaid cards.

19 For their part, suppliers provide or contract services, usually by truck, to deliver goods and collect payments; and must hire security to protect the cash.

20 There are two main programmes, with a scope of 1.2 million people, involving money transfers: *Juntos* (a conditional cash transfer programme) and *Pensión 65* (a monetary incentive to provide protection and support to people 65 years of age and older in extreme poverty). In many cases beneficiaries must be paid in cash, which involves high transportation costs.

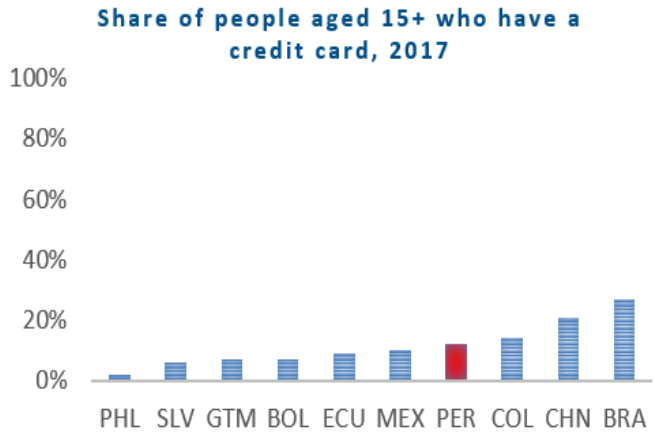
21 The website "pagalo.pe" is used to pay fees and service charges to government agencies without having to go to a BN branch in person. Transactions can be performed with Visa, MasterCard, or American Express cards.

payment by unbanked citizens, thereby increasing the scope for person-to-government payments.

2.2. Credit card usage

In some countries, the digitalisation gap has been filled via online credit card payments. However, more generally, low use of credit cards has encouraged a search for non-bank digital payment systems. In Peru, the share of credit card holders[22] was 12% in 2017, slightly more than 10% and 9% in Mexico and Ecuador, respectively (Graph 4). However, credit card penetration can be a double-edged sword. On the one hand, it allows smooth online payments for credit card holders, but it also creates an entry barrier for unbanked users. Even so, countries with high levels of credit card penetration, such as Canada (83% as of 2017), seem to ponder the advent of CBDC adoption positively as an alternative online means of payment. Particularly, it is expected to moderate POS interchange fees and provide as safe a means of payment as offline physical cash.

Credit card usage — Graph 4



Source: World Bank - Global Findex Database.

[22] As a percentage of people 15 years of age and older.

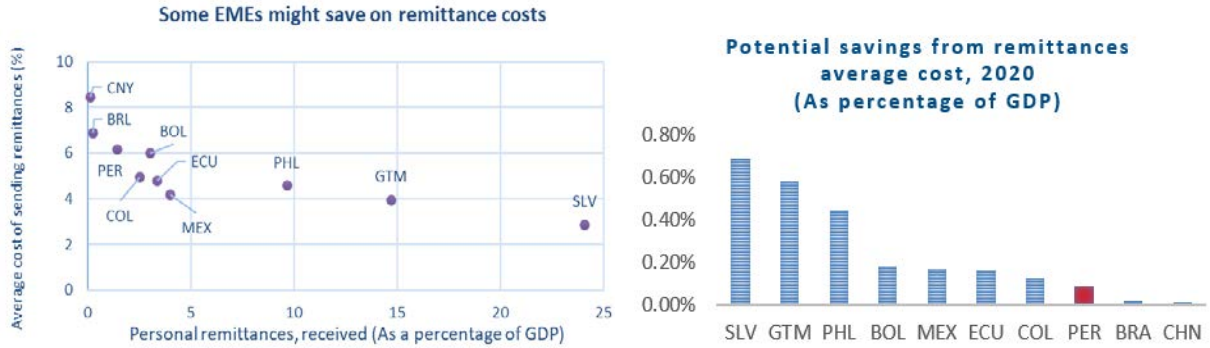
Box 1

Remittances

Due to its heterogeneous geography, a focus in Peru is to reduce the costs associated with fund transfers into remote rural areas. However, worldwide, there is increasing interest on whether CBDCs can play a role in lowering the costs of cross-border remittances. Based solely on the average cost of sending remittances, Peru ranks in the middle range of peer countries at 6,16%, with cheaper costs than Costa Rica (6.60%), Brazil (6.90%), and Paraguay (9.17%), to name a few. However, data is usually uneven so that comparing only costs is not accurate. Alternatively, country-level savings potential might be better in showcasing the economic benefits. Auer et al (2021a) report that, for a sample of more than 100 emerging market economies (EMEs), the annual fee on bank-based remittances is USD 50 billion per year. Based on the balance of payments statistics reported to the IMF, personal remittances received by low- and middle-income countries were USD 508 billion in 2020.① If the reported 6.8% average cost of sending remittances is considered, average fees would amount to around USD 35 billion. This savings potential is often regarded as a benefit of CBDC issuance Standardising these savings by economic size②, Peru's savings potential is roughly 0.09% of GDP, well below those of El Salvador and Guatemala, which stood at 0.69% and 0.58% of GDP, respectively, in 2020 (Graph 5). Having in mind the international landscape of the CBDC evaluation, as a first stage, one option is to consider the merits of a domestic digital currency issued by the BCRP with the aim of improve efficiency and encourage further competition. This choice stems from the fact that current technological infrastructure in Peru lacks a full interoperability and has high cost of operations. Then, a second stage could include an assessment of the international use of CBDC.

Potential savings from remittances

Graph 5



Source: World Bank.

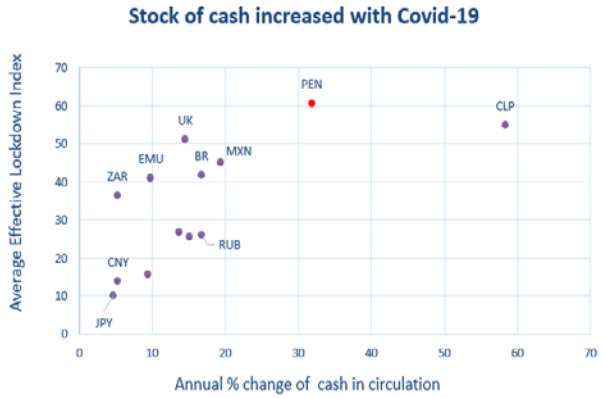
① Of which 98% was directed to middle-income countries. ② Savings potential is calculated by multiplying the average cost of sending remittances to a country (%) and the personal remittances received (as a percentage of GDP).

2.3. Impact on monetary policy

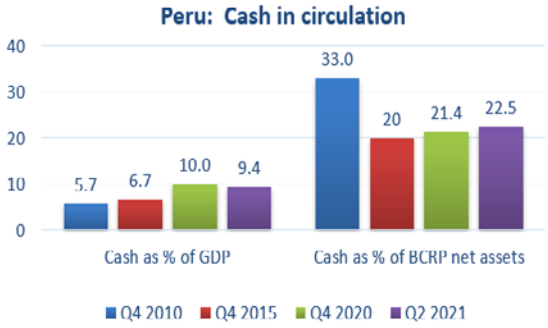
Ayuso and Conesa (2020) maintain that enhancing the efficiency of monetary policy (MP) is not commonly stated as a motivation for CBDC issuance, and the impact on MP transmission will depend crucially on the features of CBDC design. The main effects relate to bank reserve management and the degree of disintermediation. In brief, irrespective of the design option, it seems that a physical cash/CBDC coexistence would be the norm, at least in the foreseeable future.

Cash in circulation

Graph 6



Source: Official websites of central Banks; Goldman Sachs.
Both the annual change and the Average of Effective Lockdown Index comprise the 12-month rolling period as of April 2021.



Source: BCRP.
In the September 2018 issue of the *BIS Quarterly Review*, it was indicated that the value of cash (as a percentage of GDP) in 2016 was : 3.7% (Brazil), 9.2% (China), 7.3% (Mexico). In their sample, the average cash/GDP ratio was 9.7% for ALs and 8% for EMEs.

This arises mostly from the fact that the use of cash is quite common for carrying out transactions. Peru's ratio of cash in circulation to GDP was roughly 7% in 2018, much higher than for developed economies like Sweden, the United Kingdom, Australia, and Canada (3% on average).[23] However, the Covid-19 crisis encouraged cash hoarding for precautionary purposes, bringing cash in circulation in Peru to about 10% of GDP as of end-2020 (Graph 6).

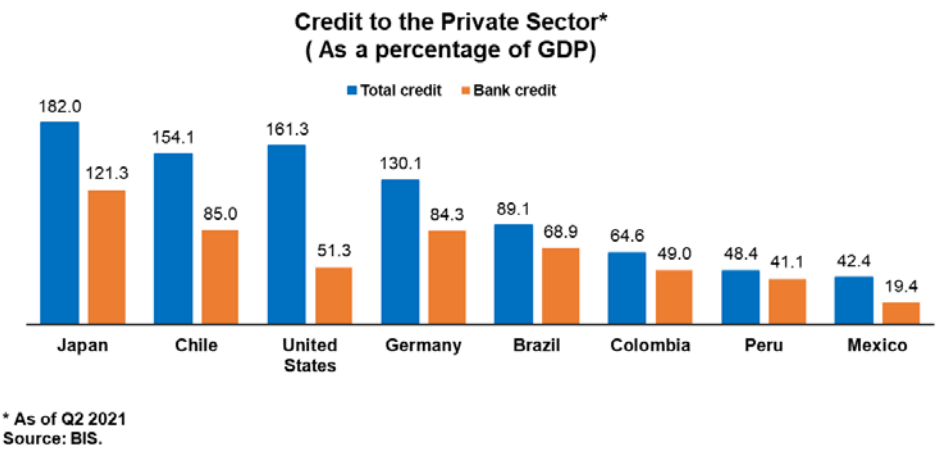
In terms of design, a wholesale issuance scenario would be very similar to bank reserve management. The central bank would issue digital money through financial intermediaries, which would distribute it to the economy. These financial intermediaries could include non-banking entities, such as technological firms, taking as a reference the experience of other countries (eg China). In Peru, most credit is sourced by banks, with funding by non-bank financial institutions[24] standing at only 7% of GDP (Graph 7). In contrast, other LAC economies have more diverse funding sources (eg non-banking credit as a percentage of GDP was 16% in Colombia, 20% in Brazil, and 23% in Mexico as of Q2 2021). However, the overall level of financial intermediation, measured as the ratio of total credit to GDP, was around 48% as of Q2 2021, lower than in other LAC countries.[25]

[23] In Peru, the cash in circulation-to-GDP ratio was 9.4% as of Q2 2021.

[24] Difference between total credit and bank credit, both as a percentage of GDP.

[25] The latest BCRP Inflation Report (December 2021) forecasts the credit/PBI ratio at 44% as of end 2021, and at 42% in 2022 and 2023.

Bank credit channel Graph 7



Usher et al (2021) pose a scenario where the absence of credit risk and a ubiquitous account-based CBDC would tend to increase competition for retail deposits. So far, the trend among CBDCs that are fully open to the public is for no remuneration on CBDC accounts.[26] In theory, the substitution effect between an account-based CBDC and bank deposits depends on whether (and at which level) a central bank pays interest on CBDC accounts. If the so-called CBDC rate remains sufficiently below the interbank corridor, then the likely result is that typical saving decisions would be tilted towards bank deposits that offer higher deposit rates to households. [27]

Particularly, this design option involves discussing the relevance of yield-bearing funds, as this element would increase the substitution degree between a retail CBDC and bank deposits.[28] Bordo and Levin (2017) argue that the interest paid on a CBDC account would act as a main policy tool and magnify the degree of monetary accommodation. These authors also foresee that, in the extreme case where a CBDC is extensively used in a cashless society, it would discourage domestic tax evasion, money laundering, and other illegal transactions.[29] This hypothetical case seems to hold for an account-based CBDC, but it is likely that a token-based retail CBDC would not rule out the possibility of illegal activities (Graph 8)

While an account-based CBDC represents no credit risk for account holders, the main concern comes from the bank lending channel, as a shrinking deposit balance might defy the asset liability management (ALM) capabilities of the banking sector. If banks become underfunded, their lending activities would deteriorate, and their

[26] The existing CBDCs as of late 2021 are: the sand dollar (officially launched in October 2020 in The Bahamas); and two ongoing pilots, DCash (launched in March 2021 in the Eastern Caribbean) and eNaira (launched in October 2021 in Nigeria).

[27] Such a decision will depend on households' risk aversion, as the credit risk associated with CBDC deposits is negligible vis-à-vis bank deposits. For risk-averse households, the decision would be biased towards making deposits at the central bank (no credit risk). However, caps on the amount that can be held in CBDC accounts should help.

[28] In this scenario, the authors theorise that the spread between short-term government debt and CBDC rates would be trivial, as these two assets would be substitutes from the perspective of the holders of excess funds.

[29] The authors contend that those transactions are more common in a cash-dominated ecosystem, where large-denomination bills are used for illegal purposes.

borrowing costs would increase. To avoid this, the CBDC rate could be adjusted so as not to become a contender for bank deposits.

Interest rate channel Graph 8

Scenario A: No remuneration	Scenario B: Interest-bearing
The interest rate paid on the reserves placed at central banks would remain as the floor of the short-term interbank market	▪ The CBDC rate would be an effective lower rate, altering interbank rates. It would also become the lower limit for deposit rates. ▪ Changes in the CBDC rate would impact on spending and saving decisions, either: ❑ Directly, to families and non-financial corporations ❑ Indirectly, to bid rates to attract deposits at commercial banks

Source: Adapted from Ayuso and Conesa (2020).

In the event of a crisis, a surge in the demand for CBDC would be expected. More research is needed about options for mitigating liquidity constraints under this new type of money format. One argument is that the speed of a bank run might be faster under a monetary system with CBDC issuance vis-à-vis the traditional pace of physical cash withdrawals. Therefore, a central bank might need to provide more liquidity and, in consequence, monitor the availability of suitable collateral for larger monetary operations. On the other hand, the risk of vault cash shortages in the financial system should decrease as CBDC preference increases.

At the same time, residents' access to CBDCs denominated in the main international currencies would expedite capital outflows. Therefore, the central bank of a small, open economy should enhance its FX buffers, particularly in the presence of currency mismatches.

2.4 Considerations for CBDC design in Peru

CBDC research in Peru builds on the acknowledgement that access and efficiency depend greatly on the degree of development of the payment system. Moreover, some issues might arise such as data silos, especially under low competition in the banking system. In this respect, a prudent approach might be to allow central banks to access data already collected by intermediaries at a certain level. The success of this design will depend on the interplay between the public and private sectors, shaping their roles in a two-tier system. For instance, a central bank could oversee the interoperability of payments and a regulatory body could foster competition among intermediaries; in turn, the private sector could be in charge of the client-facing role and of increasing the cost efficiency of the payment system.

On the other hand, a retail CBDC would provide broader access through either an account at the central bank or tokens, thus facilitating financial inclusion. Moreover, it would be beneficial to holders since there would be no credit risk, as the counterparty would be the central bank. In traditional monetary operations, the interest on reserves paid to commercial banks and, if applicable, to other financial counterparties, is commonly thought to enhance competition in the search to secure retail deposits. In the context of CBDC design, an account-based CBDC would

represent an alternative within the digital environment, which holders could use to perform 24/7 online transactions and engage in peer-to-peer (P2P) transfers.

The implementation of a CBDC under a two-tier system, would involve cooperation between the public and private sectors. In particular, the public sector would foster competition in the private sector, providing clear rules regarding the use of information and promoting the entry of new participants. In this model, the central bank would have a subsidiary role, providing what the private sector cannot provide. Some examples include interoperable platforms for retail payments, an upgraded RTGS, etc.

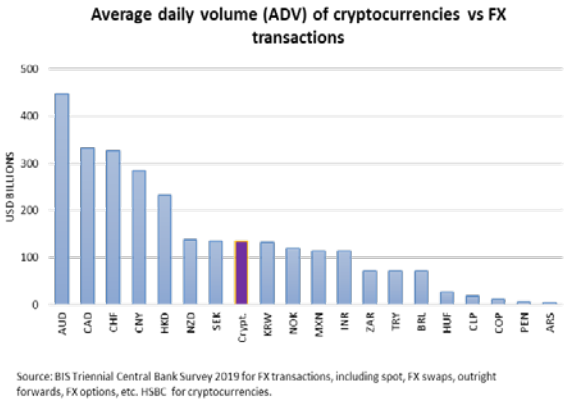
Box 2

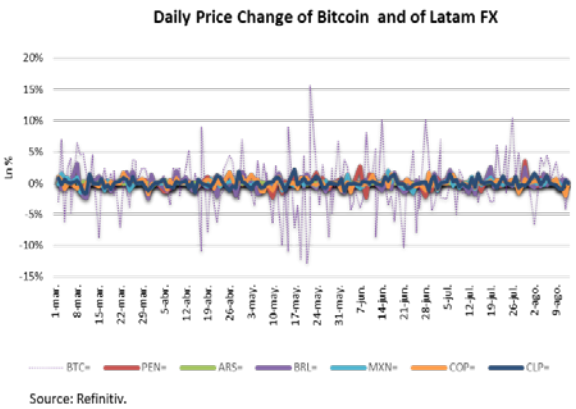
Spillover effects and risks

According to Kaminsky et al (2005), procyclical capital flows have a positive correlation with output. Moreover, capital inflows tend to coincide with episodes of accommodative international financial conditions, thus reinforcing the business cycle. From a conceptual view, Auer et al (2021a) assert that spillover effects would arise from the international use of CBDCs, mainly from digital dollarisation, whereby a foreign CBDC is used in the domestic market, partially replacing the recipient's currency in some payments or transactions. However, with no prior data on CBDCs, the implications could only be inferred from other digital markets. A major development in the global digital environment is the emergence of cryptocurrencies, which are high-risk assets that do not contend with money, as they are not government-backed①. However, average daily transaction value of cryptocurrencies has surpassed that of some national currencies (Graph 9). It is also relevant to note that the cryptocurrency market cap size is mainly determined by the bitcoin market cap (about 41%).② While bitcoin is rarely used as a means of payment, its abrupt price swings may affect financial conditions, especially when colliding with otherwise stable prices. The question that arises is whether bitcoin transactions could affect MP transmission and efficiency.

Cryptocurrencies: daily volume and volatility

Graph 9





① On top of that, cryptocurrencies represent a threat to climate sustainability due to the high-energy consumption that bitcoin mining entails. ② As of the first half of 2021, the global money supply was USD 103 trillion, the US Fed balance sheet was USD 7.94 trillion, the cryptocurrency market cap was USD 1.63 trillion, and the bitcoin market cap was USD 669 billion.

Following von Luckner et al (2021), bitcoin transactions can be classified as: (1) speculative or investment operations; and (2) FX conversion via crypto transactions. Using information on P2P transactions,[30] they find evidence that around 7.4% of bitcoin transactions were performed for FX conversion purposes. Using the algorithm proposed by the authors, the Venezuelan bolivar and the Russian rouble remained at the top of the per capita crypto ranking in 2018–20. Nonetheless, Peru has remained within the top 10 per capita ranking since 2018. Like Cheng and Dai (2020), these authors argue that cross-border transactions are driven by growing capital controls in certain geographic areas (Table 3).

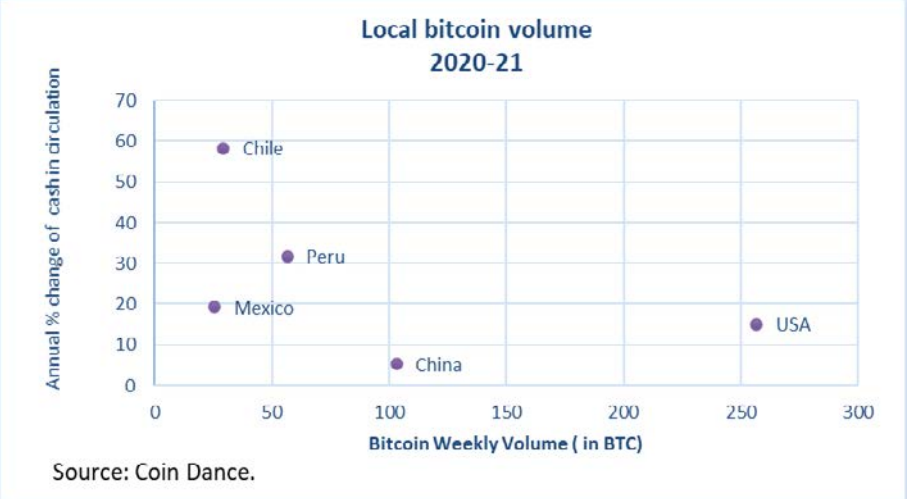
Ranking of active crypto transactions, per capita — Table 3

	2018	2019	2020
Top 1–5	**Russia, Venezuela,** Belarus, Sweden, Panama	**Venezuela, Russia,** Belarus, Panama, PERU	**Venezuela, Russia,** Belarus, Colombia, Chile
Top 6–10	United Kingdom, PERU, New Zealand, Colombia, Nigeria	Sweden, Colombia, Chile, United Kingdom, Kazakhstan	PERU, Sweden, Panama, United Kingdom, Argentina

Source: von Luckner et al (2021).

Additionally, it is commonly assumed that bitcoin use as an investment vehicle is more pronounced when cash in circulation is more significant, as people with a preference for anonymous transactions would prefer to shift from notes to cryptocurrencies. However, using raw data on P2P local bitcoins, the opposite seems to hold true. In some countries, the larger the cash injections, the lower the volume traded in P2P local bitcoins (Graph 10). For example, in Peru, this finding is related to the sample period 2020–21, when the pandemic boosted the demand for cash for precautionary purposes.

Peer-to-peer transactions and cash in circulation — Graph 10



[30] Data collected from https://localbitcoins.com/, including 135 legal currencies, in the period from 15 March 2017 to 23 July 2021.

Based on von Luckner et al (2021), the PEN-VES FX crypto vehicle ranks among the most sizeable cross-border capital flows, with 56.8% of total crypto vehicle trades starting in PEN.[31] This finding might partially reflect the large number of migrants from Venezuela,[32] where capital controls are strict.[33] Similarly, in LAC countries there are more crypto-local currency pairs with a high share of cross-border capital flows into Venezuela, originated from Argentine pesos (ARS, 46.2%), Chilean pesos (CLP, 44.6%), balboas (PAB, 37.2%), Mexican pesos (MXN, 36.2%) and Colombian pesos (COP, 24.8%). Considering these findings, further research should clarify whether the transactions respond to global (ie linked to speculative or investment reasons) or idiosyncratic factors (ie related to domestic economic conditions of the initial transaction). To further discuss this result, it is key to evaluate the coverage of the data.

The P2P market remains relatively small in the region. Volume trends show a shrinkage in P2P transactions across LAC countries, possibly signalling a common motivation. In the region, only Colombia and Venezuela have seen a significant increase in their share of the weekly BTC volume in the last five years (Table 4), with Colombia as the main destination of Venezuelan emigrants as of mid-2020.[34] Based on this compact sample, it appears that in Peru the P2P domestic BTC volume has decreased steadily since 2019. In a hypothetical scenario of CBDC issuance to promote financial inclusion, the theory suggests that the volatility of capital flows could increase. However, we contend that this P2P information is not sufficient to prove the cross-currency conversion motives, and therefore further research is needed to measure potential CBDC use for cross-currency conversions. In this regard, IMF (2020) argues that, to facilitate the payment function, it is necessary to decide whether access would be constrained by residency status. Considering the absence of comprehensive data, the most conservative approach would be to monitor the trading volume of BTC.

Share of average weekly volume of local P2P bitcoins — Table 4

Year	ARG	BRL	CHI	COL	MEX	PER	VEN	Total (units
2015	31%	15%	7%	9%	34%	5%	0%	390
2016	22%	24%	5%	17%	27%	5%	0%	377
2017	7%	25%	7%	42%	13%	6%	0%	443
2018	3%	6%	3%	28%	5%	10%	44%	888
2019	2%	3%	2%	24%	3%	8%	57%	1687
2020	5%	3%	4%	29%	4%	8%	47%	997
2021	4%	5%	6%	30%	6%	8%	40%	168

Yearly Average Percentage is calculated as the share of the total BTC exchanged for all the currencies listed above.
Source: Coin Dance.

[31] This acronym indicates that transactions begin in PEN to buy bitcoins which are then used to buy VES (bolivares), where the destination currency is the one driving demand. This percentage relates to the total FX conversion crypto transactions identified in the origin currency.

[32] According to data published in Statista as of 2020, the ranking of LAC countries with more Venezuelan emigrants are: Colombia (1.8 million), Peru (0.9 million), Chile (0.5 million), Ecuador (0.4 million), Brazil (0.3 million) and Argentina (0.2 million).

[33] Weekly data of domestic transactions could be shown in either local currency or bitcoin (BTC). As of mid-2021, The PEN-BTC weekly average YTD is PEN 2.3 million, lower than the weekly average for 2020 (PEN 3 million). Recall that von Luckner et al (2021) found that 57% of transactions were cross-border of the type PEN-VES. Using that percentage as a lower bound limit of the cross-country transactions into VES, we could assume that at most the PEN-BTC-USD could reach 43% of average weekly volume (AWV). That is, 43% times the 2021 AWV times 52 weeks per year, leads to a 2021 accumulated volume of PEN 51 million changed into BTC (only including this local bitcoin P2P exchange). Hence this yearly PEN 51 million is assumed to be the 2021 cap limit for any other type of transactions (domestic or cross-border into non-VES currencies).

[34] Based on local bitcoin data, average weekly volumes have fallen significantly from 2015 to 2021 YTD: –94% in Argentina, –93% in Mexico, –85% in Brazil, and –23% in Peru. In contrast, they increased by 43% and 68% in Colombia and Venezuela, respectively.

3. Closing remarks

CBDC issuance is not a "one size fits all" solution. Issues with existing payment instruments, the share of unbanked people operating within a cash ecosystem, and the user cases matter to properly design a CBDC that can deliver a more inclusive, efficient and accessible National Payment System. The introduction of a domestic CBDC must also consider the initial economic conditions and the context where it would take place to prevent unintended consequences. At different levels, the e-dollarisation effect is likely to arise in small, open economies whose currencies are not established as global invoicing currencies. Indeed, while hard-currency economies could mainly focus on envisioning the design choices of a domestic CBDC, other countries must also thoroughly reflect on the potential currency substitution effect derived from a foreign CBDC. This poses challenges on other fronts, such as faster and more volatile capital flows, as this innovation could expedite the settlement of cross-border transactions. However, as Peru's experience shows, it is possible to maintain an independent monetary policy in a bi-monetary system. The necessary conditions to meet this objective are establishing a credible monetary policy and achieving low and stable inflation in line with international levels.

According to Alfonso et al (2020), in LAC countries there are three types of initiatives to increase the efficiency of retail payments, namely, retail fast payment systems (FPS), open banking, and CBDC issuance. In Peru, a potential CBDC initiative would be tied to the fact that further NPS development is key to promoting financial inclusion. At the same time, central banks in other countries (eg Brazil) have already adopted an FPS while continuing to assess the possibility of CBDC issuance.[35] In the medium term, we foresee that some payment flows could be improved by introducing a domestic CBDC. Some argue that CBDC implementation could be a two-edged sword, as it has positive implications for end users in terms of timeliness and cost, but might also magnify effects typically associated with dollarisation. Nonetheless, Peru has built considerable experience in conducting an independent monetary policy in the context of partial dollarisation. For instance, the US dollar can still be used as an invoicing currency for some transactions and residents can hold bank accounts in a dual currency economy. Even so, the BCRP has achieved low inflation while playing the manager's role in the dual currency RTGS since 2000. Peru's experience in tackling financial dollarisation provides some learning leverage to navigate the potential effects of CBDC adoption.

In the near term, innovations could provide several paths for improving payment efficiency. For instance, in the case of open banking, the BIS (2019) highlighted the role of the regulatory approach, which may be prescriptive, facilitative, or market-driven. Likewise, it is likely that for CBDC adoption, the level of oversight intensity and data management would also play a pivotal role. All in all, the innovations to come ahead support a forward-looking approach in regulatory policy.

[35] Alfonso et al (2020) characterised CoDi (Mexico) and Pix (Brazil) as FPS platforms operated by central banks with similarities from a user-end perspective. The BIS defines FPS as a system whose payment flows occur in real time on a 24/7 basis, where the time lapse accounts from the transmission of an order to the availability of funds to the payee. According to the March 2020 *BIS Quarterly Review*, Chile's FPS has operated for nearly 10 years with around 30 payments per capita as of 2018.

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Deliberations of an emerging market economy central bank on central bank digital currencies[1]

Francisco G Dakila, Jr[2]

Abstract

There have been heightened activities in the past two years among central banks exploring central bank digital currencies (CBDCs). The 2019 CBDC survey of the Bank for International Settlements noted that CBDC pilot projects were under way among 10% of the survey respondents – and that the central banks which had initiated the pilot projects were all from emerging market economies (EMEs). This interest in CBDC may have been prompted by the rapid global developments among virtual currencies and stablecoins and further spurred by other central banks' advanced CBDC activities. The mobility restrictions caused by the Covid-19 pandemic may have also been a contributing factor towards a "pro-digitisation" mindset among central bankers that looks favourably on digital innovations such as CBDCs. Nonetheless, EME central banks, such as the Bangko Sentral ng Pilipinas, are in the midst of deliberations on the benefits and risks and proper motivations for the issuance of a CBDC.

JEL classification: E42, E58, O33.

Keywords: central bank digital currency, CBDC, central banking, digital currency, payment systems, Philippines.

I. Introduction

The pattern in central bank exploration of central bank digital currencies (CBDCs) may be seen in the annual surveys conducted by the Bank for International Settlements (BIS). In the first published survey, conducted in the latter part of 2018, 70% of the respondents were engaged in some form of work on CBDC (Barontini and Holden (2019)). Barontini and Holden mention that this figure was slightly higher than the share in an unpublished 2017 survey. The percentage of CBDC-engaged central banks went up to 80% in the 2019 BIS survey (Boar et al (2020)). Of the respondents, 40% had advanced from conceptual research to proofs-of-concept and 10% (all from EMEs) had initiated pilot projects. In 2020, notwithstanding the Covid-19 pandemic, the percentage went up again, with 86% of the respondents reporting ongoing CBDC activities (Boar and Wehrli (2021)).

This rising interest of central banks in CBDCs may have been prompted by developments in virtual currencies and stablecoins. Facebook, for one, announced its

[1] Article prepared for the BIS Emerging Market Deputy Governors meeting, 9–10 February 2022. The usual institutional disclaimer applies.

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proposed digital currency Libra in June 2019 (Libra has since been restructured and is now known as Diem).

This interest is being further driven by activities of the CBDC "prime movers" among central banks. In October 2020, the Central Bank of the Bahamas issued the sand dollar, a digital version of the Bahamian dollar. In the same month, the National Bank of Cambodia launched the Bakong, a "quasi-CBDC" which is actually a blockchain-based payment system.

Global developments in central bank digital currencies. Among the notable EME central banks at the forefront of CBDC work is the People's Bank of China (PBoC) with its Digital Currency Institute. It has been implementing pilot projects of the digital yuan in various provinces. The PBoC is also currently involved in a cross-border CBDC experiment with the Bank of Thailand, the Hong Kong Monetary Authority and the Central Bank of the United Arab Emirates. A recent successful implementation of a cross-border CBDC experiment was Project Jura, undertaken by Bank of France, the BIS Innovation Hub and the Swiss National Bank. Another multi-central bank initiative is Project Dunbar, a collaboration among the Reserve Bank of Australia, Central Bank of Malaysia, Monetary Authority of Singapore, and South African Reserve Bank with the BIS Innovation Hub. The Bank of Korea, Bank of Japan and Bank of Thailand are some of the central banks in the Asia-Pacific region undertaking their own pilot CBDC projects.

Meanwhile, the quarantine restrictions that resulted from the Covid-19 pandemic encouraged the move from cash towards digital payments, creating a mindset among central bankers that looks favourably on digital innovations such as CBDCs.

II. Digital financial transactions in the Philippines

One positive outcome of the Covid-19 pandemic and subsequent quarantine restrictions is the impetus it provided to the digitisation of financial services and payment transactions in the Philippines. The latest figures show that by end-2020, 20.1% of the volume of monthly payments were being made digitally, a substantial improvement from the 14% share in 2019 (BSP (2021)). In terms of value, the share of digital payments likewise increased from 24% in 2019 to 26.8% in 2020. The increase in digital payments was largely in the form of high-frequency, low-value retail transactions such as person-to-merchant payments and person-to-person payments such as electronic funds transfers.

The Philippines' National Retail Payment System (NRPS). In 2015, the Bangko Sentral ng Pilipinas (BSP) and industry stakeholders launched the NRPS framework to create a safe, affordable, interoperable and efficient retail payment system in the Philippines with the use of electronic payments to improve the speed, convenience and affordability of financial transactions and, ultimately, to bring about a "cash-lite" Philippine economy. The NRPS became operational with the formation of two automated clearing houses – PESONet (in 2017) and InstaPay (in 2018). PESONet is a batch electronic funds transfer (EFT) credit payment scheme which supports bulk payment transactions of various users. InstaPay, on the other hand, is a real-time low-value EFT credit push payment scheme that facilitates small-value payments. As of 31 October 2021, PESONet had a total of 90 participating institutions, while InstaPay had onboarded 59 institutions.

In turn, PESONet and InstaPay facilitated another two important initiatives of the NRPS: (1) the Government e-Payments facility ("EGov Pay") via PESONet; and (2) the National Quick Response Code Standard ("QR Ph") via InstaPay. The EGov Pay facility digitises government collections and disbursements to allow for more efficient government collection, better audit, enhanced transparency, and minimised revenue leaks. The adoption of QR Ph[3] provided an interoperable payment solution to the fragmented QR-driven payment services market. Thus, merchants and customers no longer need to maintain several accounts and merchants do not need to display numerous QRs.

By end-2020, combined PESONet and InstaPay transfers had grown in volume by 484.7% compared to the previous year; that is, from 46 million transactions in 2019 to 270 million in 2020, with a corresponding increase in value of 165.4%, from PHP 1.5 trillion to PHP 4.0 trillion – tangible evidence of consumers "leveraging on the benefits of these interoperable digital payment services during the pandemic" (BSP (2021)) as well as an affirmation of the efficiency, promptness and reliability of the Philippine domestic retail payment system.

III. The BSP's inquiry on CBDCs

In line with the BSP's thrust on digitisation, a Technical Working Group (TWG) was created in June 2020 to conduct an in-depth study of the policy implications of a CBDC. To allow for a broad perspective, the TWG members were selected from the Department of Economic Research (DER), the Supervisory Policy and Research Department (SPRD), the Technology Risk and Innovation Supervision Department (TRISD), the Financial Inclusion Office (FIO), the Payment System Oversight Department (PSOD), the Payments and Settlements Department (PSD), and the Office of the General Counsel and Legal Services (OGCLS).

Five months later, in October 2020, the TWG submitted a report (BSP (2020b)) that discusses the basic concepts and fundamental issues surrounding CBDC and the possible implications and potential risks from the perspectives of monetary policy, financial supervision, payments and settlements, financial inclusion, and legislative matters.

Some issues for consideration

As has been presented in numerous studies, the report discusses the nature and differences of the types and attributes of CBDC – whether retail or wholesale and whether token-based or account-based. It likewise presents the architectural options: "direct" with the central bank operating the whole system and keeping the ledger for all transactions; and "hybrid" with banks as intermediaries but with the CBDC as a direct claim on the central bank.

From the monetary policy perspective, the impact on monetary policy transmission depends on whether the CBDC is remunerated or not. For the banking system, a CBDC may result in financial disintermediation and a potentially larger central bank footprint in the financial system. In times of heightened financial market

[3] BSP Circular No 1055, series of 2019.

stress, a rapid transfer of funds from bank deposits to CBDCs or a "bank run" would pose risks to financial stability.

A legislative constraint exists for the issuance of a retail CBDC in the Philippines. While the expanded authority provided by the National Payment Systems Act (NPSA) for the BSP to own and operate a payment system may be used as the legal framework to introduce the use of CBDC in wholesale form, it cannot accommodate the issuance of a retail CBDC.

Technological and infrastructure designs should take into consideration policies on data privacy, connectivity concerns and interoperability (both within the domestic market and across country borders).

Benefits and risks. In general, a central bank's issuance of a CBDC provides an alternative means to perform financial transactions, thus promoting financial inclusion. As a form of central bank liability, it presents another instrument for monetary policy. It likewise addresses the concern of countries experiencing a decline in the use of cash. Moreover, a CBDC encourages innovation in the payments system and promotes competition with privately issued digital currencies.

However, as mentioned above, there is the potential risk of financial disintermediation as owners of bank-based deposit accounts shift to CBDCs. In response, banks may raise interest rates on deposits, increasing their costs. With no or few accompanying financial literacy programmes, there would be risks to consumer welfare and loss of privacy. More importantly, with inadequate technological understanding and/or capacity, there is a high risk for cyber security breaches and the use of CBDCs for money laundering and terrorism financing.

Nonetheless, the bottom line is that the implications for the economy and impacts on central bank functions and mandates would depend on the design and features of the CBDC. But the appropriate design and features are to be determined by the motivation – the reason for having a CBDC.

Quest for motivation

Many parts of the BSP CBDC report (BSP (2020b)) emphasised the need to determine the motivation for the CBDC as this will, in turn, determine the type and design of the CBDC.

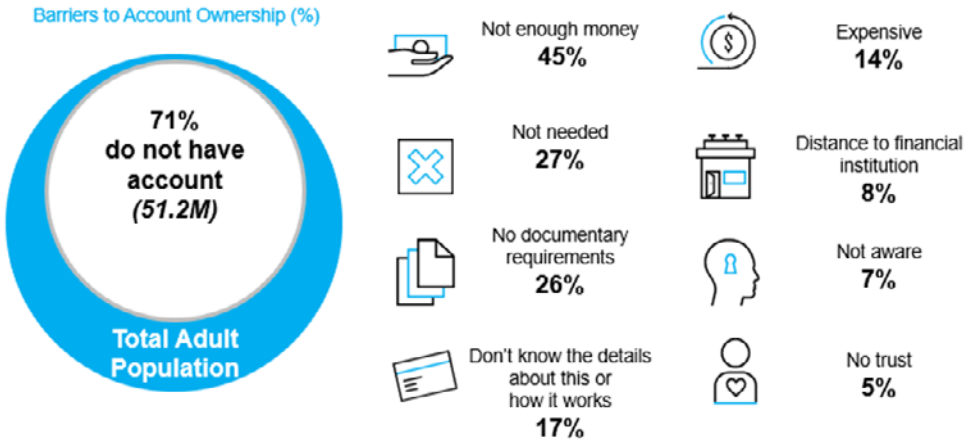
Predominance of cash. For some countries, notably Sweden, the main incentive for their CBDC research is the rapid decline in the usage of physical cash. Yet such is not the case for the Philippines. Cash is still the primary mode of payment. As presented earlier, digital payments represent only 20% of the total volume of payment transactions. If a digital peso were to be issued, it would not be to replace cash but to supplement it. In fact, the BSP CBDC report notes that the removal of cash altogether or a restriction of its holdings as a consequence of the issuance of a CBDC could result in the financial exclusion of the most vulnerable segment of Philippine society.

No virtual currency threat. Also, there is, at present, no threat from virtual currencies (or "virtual assets") as these are not widely used in the Philippines. Regulations governing entities engaged in activities regulated by the BSP, such as e-money issuers and virtual currency exchanges/virtual asset service providers, are already in place. The BSP does not regulate specific virtual assets but supervises the business or process of exchanging fiat money for crypto-/virtual assets, as well as

exchanges between virtual assets and/or their redemption back to Philippine pesos. The BSP works closely with other regulators, such as the Securities and Exchange Commission, through the Financial Sector Forum, for a coordinated approach in overseeing the wide range of virtual assets.

More targeted financial inclusion measures. One of the more popular reasons for considering a CBDC, especially among EME central banks, is the promotion of financial inclusion. It is argued that CBDCs could improve access to financial services and lower costs of financial transactions.

Financial inclusion is an important concern in the Philippines and is one of the advocacies supported by the BSP. According to the BSP's *2019 Financial Inclusion Survey* (BSP (2020a)), the number of Filipinos who do not own an account is estimated at 51.2 million, or 71% of the adult population. The survey identified the barriers to account ownership as follows:



Source: BSP (2020a).

The primary reasons are inadequate finances (45%), followed by a perceived lack of need for an account (27%) and inability to comply with documentary requirements (26%).

Still, financial inclusion may be addressed more effectively by more targeted measures than the issuance of a CBDC:

- *More financial access points*. With the rationalisation of branching guidelines, banks are expanding their network of branches and other offices, including the establishment of "branch-lite" units. BSP Circular No 940 (20 January 2017) allows banks to use third-party cash agents (such as shops, retailers and stores) as a cost-efficient service delivery channel in remote areas. With cash agents, banks are able to serve clients and expand their market, even in low-income areas.
- The number of touchpoints through agents had expanded to over 58,000 cash agents and over 84,000 e-money agents as of the fourth quarter of 2020.
- *Wider range of products*. Banks have greater flexibility to expand the range of products and services offered through their branch-lite units. BSP Circular No 992 (1 February 2018) sets out the framework for banks to offer basic deposit accounts (BDAs) to promote account ownership among the unbanked and underserved segments of the population. BDAs have simplified "know-your-customer/client (KYC)" requirements, a low opening amount, no minimum maintaining balance, and no dormancy charges.

- The number of BDAs had reached 6.6 million, with balances amounting to PHP 4.71 billion, offered by 133 banks as of the fourth quarter of 2020.
- However, as reported by the *2019 Financial Inclusion Survey* (BSP (2020a)), 60% and 46% of Filipino adults are still unaware of BDAs and of cash agents, respectively.
- *Creation of a dedicated office*. In 2018, the BSP created the Center for Learning and Inclusion Advocacy (now renamed as the Financial Inclusion Office) to work on a policy and regulatory environment that promotes the BSP's financial inclusion initiatives supportive of the country's National Strategy for Financial Inclusion.
- *Conduct of financial literacy programmes*. The BSP's regular conduct of financial literacy programmes aims to address the lack of awareness and information that result in having unbanked and underserved segments of the population.
- *Implementation of a national identification system*. The enactment of Republic Act (RA) No 11055, or the Philippine Identification System Act (PhilSys) in August 2018 provides Filipinos the means to establish a verifiable digital identity that will enable them to open accounts, use financial services more efficiently and gainfully participate in an increasingly digital economy. The BSP actively supports the implementation of PhilSys as a member of the PhilSys Policy and Coordination Council (PSPCC) and Chair of the Inter-Agency Committee (IAC) on Use Cases and Authentication. The BSP will also be involved in the production of the identification cards.

Finally, while CBDC is generally thought to promote financial inclusion, the technology aspect may create another form of barrier in the light of instability or lack of internet connectivity, particularly in rural areas.

Enhancement of the payment system. The BSP CBDC report (BSP (2020b)) notes that a potential contribution of a CBDC may be in enhancing the payment system, especially in areas "where the clearing and settlement function has not yet reached [the] operational capabilities of an RTGS system. While domestic retail payments in economies across the globe have become more rapid and efficient, cross-border retail payments remain cumbersome, expensive and slow." As presented earlier, the Philippine NRPS is one such example of a well functioning domestic retail payment system.

Cross-border payments and remittances. Cross-border transactions are made more significant for the Philippines because of the remittances of overseas Filipinos (OF). Even with the pandemic, OF remittances continue to contribute considerably to the Philippine economy. In September 2021, cash remittances channelled through banks reached USD 2.7 billion, a 5.2% increase from the USD 2.6 billion recorded in September 2020. On a year-to-date basis, cash remittances amounted to USD 23.1 billion for the first nine months of 2021, 5.6% higher than the year-ago level of USD 21.9 billion. If a CBDC could lower the cost of cross-border transfers, the potential gains would be substantial.

Accordingly, to help identify CBDC motivation/s for the BSP, its Payment System Oversight Department (PSOD) has undertaken an assessment of the existing payment system (wholesale and retail) to assess possible gaps or weaknesses which CBDC could address.

IV. Moving forward

The BSP report on CBDC (BSP (2020b)) recognises the importance of determining the motivation for a CBDC. In fact, the initial recommendation of the closing chapters is for the BSP to identify its primary motivation(s) for the issuance of a CBDC. Identifying the motivation is crucial not merely because this would determine the type, design and attributes of the appropriate CBDC but, more importantly, because it would provide clarification, set the direction and ensure alignment of all CBDC-related undertakings.

Clarity in the identification of the objective or motivation could be supported by continuing research. As mentioned earlier, an assessment of the current payment system and possible areas for improvement has been conducted. This could be supplemented by research on: (1) developments in the privately issued digital currencies in the Philippines and their business models and whether regulations (crafted on the basis of the industry sandboxes) are appropriate; and (2) developments in CBDC activities among central banks. Likewise, there could be stakeholder consultations. The determination of the motivation and, subsequently, the design and features of the CBDC should also take into account the "readiness, pain points and growth concerns of the diverse set of ecosystem players".[4]

The second recommendation of the CBDC report is to take a closer look at the technology: that is, for the BSP to learn the technology behind CBDC. To achieve this, the report proposes the following:

a. *Capacity building*. This may be done through learning sessions (such as seminars, workshops, roundtable discussions) conducted by other institutions and subject matter experts, or actual immersions with CBDC projects. The BSP may also benefit from technical assistance from international institutions such as the International Monetary Fund or the BIS.

b. *Establishing networks*. There could be consultations or collaborative experimentations with other central banks, financial institutions or international organisations that are also conducting CBDC-related research and initiatives.

c. *Developing a roadmap to pilot implementation*. A pilot implementation is a huge undertaking and would require an assessment of human resources and potential costs.

These recommendations and proposed actions are all interrelated – with all actions building towards greater knowledge and understanding of the digital payment ecosystem, and a higher level of capacity to implement or adopt an advanced digital technology in the payment system when the appropriate time comes.

[4] CBDC survey response of the BSP's Payment System Oversight Department.

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Evaluation of the rationale for the potential introduction of central bank digital currency in Poland

Marta Kightley, Renata Żak and Marta Dulinicz[1]

Narodowy Bank Polski (NBP) has been monitoring the analytical work, research and pilot tests carried out by other central banks on CBDC issuance for retail and high-value payments for four years. Discussions on this issue in various international forums, including the European Union, are also monitored.[2] Moreover, the functioning of the Polish payment system is analysed in the context of its needs and the challenges it faces. So far, the reasons prompting other central banks to embark on in-depth theoretical analysis and pilot tests on CBDC issuance have not been reflected in Polish conditions.

The use of cash in everyday transactions is still high, even though its share in retail payments shows a downward trend. In 2020,[3] 46% of all retail transactions were carried out using cash, compared with 54% in 2019[4] and 57% at the end of 2018.[5] Recent legislation has made acceptance of cash obligatory in retail payments[6] (with only a few exceptions), which guarantees that central bank money will continue to be widely accepted as a payment method.

Additionally, the value of cash in circulation has been increasing for many years, which proves that cash still plays an important role in the Polish economy. The nominal value of cash in circulation (besides banks' cash registers) at the end of December 2020 amounted to PLN 306.7 billion (for comparison, it stood at PLN 203 billion at the end of December 2018 and PLN 224 billion at the end of December 2019), maintaining a high share of cash in circulation in the M1 money supply (20.0%

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Renata Żak, Advisor, Payment Systems Department, Narodowy Bank Polski,

Marta Dulinicz, Expert, Payment Systems Department, Narodowy Bank Polski.

[2] Information on this subject is presented periodically to the NBP Management Board (currently every two months).

[3] See Narodowy Bank Polski, *Payment habits in Poland in 2020: Key results of the survey*, a payment habits study carried out by NBP. Selected results are available at: www.nbp.pl/homen.aspx?f=/en/system_platniczy/Payment-habits-in-Poland.html.

[4] See POLASIK RESEARCH, *Payment habits of Poles in 2019*, ordered by the Polska Bezgotówkowa Foundation. The main findings of the study are presented in "Special report: cashless Poland", *Miesięcznik Finansowy Bank*, July 2020.

[5] See POLASIK RESEARCH, *Payment attitudes and the development of card acceptance networks in Poland: Consumer Survey 2018*. Selected results of the survey are available in the article: "Polacy zwolennikami płatności bezgotówkowych" ("Poles are in favour of cashless payments"), www.rp.pl/Finanse/306069931-Polacy-zwolennikami-platnosci-bezgotowkowych.html.

[6] The new law came into force on 5 November 2021.

at the end of December 2020, 20.1% at the end of December 2018 and 19.4% at the end of December 2019).[7]

NBP does not face problems related to the issuance and management of banknotes and coins, even during periods of high demand, such as at the beginning of 2020 during the first phase of the Covid-19 pandemic. The streamlining measures carried out recently and planned for the near future have been and are aimed at, among others, modernising banknotes and reducing coin production costs and improving the effectiveness of cash management, as well as optimising and standardising the process of banknote and coin circulation and movement across the chain, including ensuring electronic exchange of information according to a uniform standard. In addition, the National Strategy for Cash Circulation Security, prepared by NBP in cooperation with public institutions and authorities as well as market players and adopted by the NBP Management Board in November 2021, will contribute to increasing the security of cash circulation in Poland and to improving its effectiveness in the future.[8]

In addition to the efficient handling of cash, the Polish system of wholesale payments, SORBNET2, in which RTGS (real-time gross settlement) interbank settlement is carried out for payments in zloty, enables an efficient and effective flow of money in the economy. Work planned by NBP for the coming years will modernise the existing solutions (eg by introducing ISO 20022-compliant messages) and enhance the effectiveness of the system. Retail payments in Poland can be handled through four traditional or two instant payment systems (BlueCash and Express Elixir). The latter are steadily gaining in popularity and importance.

Poland also has a relatively high level of financial inclusion; in 2020, 89% of people aged over 18 had a payment account.[9] From the perspective of place of residence, distribution of account ownership in Poland was at similar levels, proving that lack of physical access to financial services does not directly inhibit financial inclusion. The most commonly cited reasons for not using a bank account were lack of need (81%), preference to keep money in cash (30%), but also the perception that the related costs are too high (21%) as well as lack of trust in financial institutions (18%).

A variety of financial institutions are active on the market: domestic commercial banks (30), cooperative banks (533), branches of credit institutions (34), as well as numerous domestic non-bank service providers (account information service providers, small payment institutions, domestic payment institutions), all of which offer a wide range of financial services and products.[10] Several international challenger banks or fintechs (eg Revolut) also offer their payment services to Polish customers.

[7] See Narodowy Bank Polski, *Assessment of the Polish payment system functioning in the second half of 2020*, April 2021. The summary is available at: www.nbp.pl/en/system_platniczy/Assessment_summary-2-2020.pdf.

[8] Preparation of the Strategy was the responsibility of the Cash Council, a consultative and advisory body established by the NBP Management Board. A summary of the Strategy is available (in Polish) at: www.nbp.pl/home.aspx?f=/banknoty_i_monety/rada-ds-obrotu-gotowkowego.html.

[9] See Narodowy Bank Polski, *Payment habits in Poland in 2020: Key results of the survey*, a payment habits study carried out by NBP. Selected results are available at: www.nbp.pl/homen.aspx?f=/en/system_platniczy/Payment-habits-in-Poland.html.

[10] All numbers as of December 2020.

Due to, among others, competition between the above-mentioned market participants, retail payment systems and schemes operating in Poland are highly innovative and provide a variety of payment options, while customers are quite eager to adopt new instruments. Contactless payments were implemented in Poland in 2009; at the end of 2018 all payment terminals had been adapted to support such payments. According to the data for the first half of 2021, 88.5% of all payment cards issued in Poland were equipped with the contactless function, and 95.8% of all card payments were carried out by this method. Card-based mobile payments were implemented in Poland for the first time in 2012. According to the most recent data, almost 7 million cards have been added to Apple Pay or Google Pay;[11] other solutions such as Garmin Pay are also present but less widespread. Several merchants operating in Poland have started to implement their own payment-enabling applications, based on tokenisation of cards (eg ORLEN Pay (2018), Lidl Pay (April 2020) or Żappka Pay (May 2020)).[12] Among non-card-based payment solutions, the most popular scheme is BLIK (launched in 2015), a Polish mobile payments system and payment scheme embedded in banking applications and covered by all major Polish banks. BLIK offers code-based payments online and code and contactless payments in store (contactless addition active since 2021), as well as ATM withdrawals and telephone number-based P2P transactions. In 2019, BLIK transactions became a more popular online payment method in Poland than payment cards. Other non-card-based solutions are available, such as Autopay, mPay or SkyCash, but they focus mainly on market niches, such as city and intercity transport tickets or parking fees. Finally, the "buy now pay later" offer has recently gained presence on the market, both in e-commerce and for in-store purchases. The ecosystem described above ensures that the payment options available are highly differentiated, suit various use cases and are used by customers according to their needs and preferences, with central bank money – cash – still playing an important role within the system.

Analytical work on the concept of CBDC issuance is not as advanced in Poland as it is in other EU countries, such as Sweden. However, the general assumptions regarding the future CBDC system are fully in line with the outcomes of international discussions. NBP views digital currency as a public good. Its issuance should address deficiencies, solve problems or remove failure that is market- or system-based and does not correspond to particular business activity. CBDC should also correspond to the real needs of Polish consumers. So far, no specific social purpose has been identified that the issuance of digital zloty would serve, and neither have cases of possible use of CBDC in situations that have not yet been satisfied by payment service providers in Poland.

CBDC as a digital form of central bank money, accessible to all (like banknotes and coins), could become the central bank's response to the demands of today's increasingly digitised world. As people start to change their payment habits and use non-cash instruments much more often than cash as their main means of payment, CBDC could maintain public access and full usability of central bank money, especially when cash usage falls below a certain, critical threshold. Therefore, the direction of

[11] See J Uryniuk, *Apple Pay i Google Pay trafiły pod strzechy. Klienci z Polski dodali do tych usług już prawie 7 mln kart*, 9 November 2021, www.cashless.pl/10914-apple-pay-google-pay-liczba-uzytkownikow-3-kw-2021-r.

[12] See Narodowy Bank Polski, *PayTech – innowacyjne rozwiązania płatnicze na rynku polskim*, 2020, a report on innovative payment solutions prepared by NBP, available at PayTech-innovative-payment-solutions.pdf (nbp.pl).

market changes in the country and the international situation require careful monitoring. Further involvement in the concept of CBDC issuance in Poland could also be justified by the development of alternative digital payment instruments, like foreign CBDCs and stablecoins, or by the risk of market monopolisation, especially by "big tech" companies. CBDC could also be launched in Poland as a backup solution to existing retail payment systems to be used in the event of a long-term failure (technical or other).

The potential risks resulting from the introduction of digital currency by NBP should be carefully considered as it is difficult to identify obvious benefits for the introduction of CBDC in Poland at the current stage of development of the Polish payment system. Digital zloty could support cash in playing its important role as a legal tender and a main means of payment for the unbanked or underserved and in the case of elderly people. It is, however, doubtful that it could increase financial inclusion. It is also unlikely that CBDC can compete with other non-cash payment instruments in Poland. There is no clear evidence that the introduction of CBDC will be a more efficient and cheaper solution than the current ones (eg with respect to the time and cost of settling payments and securities). This refers to wholesale but also to retail payment systems.

Depending on design and adoption, CBDC could have broad effects on the financial market. It should be expected that widely available digital currency (especially interest-bearing CBDC) would provide an alternative to commercial bank deposits. It would therefore affect the size of the deposit base in the banking sector, which is the main source of acquiring cheap and stable funds to finance lending activities. The issuance of a publicly available CBDC would lead to increased operating costs for commercial banks. Large-scale use of such a CBDC could result in structural change in the financial intermediation model by infringing the two-tier banking system. The introduction of a publicly available and interest-bearing CBDC would also bring about significant changes in liquidity and activity in the interbank market. The issuance of CBDC could lead to higher short-term money market interest rates. Moreover, in the case of financial market tensions, even a non-interest bearing CBDC, as a risk-free store of value, could pose a threat to financial stability. Should confidence in the banking sector decline, one would expect a rapid and large-scale transfer of deposits from commercial banks towards CBDC. This could threaten the functioning of individual banks and even the entire traditional banking system. As a consequence, it could become necessary for the central bank to grant refinancing loans to some banks.

CBDC could pose many challenges in terms of governance and the smooth functioning of a retail payment system operated by the central bank; new risks could emerge (eg to reputation) or some existing risks could significantly increase (cyber security). Due to the role to be played by the CBDC and the importance of the issuer as an institution of the highest public trust, the CBDC system must be designed with special care, maintaining safety standards and involving all stakeholders. The system introduced must operate effectively. Its introduction will be preceded by assessment of the benefits and costs of using digital currency in the context of the achievable balance between competitiveness, innovation, security and privacy. Once a positive decision is taken, the creation of a legal foundation for its issuance by the central bank will be required. It is necessary to exclude full anonymity in a future CBDC system for reasons of security as well as prevention of tax evasion, money laundering and terrorist financing. If introduced, CBDC will most likely be distributed through a public-private partnership. It is assumed that the central bank would provide the

critical infrastructure of the CBDC system, while the private sector would support further development of the system by offering innovative user-friendly payment solutions. This model makes it possible to preserve the two-tier banking system and the role of commercial banks as the main financial intermediaries in the economy. In order to achieve an easy flow of funds to and from other payment systems and arrangements, the CBDC system would need to be domestically interoperable. It would thus contribute to broader accessibility, resilience and increased payments diversity.

Widely available CBDC would be introduced in Poland as a payment instrument additional to banknotes and coins, not with the aim of replacing them, but as an alternative to existing cashless payment methods. The activities NBP has undertaken so far are aimed at making it possible for the consumer to decide on the form of payment, ie based on available options to indicate the form of payment preferred (taking into account, among others, habits, costs incurred, convenience, speed, trust). It should be clearly indicated that the introduction of innovative payment solutions, especially with the status of legal tender as in the case of CBDC, must not lead to an increase in the financial (and technological) exclusion of certain social groups (mainly the elderly or persons with various disabilities). NBP's aim is and should be to ensure conditions for the undisturbed use of central bank money (cash, and in the future maybe also the CBDC), while creating legal guarantees of its common acceptability.

NBP takes a prudent approach to the possibility of introducing digital zloty and does not currently choose to issue it, in the absence of any convincing justification. Prior to making a decision to embark on issuing a CBDC, NBP would need to assess the value of opportunities to further pursue its objectives, balanced against any risks. NBP's current position regarding the issuance of digital zloty may be modified if factors justifying such a change arise. NBP will closely monitor domestic and international developments in order to be ready to take action when required.

CBDCs in emerging market economies[1]

Key takeaways

- A two-tier retail model of the digital ruble will enable the Central Bank of the Russian Federation to take full advantage of the existing two-tier financial system and reduce clients' dependence on financial institutions.
- Overall, the introduction of a digital rouble will result in increased competition in the financial market, enhanced service quality and customer experience, as well as improved financial inclusion.
- The digital rouble will not affect the way the central bank implements monetary policy. Its current operating procedure will still allow it to achieve its monetary policy goals after the digital rouble is introduced.
- The digital rouble offers opportunities for improved financial sector efficiency and greater financial stability. Risks to financial stability exist but remain negligible.

Introduction

The past several years have been marked by rapid changes in the payments landscape, as well as a surge in research on central bank digital currencies (CBDCs). The motivations behind CBDC-related work vary across economies and depend on multiple factors. This paper contains a review of the key objectives of issuing a digital rouble, along with the main challenges for financial stability and monetary policy accompanying its introduction.

[1] The access of the Central Bank of the Russian Federation to all BIS services, meetings and other BIS activities has been suspended.

1. Main objectives of introducing a digital rouble

In recent years, many central banks have accelerated their research on CBDCs, with a number of them proceeding to more advanced stages and opting for different models, ie retail or wholesale CBDCs. In general, the design choices are determined by various policy objectives and shaped by local circumstances.

The Central Bank of the Russian Federation is among the central banks and other monetary authorities engaged in exploring and developing CBDCs. At present, the central bank is actively working on the digital rouble project. A digital rouble will be the third form of money issued by the central bank and will be the central bank's liability. Like other central banks around the globe, the Central Bank of the Russian Federation believes that the launch of a digital rouble will lay the foundation for a new payment infrastructure enabling a range of additional advantages for households, businesses and the state.

More specifically, the introduction of a digital rouble will help reduce clients' dependence on financial institutions, since customers will access their wallets through the infrastructure of any financial institution that holds their accounts. Moreover, transactions in the digital rouble will be charged under unified rules throughout the country and the cost will be minimal. Overall, these measures will be instrumental in increasing competition in the financial market, and improving service quality and customer experience.

Another key motivation for issuing a digital rouble lies in enhancing financial inclusion. The chosen model provides for maximum accessibility of the digital rouble for customers. The possibility of using it without internet access will allow for better financial inclusion, especially in remote and sparsely populated areas.

Furthermore, financial institutions will have the opportunity to develop and offer innovative financial services to households and businesses, particularly with the use of smart contracts.

The two-tier retail model has been selected as the target model for the digital rouble.

1. In Tier 1, the central bank:

- launches, maintains and develops the digital rouble platform;
- connects credit institutions to the digital rouble platform;
- defines the rules for carrying out transactions through the platform;
- issues digital roubles via the platform;
- ensures the creation of wallets for credit institutions and clients (individuals and legal entities) on the platform.

2. In Tier 2, credit institutions:

- engage and interact with clients;
- implement the procedures stipulated by the anti-money laundering/combating the financing of terrorism/countering proliferation financing (AML/CFT/CPF) legislation, and carry out client identification and anti-fraud checks for the purposes of foreign exchange control;
- create wallets on the digital rouble platform upon clients' instructions;

- execute payments and transfers via the digital rouble platform upon clients' instructions.

From a technological perspective, the central bank, based on its estimates, considers a hybrid IT architecture (consisting of both centralised system components and distributed ledgers) to be desirable during a test period.

With a view to securing client transactions, the central bank intends to develop a software module embedded in financial institutions' mobile applications and enable the digital rouble platform to interact with clients to confirm operations when they create wallets and deposit or transfer funds. Such a mechanism will ensure that digital rouble transactions are carried out only upon a client's authorisation.

Regarding the project's implementation stages it should be mentioned that a prototype of the digital rouble platform was developed in 2021 and currently its testing jointly with financial market participants is already underway. For this purpose a pilot group consisting of 12 banks was formed.

The development of the digital rouble platform is intended to be gradual. During the first stage, the plan is to start issuing digital roubles and to enable transfers between individuals. The second stage will launch more operational scenarios for households, businesses and the state, and enable the use of smart contracts. Subsequently, the central bank plans to introduce an offline mode and provide an opportunity to create wallets for non-resident clients, as well as to convert digital roubles to foreign currencies.

On balance, when considering the design of a CBDC, regulators may face a number of challenges, including those that concern monetary policy implementation, financial intermediation and financial stability, which will be touched upon below.

2. CBDC-related challenges for monetary policy, financial intermediation and financial stability

The emergence of a new form of money, besides the existing two – cash in circulation and bank deposits – will undoubtedly have an effect on monetary policy implementation, financial intermediation and financial stability. The magnitude of this effect will depend largely on the parameters of the digital rouble, including transaction and/or wallet size caps as well as its use by the public sector, eg for social security payments and other government expenditures.

The central bank is not planning to remunerate the funds in digital wallets. Therefore, the digital rouble will not be used as a monetary policy instrument. However, the introduction of a digital rouble will have an effect on how the central bank implements its monetary policy. Currently, the Russian banking sector is enjoying a moderate liquidity surplus. The central bank manages banking sector liquidity in a symmetric corridor framework, absorbing excess liquidity through its regular auctions. The digital rouble will likely drain liquidity from the banking sector, which will result in a shift to a liquidity deficit. However, both the central bank's approach to monetary policy implementation and the Russian banking sector are well adapted to such changes: during the periods characterised by a liquidity deficit over the last decade the central bank proved that it could retain control over short-term interest rates.

After a liquidity deficit emerges, the central bank will move from absorbing liquidity through deposits and bond issuance to providing liquidity through repos. If required, the central bank can expand its marketable collateral list, which currently contains only top-quality securities and, if need be, it can also initiate auctions for loans secured by non-marketable collateral. According to the central bank's estimates, the volume of potential collateral is sufficient to accommodate banks' demand for liquidity arising from the introduction of a digital rouble.

The switch to a liquidity deficit, in turn, will affect the position of the short-term money market interest rates in the central bank's interest rates corridor. Currently, due to small market inefficiencies the short-term rates have a predominantly negative spread to the central bank's main policy rate. The liquidity deficit means that the overnight money market rates will form in the upper end of the corridor. The factors behind the interest rates' spread to the policy rate are well researched, and once the liquidity situation is settled, the spread will stabilise at some level. Then, the central bank will be able to incorporate this spread into its policy rate decisions so as to set short-term rates on the desired trajectory.

During the transition period there might be some short-term interest rate volatility; however, this volatility is expected to be brief and its effect on the longer rates (and the economy in general) will be quite limited.

The liquidity drain may disproportionally affect large banks that rely more than others on cheap or free funds in their clients' current accounts, taking advantage, inter alia, of the network effect and their central role in payments. The profit margins of these banks will be compressed most prominently, which will even out the competition in the banking sector. Conversely, the banks offering their clients better conditions like remuneration of current accounts and other benefits will be able to attract clients more easily. Overall, since Russia is firmly in positive rates territory, a digital rouble will not compete with banks' liabilities as a means of saving, so the liquidity outflow from the banking sector will likely be moderate and will not result in any form of financial sector disintermediation.

The digital rouble will affect financial stability as well. On the one hand, the introduction of a new secure and sustainable means of payment will further promote financial stability as well as the emergence of new types of financial transactions such as transactions with automatic execution (smart contracts). On the other hand, the digital rouble could pose a threat to financial stability. In the event of an adverse external event a bank run could be facilitated by the existence of an extremely liquid (compared even to cash) and secure form of money. However, in reality such developments are unlikely, for several reasons. First, the central bank will establish transaction caps to ensure that clients cannot convert large sums from bank deposits into digital roubles at once. Second, the Russian banking sector enjoys much higher trust from the public than 5 or 10 years ago. In the previous periods of financial turmoil, the banks witnessed deposit outflows but even they were short-lived and manageable. With time, as both financial inclusion and the resilience of the payment system increases, the risk of "flight to safety" will further decline. . Finally, the central bank has a strong lender of last resort framework, under which the banks can quickly borrow liquidity from the central bank against a wide pool of collateral. So overall, the balance of risks and opportunities for financial stability is positive.

Due to the already high level of financial inclusion in Russia, the introduction of a digital rouble will not substantially affect monetary policy transmission. The efficiency of monetary policy may increase somewhat over the long term owing to

greater competition in the banking sector and enhanced financial stability. The decrease in transaction costs will improve economic efficiency. The overall positive impact from the introduction of a digital rouble will increase over time, as its usage increases.

Conclusion

Amid ongoing digitalisation of the financial markets and a rapidly changing payments landscape, central banks are stepping up their efforts dedicated to CBDC research and development. The Central Bank of the Russian Federation has work under way in this area too, as it is aspiring to achieve enhanced quality of products and services, increased competition and financial inclusion. Despite a number of possible challenges related to the introduction of a digital rouble, it provides opportunities for improved financial sector efficiency and financial stability.

CBDC and its associated motivations and challenges – Saudi Central Bank

Introduction

Technological progress, and its applications specifically in the financial sector, is resulting in higher adoption of digital services in addition to the considerable shift to cashless and contactless transaction methods. During the pandemic this has prompted central banks and financial institutions to examine even more closely the potential benefits of introducing a new form of central bank money through the issuance of central bank digital currencies (CBDCs). The ongoing shift from traditional economic transactions towards more data-driven and platform-enabled activities emphasises the importance of the digital economy. For the Kingdom of Saudi Arabia, promoting financial innovation is one of the key drivers behind researching and experimenting with CBDC use cases and investigating its related potentials and drawbacks and its alignment with the Saudi Central Bank's policy objectives as well as Saudi Arabia's Vision 2030 strategy. Many authorities around the world have meanwhile also launched CBDC-related efforts, including exploration of CBDC use cases and experimenting with different design approaches.

This paper provides an overview of the CBDC concept, as well as its different types and designs, sourced from international entities' studies and countries' experiences. The paper also discusses the main motivations behind issuing a CBDC and the difficulties and obstacles associated with CBDC issuance while highlighting Saudi Arabia's recent experience in the "Aber" project.

CBDC definition

Central bank digital currency (CBDC) is a digital payment and settlement medium denominated in the national unit of account that is a direct liability of the central bank. CBDC represents a third form of central bank money that coexists with the two other forms: banknotes and bank reserves. It is fully fungible, one-to-one at par with cash and central bank reserves. CBDC can be categorised into three main types: retail CBDC, wholesale CBDC and cross-border CBDC. In a simplified description, a CBDC would be equivalent to a digital banknote that could be used for two purposes: transactions and settlements by individuals and businesses in the case of a retail CBDC, and transactions and settlements between financial institutions only in the case of a wholesale CBDC.

The difficulties, challenges and potential benefits associated with CBDC

Legal and regulatory constraints

The legal and regulatory aspects are one of the key potential challenges associated with CBDC issuance. Current legislation in some jurisdictions may prevent or restrict the issuance of CBDCs. According to several central banks, they have the legal foundation to issue a CBDC, but the law still needs to be adjusted in order to regulate some legal issues related to CBDCs' specific features such as programmability.

Bank disintermediation

If it is not suitably designed, the issuance of a CBDC may have major consequences in terms of financial stability given that it may result in bank disintermediation and lead to serious implications for banks' core business. In view of the prominence of banking sectors in many jurisdictions, and their interlinkages with other segments of the financial ecosystem, such potential implications could spill over to the broader financial ecosystem and the real economy.

Technical challenges

Another major challenge is related to CBDCs' technical infrastructure and application. Many possible difficulties could arise at the technical level, for example relating to internet connectivity, especially in rural areas, interoperability with the existing systems, or cyber attacks.

Financial literacy

Financial literacy of the public is a serious challenge, especially for central banks whose primary objective behind issuing a CBDC is promoting financial inclusion. Even if a country's digitalisation in daily life and in the financial services industry has increased, this does not necessarily imply an increase in financial literacy among its population. It may make it even harder for specific segments of the population to access and use the new technologies and the related digital services which – if not properly managed – could result in financial exclusion of those segments.

CBDC types and designs

CBDCs can take on various forms or models, based on their application. The main models are retail CBDC (also known as general purpose CBDC), wholesale CBDC and cross-border CBDC. These models have potential benefits in acting as a catalyst for innovation and development of financial ecosystems.

Retail payments

A CBDC for retail applications enables real-time peer-to-peer (online and offline) transfers with instantaneous settlement, which could promote financial inclusion and

support a competitive and innovative payments landscape with digitalisation and a future-proof payments channel.

Wholesale payments

A wholesale CBDC can facilitate access for multiple financial institutions to a large-value payment system and support settlement for a digital financial market infrastructure. The potential benefits of this type of CBDC could include, but are not limited to: broader access to risk-free central bank money for large-value payments; supporting delivery-versus-payment and payment-versus-payment transactions; and enabling digitalisation of financial markets.

Cross-border payments

A cross-border CBDC could facilitate direct cross-border monetary relationships with other CBDC networks to be established under the supervision of central banks. The cross-border payments would aim to reduce risks and delays in cross-border transactions, disintermediate correspondent banking models, reduce costs and enhance financial market integration.

Motivations behind issuing CBDC

There are many general driving factors that motivate central banks to issue a CBDC, including the following:

Financial innovation:

A CBDC is about financial innovation, with the introduction of a new medium that serves as an enabler for a digital financial market. CBDC can be compared to the introduction of banknotes during the second half of the 19th century, aiming to bring new convenience to payments and responding to an evolving payments landscape to ensure central bank money will remain future-proof.

Access to central bank money:

In some jurisdictions, a significant decrease in the use of cash can be observed amid an increasing digitalisation of payments, reducing households' and businesses' access to risk-free central bank money. By issuing a CBDC, the central bank is offering a medium, with direct claim on the central bank, that can be used in digital transactions, thereby enlarging the scope of a digital currency's use. Additionally, a CBDC could be seen as a potential mechanism to provide an alternative and safe payment solution compared to the private money issued by non-bank issuers.

Payment diversity:

The diversification in payment methods implied by the adoption of a new medium would enhance choice and competition in the payments sector. Access to CBDC for

digital payments would make the safety of central bank money available to a broader range of payment applications, increasing overall system stability.

Financial inclusion:

The central bank could potentially promote financial inclusion by providing access to a digital means of payment for the unbanked population. Similarly, for the underbanked population, the CBDC could serve as the foundation for new and potentially cheaper financial services provided by the private sector. Fintechs, for instance, could build upon the CBDC infrastructure to provide cheaper services accessible to the portion of the population that does not have access to an extended range of financial services, e.g. due to costs.

Cross-border payments:

Cross-border payments may involve numerous participants/intermediaries, time zones and jurisdictions with varying regulatory requirements, which greatly increases complexity, making such transactions slow and costly to process. The functionalities offered by CBDC are likely to have their biggest impact on international payments. A CBDC infrastructure could be deployed in a foreign jurisdiction, or designed to integrate several jurisdictions or to be interoperable with other currency systems through participation of non-residents, direct connections between networks, or common technological standards applied to the networks.

Transparency and privacy:

A CBDC will bring new transparency to payments for the central bank. As all digital payments are traceable, it may also offer new approaches to ensure that needed prudential standards are met, including on the prevention of money laundering and the financing of terrorism. At the same time, digital payments will most probably have to comply with privacy norms, concerns and standards to acquire legitimacy, adoption and safety.

The Kingdom of Saudi Arabia's experience

Project Aber:

Project Aber was a collaboration between the Saudi Central Bank (SAMA) and the Central Bank of the United Arab Emirates (CBUAE) to explore the potential of a CBDC and distributed ledger technology (DLT). It was considered as one of the first cross-border CBDC projects. The primary goal of this initiative was to undertake a proof of concept for studying, understanding and evaluating the feasibility of issuing a CBDC involving commercial banks (wholesale CBDC) with a view to developing a cross-border payment system that would reduce transfer times and costs between banks. In addition, it aimed at experimenting with the direct use and actual application of technologies such as distributed ledgers. The wholesale CBDC was issued by SAMA and the CBUAE, used only by them, and by the commercial banks participating in the initiative as a settlement unit for domestic as well as cross-border

transactions between Saudi Arabia and the UAE. Over the course of a whole year, usage solutions were designed, implemented and managed. The solutions, results and main lessons learned were all documented in a Final Report that was published in November 2020.[1] Based on the project's outputs, the report aims to significantly enrich the knowledge content in this field, in addition to laying the foundations for future work to be explored in the coming years.

Conclusion

There are numerous key motivations for implementing a CBDC around the world, including fostering payment innovation domestically, allowing for a higher quality in payments in a cross-border context, and responding to the reduction in the use of cash by the general public. Despite the fact that the issuance of a CBDC is associated with numerous benefits, it is also associated with some potential risks such as legal and regulatory issues as well as technical challenges. In conclusion, while the majority of jurisdictions report similar motivations and challenges, CBDC has given central banks a new role in promoting financial innovation.

[1] www.sama.gov.sa/en-US/News/Documents/Project_Aber_report-EN.pdf.

Economic considerations for a retail CBDC in Singapore

1 The future of money is an active area of inquiry for authorities globally and, arguably, holds particular relevance for emerging market economies (EMEs). New forms of digital money can potentially enable greater payment efficiency, foster financial inclusion and accelerate digitalisation. At the same time, EME authorities should seek opportunities for efficiency and welfare gains by leveraging rapid global innovations in payments and money. Trade, financial and digital interlinkages between EMEs and the global economy will continue to deepen, setting the backdrop for greater use of foreign (digital) currencies in our economies. As part of the future monetary landscape, central bank digital currencies (CBDCs) are one option that policymakers are exploring.

2 **The global monetary and payment landscape appears to be on the cusp of far-reaching change.** Today, central banks and commercial banks are at the core of the two-tier monetary system. As Singapore's central bank, the Monetary Authority of Singapore (MAS) uses its liabilities to serve as money to the general public (physical cash) and to commercial banks (digital reserves). Commercial banks, in turn, provide their liabilities as another form of money (deposits) to households and businesses. These deposits facilitate electronic payments, which are ultimately settled on MAS' balance sheet. The impact of the ongoing digital revolution in finance – characterised by the emergence of new financial and payment business models, and novel general purpose technologies that could potentially bypass central intermediaries – challenges the two-tier status quo. Large swathes of commercial activity are also migrating online, and with this shift, the need for quick, seamless and low-cost digital payments has increased.

3 **One implication of the digital revolution is that the relevance of cash as a means of payment is diminishing.** Physical cash is already a small part of the stock of money in most advanced economies, including Singapore, but its disappearance from widespread use because of its incompatibility with the digital economy would still be perceived as an unprecedented shift in monetary arrangements.

4 **A further implication is that the market structure of payments may undergo a fundamental change.** Payments may no longer be the sole preserve of banks. As software and the internet pervade all aspects of commerce, a broad range of technology firms are integrating their digital services with payments. These new business models are unbundling payments from the traditional bank business model of lending and deposit taking, to produce seamless and innovative experiences for households and merchants. In the first instance, this raises the question of how the current bank-centric payment system must be adapted to reap the benefits of this changing payment landscape. However, powerful network and scale effects in these data-driven business models pose new risks as well. They may eventually lead to excessive market power, accentuated by the creation of closed-loop ecosystems that reduce contestability and increase fragmentation in payments and related digital services.

5 **The acceleration of digitalisation globally is also uniquely marked by the emergence of new forms of digital money.** These include CBDCs issued by central banks and stablecoins from large firms, which seek to address needs unmet by the current bank-centric payment system. These monies are primarily designed for retail use and many have the potential to cross borders, riding on the strong network effects of existing vehicle currencies and global platforms. They could be made easily accessible to businesses and households in Singapore and be underpinned by convenient ecosystems and high efficiency in payments. In a small, open and highly digital economy, the Singapore dollar could be vulnerable to being displaced by a widely used foreign digital currency. Prudential regulations can be used to defend against such an outcome, but only up to a point. If domestic payment efficiency and innovation in the long term failed to keep pace with global digitalisation trends and standards, the attractiveness of other foreign money would eventually prevail.

6 **An option that the central bank community has been considering in response to these developments is the issuance of a retail CBDC.** As with many jurisdictions, the starting assumption for the assessment of a retail CBDC in Singapore is that it would be facilitated via a public-private partnership, much as how Singapore dollar cash is issued and distributed today. MAS would issue the digital Singapore dollar, while the private sector would handle distribution and customer-facing activities, including compliance and know-your-customer checks. A retail CBDC would have to be held in electronic wallets, which would primarily be provided by the private sector. Unlike existing forms of digital Singapore dollars available to members of the public, it would be a direct claim on MAS.

7 **A retail CBDC would preserve the relevance of generally accessible central bank money as the economy digitalises. As a public digital payment alternative, it would help safeguard consumer and merchant interests as commerce moves further online**. Physical cash plays a key role for in-person transactions today – individuals and firms can turn to cash issued by MAS as a means of payment if the cost, speed or other qualities of private sector payment solutions fall short of their needs. Cash still makes up a meaningful share of transactions in Singapore, which studies attribute in part to high transaction costs that merchants continue to incur when accepting digital payments. As more commercial activity shifts towards the virtual such that physical cash is no longer a practical payment option, a retail CBDC would allow a public payment instrument to continue its useful role as a basic fail-safe alternative payment method.

8 Regulation would also be a means of ensuring that electronic payments meet the desired minimum standards in end user experience. For instance, MAS could stipulate the cost of electronic payments or how transaction privacy should be protected. Interchange fee caps in other jurisdictions have set some precedent for such regulation. However, there is a trade-off with highly prescriptive regulations that constrain business models and stifle innovation, leaving consumers ultimately with fewer choices.

9 MAS' progressive implementation of FAST, PayNow and SGQR[1] in collaboration with the industry over the past few years has been important in fostering greater interoperability and leaning against the build-up of "walled gardens" in payments. MAS has also significantly enhanced new entrants' access to core payment and banking infrastructures with the opening up of FAST and PayNow to eligible non-bank financial institutions, and the awarding of four new digital bank licences in 2020.

10 **A retail CBDC would go a step further by establishing a universally accepted digital medium of exchange in Singapore.** Given the intrinsic characteristics of a digital Singapore dollar issued by MAS – safe, liquid and widely accepted – it would reduce the need for new players in payments to build up their own e-money offering and a large merchant or customer base that accepts it. Instead, new entrants could integrate with the CBDC platform and offer new digital services around it. Startups and smaller firms would likely benefit most, given the high fixed costs associated with existing models of entry into electronic payments. There could also be greater innovation in "payment-adjacent" digital services as easier integration with the CBDC system would allow more firms to tap into payment data.

11 **To be sure, a retail CBDC that is elastically supplied and universally accessible just like cash is today could impact credit creation and, more broadly, financial and monetary stability in Singapore**. As a new form of money, any retail CBDC is subject to significant uncertainty over take-up. There is the possibility that economic agents will be attracted to a retail CBDC as a store of value and switch their holdings from bank deposits to it in large amounts. A significant outflow of retail deposits, which are a key source of low-cost stable funding for banks, would mean higher funding costs and liquidity risks for the banking system. Banks might choose to cut back on lending or raise lending rates to preserve their profit margins, which would result in tighter credit conditions in the economy if non-bank sources of financing are unable to step in to fill the gap. Alternatively, banks could absorb the rise in funding costs. However, lower profitability from banks' core intermediation business could then make them more vulnerable to shocks, reducing their ability to sustain credit flow and serve as anchors for the real economy during crises, as they have done in the past.

12 In the presence of an elastically supplied retail CBDC, systemic runs on the entire banking system are more likely to occur, and at greater speeds during times of financial stress. With the friction of converting bank deposits into risk-free central bank money (ie cash) greatly reduced, depositors are more likely to do so at the first signs of trouble.

13 Singapore could face more volatile capital flows, especially if the retail CBDC was universally accessible. A retail CBDC could make the domestic currency more attractive to non-residents given its advantages over existing forms of Singapore dollar money – holding costs of a CBDC will be lower than for cash, while being similarly free of credit risks, and possibly more readily available as compared to bank deposits.

[1] FAST is Singapore's real-time retail payment system, while PayNow is a central addressing service that allows users to initiate FAST payments through various proxies, including mobile phone numbers and national identification numbers. SGQR is a single standardised QR code for e-payments and combines multiple payment schemes into a single label.

14 It is worth noting that some of these risks to domestic credit creation and financial stability could also arise as major jurisdictions issue frictionless retail CBDCs or equivalent instruments, even if Singapore does not. This could occur, for instance, if there is substitution of domestic bank deposits to these digital monies in a crisis. Digital currencies issued by foreign central banks, or stablecoins fully backed by foreign safe assets (particularly central bank reserves), could be seen as substantively safer than bank money in Singapore during times of stress, while being potentially more easily available through digital channels than foreign bank accounts are today.

15 **With appropriate regulatory safeguards, the macro-financial risks posed by retail CBDCs can likely be made manageable.** Possible measures include financial disincentives or hard limits to prevent excessive CBDC holdings, as well as restrictions on the use of CBDC by non-residents. These risks could further be tempered by innovative design and technological solutions built into a new digital currency. Such safeguards should ensure that retail CBDCs serve primarily as a medium of exchange and not a major store of value.

16 **Overall, MAS' current view is that there is no pressing need for a retail CBDC in Singapore at this point in time**. Demand for cash domestically remains some way from the "minimum threshold" where concerns regarding the negative implications from the lack of cash in circulation might arise. Retail electronic payments are generally competitive, efficient and cheap, and innovation continues to flourish. Even as pockets of frictions and high costs remain, there are other initiatives in the pipeline to address them. The fundamental soundness of the Singapore dollar and its dominance in the domestic economy will also be a bulwark against any rapid move towards substitution with foreign currencies.

17 **Nevertheless, MAS recognises the possibility that retail CBDCs may offer innovative solutions in the future.** The gains from enabling greater innovation in payments and payment-adjacent digital services will grow as businesses continue to digitalise their operations. The case for a public payment alternative to protect end user welfare in digital payments will naturally strengthen as more payments move entirely online, and could be underscored if the market structure of electronic payments grows more concentrated and rent-seeking behaviour begins to emerge, as has already occurred in some jurisdictions.

18 **There is thus value in MAS embarking on the upstream technical work pertinent to the issuance of a retail CBDC.** The development of a retail CBDC system and its ecosystem is likely to be an extended and complex undertaking. Structural trends reshaping domestic money and payments have long runways and could accelerate unexpectedly. MAS and the financial and technology industries should begin to build up the necessary expertise and capabilities to issue a CBDC if the need arises.

19 **MAS' exploration of CBDC technology, in partnership with the industry, has the potential to generate transferable know-how that could benefit payment innovation more broadly.** Retail CBDCs have uniquely high requirements, of scalability, extensibility and reliability. They are thus a useful "high-water mark" to spur innovations around this payment trilemma, which could have spillover benefits to payments even beyond CBDCs.

20 Several other important areas remain to be explored, including a retail CBDC's regulatory, legal and operational aspects. Depending on its design and technology, there are both risks relating to money laundering, terrorism financing and tax evasion and the potential for authorities to combat them through the issuance of a CBDC. There are also broader, non-economic considerations, such as the citizenry's desire for continued access to public money and payment privacy.

21 **MAS notes that the adoption of next-generation payment technology and rails is in principle a distinct consideration from the issuance of a retail CBDC using such technology** – while there are likely to be synergies from having public money on next-generation rails, the latest technology could yield significant benefits even when applied to private liabilities. As such, MAS will continue to study other emerging forms of digital money that may utilise such technology, such as privately issued Singapore dollar-denominated stablecoins and synthetic CBDCs, on their own merits. MAS remains open to a range of possibilities for the future of money and payments, in parallel to the exploratory work on a retail CBDC.

22 **Trusted money and efficient payments are core public goods.** A high degree of public intervention in their provision is crucial in ensuring that payments are able to function smoothly and meet the evolving needs of society. MAS will continue to assess the role of public money in the growing sphere of digital payments, in conjunction with the regulatory, developmental and infrastructural initiatives already under way.

CBDCs in emerging market economies

Background

The request to the South African Reserve Bank (SARB) – and indeed all participating EME Deputy Governors – was for a "short paper (5–6 pages) on one or two aspects or questions listed in the draft agenda". While there are multiple questions listed, the five main aspects are as follows:

- Main objectives of introducing CBDCs
- Guiding principles of CBDC design and data governance
- Challenges of CBDCs for monetary policy, financial intermediation and financial stability
- CBDCs and financial inclusion
- Cross-border aspects of CBDCs

Although the SARB's note will touch on all five aspects listed above, particular attention will be paid to our reflections on the objectives of retail CBDCs and the cross-border aspects of CBDCs given the SARB's ongoing feasibility study and its participation in Project Dunbar respectively.

Overview of the SARB's CBDC research and exploration

The SARB has initiated projects in both the wholesale and retail CBDC space.

From a retail or rCBDC perspective, the SARB is continuing its research to practically investigate the feasibility, desirability and appropriateness of a CBDC as electronic legal tender, for general purpose retail use, complementary to cash. The objective of the feasibility study is to consider how the issuance of a general purpose CBDC will feed into the SARB's policy position and mandate. The SARB is working with two vendors to explore the different deployment solutions to unpack and understand the options and considerations for a retail CBDC in South Africa.

On the wholesale or wCBDC side, the SARB is currently finalising the second phase of an initiative called Project Khokha, which explores the technical, policy and regulatory implications of distributed ledger technology (DLT)-driven innovation in South Africa's financial markets. In our first iteration, Project Khokha 1 sought to trial interbank wholesale settlement using DLT, while Project Khokha 2 seeks to issue, clear and settle debentures on DLT using tokenised money. One of the key technical objectives of Project Khokha 2 is to explore interoperability in financial markets with multiple tokenised assets. We expect to publish our report on Project Khokha 2 during the second quarter of 2022. The report will guide the next phase in our strategy and inform our strategic direction in the wCBDC area.

From a regional payments perspective, the SARB currently operates the real-time gross settlement (RTGS) system for the Southern African Development Community (SADC), or SADC-RTGS, which was originally established in part to support and facilitate trade in the region among member countries. The SADC-RTGS is supported

by a well-established legal framework primarily based on rules, operating procedures, contractual agreements, laws and regulations. Thus, our experience in operating a centralised platform for settlement of cross-border obligations between participants in the SADC region means that we are well positioned to participate in Project Dunbar.

Project Dunbar brings together the South African Reserve Bank, Reserve Bank of Australia, Central Bank of Malaysia and Monetary Authority of Singapore with the BIS Innovation Hub to test the use of CBDCs for international settlements. In line with this objective of promoting regional trade, cross-border CBDC interoperability and usage from a regional perspective may have the potential to make cross-border payments faster, cheaper and safer, and therefore stimulate trade and economic activity more broadly in the Southern African region. Given the SARB's role in the SADC-RTGS, any considerations around CBDC would necessarily require careful reflection on the potential repercussions from a regional perspective – both positive and negative. What Project Dunbar is usefully highlighting and eliciting debate on at a global level is that there is some form of emerging convergence towards a common appreciation that exploring the potential benefits of a shared, multilateral and multicurrency CBDC (ie mCBDC) is a natural next step on the broader CBDC journey.

Potential advantages of CBDC issuance and SARB views on CBDC

Like many central banks, the SARB's motivation for experimenting with CBDC is based on several factors.

First, we acknowledge that the world is changing. Technology now enables central banks to make central bank money, in particular cash, available in digital form. In order to evolve and continue to provide trusted money to the public in a digitised world, it is important for central banks to explore the feasibility of a CBDC.

Second, notwithstanding South Africa's sophisticated banking and payment systems, it remains a highly unequal society with a large informal sector and unbanked population, with limited access to financial services. In many rural areas, access to bank branches, physical point of sale payment devices or automated teller machines to acquire cash is severely limited. Although the use of technology and increased competition in the provision of payment services has improved financial access in South Africa, there is still much scope for improvement. A CBDC could potentially provide complementary central bank money to the public to support a more resilient and diverse domestic payment system, in a way that deepens financial inclusion for individuals.

Third, from a South African perspective, the exploration of a CBDC has less to do with the fact that the demand for physical cash is declining; indeed, the demand for cash in South Africa continues to grow. Part of our exploration of a CBDC is to consider whether it potentially provides a catalyst for new and innovative solutions that can potentially assist in solving the problems associated with the lack of interoperability between existing closed loop digital payment systems and other payment channels, both public and private, and both domestically and across borders.

At this stage, the SARB is exploring a digital version of cash denominated in the national unit of account that represents a liability on the SARB's balance sheet, no

different from actual money or cash. As we continue to explore the feasibility, desirability and appropriateness of a CBDC, we remain cognisant of the related work being done by our National Payment System Department to improve and modernise our payment system in order to follow a holistic and integrated approach.

SARB insights and takeaways from running the SADC-RTGS

One of the main challenges the SARB has faced in operating the SADC-RTGS is how to move from a single currency settlement system in rand (ie all participating central banks have rand accounts with the SARB, and settlement takes place in rand) to an actual multicurrency settlement system. In the SARB's experience of operating the SADC-RTGS, the two key challenges in migrating to a true multicurrency regional settlement system – and which are likely to manifest in a multilateral, multicurrency CBDC arrangement – are: (1) ensuring and maintaining adequate liquidity in several currencies across several borders, with the problem being exacerbated as the number of currencies and jurisdictions involved increases; and (2) answering the key question of how to create a system or solution that does not simply replicate the challenges experienced in the correspondent banking model, ie where the central bank is positioned as the intermediary, similar to the role played by commercial banks in the correspondent banking model, resulting in slow and costly cross-border payments.

Similarly, one of the SARB's key insights from operating the SADC-RTGS is that the establishment of a centralised settlement system with participation from various jurisdictions requires extensive coordination and collaboration to address the various technical, operational, legal and governance challenges. While there is a growing appreciation that the technology can be harnessed to make multilateral, cross-border payment system interoperability feasible, moving from a prototype to an implementable solution requires further work around the various operational, policy and legal elements. Thus, a gradual and systematic approach, with realistic and achievable smaller milestones along the way, allows central banks and other relevant stakeholders and role players to be part of the solution and can lead to greater levels of interoperability from inception.

Through its participation in Project Dunbar, the SARB intends to continue exploring whether DLT could assist in creating an appropriate multilateral platform for solving some of these well recorded challenges, particularly around ensuring appropriate liquidity in all relevant currencies on the multilateral platform, and then exploring how a multilateral platform could provide an appropriate solution for integrating different countries' CBDCs.

Moving fast and not breaking things

Central banks are often asked whether they are moving fast enough, but possibly the question may be "are central banks moving cautiously enough, given the complexity of the issues in a rapidly changing ecosystem"? Given that CBDC generally remains broadly uncharted territory, and mCBDC even more so, coupled with the high stakes involved, proceeding with caution might be the most appropriate, and definitely the most prudent, option. Changes in the payments environment generally take time to

implement, thus underscoring the need to get it right the first time, as central banks do not get many opportunities to redo things. As a result, gradual, incremental progress is preferable in the mCBDC context, and Project Dunbar therefore comes at a particularly opportune time to explore mCBDC.

From the SARB's perspective, we agree strongly with the BIS position that money remains a public good, the fundamental supply of which should continue to be controlled by public institutions such as central banks. In the wholesale space, central banks provide a riskless settlement option to financial markets and it should continue to explore how it continues to do so in tokenised markets. Through its ongoing research into and exploration of CBDC, the SARB aims to continue to provide a strong platform on which the private sector can build and innovate.

Hands-on CBDC experiments and considerations – a view from the Bank of Thailand

Vachira Arromdee and Tunyathon Koonprasert[1]

Main objectives of introducing CBDC

The rapid development of financial technology has initiated wide-ranging dialogues and considerations on the appropriate architecture for the financial system. For many central banks, the challenge lies in how best to harness the benefits of technological advances while minimising risks. At the Bank of Thailand (BOT), we believe that technology can help address long-standing pain points within the wider financial system, especially in terms of improving efficiency, access and inclusion.

Central bank digital currencies (CBDCs) are one promising form of technology-enabled money that we believe has the power to change the future financial landscape. The BOT foresees CBDC as a having the potential to: 1) become a reliable and trustworthy digital form of central bank money to better serve consumer needs in an increasingly digital economy; and 2) provide the foundation for Thailand's future financial infrastructure. Leveraging upon the CBDC infrastructure, private sector participants could potentially build diverse and innovative financial services. CBDC could lay the groundwork for interoperability and close collaboration with banks and non-banks alike to usher in a new era of financial innovation in Thailand.

CBDC journey and experiments

With the above objectives in mind, the BOT has been a fast mover in researching and developing CBDC through continuous engagement and cooperation with industry partners as well as other central banks. Our CBDC journey began in 2018 with Project Inthanon, where we joined hands with eight domestic commercial banks. In Inthanon Phases 1 and 2, we developed a proof of concept (PoC) for a real-time gross settlement (RTGS) system using distributed ledger technology (DLT), which was able to successfully carry out basic payment functionalities within the interbank market, as well as more complex and innovative features using smart contracts.

In Phase 3, Project Inthanon-LionRock, the BOT joined hands with the Hong Kong Monetary Authority to develop a PoC cross-border corridor network, where funds transfers between Thai and Hong Kong banks can occur instantaneously on a P2P basis, eliminating settlement risk. Our design also allowed for FX price discovery in the corridor network, enabling on-demand FX conversion and settlement.

[1] Vachira Arromdee, Deputy Governor, Corporate Development, Bank of Thailand.

Tunyathon Koonprasert, Senior Specialist, Digital Currency Team, Bank of Thailand. Email: DigitalCurrencyTeam@bot.or.th.

After the completion of Inthanon-LionRock, we wished to scale our corridor network to include more currencies and jurisdictions to simulate real world conditions as best as possible. Therefore, in early 2021, we welcomed the Digital Currency Institute of the People's Bank of China and the Central Bank of the United Arab Emirates and embarked on an extension of Inthanon-LionRock, renamed as the m-CBDC Bridge project, or mBridge for short. The project is supported and overseen by the BIS Innovation Hub Hong Kong Centre. Going forward, mBridge will continue to explore and conduct experiments to resolve existing limitations of the current system, related to privacy controls, liquidity management and the scalability and performance of DLT in handling large transaction volumes. In addition, mBridge will incorporate policy requirements and compliance with jurisdiction-specific regulations into the system, along with laying down appropriate governance for a more complex structure and controls.

Since early 2021, the BOT has also been actively exploring retail CBDC alongside our wholesale projects. After collection and consideration of industry feedback, we have successfully completed a PoC for a retail CBDC prototype. In the next step, we expect to launch a small-scale pilot in the second half of 2022 to test the prototype's performance in a real-life environment as well as collecting data on user behaviour patterns and feedback, which will be important steps towards fine-tuning the CBDC design for future wider adoption and mitigating any risks involved.

Guiding principles for retail CBDC design

Retail CBDC must be designed to be beneficial for Thai citizens and appropriate to the Thai context. The design must not result in adverse effects on monetary policy or overall financial stability. In this regard, the following design characteristics for retail CBDC are most suitable:

1. Should be cash-like and accessible by all segments of the Thai population to conduct financial transactions, while also considering those without internet access.
2. Should not impose any financial costs on end users and should be open to all participants willing to build innovative financial services on top of it, such as programmability features.
3. Intermediaries, such as financial institutions and financial service providers, should be able to distribute retail CBDC given their expertise in know-your-customer (KYC) processes with businesses and retail consumers.
4. Should not bear interest and should have certain holding or conversion limits to prevent bank runs during distressed periods and money laundering.

   Should utilise the advantages of both centralised and decentralised technology, as centralised technology can support large volumes of transactions while decentralised technology can provide greater resiliency with cryptographic techniques to enhance security.

Implications for monetary policy and financial stability in Thailand

Money supply and central bank balance sheet

We predict that future widespread public adoption of retail CBDC may affect the money supply in the economy and the central bank's balance sheet, but these impacts will probably be limited. If retail CBDC were to widely replace cash, the amount of money issued by the central bank (monetary base) would largely remain unchanged. However, if retail CBDC were to widely replace e-money, the monetary base would expand. Deposits of e-money service providers held at financial institutions would be converted to retail CBDC, resulting in smaller proportions of privately issued money. Regardless, the overall money supply in the system (the total amount of money issued by the central bank and private sector) would remain unchanged.

It is worth noting that the issuance of retail CBDC may change the composition of the central bank's and financial institutions' balance sheets. However, given the expected gradual uptake, they would have time to adapt to these changes.

Monetary policy transmission

The issuance of retail CBDC would help maintain monetary policy effectiveness by enhancing the efficiency of fiat money. If the usage of alternative digital currencies as money becomes widespread, the role of central bank money in the economy and the role of financial intermediaries in the future may be reduced, affecting monetary policy effectiveness. Central banks around the world are exploring ways in which retail CBDC, equipped with programmability features, could enhance monetary policy transmission or become a new monetary policy tool given some limitations of the current tools. For instance, tying retail CBDC remuneration to the central bank's policy rate could improve transmission to financial institutions' interest rates. However, the pros and cons must be carefully assessed further.

Financial stability

The BOT emphasises the following key risks associated with CBDC:

1) Liquidity risk: rapid and large conversions of deposits to retail CBDC that may lead to panic runs among depositors and ultimately impact financial institutions' liquidity should be prevented. Measures must be established to mitigate this risk, such as setting conversion limits or increasing liquidity assistance channels for financial institutions.

2) Disintermediation risk: retail CBDC must not disintermediate the role of financial institutions. Disintermediation may occur when consumers convert large amounts of deposits into retail CBDC, reducing deposit funding or raising financial institutions' costs of funds and hence also increasing the costs of their lending to businesses and consumers. However, this risk is low as total deposits of the Thai financial institutions system have consistently exceeded total loans, reflecting financial institutions' ability to extend further loans. In addition, we

anticipate that the general public would still prefer to hold deposits with financial institutions to earn interest and access other financial services.

Cross-border aspects of CBDC

There are multiple policy challenges if CBDCs are to be used across borders. The first and foremost challenge will be how to address the implications for capital flow management and how to establish safeguard measures to protect each jurisdiction's monetary sovereignty. Specifically, requirements should deter local CBDCs from being internationalised by foreign players, as well as limiting the amount of foreign CBDC usage in domestic markets to prevent currency substitution.

In addition, many central banks are now involved in multiple-CBDC network projects, similar to the mBridge Project mentioned above. For such projects, central banks will have to work together closely to find how to incorporate the many diverse jurisdiction-specific compliance regulations and formats, how to achieve privacy and liquidity provision requirements when there are more currencies involved, and how to establish a robust governance structure, appropriate participation criteria and an incentive/fee model. The success of these projects will ultimately depend on network effects and their ability to interoperate with payment rails across many jurisdictions.

View on CBDCs – Central Bank of the Republic of Türkiye

This paper provides an overivew of the latest developments in **payment ecosystems, and specifically central bank digital currencies (CBDCs).**

Payment ecosystems are the fastest-changing area relevant to the societal functions of central banks. A resilient and competitive payment ecosystem has become another important pillar among central banks' main responsibilities. This trend has been supported by rapid development in information systems and mobile technologies which provide lower costs and scale economies enhancing the efficiency and reach of financial services.

Compared to advanced economies (AEs), many emerging market economies (EMEs) have a relatively less developed financial sector and a larger percentage of financially excluded population. If properly utilised, innovative technologies can provide EMEs a chance to leapfrog in financial services digitalisation. Thus, it is important for central banks and the regulatory community to keep track of current developments and to keep regulatory frameworks up to date and adaptive to leapfrog potential.

With the digitalisation of economic activity continuing to accelerate faster than non-adaptive payment methods can evolve, instant payment systems (IPS) and central bank digital currencies (CBDCs) have risen up the agenda of central banks. As societies demand safe, efficient and 24/7 instant payments, central banks cannot ignore new technologies. In our case, we responded to the urgent need to design, develop and operate an IPS by launching an in-house system, called FAST, in January 2021. FAST has become so popular that 15.6 million customers had used it to initiate instant payments via a national ID number, phone number or email address within 12 months of its launch.

In recent years we have also noticed that although quantitative and digital data collection has become the new norm in central banking, the technical capacity to mine the data has not caught up with the expectations. Analytical tools have not matched the speed of data accumulation. It has looked like there was a bottleneck in human resource capabilities.

This encouraged us to make a change to turn challenges from technological developments into opportunities. We felt that the gap between the massive data pile and limited data processing capacity could be closed with a renewed approach to human resource management. Therefore, we established a new department that is totally dedicated to innovation. Then we moved beyond the traditional central banking human resource strategies and hired from an area that is not typical for central banks: engineers.

We decided to increase our efforts to experiment with the limits of technologies by utilising technologies such as blockchain, which are emerging fast with potential to play a role in payments. We define our basic strategy as managing the change in our favour to catch up with the most efficient and effective strategies for digitalisation of payment services.

Enabling cheaper cross-border payments is one area where desperation for innovation is so high. Higher global trade and investment with lower costs is critical

for Türkiye's future economic potential. We support rule-based free trade and investment. We also support cheaper payments to eliminate payment cost barriers to trade and investment.

BIS initiatives already cover decreasing the cost of cross-border payments through instant payments. The focus should not only be kept on one type. CBDCs as a complementary alternative should also stay on the agenda. As far as the final aim is to close any gap on cheaper payments for cross-border trade and investment, the BIS should stay in the field to encourage all sorts of initiatives along these lines.

We appreciate the BIS initiatives such as Project Nexus and Project Dunbar, implemented in order to cover key issues and challenges in achieving interoperability in IPS and CBDCs. These projects present a useful analytical framework for addressing issues around multilateral cross-border retail payments. We welcome all kinds of initiatives to create a compatible payment system infrastructure to support free trade and investment for all.

One problem that will stay with us longer than expected seems to be interoperability. We are conducting extensive research on this issue and one of our findings is that empowering interoperability speeds up with the direct involvement of regulators. Fintech companies enjoy a clarified roadmap for background work and maximise innovative capacities with preset standards.

In order to speed up the adoption of interoperability, one strategy is to support emerging open banking strategies. We are conducting extensive research in this particular area as well: our internal research findings on a successful launch of open banking identified six pillars, including: standardised application programming interfaces (APIs) and shared platforms; IPS; public-private partnerships; public governance; mandatory provision of APIs; and specific licensing regimes. The first three components support "fast penetration by design". The remaining three are related to the "governance of an open banking system''. Analysis of these six parameters encourages optimal conditions for open banking to function smoothly as well as in harmony. To capture the true potential of open finance, direct involvement and governance by regulators is going to play a critical role.

In the Turkish case, we announced Turkish QR code standards in advance. Private initiatives welcomed our strategy. We see this as a good example of public-private partnership to speed up adoption.

Sustaining national interoperability is no panacea for cross-border transactions. Domestic APIs cannot close the gap. We need global initiatives to set the standards. We need to maintain transparent data-sharing to empower cross-border payments without any inconvenience under democratic data flows.

Almost every day, we see a new cryptocurrency proposal coming to the cross-border payments ecosystem, most probably due to unobservable gaps in the global payment digitalisation market. Also, with the side effects of the Covid-19 pandemic, ever increasing digitalisation of life is the new norm. Payments have to follow the same level of digitalisation. Public-private partnership is the right option to close the gap between the speed of digital life and digital payments.

In order to improve international cooperation while considering jurisdiction-specific conditions and circumstances, the BIS should increase activities around the Innovation Network. In this context, Innovation Hub activities should be supported.

Central banks need to face the challenges of digital life as the new norm. Our staff need to adapt as well. One way of sustaining public-private partnership synergies to solve problems globally is to support the BIS as the umbrella institution. The BIS can make the adjustments that fit us all best. This will surely be the globally optimal solution to our joint problems with regard to global cross-border retail payments in the digital age.

As regards our CBDC initiatives, we have not yet reached a final decision regarding the issuance of a digital Turkish lira. We are continuing our research on the potential benefits of introducing a digital Turkish lira to complement the existing payments infrastructure. Our basic proof of concept study regarding existing technologies is already completed.

All our research follows the patterns and principles of experimental R&D utilising a technology-agnostic approach. After assessing the capacity, scalability, interoperability and resillience of different technological alternatives, we will finalise the architectural setups. Finally, we will decide whether the existing technologies can meet the economic, legal and financial requirements of the digital Turkish lira. The results of our first phase initiatives will be announced in 2022 after our tests are completed.

The next stage is the participation of our technology stakeholders. For this purpose, we have signed bilateral memorandums of understanding with ASELSAN, HAVELSAN and TÜBİTAK BİLGEM, technology companies with very effective and efficient talent pools, and established the "Digital Turkish Lira Collaboration Platform".

We will first develop a prototype "Digital Turkish Lira Network". Then, we will run limited closed-circuit pilot tests with technology stakeholders. Based on the results of those tests, we will proceed to advanced phases to reflect a broader participation. We also plan to carry out tests that may diversify the coverage of the digital Turkish Lira project. We will look into areas such as blockchain technology, the use of distributed ledgers in payment systems, and integration with IPS.

We need to remember that only sovereign money in the form of cash enables real-time payments with ultimate finality. Cash as banknotes and coins provides unconditional finality of debt or due payments. This is a societal function of money that no other alternative can fulfil yet. However, cash also represents a perfection with a limitation: it simply does not function in a fully fledged digital economy. We are not aiming to replace cash but compliment it.

Central banks need to adapt to the changing market dynamics. Governments, households and corporates demand safe, resillient, efficient and 24/7 instant payments with finality.

We have been developing our skills to adapt to the speed of change in the technology. During the technical design and development of our fast payment system, we considered the future requirements as well as today's payment capabilities. We relied on certain facts: payments should be made available in the recipient's account within seconds; the system should scale well against annual volume growth; peak times should be taken into consideration; the scheme should be independent of the existing payment systems; there should not be any strict vendor or product dependency; and the system should be robust, secure and continuous, and operate seamlessly on a 24/7 basis.

We also identified three critical areas to improve on our instant payments: first, technologies for offline payments; second, integration of a digital Turkish lira; and

third, working models for connecting all of these into a single cross-border platform. Our aim is to enable international payments instantly.

The challenge is not only national but also international. And the job is not done yet. The gap is still there. It will stay there until we can operate a fully fledged digital payment infrastructure, nationally, regionally and globally. We need to guarantee digital payments which are perfectly compatible with the fully digital way of life. We need to work together until all stakeholders' expectations from central banks are delivered once and for all.

CBDCs in emerging market economies

1. Introduction: the Central Bank of the United Arab Emirates (CBUAE) in the global CBDC environment

Currently, 86% of central banks are exploring CBDC use cases. Based on our recent research, there are 76 existing CBDCs from 67 jurisdictions around the world who are involved in the CBDC exploration journey. Within these 76 CBDCs, there are 11 consortiums, and CBUAE is proud to be involved in two of these, namely the "Aber" project and the "mBridge" or Multiple CBDC Bridge project.

The "Aber" project was a CBDC project jointly conducted by CBUAE and the Saudi Central Bank (SAMA) as an innovative initiative which was considered one of the first of its kind internationally at the level of central banks. This initiative aimed to provide a proof of concept to study, understand and evaluate the feasibility of a digital currency being issued jointly by central banks (wholesale CBDC) with a view to developing cross-border payment platforms and reducing transfer times and costs between banks, as well as experimenting with the use of technologies such as distributed ledgers. The wholesale CBDC was fully covered and issued by CBUAE and SAMA and was only used by the two central banks and the banks participating in the initiative, as a settlement unit for domestic as well as cross-border payment transactions between the United Arab Emirates (UAE) and Saudi Arabia. A final report was issued on 29 November 2020.[1] We were also honoured to be awarded the 2021 Global Impact Award for this first-of-its-kind cross-border payment initiative in June 2021.[2]

The "mBridge" project is for international payments and involves collaboration among a number of central banks, including the BIS Innovation Hub (BISIH) Centre in Hong Kong SAR, CBUAE, the Hong Kong Monetary Authority (HKMA), the Bank of Thailand (BOT), and the Digital Currency Institute of the People's Bank of China (PBoC). The early results of the mBridge prototype indicated substantial improvements in cross-border funds transfers from an average of three to five days to near real-time cross-border payment.[3] In addition, the potential to reduce several of the core cost components of correspondent banking[4] was identified. The project at present involves 22 private sector participants. A report was published to explore 15 potential use cases during Hong Kong Fintech Week, a global event held from 1–5 November 2021 in Hong Kong SAR. The mBridge project is currently progressing in a satisfactory manner, and CBUAE looks forward to continuing close collaboration with the BISIH and peer central banks, with the mutual objective to deliver better,

1 See CBUAE and SAMA, "CBUAE and SAMA issue report on results of joint digital currency project "Aber"", 29 November 2020, www.centralbank.ae/sites/default/files/2020-11/CBUAE and SAMA Issue Report on Results of Joint Digital Currency Project Aber_EN.pdf.

2 See CBUAE, "CBUAE and SAMA awarded the 2021 Global Impact Award for their first-of-its kind cross-border payment initiative Project Aber", 16 June 2021, www.centralbank.ae/sites/default/files/2021-06/CBUAE_Global Impact Award_Project Aber_Press Release_EN.pdf.

3 Near real-time is defined as less than 10 seconds.

4 See BIS Innovation Hub, Inthanon-LionRock to mBridge: building a multi CBDC platform for international payments, September 2021, www.bis.org/publ/othp40.pdf.

faster, safer and more cost-effective means of international funds transfers. CBUAE would like to take the chance to express our appreciation to the BISIH and peer central banks for the project's ongoing robust progress through successful collaboration and strong teamwork in the consortium.

2. Main objectives of introducing CBDCs

The main objectives of our participation in the mBridge project are to create more efficient and innovative infrastructure to reduce obstacles and address the pain points of cross-border payments, including high costs, lack of transparency, low efficiency and other operational complexities.

Currently the global nature of Covid-19 and its impact on e-commerce continues to encourage the strengthening of international collaboration and further development of policies for online purchases and supply.[5] On the other hand, the global digital payment market is also growing, and expected to grow through 2023 at the rate of 20%.[6] It is important for CBUAE and other central banks to explore potential solutions for a more resilient payment infrastructure that allows both individuals and businesses to make fast, yet efficient and reliable payments, and at the same time to benefit from an innovative, competitive and inclusive payment system.[7] CBDC provides a potential solution which can be built alongside other existing payment systems, eg real-time gross settlement (RTGS) and private sector initiatives, to continue enabling and supporting the private sector to create choices for markets.[8] Most importantly, while CBDC can be a building block for more resilient and efficient cross-border payment, it should be carefully regulated to allow more secure and trustworthy means of payment services for individuals and businesses.

It is also crucial to note that any CBDCs would also have important public policy implications, including for monetary policy and financial stability, legal and governance frameworks, and data privacy, operational resilience and cyber security.[9]

CBUAE is well aware of the many benefits that both retail and wholesale CBDC can bring to the table. Retail CBDC will essentially establish a direct connection with consumers; it has the potential to minimise effort and processes for governmental and commercial activities.[10] Wholesale CBDC will have the potential to create a faster and more secure payment and settlement system across different local and international banks, as well as directly linking securities, FX features, settlement on

5 See www.businesswire.com/news/home/20210604005270/en/Digital-Payments-Market-Report-2021-Transaction-Value-was-5.44-Trillion-in-2020---Global-Growth-Trends-COVID-19-Impact-and-Forecasts-2021-2026---ResearchAndMarkets.com.

6 See The Business Research Company, "Increasingly being used to curb the spread of Covid-19, digital payments market to reach a whopping $5.4 trillion in 2020!", 7 May 2020, www.thebusinessresearchcompany.com/press-release/digital-payments-market-size.

7 See Bank of England, "Central Bank Digital Currency: opportunities, challenges and design", Discussion Paper, March 2020, www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper.

8 Ibid.

9 See Group of Seven, *Public policy principles for retail central bank digital currencies*, October 2021, www.mof.go.jp/english/policy/international_policy/convention/g7/g7_20211013_2.pdf.

10 See "CBDCs: A Monetary Highway to Hell", www.hustleescape.com/cbdc-advantages-disadvantages/.

OTC markets, etc, while syndicated lending and trade finance could also experience enhanced speed.[11]

3. Guiding principles of CBDC design and data governance

Given policy objectives, should a retail CBDC architecture be "intermediated", "hybrid" or direct? How should competition among payment service providers (PSPs) factor into design considerations?

CBUAE envisions a retail CBDC model to be an "intermediated" architecture in a two-tier distribution model, where detailed retail transactions and balances are maintained at the intermediary level (banks and PSPs), and the central bank maintains only the wholesale payments of individual intermediaries. Since there is quite a significant decoupling between the wholesale and retail ledgers in this architecture, the detailed records of retail transactions and balances are maintained by the respective intermediaries,[12,13] the principle to segregate exists and may ease the operational burdens on central banks, which also lowers the responsibility to safeguard user data and provide better cyber resilience.[14] The two-tier distribution model has substantial benefits over a single-tier system as it allows central banks and private sectors to work in a complementary way, each doing what they do best, eg the central bank providing stability and guarantee of value while the private sector executes consumer-facing services and is responsible for innovation, maintaining the accuracy of the retail balances, and handling various complex and paperwork-intensive operational processes such as know-your-customer (KYC) and anti-money laundering (AML).[15]

In terms of PSPs, it is worth noting that the UAE has an increasingly digitally savvy population, with smartphone penetration reaching 80–90% in leading markets, while at the same time consumer digital payment transactions have grown at an annual rate of around 10%, and are currently accelerating further due to the pandemic, which is shifting consumers more towards contactless payments. In addition to the issuance of four payment regulations by CBUAE to facilitate payment industry innovation and development (the Stored Value Facilities (SVF) Regulation,[16] the Large-value Payment Systems Regulation, the Retail Payment Systems Regulation, and the Retail Payment Services and Card Schemes Regulation), there has also been a recent rise of fintech

[11] See Finextra, "Towards a central bank digital currency: retail versus wholesale", 26 July 2019, www.finextra.com/blogposting/17556/towards-a-central-bank-digital-currency-retail-versus-wholesale.

[12] See R Auer R and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", *BIS Working Papers*, no 984, June 2021.

[13] See Bank for International Settlements, "CBDCs: an opportunity for the monetary system", *Annual Economic Report 2021*, June 2021, pp 65–95.

[14] See Hong Kong Monetary Authority, *e-HKD: A technical perspective*, October 2021, www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/e-HKD_A_technical_perspective.pdf.

[15] Ibid.

[16] See Simmons & Simmons, "New UAE regulations for payments providers and card scheme operators", 29 July 2021, www.simmons-simmons.com/en/publications/ckroryt8u176h0a53deo3qbrx/licensing-scheme-for-uae-payments-providers-and-card-scheme-operators.

companies aiming to provide more niche financial services such as digital KYC services to prevent financial crime. Having identified this active and competitive environment in the UAE, the "intermediated" architecture caters for a more inclusive ecosystem with the PSPs, allowing opportunities for growth and innovations in the fintech space as well as the private sector.

How would CBDC (public money) coexist with commercial bank money (private money) as well as electronic money (eg stored value, liability of a regulated non-bank payment company, such as stablecoins)? What would be the regulatory framework for these three categories of money?

In contrast to CBDC (defined in section 1), commercial bank money is described as the portion of a currency which is made of book money – debt generated by commercial banks – and poses as a liability to the commercial bank, such as loans, certificates of deposit and savings accounts.[17] In recent years, various forms of money have emerged which exist purely in computer systems or distributed ledgers, such as payment tokens (which typically use decentralised control as opposed to a CBDC[18]) and stablecoins (a digital asset designed to maintain a stable value relative to a national currency or other reference assets[19]).

In Section 2, we mentioned the importance of enabling a competitive and inclusive payment system that is able to meet payment needs and foster market growth.[20] However, central banks also need to ensure adequate consumer protection and prevent undesirable impacts on monetary policy and financial stability, and proper regulations on such development would be important.[21] While CBDCs will be issued and regulated by central banks when launched, all other forms of money should also be subject to proper regulatory oversight, depending on their classification as assets, securities, or even money market funds.[22] A balance would need to be struck between encouraging diversity and competition within the ecosystem, and maintaining sufficient regulatory standards for private service providers.[23]

How can CBDCs be designed to protect consumers' data and privacy? For example, who can access which parts of payments data and under what circumstance?

Supporting privacy could be a key motivation for CBDC issuance,[24] given that in the "intermediated" architecture in the two-tier distribution model mentioned earlier

17 See www.moneyland.ch/en/commercial-bank-money-definition.

18 See https://en.wikipedia.org/wiki/Cryptocurrency.

19 See C Waller, "Reflections on stablecoins and payments innovations", remarks at "Planning for surprises, learning from crises" 2021 Financial Stability Conference, Cleveland, 17 November 2021.

20 See Bank of England, "Central Bank Digital Currency: opportunities, challenges and design", Discussion Paper, March 2020, www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper.

21 See I De Bode, M Higginson and M Niederkorn, "CBDC and stablecoins: Early coexistence on an uncertain road", 11 October 2021, www.mckinsey.com/industries/financial-services/our-insights/cbdc-and-stablecoins-early-coexistence-on-an-uncertain-road.

22 Ibid.

23 See Group of central banks, Central bank digital currencies: foundational principles and core features, October 2020, www.bis.org/publ/othp33.pdf.

24 See Group of central banks, *Central bank digital currencies: system design and interoperability*, September 2021, www.bis.org/publ/othp42_system_design.pdf.

in Section 3, detailed retail transactions and balances are maintained by intermediaries (banks and PSPs) only, and consumer data privacy is therefore expected to be the responsibility of the intermediaries.[25]

Various key principles such as adequate privacy design should be embedded into the CBDC from early on, followed with privacy regulations/policies/rules that should be clearly defined and regulated.

How to avoid dominance of big tech and the possibility of "walled gardens" in the domestic payment system?

Digital currencies issued by big tech companies are vulnerable to credit risk (ie default by the issuing company) and cash-out risk due to their need to emulate the properties of money.[26] This risk can be mitigated if central banks can design a more balanced CBDC and payment regulations that encourage diversity and competition within the ecosystem, while maintaining sufficient regulatory standards for private service providers.[27]

Is an interoperable CBDC system envisaged? What are your main concerns when making systems interoperable? What is the scope for public and private partnerships in CBDCs?

CBUAE envisages an interoperable system domestically. In this regard, major challenges to note include achieving compatible standards across various systems, and achieving a single agreed framework between different policies and regulations as well as between the public and private sector. This is especially relevant in the case of a retail CBDC, where distribution of funds often relies on private sector companies which are closer to day-to-day needs of consumers, such as fintech companies.

4. Cross-border aspects of CBDCs

Will cross-border use of CBDCs lower costs involved in cross-border payments, including remittances? How large are risks for digital dollarisation in EMEs or capital market integration? How would you weigh the trade-offs between improved efficiency with CBDCs and the possibility for currency substitution?

Cross-border payments have been known to be prone to various frictions such as fragmented and truncated data formats across regions, complex processing of compliance checks, and limited operating hours across jurisdictions, which incur substantial cost for parties. This includes major issues such as high fees due to multiple intermediaries (correspondent banking) and a lack of guarantee as to whether funds have been received in full (ie finality).[28] CBDCs aim to simplify the intermediation chains and increase availability (as they would operate on a 24/7 basis) by starting a "clean state" system designed to achieve interoperability between

[25] Ibid.

[26] See "Walled gardens versus open markets in payments", Financial Times, 30 June 2020, www.ft.com/content/75ae3ae0-c09f-4242-ab3e-f293d67d5c07.

[27] See Group of central banks, *Central bank digital currencies: foundational principles and core features*, October 2020, www.bis.org/publ/othp33.pdf.

[28] See Committee on Payments and Market Infrastructures (2021): *Central bank digital currencies for cross-border payments*, July, www.bis.org/publ/othp38.pdf.

different jurisdictions. The mBridge project is a good example for resolving these pain points.

While CBDCs improve efficiency, central banks should prioritise assessing their monetary risks before adopting one, through careful CBDC design. For instance, design choices that limit non-resident holdings and that require onboarding protocols for users and merchants might help counter the currency substitution risk. Additionally, tactical pricing mechanisms, such as placing higher fees on frequent cross-border transactions, could also reduce the scale of use, limiting the CBDC in circulation. Undoubtedly, decisions concerning this case would really depend on each jurisdiction's currency stability and monetary framework, and there may not be a "one size fits all" approach.

CBDC survey

Objectives and design considerations for central bank digital currencies

1. In what area of CBDC research and development is your institution active in?

- Wholesale CBDC
- General purpose/retail CBDC
- Both

2. The potential benefits of retail CBDC issuance include (Please select the top 3, 1 being the most important):

- Competition among payment service providers and increased efficiency
- A cash-like but digital payment option
- Economising on the cost of physical cash distribution
- Better privacy vis-à-vis commercial parties
- More effective monetary policy
- Programable money as basis for the Internet Of Things (IOT)[1]
- Tackling money laundering, tax avoidance
- Enabling person-to-person payments
- Better financial inclusion

3. The potential downsides of retail CBDC issuance include (Please select the top 3, 1 being the most important):

- Crowding out cash
- Crowding out private sector payments
- Disintermediating banks
- Mandating inferior technology
- Reduced privacy relative to cash
- High operational burden for the central bank
- Low user adoption
- Cyber security risks

[1] See "What is programmable money?" for a definition.

4. If you chose retail CBDC above – what is the architecture you envision for the CBDC?

Please see *Central bank digital currency: the quest for minimally invasive technology* for detailed descriptions of different architectures.[2]

- Direct – central bank handles all payments in real time and keeps a record of all retail balances
- Intermediated – record of consumer payments maintained by payment service providers (PSPs); central bank only keeps wholesale balance of PSPs
- Hybrid – PSPs handle real-time payments; central bank updates and retains a backup record of retail balances.

5. Will you limit access to or define payment use cases for CBDCs?

- Yes
- No – universal access as with cash for residents
- Not sure yet

6. In the CBDC ecosystem, do you envision sharing the processing infrastructure with other payments systems?

- Yes
- No – a parallel and diverse system is safer
- Not sure yet

Data privacy

Technological development involved in the introduction of CBDC could bring wide benefits, but also risks. Technology could encourage either a virtuous circle of equal access, greater competition and innovation, or it could foment a vicious circle of entrenched market power and data concentration. In some countries, the government sets general data policy; in others, data policy differs sector by sector. The rules governing the payment system and whether these will result in open payment platforms and a competitive level playing field will have important implications on the nexus between payments and data.

7. Would a general data policy or a separate policy apply to CBDC in your jurisdiction?

- A general data policy
- A separate, CBDC-specific, policy
- Uncertain

[2] Detailed descriptions of these architectures can be found in https://www.bis.org/publ/work948.pdf.

Interoperability

An interoperable CBDC helps ensure the coexistence of a CBDC system within a wider payments ecosystem. A retail CBDC would require an underlying system to be provided and distributed to the public. It can include various components. Narrowly, it includes the central bank, payment service providers that are banks, and other participating payment service providers. More broadly, in an ecosystem, it includes data service providers, companies providing and maintaining applications, and providers of point-of-sale devices to initiate and accept payments. The distribution of CBDC requires that these systems, from the central banks end to private payment services to data service providers, be interoperable. An interoperable CBDC network could enable banks and other intermediaries to offer innovative payment services and/or allow for more diverse forms of finance (eg with less reliance on correspondent banks).

8. Do you envisage an interoperable system domestically?

- Yes
- No
- Do not know yet

Monetary policy, financial intermediation and financial stability

9. Do you expect CBDC to affect banks' credit provision?

- Not at all
- Somewhat
- Significantly

10. If you select "somewhat" or "significantly" above, how likely are the following (Please rank 1–5, 1 being most likely):

- Increased volatility in consumer deposits
- Long-term reduction in consumer deposits at banks (that is, disintermediate banks)
- Increased cost of funding for banks
- Reduced volume of bank loans
- Increased loan rates
- Increased risk taking from banks
- Improved cost efficiency by lowering cost of cash holdings

11. Do you envision that retail CBDCs would bear interest?

- Yes
- No
- Not sure yet

12. Will you set a limit on the amount of retail CBDC holdings (ie a per-household cap on holdings) or transactions?

- Yes
- No
- Not sure yet

13. Will CBDC improve your monetary operations and policy implementations?

- Not at all
- Somewhat
- Significantly

Questions about CBDC and financial inclusion

The aim of the financial system is to provide financial services to the population. For this, individuals should be brought into the financial system with products available for use by them. Accordingly, 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. One of the metrics of financial inclusion is access to payments technology and bank accounts. For this group of 26 EME central banks, over 70% of adults in two-thirds of these jurisdictions have a bank account and around half of these economies have a fast payments system (FPS). How can CBDC issuance contribute to financial inclusion and which CBDC features are important for inclusion?

14. What are the main challenges to financial inclusion in your area? Please rank the top 5 challenges (Rank 1 - 5, 1 being most important).

- *Insufficient ICT infrastructure*
- *Financial illiteracy*
- *Inefficient financial infrastructure*
- *Lack of access points, especially in rural areas*
- *High costs of financial services*
- *Dominance of financial services by few providers*
- *Lack of access to smart phones*
- *Lack of private sector willingness or capacity*
- *Lack of credit contracts and procedures suitable for individuals and/or firms with erratic and/or undocumented cash flows*

15. For your CBDC issuance, which design features will be most important for addressing your financial inclusion challenges? Please rank the top 5 most important features (Rank 1–5, 1 being most important).

- *Offline functionality*
- *Access to CBDC accounts via cards and feature phones*
- *Anonymous accounts*
- *Allowing remote registration or e-KYC*
- *Separation between transaction data and personal data*

- *Interoperability with existing payment systems including fast payments systems (FPS)*
- *Integrating CBDC with existing payment instruments including credit transfers, cards and mobile money*
- *Interoperability with cash-in and cash-out networks*
- *Low cost/free CBDC service (subsidised by government)*
- *Integrating CBDC with government payments and services*
- *Facilitating access of merchants and their acceptance to CBDC*
- *Integrating CBDC with remittances services*
- *Expanding payment services through smart contracts*
- *Integration with national digital ID system*

16. For your CBDC issuance, what regulatory adjustments are/will be most important to addressing your primary financial inclusion challenges? Please rank the top 3 most significant features (Rank 1–3, 1 being most important).

- *Legal framework for the CBDC itself*
- *AML/CFT including anonymous access to CBDC accounts or tokens*
- *Data protection*
- *Risk management (cyber security)*
- *Non-bank access to payment systems*
- *Direct provision of payment services by non-banks.*
- *Access of non-citizens or non-residents to CBDC accounts*

17. Overall, what is your current judgment on how well a retail CBDC might address your main financial inclusion challenges when compared with other potential solutions (eg faster payment systems/ private e-money services)?

Please indicate whether you have a FPS system,

- Yes
- No

and enter on a scale of 1 (other solutions are vastly superior) to 10 (CBDC is vastly superior), with 5 meaning they are equal:

Infrastructure

A choice in the design of a CBDC is about the infrastructure – in particular, whether the CBDC should be implemented using a conventional centrally controlled database or distributed ledger technology (DLT). Both types of infrastructure can store data multiple times and in physically separate locations. However, in DLT-based systems, the ledger is jointly managed by different entities in a decentralised manner. Each update of the ledger has to be harmonised between the nodes of all entities, which takes time. DLTs thus have lower transaction throughout than conventional architectures. When it comes to achieving resilience, neither a DLT-based system nor a conventional one has a clear-cut advantage. The key vulnerability of a conventional architecture is the failure of the central entry point, for example via a targeted hacking

attack. The key vulnerability of DLT is the consensus mechanism, which may be put under pressure, for example, by a denial-of-service type of attack.[3]

18. For your CBDC issuance, what infrastructure are you considering?

- *Centrally controlled database*
- *DLT*
- *A combination of the two*

19. In determining whether your infrastructure is DLT-based or centrally controlled, what are the main considerations (Rank 1-5, 1 being the most important)?

- *Greater availability of technological solutions on the market and lower development cost*
- *Better functionalities for smart contracts*
- *Greater network resilience*
- *No technology is optimal for all aspects of the infrastructure. A combination is the best option.*
- *Scalability issues can be overcome*

Others (please specify):

Enter your answer here

20. Please provide details of the characteristics of the infrastructure you have chosen or are considering and the motivations:

Enter your answer here

Cross-border impact of CBDC

A retail or wholesale CBDC can be also used beyond the borders of a jurisdiction. Multi-CBDC arrangements can join up countries' CBDCs to interoperate across borders. They focus on coordinating national CBDC designs with consistent access frameworks and interlinkages to make cross-currency and cross-border payments more efficient. Multi-CBDC arrangements are especially relevant to EMEs poorly served by the existing correspondent banking arrangements for cross-border payments, which imply highly inefficient notably for remittances.

At the same time, the use of CBDC across borders and the threat of digital dollarisation is a first-order concern for EME. The national currency may be supplanted in domestic transactions by foreign CBDC issuance or the emergence of a global stablecoin. Among many other adverse side effects, this may reduce the local

[3] For a detailed discussion of the relative merits of centrally controlled databases and DLT, see The technology of retail central bank digital currency and Permissioned distributed ledgers and the governance of money.

authority's ability to conduct monetary policy, enforce foreign exchange restrictions or capital flow management measures.

21. Do you envisage an interoperable system cross-border?

- Yes
- No

22. On potential risks from interoperable cross-border CBDCs, how likely are the following?

Risk of digital dollarisation at home
- Not at all
- Somewhat
- Significantly

Increased exchange rate volatility
- Not at all
- Somewhat
- Significantly

Tax avoidance
- Not at all
- Somewhat
- Significantly

Other concerns (please specify):

Enter your answer here

23. Do you expect cross-border use of CBDCs lower costs involved in cross-border payments and thus facilitate remittances?

- Not at all
- Somewhat
- Significantly

24. How do you assess the risk of digital dollarisation from your perspective?

- High
- Low

If high, how would you weigh the trade-offs between improved efficiency from the cross-border use of CBDCs and the possibility for currency substitution in the receiving countries?

- *Benefits from improved efficiency dominate concerns over the possibility for currency substitution*
- *Concerns over the possibility for currency substitution dominate benefits from improved efficiency*

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