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

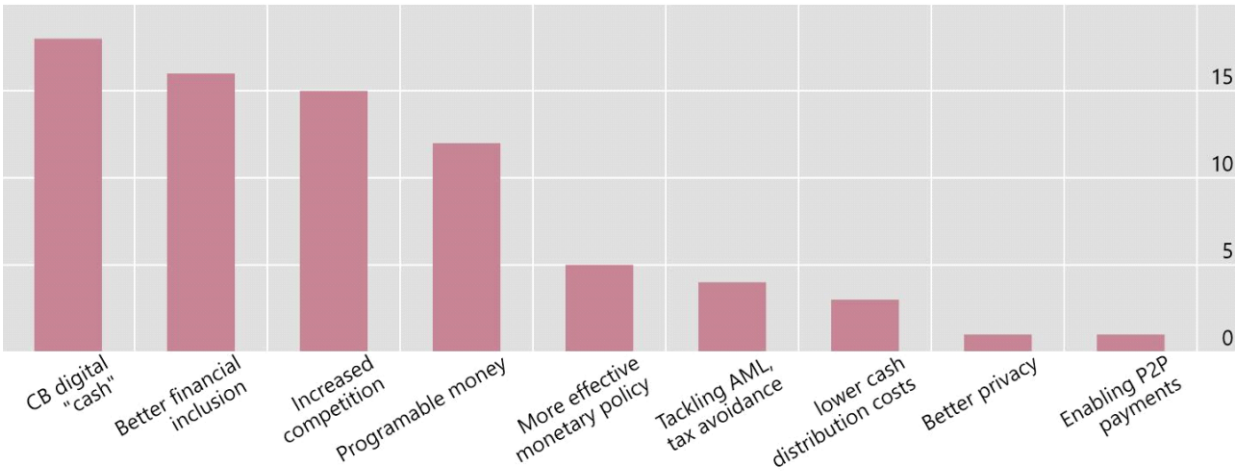
The digital revolution is changing the payments landscape. As big techs and fintech firms move into financial services, payments are no longer a commercial bank monopoly. New forms of digital asset such as cryptocurrencies and stablecoins are also emerging as a potential means of payment. In many EMEs – 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).

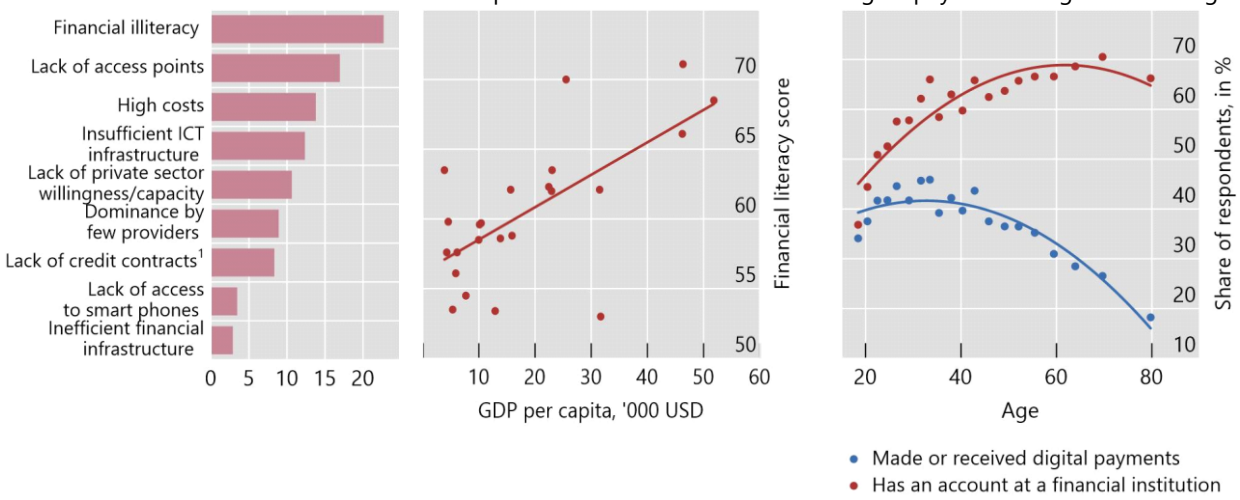
The introduction of a CBDC as an alternative means of payment can affect the competitive structure of the underlying payment system. Depending on design, it could improve competition and reduce costs; it could also help prevent "walled gardens" (Box A). The Central Bank of Israel raised one specific 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

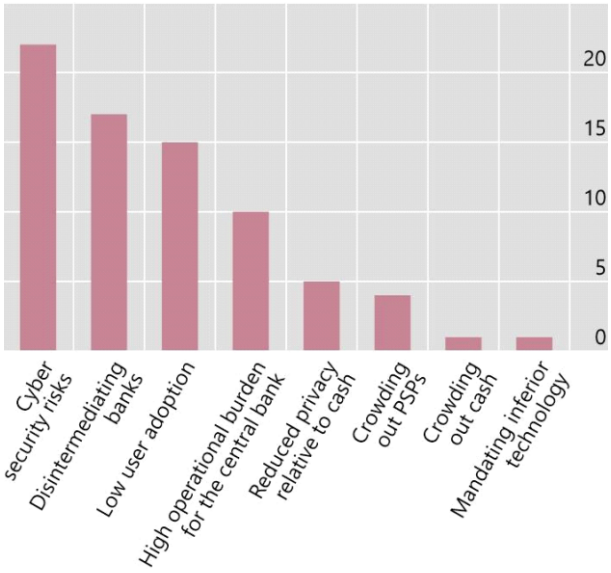
[1] Retail FPS, such as UPI and PIX, and CBDCs have a lot in common: both rest on digital ID and technical standards such as APIs that ensure data privacy.

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.

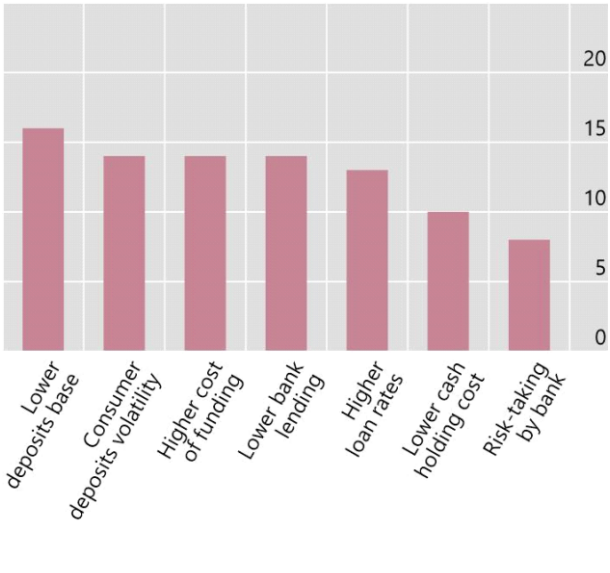
Concerns related to CBDC issuance

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.

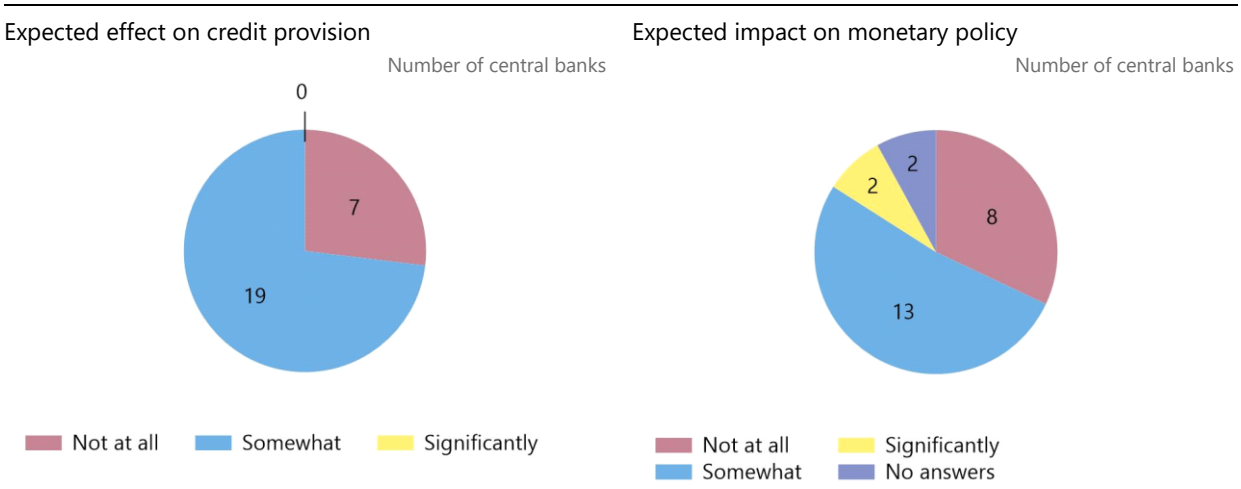
[3] The literature's verdict on this possibility, however, is not unanimous. Chiu et al (2019), for example, argue that a CBDC could inject greater discipline into banks in the imperfectly competitive deposit market, and not necessarily disintermediate banks. Rather, banks may compete away the rents.

[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

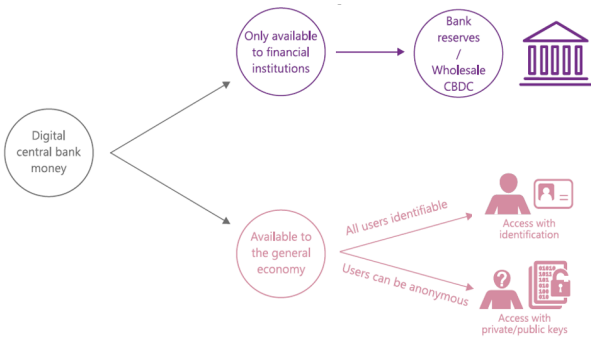
CBDC design elements

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?

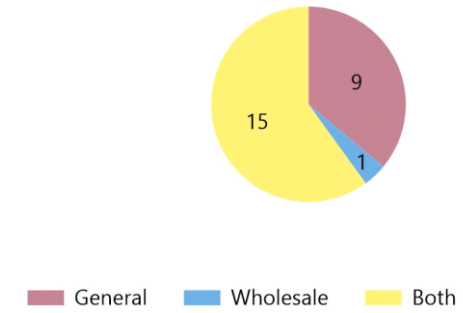
Graph A

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.

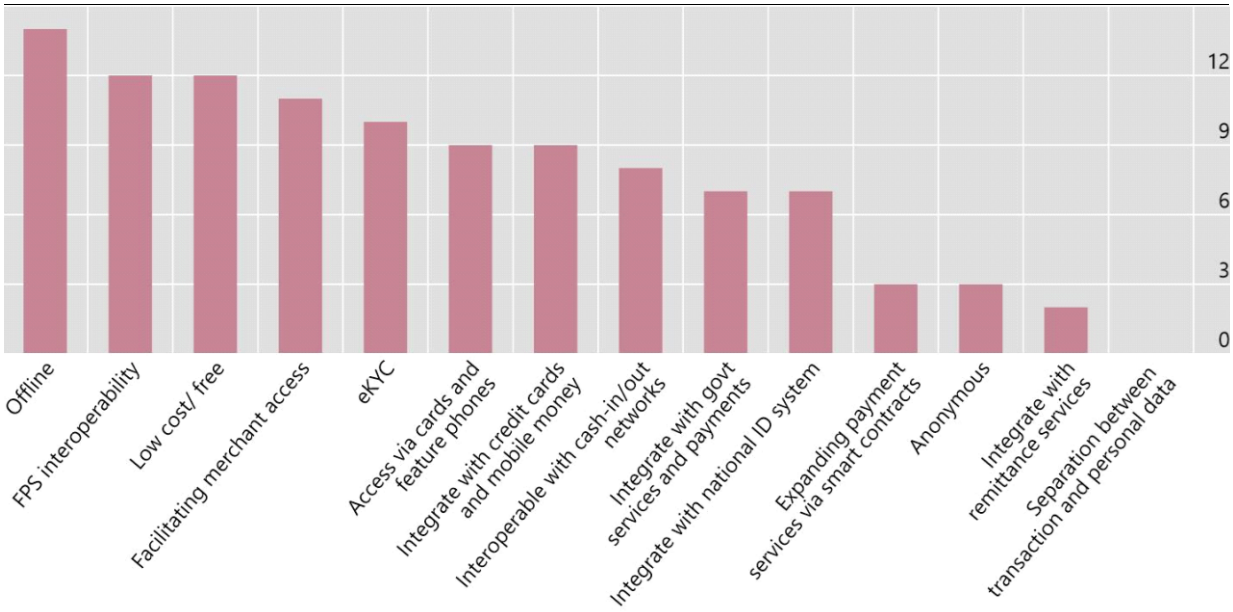
(5) Data governance. A majority of central banks (15 out of 26) are uncertain as to CBDC data governance policy. This high degree of uncertainty probably reflects the absence of a globally accepted standard on data governance, including for digital currencies (as noted in Box A). Yet, some central banks 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.

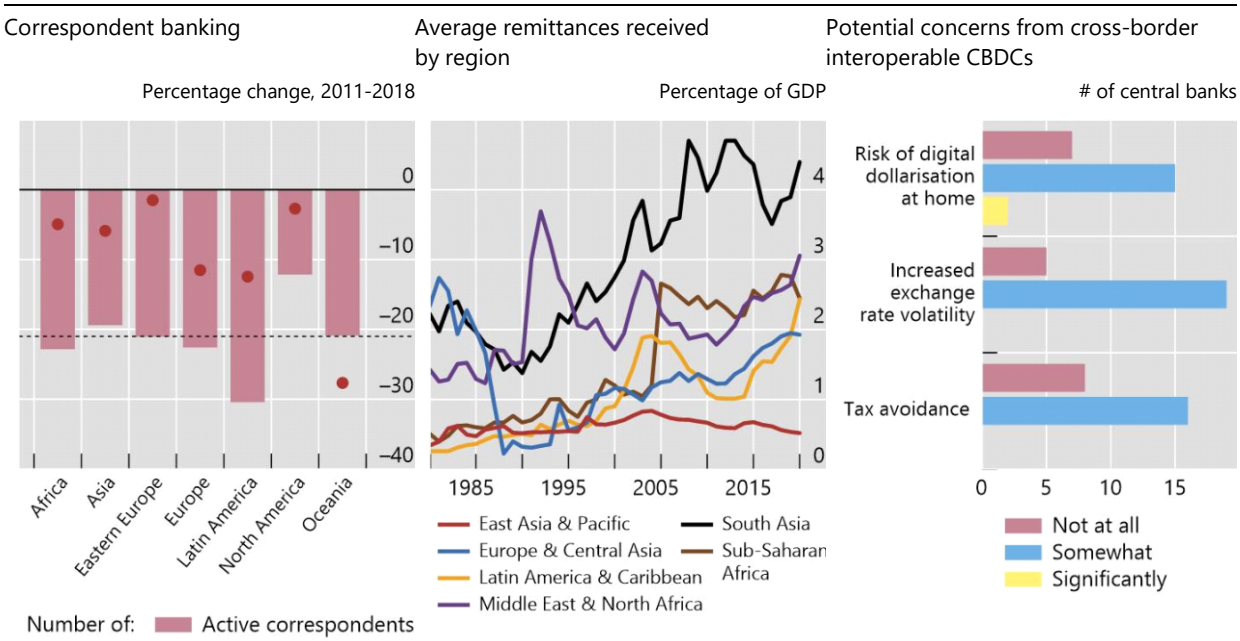
At the same time, more than half of the central banks believe that cross-border CBDCs, if not carefully managed, could spur currency substitution, exchange rate volatility and tax avoidance (Graph 6, right-hand panel).[5] The risk of currency substitution is higher for economies that face high inflation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

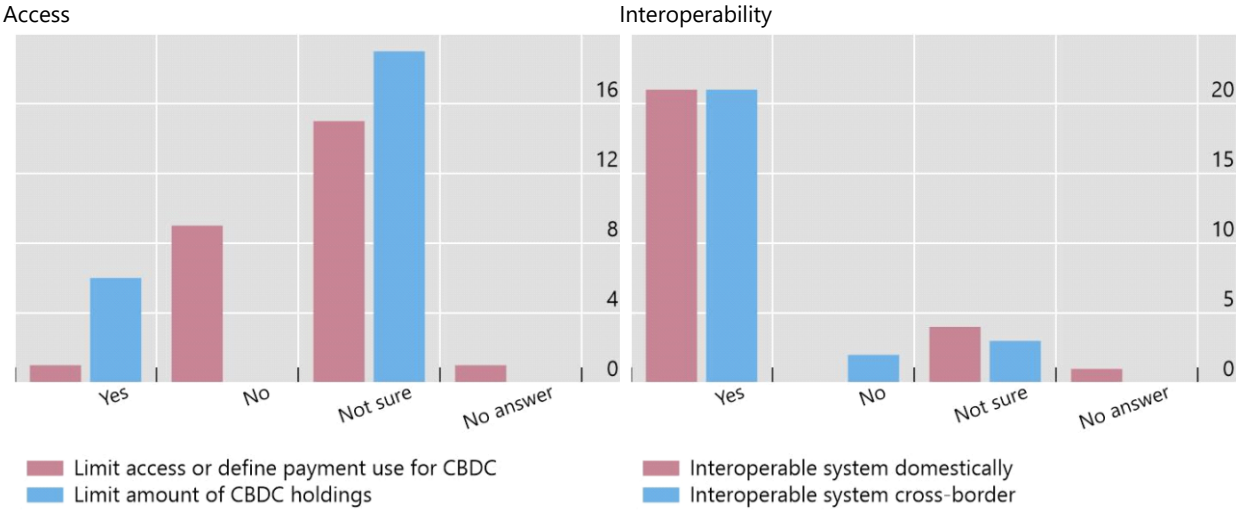
Algeria	India	Russia
Argentina	Indonesia	Saudi Arabia
Brazil	Israel	Singapore
Chile	Korea	South Africa
China	Malaysia	Thailand
Colombia	Mexico	Turkey
Czech Republic	Peru	United Arab Emirates
Hong Kong SAR	Philippines	Vietnam
Hungary	Poland	

Annex 2: Summary of survey responses

Use limits and interoperability

Number of central banks

Graph A1

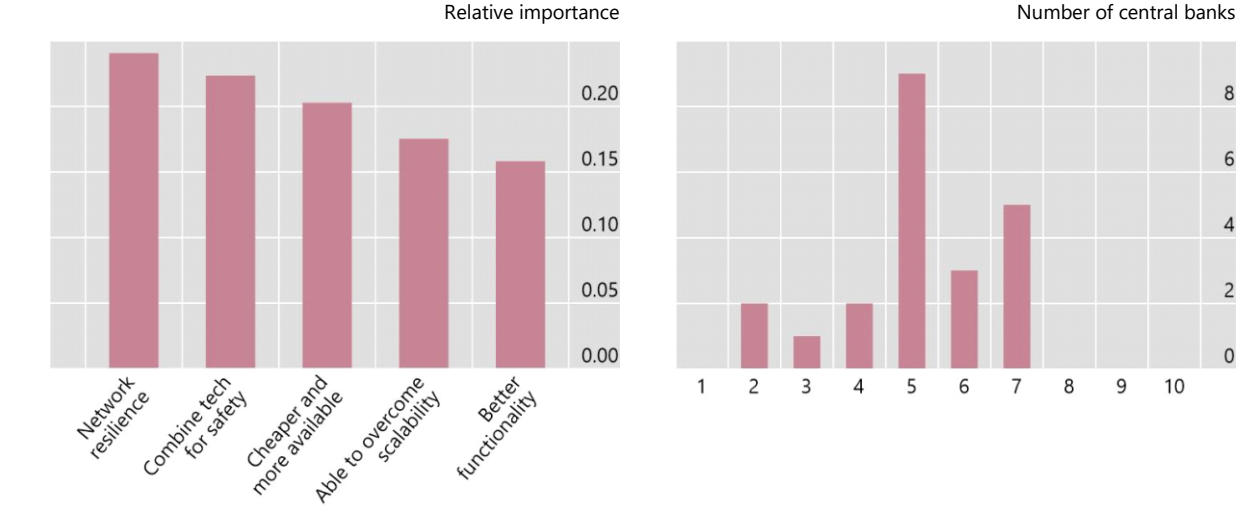


[1] Fraction of respondents that chose the design option as among the top five that can help improve inclusion.

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.