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Central Bank Digital Currencies: Design and Implementation in the Evolution of Sovereign Money

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INTRODUCTION

In recent years, there has been a surge of interest among central banks globally in researching and creating central bank digital currencies (CBDCs). More than 100 countries are at various stages of conceptualization, design, and implementation. In addition to the six-country Eastern Caribbean Currency Union, three countries have formally established CBDCs for their currencies to date.[1] An additional 21 countries, including China, are undertaking pilot projects with a goal of moving forward to full implementation in the next few years.

What are central banks chasing? What are the goals in creating a CBDC? What are the key design considerations to ensure that a CBDC is trusted and well suited to achieving those goals in a way that is consistent with the efficient execution of monetary policy and financial stability?

These are some of the questions that we will explore in this brief. In our discussion, we will argue that CBDCs need to be viewed as a means to an end. Can they facilitate the development of a more efficient and inclusive financial system? Can they enable a real-time payments regime and less expensive cross-border payments? The answers to those questions depend, in part, on the starting point (i.e., where we are today) and the important design choices made in the development and execution of CBDCs.

The rest of this brief is broken down into four sections:

- Motivations for establishing a CBDC, what the desired end state(s) could look like, and how CBDCs might facilitate such outcomes
- Design choices for a CBDC and how those choices relate to the goals one wishes to achieve
- An evaluation of key technology issues that will be critical in CBDC design and implementation
- The current state of play and what steps should be taken at an international level to facilitate a coherent global CBDC and payments regime

1 The Atlantic Council has been monitoring the development of CBDCs and reporting on their status through its "CBDC Tracker," atlanticcouncil.org/cbdctracker.

I. A CBDC AND ITS ALTERNATIVES

There are many motivations for establishing a CBDC. They differ markedly across countries—not only because of differences in initial conditions with respect to payments infrastructure, the structure of the financial system, and legal and regulatory differences—but also because of the diverse goals of government and preferences of the citizenry.

A country such as China might want to reduce its reliance on the US dollar in international trade, anticipating that a credible CBDC would encourage greater use of the CNY in international transactions. Another country, such as India, might view a CBDC as a means of achieving greater inclusion in the financial system. Many low-income countries, such as in sub-Saharan Africa, might find CBDCs are the building block to facilitate low-value digital payments and greater financial inclusion and to encourage greater saving and investment as a means of spurring economic development. For the European Union, a CBDC may be viewed as a means to strengthen the Euro as a global currency and preserve "monetary sovereignty." For other countries, such as the United States, a CBDC might be introduced as a defensive measure to ensure a regime that keeps the US dollar as the world's dominant reserve currency, but not necessarily to act as a catalyst to change the existing regime.

The choices depend in part on the starting point, including the effectiveness of the current regime and the goals of implementation. Motivations can range from using a CBDC as the medium of exchange in a low-value retail payments system to having a tool that could enable a much broader set of monetary and fiscal policy responses (e.g., the ability to have deeply negative interest rates or fiscal transfers that automatically diminish in value over time if they are not spent).

Nevertheless, beyond these differences, there are common motivations for developing a CBDC.

First, as the use of cash diminishes, there is a strong interest in developing a new form of public money that retains the key, attractive attributes of cash, including privacy, portability, and broad acceptance as a means of payment (i.e., legal tender).[2] In this role, a CBDC can be an important complement to physical cash because it can be transmitted digitally and offer greater functionality than currency.

Second, a CBDC may have advantages as a foundation for a retail payment system. It has the potential to be superior to cash with respect to safety, transferability, and portability. With appropriate safeguards, there should be less risk of loss or of the CBDC being stolen. Also, in contrast to cash, it is much easier to use as a medium of payment when the payee is remote from the payor.

It also could prove superior to private monies (e.g., cryptocurrencies, stablecoins, and bank balances) with respect to its financial safety, its legal basis as a means of payment, and as a stable store of value. Also, the fact that a CBDC would be sponsored by a nation's central bank could facilitate greater trust and acceptance as a medium of payments, given the historical role of central banks in national payments regimes and their perceived safety as a counterparty.[3] In principle, this could enable more rapid acceptance and greater network effects that would facilitate further acceptance and usage. Central bank sponsorship might also make it easier to develop and agree on the standards necessary to ensure interoperability across domestic and international payment systems. In this regard, the Bank for International Settlements (BIS), with its broad central bank membership, is playing an important coordinating role in the push for interoperability.

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2 This is not universal. In some regions the demand for banknotes as a store of value has increased. It is noteworthy that most of the USD currency outstanding is held overseas.

3 This may not always be true. Some are distrustful of a CBDC because it could expand the power of government in terms of monetary policy (the possibility of deeply negative interest rates) and impinge on privacy. Of course, such concerns can be addressed by how a CBDC is designed and functions.

Ideally, CBDCs could be a core element of a payments regime that would offer

- real-time payments on a 24-hour, 7-days-a-week basis,
- atomic settlement (e.g., both instant and simultaneous),
- low-cost services with broad accessibility, and
- domestic and cross-border payments.

While a system of national CBDCs does not need to facilitate all of these goals to have value, an integrated global regime is the holy grail: It could reduce the cost of both domestic and international payments, reduce settlement risk, and improve financial inclusion and access.

It is important to acknowledge that a CBDC payments regime could potentially have a number of disadvantages compared to private payment regimes. These include the following:

- Less diversity. More of the eggs could end up sitting in one basket—in terms of both the institutional setup and the technology. Also, if a CBDC system became the dominant payments regime, any system outage (e.g., a successful cyber attack or disruption due to bad weather) would have more adverse consequences than in a regime that was more diversified and decentralized.[4]
- Path dependency. Future evolution might be constrained by bad choices with respect to design and technology. In contrast, private operators that make bad choices will simply fail and go out of business.
- Less innovation. Central banks may face a difficult challenge in building cutting-edge infrastructure and software applications. Not only is it not their core competency, but there is also the difficulty in attracting and retaining the needed expertise in technology and systems design.
- Potential bank disintermediation and financial instability. In a direct central-bank-to-consumer framework, a CBDC could disintermediate banks and increase the risk of bank runs during times of stress. CBDCs have the potential to increase financial stability risks compared to cash or private sector alternatives.

Moreover, a CBDC-based system simply might not offer sufficient advantages to induce households and businesses to migrate to a new CBDC-based payments regime.

Thus, the design choices of a CBDC will be critical in determining its efficacy and whether it will help facilitate a faster, less costly, and more inclusive payments regime.

II. KEY CBDC DESIGN CHOICES

A number of design choices will be important in determining the benefits and costs of a CBDC-based system. In large part, these will be influenced by whether the goal is a wholesale CBDC, a retail CBDC, or both in coexistence. These choices include

- single-tier versus two-tier,
- interest-bearing versus non-interest-bearing,
- managing privacy and Bank Secrecy Act / anti–money laundering (BSA/AML) compliance, and
- whether the regime incorporates programmability in payments.

In most cases, the CBDC should cater to wholesale and retail payments in one system.

If the motivation is to have the CBDC serve as a core component of a broad, real-time payments system, then that argues for a CDBC that is available broadly to households and businesses. A wholesale CBDC alone is not much of an improvement over the existing regime in which central bank money is already moved digitally among banks and other financial intermediaries over payment rails operated by the central bank.

In most circumstances, the CBDC should be two-tiered, with the central bank issuing the CBDC liability and

4 How big this risk is depends largely on the design choices. For example, a CBDC that supported offline payments might not be as vulnerable to this type of risk. Of course, a CBDC regime that enables offline payments has a greater exposure to being used for illicit purposes.

managing the payment rails and settlement of the CBDC, while commercial banks (and other financial intermediaries) manage the customer accounts and compliance with BSA/AML requirements.

There are several benefits from such a division of labor. First, it is consistent with the role and expertise of central banks versus private financial market intermediaries. Central banks typically have counterparty relationships with depository institutions but do not interact directly with households and businesses.

Second, it enables the customer to be shielded from the potentially "routine" prying eye of the government. The central bank would only have pseudonymous access to all of the transactions in the ecosystem and would not have access to specific account information and/or the ability to track account usage.

While this is likely to be the preferred approach, one can imagine exceptions in certain cases. For example, in low-income countries, there may be a stronger case for the government taking a bigger role because financial inclusion is low and the private financial system is not well developed. And, for countries with poor financial inclusion, allowing households to hold CBDCs in modest quantities outside of the banking system might be desirable, as this could significantly improve the ability of those who are unbanked to execute payments. Of course, this comes at a potential cost that the CBDC could then be used more easily for illicit transactions, but this is a tradeoff that can be managed by restricting the size of such holdings and transactions.

A CBDC should be a non-interest-bearing asset.

This has several advantages. First, it emphasizes that the CBDC's role is as a medium for payment rather than as a financial asset. The CBDC is a digital form of cash rather than an alternative to an interest-earning bank deposit. Cash has many valuable characteristics and benefits as a public good since it is accessible to all and allows instant, non-intermediated transactions. In this regime, the volume of CBDC outstanding would be much lower and the turnover rate would be much higher compared to a regime in which the CBDC was an interest-bearing asset.

Second, it reduces the risk that introduction of a CBDC would make the implementation of monetary policy more difficult. If a CBDC were interest bearing, the money flows into and out of the CBDC might become more volatile and difficult to forecast. In an "excess reserves" regime such as utilized in the United States by the Federal Reserve, this could lead to more volatility in reserves outstanding. The potential for increased volatility might force the central bank to expand the size of its balance sheet and the total amount of its reserve liabilities, increasing the size of its footprint in the financial system. Although the demand for a non-interest-bearing CBDC would undoubtedly fluctuate both seasonally and during times of stress, remuneration would likely significantly increase volatility.

Third, an interest-earning CBDC could potentially raise borrowing costs as it could drive up bank funding costs. Also, an interest-bearing asset would increase the incentives for bank deposit runs into the CBDC during times of stress.[5]

There should be caps on how much one can add to one's CBDC holdings over short time periods.

Because the cost of running into a CBDC is lower than the cost of running into cash, there needs to be a way to mitigate the risk of runs into the risk-free CBDC asset. This could be accomplished by placing limits on how much one could increase one's CBDC holdings over short periods of time. In contrast, from a financial stability perspective, there seems less need to cap the total magnitude of holdings. High but stable holdings would not create significant additional risks to financial stability even though this would disintermediate banks. The level of holdings can be left to the user's own judgment—weighing the benefits of the CBDC as a payment medium relative to the costs of holding the CBDC as a non-interest-bearing asset.

5 There are other potential alternatives to ensure that the CBDC is helpful for use in making payments and not as an investment asset. For example, the CBDC could be restricted to paying a lower interest rate relative to market rates or even potentially have a negative rate.

The goals of user privacy and ensuring that the CBDC will not be used for nefarious purposes need to be carefully managed.

In many countries, there is concern that a CBDC could enable the government to gain greater information about the activities of its citizens than is possible under current legal regimes applicable, for example, to the transfer of bank monies.

For this reason, a CBDC should be designed so that transactions are pseudonymous and not publicly traceable. It is also important that the government not have access to the details underlying the transactional data except for predefined and strict exceptions relevant to investigations of criminal activity (e.g., a suspicious activity report filing).[6]

In this setup, the central bank would need to know the amount of CBDC that is to be transferred from one bank to another. But the bank would own the customer relationship and would be responsible for ensuring the transactions were compliant with BSA/AML requirements.

This could be achieved by ensuring that institutional and consumer identity data are held in a secure enclave that is accessible by the bank or other payment provider. Only the data that are needed for compliance verification would be made available to the relevant institutions. For example, this could be achieved through the World Wide Web Consortium (W3C) decentralized identity standards and verifiable credentials.[7]

In this approach, the issuer of the verifiable credential must be a trusted source (e.g., bank, government, or consortium). In contrast, it would be more difficult to integrate into such a regime a verifiable credential issued by a random third party.

Another way to limit the scope for nefarious use would be to add restrictions in the type of permitted transactions such as volume and amount, rate, and the eligibility of the transacting parties. Such restrictions can reduce the risk of abuse. For example, in Brazil, Pix transaction sizes were limited at certain hours following a string of kidnappings and Pix thefts.

Lastly, another approach to protect privacy is through zero-knowledge proofs and homomorphic encryption.[8] However, zero-knowledge proofs are still early in the research-and-development stage and have been shown to impair system scalability. This may make it difficult to adapt this technology to high-volume payment regimes. There are also other technical options that are being considered for use in high-volume applications.

The benefits of utilizing a technology that enables programmability through smart contracts should be carefully evaluated. Programmability should be an optional domain for the private sector to engage in rather than the central bank or finance ministry. To accomplish this, the CBDC could be designed to accommodate private sector initiatives regarding programmability.

Payments conditioned on delivery of products and/or services could reduce fraud and settlement risk. For example, smart-enabled payments could provide significant benefits for securities settlement, escrow, and trade finance.

However, giving the government the power to make the execution of CBDC-based transactions conditional on a defined set of conditions would represent a significant expansion of the government's powers, would alter the substitutability between cash and a CBDC, and could potentially blur the line between fiscal policy and payments (e.g., consider a government payment of CBDC that declined in value over time if it was not spent on a particular set of goods and services).

Alternative methods of programmability to smart contracts, such as through application program interfaces

6 The baseline here is the current privacy standard, which differs across various countries and regimes.
7 Such formats are already being specified for use in digital identity schemes such as in the European Union.
8 A zero-knowledge proof is a means by which someone can prove to another that something is true without actually conveying any additional information. Homomorphic encryption allows analytical functions to be performed on the encrypted data directly as if they were not encrypted. This means that the underlying data never are visible and vulnerable to privacy breaches and hacks.

(APIs), should be considered, including who is in charge of implementing programmable features.

Controlled programmability with APIs avoids the potential system safety issues that arise from full Turing-complete languages found in many smart contracting platforms.[9] Though programmability can be helpful with a multitude of value-added services (such as escrow payments), central banks may decide to make it an optional feature that can be instituted instead by the private sector commercial banks. Furthermore, banks would presumably find it easier to institute common business controls consistent with regulatory requirements.

III. TECHNOLOGY DESIGN CHOICES

There are additional important design issues that need to be addressed in terms of technology. Some problems that need to be solved include scalability to be able to accommodate millions of users, interoperability between different payment networks and ledgers, and protecting consumer and institutional data privacy in transactions.

In addition to the technology improvements needed to implement CBDCs and to improve the global payments system, a new infrastructure needs to be compatible with existing regulatory governance structures and existing banking relationships. At the same time, it must be sufficiently flexible to be able to accommodate future innovations in product design and ways of doing business.

As part of this, a new technology infrastructure should accommodate issuing not only CBDCs but also tokenized deposits and securities issued by commercial banks. Including support for tokenized deposits in the remit should provide greater incentives for the technology to be tested and implemented quickly.

If the new technology is designed with existing regulatory governance standards and the two-tier banking system in mind, addressing the scalability, interoperability, and privacy issues will be much easier to implement. This section explores how better technology and industry standards can be constructed around these pillars.

Scalability

CBDCs, regardless of the architectural model, must be able to scale to the demands of the entire population of the country/currency union. While CBDC research and development is taking place all over the world, most of the countries that have either piloted or fully launched their CBDCs have small populations using their digital currencies. For example, the Bahamas (population of less than 400,000), Jamaica (about 2.8 million), and the Eastern Caribbean Currency Union (combined about 650,000 across six countries and two territories) were some of the earliest to launch CBDCs. These countries comprise 10 of the current 11 launched currencies on the Atlantic Council's CBDC Tracker.

Even Nigeria, the last of the 11 fully launched CBDC countries, is not operating at a large scale despite a population of 230 million people. Only about 0.5 percent of the population is using CBDC a year after the launch, or just over 1 million users.[10]

Each of these countries has utilized a privatized, permissioned distributed ledger technology (DLT) solution. As a consequence, this is likely to lead to bottlenecks in terms of transaction speeds as the number of users increases. In contrast, the one large-scale pilot project that is in the hands of hundreds of millions of users—the e-CNY—is not DLT-based.

Distributed ledger–based payment regimes have scalability problems because they require generating a distributed consensus to authorize payments or to assess the validity of a given token. To address the throughput problem, developers are implementing sharding techniques to enable greater concurrent transaction processing as a means of increasing throughput. Sharding is a means of sharing the workload across the different nodes of the system. With sharding, each

9 A Turing-complete language is a regime where a computer can perform the same computational tasks as any other system.

10 The case of Nigeria's eNaira is examined in Jookyung Ree, "Nigeria's eNaira, One Year After" (IMF Working Paper No. 2023/104, International Monetary Fund, May 2023).

node in the system is only responsible for maintaining the information in its immediate sphere, rather than being responsible for the entire system. By adding more nodes, the throughput of the system can be increased.

For an architecture to be judged viable, it should be able to ensure and maintain atomicity, consistency, isolation, and durability (ACID) principles within its system. Atomicity means that each statement is treated as one distinct entity. Either it is executed in total or not executed. Consistency means that execution always happens the same way. Isolation ensures that different transactions don't interfere with each other even when they are happening nearly simultaneously. Durability means that the transaction data are saved even when there are system outages or failures.

While distributed ledger technology is grappling with how to increase throughput and reduce computational resources, existing account-based systems have their own set of shortcomings. They typically attempt to maintain multiple disjointed ledgers that are reconciled via use of a separate messaging layer. This makes account-based systems slow and error-prone. In addition, these systems are not designed to establish an audit trail for each transaction and do not interoperate with each other easily. Indeed, auditability and interoperability usually require building an add-on system that typically adds complexity and risk to the overall operation.

Interoperability

The current payments landscape is a patchwork from different eras, industries, and technologies. A viable CBDC launch would have to work across and integrate with this disparate landscape. A new technology platform would need to be able to talk with both traditional legacy and new age DLT systems.

This is a challenging assignment. On one side, while distributed ledger systems have many security and interoperability advantages over traditional account-based systems, these systems still fall short in many ways. For example, on-chain smart contracts still require bridges to talk to other chains and don't have the ability to talk to traditional rails. On the other side, systems such as FedNow don't even provide interoperability options and instead require all participants to operate solely within the FedNow network with limits imposed on the size of payment transactions.

On the wholesale side, CBDCs should implement default financial messaging standards (e.g., ISO 20022, SWIFT) whenever feasible in order to minimize the difficulty of integrating with legacy systems. Eventually, there should also be an option for adding smart contract–like capabilities to the platform (potentially through programmable APIs), whereby verified users could write their own programs (with guardrails) to handle the execution of some of their transactions.

On the retail side, CBDCs should be able to work in most retail situations. There is no reason why consumers should be unable to make a payment because the vendor they want to buy from does not take their preferred payment method (as often happens with credit cards today). However, this creates huge integration challenges that should not be underestimated.

In addition to the features outlined above, CBDC and related digital payment systems would need to be able to perform some limited transactional capabilities offline, especially in areas with poor internet connectivity and in areas that have been hit by a natural disaster. This offline payment feature may increase the risk of fraud and illicit activity, so a balance must be found between providing legitimate users expanded access to payments while still preventing malicious actors from using the offline transaction channel for nefarious purposes.

Privacy

As discussed earlier, privacy is of critical importance in any payments system and must be considered from the beginning in any CBDC design. CBDCs must be able to balance the information-gathering requirements for know your customer (KYC) and AML verification, while still ensuring that users know their data are secure and only can be accessed when this is absolutely required by law. It is imperative that sensitive user data be held and controlled by users, with modern cryptographic protection schemes safeguarding the data. This means that

asset transfer and sensitive data are disaggregated so that users only share the necessary data needed for compliance checks, and banks still have the ability to conduct all of their pre-validation AML, CFT, and KYC checks.

Fortunately, in recent years a number of privacy-enhancing techniques (PETs) have been developed to support such an arrangement. At their core, these techniques are focused on being able to confirm certain critical information about an individual engaging in a transaction (e.g., the individual isn't on a terrorist watchlist) without revealing PII about that individual. Promising areas include verifiable credentials, decentralized identifiers, zero-knowledge proofs, homomorphic encryption, and multi-party computation, which generally enable parties to prove that an encrypted proposition is true without revealing the underlying information. Cryptography can facilitate portable credentials that prove, rather than disclose, key elements, such as what trusted entity has conducted customer due diligence and what elements of information were checked, such as sanctions lists. This approach can facilitate greater access to financial services through digital wallets.

IV. WHAT WE HAVE LEARNED SO FAR

More than 100 central banks around the world are engaged in the consideration, design, and implementation of CBDCs. Some have formally established CBDCs, including the Eastern Caribbean Union (DCash), the Bahamas (the Sand Dollar), Nigeria (the Nigerian eNaira) and Jamaica (JAM-DEX). Others, such as China (e-CNY), are engaged in pilot programs with the intention of full implementation within the next few years. Another group is still in the process of designing prototypes, with pilot programs likely to follow. [11]

In contrast, the United States is lagging behind. For example, the Federal Reserve is focused currently on the rollout of a 24/7 retail payments system (FedNow), rather than implementation of a USD CBDC. Moreover, the Federal Reserve has committed to not implementing a CBDC without explicit congressional legislation.[12]

For the countries that have implemented a CBDC, the design elements are similar—a retail based, two-tiered system, with no interest paid. The CBDC is intended to be a complement to physical cash, broadening the offering of retail public money, and is designed to be the anchor and unit of account for the domestic payment regime, but not to be a substitute for interest-bearing bank deposits or to encourage bank disintermediation.

To date, the usage of CBDCs among the countries that have implemented them or have active pilot programs has been very modest. The experience of the e-CNY is a case in point. Despite rapid growth of e-CNY wallets, usage as a payment medium has remained low. Most of the population continues to use the two dominant private-sector payment systems—Alipay and WeChat Pay—presumably because they are better integrated into other services and have a first-mover advantage.[13]

The scope for rapid adoption may be higher in the case of low-income countries with underdeveloped financial sectors, or when the country already plays an active role in the retail payments infrastructure. Examples of the latter include India, which has implemented a biometric digital identity system that covers nearly all of its population and has established a Unified Payments Interface (UPI) that facilitates P2P and P2B transactions through the banking system. This may facilitate a faster adoption of the Indian e-Rupee when it is implemented. Similarly, the Brazilian CBDC may have broader success

11 In addition to the Atlantic Council's CBDC Tracker, the BIS has carried out six annual surveys of CBDC development, the latest of which was completed by Anneke Kosse and Ilaria Mattei and published in July 2023 ("Making Headway—Results of the 2022 BIS Survey on Central Bank Digital Currencies and Crypto," BIS Papers No. 136).

12 Nevertheless, in the United States, there have been some important technology studies, including Project Hamilton (Federal Reserve Bank of Boston) and Project Cedar (Federal Reserve Bank of New York). And the US Treasury has established a framework for interagency cooperation with foreign counterparts with respect to CDBC development. Public comments in response to the Federal Reserve's *Money and Payments: The U.S. Dollar in the Age of Digital Transformation* (January 2022) have generally opposed the Federal Reserve implementing a CBDC.

13 China's progress toward the development of the e-Yuan is discussed in papers by Ananya Kumar, "A Report Card on China's Central Bank Digital Currency: The e-CNY," Atlantic Council (March 1, 2022), and by Theodore Benzmiller, "China's Progress Towards a Central Bank Digital Currency," Center for Strategic and International Studies (April 19, 2022). The e-CNY also provides an alternative should there be a problem in the operation of the private payment system; the use of the traditional alternative—physical cash—has already diminished significantly.

with the support of its national instant payment scheme (Pix), which currently reaches more than 70 percent of the population.

At the global level, the BIS has been active in supporting central banks that are exploring whether and how to implement a CBDC. The BIS has published a number of technical papers analyzing the benefits and risks of establishing a CBDC and has been monitoring the status of CBDC development around the globe. On the technical side, through its Innovation Hub (BISIH), the BIS has been conducting experiments with a number of central banks to learn more about what design elements are best suited to manage cross-border payments and settlement on a multilateral basis, including multi-party and multi-asset transactions.

One particularly important effort in this regard has been Project mBridge. The BISIH has been coordinating with the central banks of China, Hong Kong, Thailand, and the United Arab Emirates on how to use wholesale CBDCs on a common platform for the multilateral clearing and settlement of cross-border payments among the four countries. The goal here is to circumvent the costs and delays of the current regime that relies on existing correspondent banking relationships.[14]

The BIS experiments show that a multiplatform CBDC system is operationally feasible, allowing multiple currencies and assets to be settled and various access policies to coexist. The experiments also have indicated the potential for greater operational efficiency including lower overhead, faster settlement, and increased operational transparency.

Project mBridge has also underscored the importance of collaboration among countries at an early stage in the design process. In particular, the project illustrates the importance of establishing common legal and technological standards for the identification of CBDCs, data formatting and messaging, and the transfer, clearing, and settlement of central bank reserves by means of CBDCs.

The IMF and the World Bank are also playing important roles in CBDC development. This includes an active technical assistance program with member countries that are considering and/or in the process of implementing CBDCs and the design elements for an international platform (XC platform) that would facilitate international transfers and cross-border payments between national regimes without reliance on cumbersome correspondent banking networks.[15]

Projects such as the Regulated Liability Network (RLN) are testing the integration of CBDCs alongside other tokenized forms of regulated securities and deposits held with commercial banks—specifically how these different tokenized forms of money can be represented in one system, or through synchronized ledgers. Different implementations of RLN are dedicated to various use cases such as multicurrency cross-border payments, delivery versus payment for securities, and wholesale payment versus payment. Each phase of the RLN project explores which technical, legal, and business characteristics are necessary to provide on-chain, 24/7 programmable, final settlement in sovereign currencies, for the liabilities of both public and private regulated financial institutions.

These efforts underscore the importance of building a global regime that enables interoperability and rapid settlement. But doing so is difficult when individual countries' attention is focused mainly on the role of CBDCs within their domestic payment systems.

V. CONCLUSION

CBDC development is moving ahead rapidly, with a growing number of countries and their central banks moving swiftly through the various stages of CBDC development. While only a few central banks have officially launched a CBDC, this number is likely to grow quite rapidly given the number of pilot launches that

14 The work of the BISIH and the focus of its 12 experiments on different aspects of retail and wholesale CBDC operations (including Project mBridge) is explained in "Lessons Learnt on CBDCs: Report Submitted to the G20 Finance Ministers and Central Bank Governors" (Bank for International Settlements Innovation Hub, July 2023).

15 The "XC platform" is discussed in Tobias Adrian and Tommaso Mancini Griffoli, "The Rise of Payment and Contracting Platforms" (IMF Fintech Notes No. 2023/005, International Monetary Fund, June 2023).

have occurred and the number of central banks in the advanced stages of proof-of-concept testing.

Based on a review of these initiatives, it is clear that there are similar motivations for developing and implementing a CBDC. A CBDC is widely viewed as an important catalyst for major improvements in the efficiency and resilience of domestic payments systems and as a spur to private sector innovation. CBDCs are also seen as important in ensuring that the official sovereign currency remains at the core of the monetary system and is not supplanted by other sovereign currencies or private sector substitutes, such as cryptocurrencies or private stablecoins. However, CBDCs should be able to interact with any form of regulated digital money such as tokenized deposits and securities that are held by commercial banks.

For low-income and emerging-market countries, CBDCs are also viewed as being an important element to help facilitate greater financial inclusion for those who operate in the informal economy and have no or limited access to traditional banking and payment services. CBDCs are also seen as a potential vehicle for lowering the cost and improving the speed of cross-border payments and transfers. For many low-income countries, the large volume of remittances received from citizens working abroad make this an attractive objective.

The major design elements of a CBDC are also broadly shared. CBDCs are generally being designed as non-interest-bearing and as a two-tiered system with commercial banks managing the customer relationship. Typically, limits on holdings are put in place—both for financial stability reasons and, in the case of offline transactions, to limit the opportunity for illicit usage. Technology solutions should prioritize horizontal scalability with atomic settlement, interoperability between networks and financial standards, and privacy of identification data in payments.

Because CBDC development is evolving quickly, it is not clear yet what will work best and what will turn out to be the important bottlenecks and sticking points. But there does seem to be a pressing need for greater multilateral engagement to ensure that the results of the various domestic initiatives can be integrated globally to facilitate faster, more efficient international payments.

With this in mind, two steps should be taken immediately. First, the BIS and the FSB should take the lead in establishing a set of principles for CBDCs, similar to what was done for central counterparties (CCPs) following the Global Financial Crisis.[16] These principles would establish what functionality a CBDC regime should have in its ability to connect with other regimes globally and would include clear principles for issues such as privacy, data protection, operational resiliency, Know Your Customer, timeliness of settlement, dispute resolution, and financial stability. How to achieve such goals would be left to the individual countries.

Developing a set of principles could encourage greater interoperability and instill a higher level of trust and credibility in CBDC initiatives. Additional benefits include the potential to reduce regulatory arbitrage when differences in regulatory regimes across countries are exploited. Moreover, having shared principles can make it easier for central banks and financial institutions to collaborate. This can facilitate the broad adoption of best practices that would help the development of a robust international CBDC ecosystem.

Second, the BIS should take the lead in proposing settlement rules and standards for cross-border CBDC payments. The BIS is best positioned to do so for several reasons. First, at a practical level, the BIS has decades of experience in providing banking services to central banks and to other official institutions around the world. Second, through the work of its Innovation Hub in collaboration with several central banks, the BIS has developed a strong knowledge base about the technological and operational aspects of making cross-border payments via CBDCs.

Multilateral cooperation and coordination are needed to ensure a well-functioning global payments regime.

16 See BIS, "Principles for Financial Market Infrastructures" (CPMI Papers No. 101, Committee on Payments and Market Infrastructures, April 16, 2012).

SELECTED READINGS ON CBDCs

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