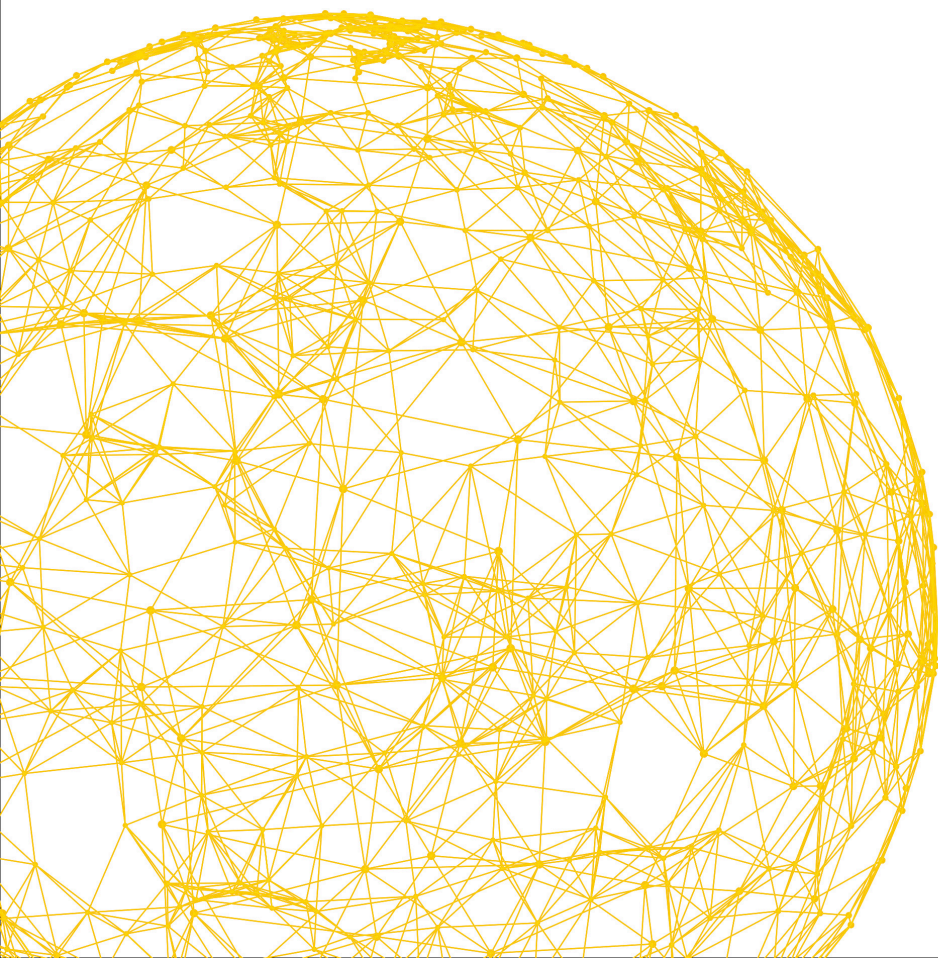




Imagining an open
future for payments

The art of public money: Policy considerations for central bank digital currencies

Central bank digital currencies (CBDC), or digital payment instruments issued by a central bank, are gaining widespread interest and are coming under closer examination. This paper offers policymakers who are considering a CBDC a series of tough questions to address as they decide whether and how to move forward.



Synopsis

Central bank digital currencies (CBDC), or digital payment instruments issued by a central bank, are gaining widespread interest and are coming under closer examination. While several countries have taken concrete steps to advance a CBDC framework, or even move into a pilot stage, there is still a great deal that is unknown about CBDCs or how their introduction will affect a nation's economy. If central banks decide to move forward with a CBDC, they will need to draw upon the expertise, distribution channels, and experiences of the private sector within the payments ecosystem. This paper explores some of the motivations leading central banks on this journey, examines the policy implications of building different types of CBDC, and identifies the risks every central bank is likely to encounter. The paper provides policymakers who are considering a CBDC the opportunity to explore a series of tough questions as they decide whether and how to move forward.



The art of public money: Policy considerations for central bank digital currencies



Visa Economic Empowerment Institute





Acknowledgments

This paper was authored by Catherine Gu from Visa Crypto and Chad Harper from the Visa Economic Empowerment Institute. We thank Erin English for leading initial drafts of the paper and wish him the best. We also thank the following Visa colleagues for their review and input: Clinton Chen, Clement Cher, Aakash Degwekar, Jill Friant, Barbara Kotschwar, Jake Levy, Ciyi Lim, Max Malcolm, Ram Rakkappan, Flora Shi, and Andy Yee. For their helpful comments and contributions, we also gratefully thank Jen Swetzoff for editorial assistance and the design team from 451.

About the Visa Economic Empowerment Institute

The VEEI is a non-partisan center of excellence for research and public-private dialogue established by Visa.

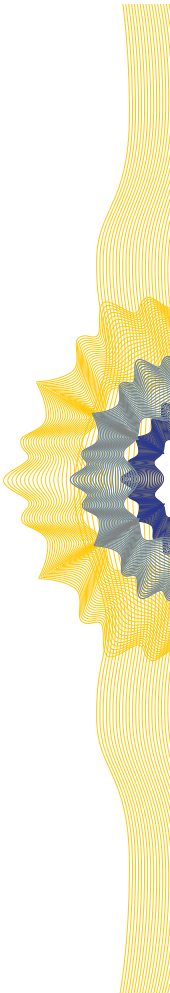
The VEEI's overarching mission is to promote public policies that empower individuals, small businesses, and economies. It produces research and insights that inform long-term policy within the global payments ecosystem. Visa established the VEEI as the next step in its ongoing work to remove barriers to economic empowerment and to create more inclusive, equitable economic opportunities for everyone, everywhere.

Visit: visaeconomicempowermentinstitute.org

Index

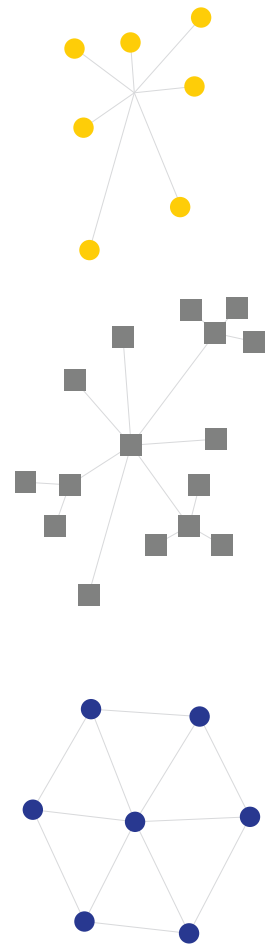
| | |
|--|----|
| Making public money digital | 7 |
| Introduction | 9 |
| Why governments around the world are thinking about adopting CBDCs | 10 |
| The different types of CBDC | 12 |
| Central bank motivations for introducing a CBDC | 16 |
| The potential challenges facing CBDC introduction | 19 |
| Solving for common CBDC challenges | 22 |
| Important questions for policy makers to think through | 25 |
| Not the end, but the beginning of a dialogue | 27 |
| Annex 1: Text descriptions of figures | 29 |
| References | 30 |
| Notes | 35 |

Making public money digital



Public money, today mostly in the form of banknotes and coins, can be strongly attached to national identity and pride. For a long time, it was used to memorialize the accomplishments of sovereigns and other rulers. More recently, nations and their central banks have used banknotes and coins to celebrate civic virtues or the accomplishments of pioneers in various fields, and perhaps even to publicly recognize prior societal shortcomings. The UK's beautiful new £50 note, for example, recognizes the accomplishments of Alan Turing, a wartime code-breaker and early computer pioneer. These are deeply personal things to a country. The materials used for coins and banknotes—and the intricate designs incorporated into them, sometimes for security, at other times to inspire and delight—are an artistic expression and method of differentiation. Global interoperability has not been a goal—rather the opposite—as nations have sought to differentiate their physical public money.

When faced with the question of making public money digital, where it might lose some of its beautiful individuality and ability to inspire a nation's citizens, it is essential for central banks, policymakers, and the public to ask, “Do we really need to do this? What problem would we be solving?” And it is entirely possible that some nations, perhaps those with existing robust digital payment systems and few digital equity issues to address, might not have as much to “fix” with a central bank digital currency as other countries would. Still, though, now is the time to be looking into the technologies, and now is the time to be thinking through the myriad policy issues, and now is the time to puzzle through the likely and perhaps less likely consequences of introducing digital money to the public. The decision to introduce a central bank digital currency is not one that needs to be made hastily, but the window of time to think through things is one that might close faster than we wish.



Introduction

In the past few years, many central banks have debated whether a CBDC¹ makes sense for their economies, and if so, what a CBDC would look like and do. Since 2019, Visa has been active in these discussions, and we appreciate that most central banks are being thorough and keeping an open mind. To be clear, despite a central bank's best efforts, a CBDC will create impacts to the economy—both good and bad—that cannot be entirely foreseen. This is simply the nature of technology and innovation. Throughout these discussions with central banks, it has been our view that it is still too early to predict where and how CBDCs will have the greatest impact. It is clear that the central banks need to get very specific about the issues they hope a CBDC will solve, and central banks need to have very clear policy objectives in mind as they decide if and how to build a CBDC. We have found the G7's (2021) Principles for CBDC a very good foundation to help central banks in their decision making. Ultimately, the decision to build a CBDC rests with the central bank, and should reflect a Bank's objectives, planning, and resources. The following analysis intends to provide a common understanding for policy makers that may be new to this debate and provide them with an objective assessment of some of the advantages and disadvantages of making public money digital. Finally, we pose a series of critical questions on competition, security, and innovation that we hope will advance the policy dialogue as CBDCs continue to gain greater interest.

Why governments around the world are thinking about adopting CBDCs

Clearly, the world's central banks are in a race to explore a novel technology solution. According to a running tally by the Atlantic Council (2022), 105 central banks have announced in the past few years that they are exploring a CBDC. Figure 1 shows the proliferation of CBDC projects over the last few years.

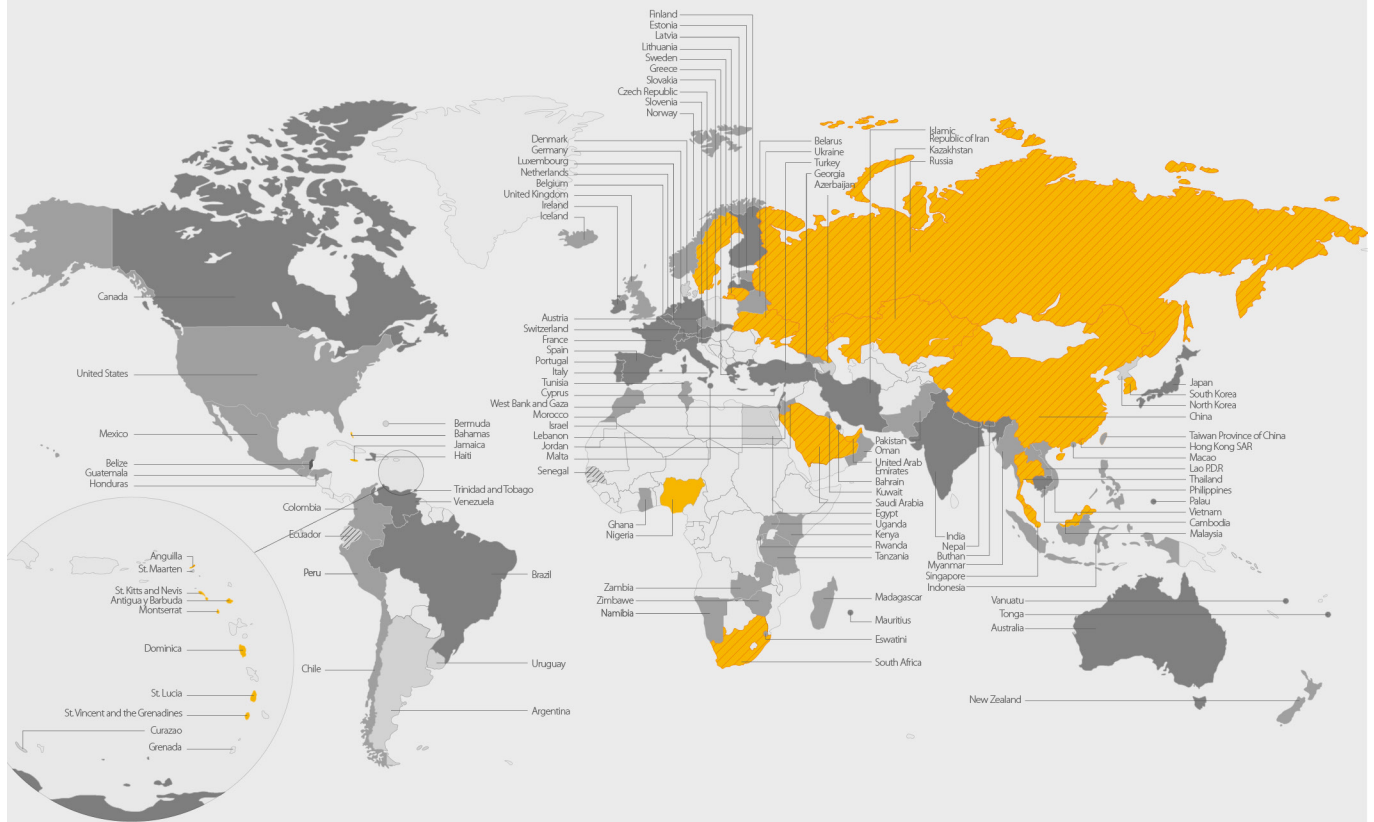
In January 2022, the United States Federal Reserve, America's central bank, released a public discussion paper to examine the "pros and cons" of a potential US CBDC. In the Federal Reserve's words, a US CBDC "would represent a highly significant innovation in American money" (Board of Governors of the Federal Reserve System, 2022). The Federal Reserve's paper came on the heels of a tweet from Mexican President Andrés Manuel López Obrador in December 2021, announcing that Mexico's central bank will launch its own CBDC by 2024 (Gobierno de Mexico, 2021). Both of these announcements followed a wave of similar declarations.

Why are central banks, which are cautious by nature, moving with such relative haste? One could point to the Libra Association's announcement of its digital currency in June 2019. An earlier clue may have been revealed in November 2018—seven months before the release of the Libra white paper—when at the annual Singapore Fintech Festival, then-IMF Chief Christine Lagarde gave a speech called, "Winds of Change: The Case for a New Digital Currency." In this speech, Lagarde (2018) asked some provocative questions: "Should we go further? Beyond regulation, should the state remain an active player in the market for money? Should it fill the void left by the retreat of cash?"

Central banks may have been concerned that a private digital coin such as Libra could undermine their own currencies (Bain, 2020). In fact, a few months after Libra's launch, the former head of the Bank of Japan's head of payment and settlement division warned, "If Libra becomes more widely used than the sovereign currency of a particular country, the effect of monetary policy may be severely undermined" (Kihara et al., 2019). As Eswar Prasad (2021) noted, we find ourselves in an era where private currencies are in real competition with central bank digital currencies. The Bank for International Settlements (BIS, 2020), however, challenged that notion when it said, "CBDC issuance is not so much a reaction to cryptocurrencies and private sector 'stablecoin' proposals, but rather a focused technological effort by central banks to pursue several public policy objectives at once." This begs the question: What are those policy objectives?

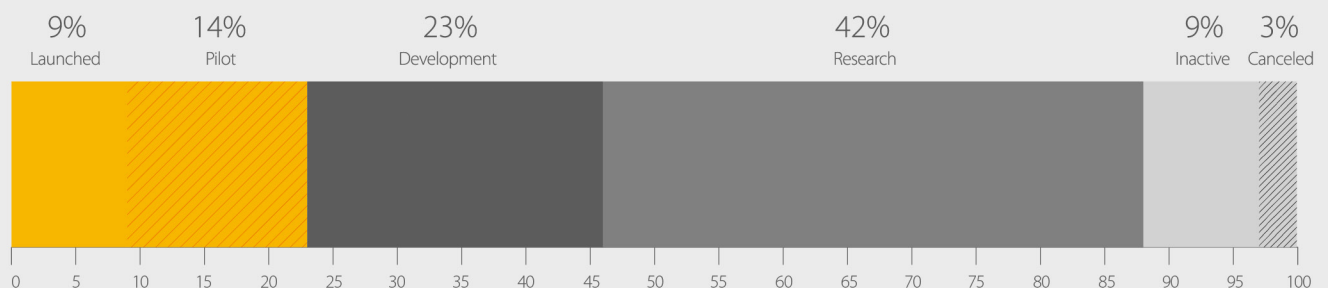
Figure 1. Global CBDC progress tracker

See Annex 1 (page 29) for more information



Over 100 central banks are exploring CBDCs as of May 2022

CBDC progress



Source: the Atlantic Council CBDC tracker as of June 2, which includes inputs from Bank of International Settlements, International Monetary Fund, and the John Kiff Database

The different types of CBDC

How a central bank designs and then builds a CBDC depends on the objectives the bank seeks to realize through its issuance. Wholesale CBDCs are used for transactions between the central bank and other financial institutions, whereas retail CBDCs are used for everyday person-to-person or consumer-to-merchant transactions and are available to the general public. It is this second category of CBDCs, the retail version, that requires the most examination. While interbank transactions already take place in digital form, retail CBDC use would represent a significant shift in how central banks issue tender to their citizens. Finally, we look at a pared-down version of the retail CBDC, the so-called synthetic CBDC.

Wholesale CBDC

Wholesale CBDCs are intended to facilitate secure interbank transfers and settlements between financial institutions, and the accounts are limited to member banks to limit disruption to the financial system and scope distribution to regulated entities of the central bank. This scoping simplifies launching a wholesale CBDC, particularly as the money exchanged between banks is already largely digital (BIS, 2021). Some central banks may explore a wholesale CBDC because it could improve, but not disintermediate, the settlement efficiency and risk management aspects of traditional central bank processes (Committee on Payments and Market Infrastructures, 2018). In a pilot conducted by the Monetary Authority of Singapore (MAS, 2019), the central bank noted that the correspondent banks that process cross-border payments would still serve as intermediaries, but without the need for a correspondent bank to hold the settlement funds. In markets where real-time payment rails are not established, this implementation could allow countries to streamline interbank transfers and experiment with digital currency. Building upon this function, some central banks see wholesale CBDC as a means to improve the efficiency of cross-border payments. As of January 2022, 11 central banks were exploring wholesale CBDCs, with six of those using their wholesale CBDC pilot to test cross-border payments (Kiff, 2022). Commenting on one of the pilots between the Bank of Thailand and the Hong Kong Monetary Authority, the Bureau of International Settlements Innovation Hub (2021) noted that the pilot “demonstrates the potential of faster and lower cost cross-border transfers for participating jurisdictions. The benefits would be further increased for jurisdictions that do not benefit from a vibrant correspondent banking network.”

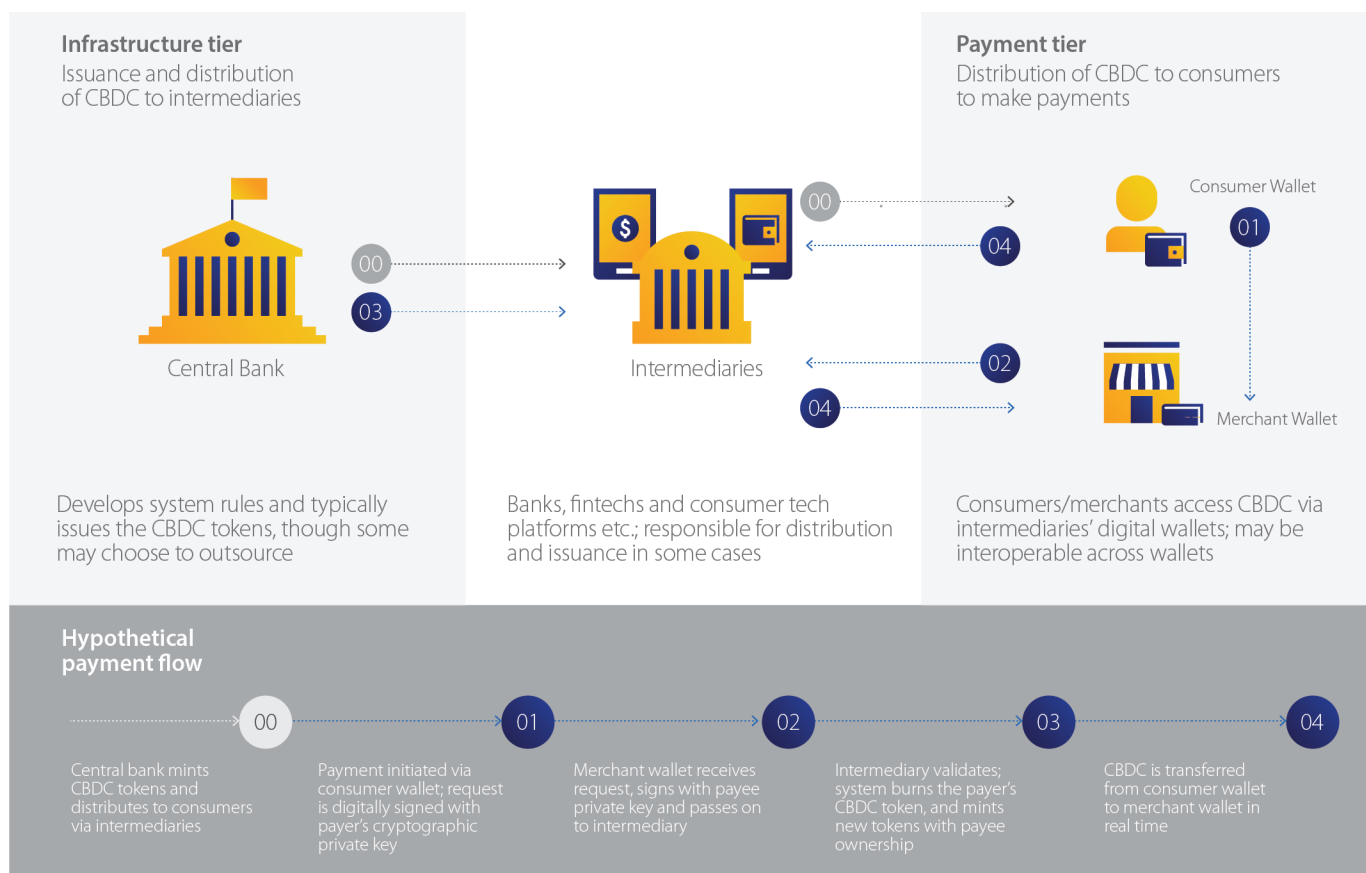
Retail CBDC

Whereas a wholesale CBDC would be used for the settlement of interbank transfers, a retail CBDC requires public understanding, use, and acceptance. Naturally, each country will approach its design differently. Acknowledging these differences, the IMF defines a retail CBDC as “a digital representation of a sovereign currency issued by and as a liability of a jurisdiction’s central bank or other monetary authority” (Alwazir et al., 2020). A retail CBDC will likely use a ‘two-tier’ approach to implementation that will include a mix of public and private participants to issue the CBDC and then distribute it to the public. Central banks would manage the infrastructure, or first tier, and be responsible for the “minting and burning” (creation and destruction) of the digital currency, though designated intermediaries could also play these roles. The private sector would then handle the payment, or second tier, which would entail customer engagement activities such as currency distribution, customer due diligence, and other compliance functions. In a distributed ledger technology (DLT), or blockchain design, public-key infrastructure would be used with the central bank as the authority (i.e., the root certificate) for generating digital signatures, and other financial institutions as a delegated authority (i.e., the intermediate certificate).

Figure 2 describes the relationship between the infrastructure and payments tiers.

Figure 2. Infrastructure tier and payment tier interaction

See Annex 1 (page 29) for more information



Source: Visa analysis

Synthetic CBDC, or the narrow bank option

Another variant for a retail CBDC is a synthetic CBDC (sCBDC), or 'narrow-bank.' According to Tobias Adrian and Tommaso Mancini-Griffoli (2019) of the IMF, in the sCBDC model "the central bank would merely offer settlement services to e-money providers, including access to central bank reserves. All other functions would be the responsibility of private e-money providers." Unlike retail CBDCs, the commercial bank, and not the central bank, would issue the CBDC. There are no sCBDCs operational, but this design likely requires commercial banks to issue their own stablecoin, but those stablecoins would be backed by the central bank (DiPippo, 2022). Adrian and Mancini-Griffoli further elaborate that "sCBDC is thus a far cheaper and less risky model of CBDC for central banks, relative to the full-fledged model. It is also one that preserves the comparative advantage of the private sector to innovate and interact with customers, and of the central bank to provide trust and efficiency." In this instance, the central bank would merely offer its wholesale accounts to stablecoin providers, and allow for greater interoperability among different stablecoin providers (Selgin, 2022). However, central banks may balk at a CBDC that limits their control. For instance, the Dutch central bank argued that a sCBDC is "not a CBDC because the customers in this case do not hold their money directly with the central bank. In this case, their money is still a liability of a private institution and not the central bank. For that reason, balances with a public or private deposit bank are not general purpose [retail] CBDC in our definition" (De Nederlandsche Bank, 2020).

Versions of retail CBDC: Account, token, and hybrid

Retail CBDCs can be divided into three broad categories: account-based, token-based, and hybrid CBDCs. In an **account-based** system, the central bank would structure the CBDC following the present banking system by creating cash current accounts for citizens. In a **token-based** CBDC, the central bank creates a digital bearer instrument and distributes digital tokens through a regulated digital wallet. This most closely resembles a digital version of how currency and coin function today.

Token-based CBDCs would represent a significant change in the way payments are made compared to the existing electronic payment system. Electronic payments today are typically messages transmitted on payment networks that instruct participants to credit or debit liability accounts on a financial institution's balance sheet. However, token-based CBDC payments represent the digital asset itself moving on the network.

A helpful way to differentiate these two types comes from a November 2020 paper by the IMF which frames the difference by looking at the different identity requirements. In an account-based CBDC, the identity of the account holder allows the holder to access the funds: "I am; therefore I own." In a token-based CBDC, the knowledge of a password is needed to hold a cryptographic key, and possession of the digital currency is determined by: "I know; therefore I own" (Bossu, 2020). Adrian and Mancini-Griffoli (2019) of the IMF provide a similar way to imagine this currency as "claim-based" or "object-based." They argue that a claim-based currency requires the payer be recognized as the rightful owner of the claim, whereas an object-based payment is settled immediately as long as both parties agree on the validity of the object.

The final type of retail CBDC layers token-based CBDC implementations with account-based features. In a **hybrid CBDC**, the participating banks would still manage the retail payments and customer interactions, distribute a tokenized version of the CBDC, and according to the BIS staff, the central bank would “keep a central ledger of all transactions” (Bossu et al., 2022).² Michael Lee, Brendan Malone, and Antoine Martin (2020) acknowledged in Liberty Street Economics that, “if a digital currency can be both token-based and account-based, then the classification loses its power to meaningfully distinguish between new and existing methods of digital payments.” Focusing too heavily on these distinctions could limit understanding in digital payments. Nevertheless, these classifications still manifest in central bank discussions, and they are at least important to understand some of the general technology and policy implications of a CBDC.

Central bank motivations for introducing a CBDC

Each central bank that is exploring a CBDC has its own motivations and priorities for doing so. In some instances, the challenges that central banks seek to address with a CBDC, such as financial inclusion, are issues that central banks have struggled with for decades. However, other concerns, such as the growing use of privately issued crypto-assets within their jurisdiction, are obviously new. While not exhaustive, the following list outlines some of the more common motivations (Boar & Wehrli, 2021; Bossu et al., 2022).

1. To maintain the central bank's effectiveness and independence in monetary policy

Central banks often cite the growth of crypto-assets and stablecoins as a risk to their ability to execute monetary policy. Stablecoin issuers could pull liquid assets, such as cash and short-term Treasuries, from the financial market and away from commercial banks. According to Rod Garratt, Michael Lee, Antoine Martin, and Joseph Torregrossa (2022) in *Liberty Street Economics*, “tying up safe and liquid assets in a stablecoin arrangement means they are not available for other uses, such as helping banks satisfy their regulatory requirements to maintain sufficient liquidity.” Stablecoin growth in particular could also lead to the creation of a ‘parallel’ money supply that could inhibit the transmission of monetary policy. Using private digital currency to move value across borders could also impact the stability of exchange rates and limit the ability to use tools such as capital controls. Confronted with these risks, some central banks see the creation of a CBDC as a public sector alternative that could provide many of the attractive features of crypto-assets, and hopefully limit the use (and risks) of stablecoins and other crypto-assets.

2. To continue providing public access to central bank money

At the start of the pandemic in March 2020 and going on until March 2021, the volume of cash lodged at central banks and commercial in the Euro area dropped approximately 20-25% (Panetta, 2021). According to Benoît Cœuré (2021), former head of the BIS Innovation Hub, “The pandemic has accelerated a longer-running move to digital.” Indeed, in 2020 total number of cash withdrawals declined by 23 percent³ (CPMI, 2021). In many developed countries the public has used less cash and more digital payments in everyday commerce. As cash use declines, central banks have become concerned over public access to central bank money. For example, within the last decade, the percentage of people paying with cash in Sweden has decreased from 39 percent to 9 percent. (Sveriges Riksbank, 2020). Nevertheless, Sveriges Riksbank (2021) still sees cash as an important part of its economy, and it views CBDC as a way to complement cash. Digital payments also provide consumers more opportunities to participate in every day commercial activities during quarantines or lockdown (Singh & Zandi, 2021). With the increasingly marginalized role of cash and the growth in digital payments, central banks may view a CBDC as an effective way to ensure continued access to risk-free central bank money and capitalize on the digital shift in consumer behavior.

3. To increase resilience during crises

CBDC can also be seen as a means to address long-standing problems of distributing central bank money to geographically remote areas or to people in times of crisis (BIS, 2020). The Bank of Japan (2020) sees CBDCs as a way to ensure that the public has access in times of emergency, and that individuals can still have access to payments when in the event of “system and network failures as well as electrical outages” and ensuring that a CBDC can still be accessed “offline” during natural disasters. The pandemic has also reminded governments that distributing emergency payments can be costly and difficult when people do not have access to a bank account. This prompted a debate in the United States whether a US CBDC, or a “digital dollar,” could be used to distribute stimulus payments to unbanked Americans (Toh, 2020). Lael Brainard (2021), one of the Federal Reserve Bank’s Governors noted, “While the large majority of pandemic relief payments moved quickly via direct deposits to bank accounts, it took weeks to distribute relief payments in the form of prepaid debit cards and checks to households who did not have up-to-date bank account information.”

4. To drive financial inclusion

The introduction of CBDC will have the greatest impact where the level of financial and digital exclusion is high and where large portions of the population remain unbanked and cash usage is high. Building on this previous motivation, approximately 1.7 billion adults in the world do not have a bank account (Demirgüç-Kunt, 2017). However, the global pandemic put into focus how digital payments could potentially improve financial inclusion. According to a World Bank (2021) study, “In spite of the contraction in economic activity, mobile money grew twice as fast as had been forecast for 2020, at 12.7 percent, reaching 1.2 billion accounts.” The creation of a CBDC in and of itself does not solve financial inclusion, but how a government markets the CBDC and designs it could provide some secondary benefits (World Bank, 2021). Central banks will have to ensure broad public approval for a CBDC, which will likely entail educating the public on the benefits of digital payments and providing or directing people to digital wallets or other applications to access a CBDC. Also, depending on the design, a CBDC could allow for application programming interface (API) integration for digital tools to provide individuals to access additional financial services. This could conceivably make it easier for a regulated financial institution to conduct normal customer due diligence and know-your-customer procedures. Finally, depending on the design, a CBDC could ensure no minimum balance requirements, and could be important to attracting unbanked consumers to CBDC accounts (Maniff, 2020).

5. To encourage competition and interoperability

CBDCs have the potential to encourage competition and interoperability if they act as a neutral technology platform for future payments innovations. To accomplish this, central banks will need to ensure that whatever CBDC infrastructure they build is compatible with ISO 20022 standards, which will ensure the integration of existing payment systems into the new CBDC architecture (World Economic Forum, 2021). By ensuring the integration of ISO 20022, it should be easier for central banks to leverage public-private partnerships and API integration. For instance, central banks could facilitate collaborative participation across financial institutions, fintechs, wallet players and others in the ecosystem. According to a BIS (2021) analysis, an “intermediated CBDC model” could enable an open architecture in which payment service providers retain an important role in protecting customer data and interoperability by enabling greater API functionality among the payments ecosystem. To further encourage innovation, central banks could develop common standards and foster a developer-friendly ecosystem to stimulate the growth of valued-added services.

The potential challenges facing CBDC introduction

As central banks and policymakers weigh the different motivations for building a CBDC, they must also weigh how these objectives can introduce new risks. For example, creating a new payments infrastructure that broadens access to public money may also expose the central bank to new, and potentially broader, cyber attacks. How central banks weigh any new benefits from a CBDC against new risks is essential to the bank's, and the government's, decision making process. Failing to mitigate these new risks can have profound implications on the central bank's reputation. The following challenges are some of the most commonly expressed by central banks (Boar & Wehrli, 2021; Bossu et al., 2022).

Public interest in a CBDC

Perhaps the greatest challenge to CBDC deployment will come from the public's willingness to use it. Inevitably, CBDCs will come up against payment solutions that the public has already come to rely on, and given that there are only a handful of CBDCs in operation, how people will respond to this new innovation is an open question. This was the case in Ecuador when after three years, the Banco Central del Ecuador's Dinero Electronico failed because it could never generate a critical mass of users, nor dispel criticisms that it was never fully backed by the central bank, that it could not be used for cross-border payments, that it facilitated criminal activities, and that it contributed to a surveillance economy (Arauz, 2021). While many of these arguments were probably misleading or simply false, the larger lesson is that the central bank and the Ecuadorian government were unsuccessful in convincing the public of its benefits and could not dispel the various criticisms. It is possible that the public may not trust an innovation that the government did not prepare them for, or that fails to perform as advertised. What happened in Ecuador may portend future challenges for CBDC adoption. In a recent Visa consumer survey of "crypto aware" users, 49 percent of respondents in developed countries and 70 percent of respondents in emerging economies were aware of CBDC, but those numbers dropped when respondents were asked if they would prefer to spend CBDC. Only 20 percent of individuals in emerging markets prefer to spend CBDC, and even fewer, 13 percent, have interest in spending it in developed markets (Visa, 2021).

Impact on the financial system and payments

CBDC can present financial stability risks to the country issuing a CBDC, and to other countries. For the country issuing a CBDC, it could have significant impact on bank funding sources, with effects on credit creation and monetary policy transmission. Even if a CBDC is introduced primarily as a payment mechanism, its status as a legal tender and wide monetary base (i.e. M0 money)⁴ may cause some shifts from bank deposits to the new CBDC asset. This is because the public will rightly conclude that deposits backed by the central bank are more secure than those in a commercial bank. For example, during a financial crisis, a CBDC could become the most trusted form of money, which can put extra strain on the system if there were a bank run. This is especially true for small or regional banks. This would complicate the central bank's role in a crisis as a lender of last resort. Over time, this could both limit the availability of bank lending and increase the cost of funds. Another risk is that another country's CBDC could incentivize currency substitution, or "dollarization," given that some CBDCs may make it easier to conduct cross-border payments. Naturally, this scenario isn't limited to just one CBDC, and it is possible that several CBDCs may scale in countries with relatively weaker currencies (Zhang, 2020).

Offline use of a CBDC

While the use of cash may be declining in many countries, cash's efficacy is unhindered by power outages, service interruptions, natural disasters, and hard to reach locations (Khan, 2021). Though there are notable cash distribution challenges in some of these events, these can be partially overcome by the forward-positioning of ample supplies. As stated earlier, central banks have emphasized the importance of making a CBDC payment "offline." The search for a digital alternative to cash can also bring unintended technology risks. Specifically, it could create opportunities for criminals to digitally counterfeit a CBDC. This is what is known as double-spending attacks, or the attempt by an individual to spend his or her digital currency more than once during the offline period (English, 2021). In October 2020, the Bank of Japan expressed concern that offline CBDC usage, without proper security protocols, could deteriorate CBDC security and make it more prone to counterfeiting.

Cybersecurity risks

A CBDC brings with it two main cybersecurity risks: (1) the risk to the central bank's new CBDC-supporting infrastructure, and (2) the risks to the private institutions supporting the distribution of CBDCs. Recent high-profile cyber attacks against central banks—for example, the attack on the Bank of Bangladesh in 2016 or the SolarWinds attacks in 2020—have demonstrated that government agencies such as central banks are not immune from nation-state cyber attacks (U.S. Department of the Treasury, 2019). Once a CBDC is active, it will never cease to be a rich target for criminals that wish to steal it, or nation-states that want to infiltrate another nation's critical infrastructures. A CBDC that provides a single source of transaction information is also at a risk of cyber espionage. However, the second set of cyber risks in the "payments tier" of a CBDC are just as concerning. For instance, a recent Federal Reserve study concluded that cyber actors could disrupt wholesale, interbank payments by targeting the five largest participants in Fedwire (Mester, 2021). In a two-tiered CBDC, cyber actors could disrupt a CBDC by targeting central bank that issues a CBDC or the commercial banks that distribute it to the public.

Cross-border payments

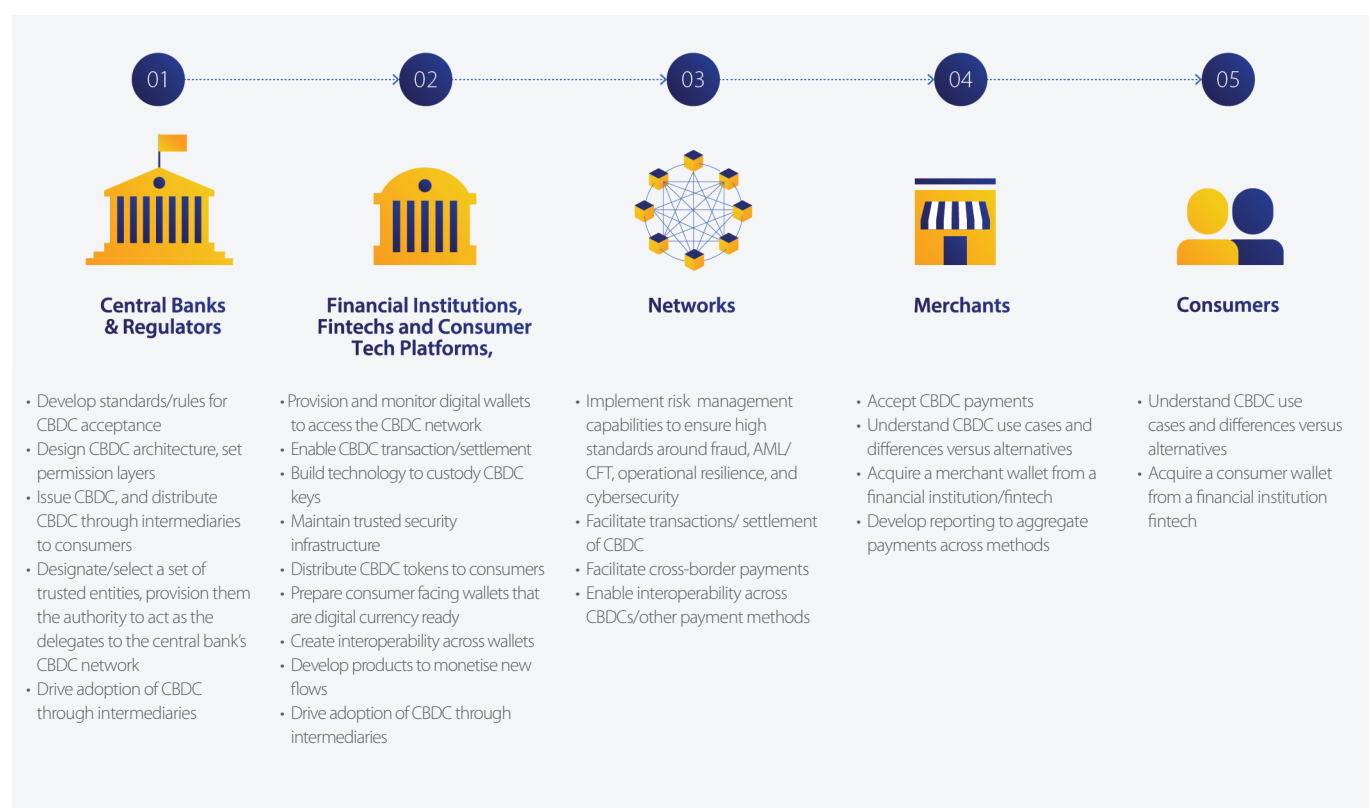
Central banks are likely to prioritize a CBDC for domestic use. However, without proper planning or coordination with other central banks, a CBDC could worsen how cross-border payments operate. None of the multijurisdictional and compliance frictions that come from sending money overseas disappear with a CBDC. These frictions are attributed to several underlying factors such as mitigating the higher fraud rates for cross-border payments compared to domestic transactions; the higher technology requirements for authorization, clearing, and settlement; and differing regulatory compliance requirements from country to country. Central banks will also have to expect that cross-border payments using its CBDC must interact with another jurisdiction that does not have a CBDC, or a CBDC using a different technology platform (Christodorescu et al., 2021). The IMF identified the challenges of cross-border payments for a CBDC in 2020, warning that “it would seem prudent for central banks to consider coordinating their CBDC efforts closely and introducing sufficient flexibility into their CBDC designs to facilitate cross-border interoperability and standardization across CBDC implementations” (Alwazir et al., 2020).

Solving for common CBDC challenges

It would be a mistake for the central bank to take on these challenges alone. Since most CBDC designs will require a two-tiered CBDC infrastructure, this is an opportunity for central banks to leverage private sector expertise in payments and technology, which could encourage software and other technology developers to build solutions that are interoperable with the CBDC. This structure would create a balance where designated private sector players focus on the distribution of the digital currency while the central bank focuses on regulation and supervision. Critically, both the central bank and the private sector participants would each be responsible for risk mitigation. This model would build on the comparative advantages of the public and private sectors while also cultivating a space for payments innovation and financial stability. Figure 3 illustrates the potential ecosystem player roles.

Figure 3. Potential ecosystem roles and responsibilities

See Annex 1 (page 29) for more information



Source: Visa analysis

Driving adoption

Adoption of retail CBDCs will largely depend on two factors—consumer use and merchant acceptance. As payment platforms and choices proliferate, consumers have come to expect high quality and streamlined digital experiences as baseline offerings. At the outset, central banks will need to explain to the public the value of CBDCs and why they are building it. Consumers also need to have a choice between payment methods and networks, enabling them to make use of the features most important to them when they want. Therefore, it would be essential for CBDCs to be usable across all payment networks, such as cards and instant payments, to offer both choice and larger scope for additional functionalities and use cases. Central banks have an opportunity to build public confidence, especially in markets where access to the financial system is limited. CBDC transactions with the appropriate features could improve access to the unbanked and underbanked population. With respect to merchant acceptance, CBDCs should be well integrated and interoperable with the existing payment system to ensure it can be easily accepted at acceptance points for cash and non-cash payments. Especially for a new currency and new experience, consumer adoption may largely depend on the robustness of the acceptance network. Further, merchants currently benefit from digital payments in ways such as improved cash flow, transaction processing time, security, resilience, and consumer convenience.

Supporting offline use of a CBDC

Digital payments traditionally rely on online communications with several intermediaries such as banks, payment networks, and payment processors in order to authorize and process payment transactions. While these communication networks are designed to be highly available with continuous uptime, there may be times when an end-user experiences little or no access to network connectivity. To allow CBDC to be broadly accessible and transferable in real-time without continuous dependency upon digital connectivity, an “offline” capability to create secure point-to-point payments through the use of authorized hardware will be critical.

In December 2020, Visa published a technical research paper where we proposed an offline payment system (OPS) protocol for CBDCs that allows a user to make digital payments to another user while both users are temporarily offline and unable to connect to payment intermediaries (or even the internet). OPS describes how a user can instantly complete a transaction involving any form of digital currency over a point-to-point channel without communicating with any payment intermediary, achieving virtually unbounded throughput and real-time transaction latency. In addition, the OPS protocol describes the standards needed to address the need to ensure funds cannot be double-spent during offline payments given that no trusted intermediary is present in the payment loop to protect against replay of payment transactions (Christodorescu et al., 2020).

Defending against cybersecurity risks

As noted earlier, CBDCs may come under cyber attack even before they become fully functional, as cyber actors will seek to infiltrate the system's architecture, hardware, and software supply chains. To defend against these cyber intrusion attempts from nation states and other sophisticated cyber actors, central banks must adopt two complementary mindsets that mitigate cyber risks in the CBDC the infrastructure tier and in the CBDC payments tier: develop a robust cybersecurity risk management program to secure the part of the CBDC that are outside of the central bank's direct control or the payments tier, and a comprehensive cybersecurity risk management program for those parts of the CBDC infrastructure that are within the bank's control, or in the infrastructure tier. While there are cybersecurity risks, such as double spend attacks, that can occur at the user level, it is the cyber risks to the CBDC's infrastructure that require the greatest attention.

Improving cross-border payments

For CBDCs to be successfully integrated in the economy, public and private partners will need to draw upon their respective areas of expertise, distribution channels, and responsibilities within the payments ecosystem. These issues can be mitigated by considering cross-border use cases in the initial designs of CBDC systems and by agreeing on interoperable global standards with international organizations. While many new multilateral platforms resolve the challenges introduced by correspondent banking and make cross-border payments faster, cheaper, and more transparent, innovations will also be needed to move CBDCs across borders.

Visa research has proposed a set of standards and techniques through interoperable cross-border CBDC payment routes called Universal Payment Channels (UPC) that could allow instant transfer of funds across CBDC ledgers in a scalable and interoperable way. In this model under a hub-and-spoke design, the UPC hub would interconnect multiple blockchain networks and allowing for secure transfer of digital currencies. Think of it as a "universal adapter" among blockchains, allowing central banks, businesses, and consumers to seamlessly exchange value, no matter the form factor of the currency (Gu, 2021). Of course not every CBDC will use a DLT or blockchain network, and this represents an active area of research as multiple concurrent international projects are under way by the BIS Innovation Hub and others.

Important questions for policy makers to think through

The development of a CBDC has significant implications for the financial landscape, with complex policy issues to navigate. CBDC proposals vary greatly in their specifics, and the balance between costs and benefits for many of these issues depends on a country's situation and the proposal's details. Given the potential substitutability between CBDC and other payment infrastructures, there is the possibility that a CBDC could crowd out other payments networks or increase risk to the financial system. Acknowledging these risks should not necessarily cause a central bank to abandon the idea of a CBDC, but policymakers in the central bank and within the government at large should carefully weigh the risks and rewards. The following policy principles and related questions could be useful guides for policymakers as they continue to explore a CBDC.

The creation of a CBDC will have broad implications for a country's economy and impact current and future innovations in the payments ecosystem. Whether a central bank decides to explore a CBDC should be evaluated extensively by other stakeholders, including other government agencies, the nation's legislature, and civil society through a public comment process.

- What are the public policy objectives that the central bank is looking to achieve and the problems the central bank is looking to solve?
- How can a CBDC ecosystem support, and not further complicate, an already robust cross-border payment system that markets have come to depend upon?
- How can CBDCs coexist with existing means of payment within an open, secure, resilient, and transparent environment? What steps should the central bank take to ensure that a CBDC is not crowding out other payment providers or legitimate non-sovereign digital currencies?
- How is the central bank accounting for the costs associated with building, and maintaining, a CBDC? Relatedly, what are the incentives for the private sector tier, or banking members, to distribute the CBDC when they will likely incur new costs for conducting due diligence on individuals who do not hold deposits at the bank?
- How should the central bank balance potential cost recovery obligations against the creation of money as a public good? For example, in the United States, the Federal Reserve must comply with the Monetary Control Act for many financial services, which states in the long run any new service must achieve full cost recovery (Board of Governors, 2021). How should these obligations be seen in the context of a competing with other payments systems?

The Financial Action Task Force (FATF, 2021) warned that CBDCs will confront unique money laundering and terrorist financing risks that a central bank should address in a “forward looking manner.” It stands to reason that this warning should also apply to cyber crime. Every stakeholder in the CBDC ecosystem must expect that criminals and nation states will exploit weaknesses in an infrastructure almost immediately. Any CBDC must meet or exceed the cybersecurity, availability, and fraud prevention standards that consumers expect today.

- How is the central bank working with other government agencies to prepare for attacks to the CBDC?
- Depending on the design, a CBDC can provide the government an electronic record of every transaction. How will the government balance the potential law enforcement benefits of such a record against individual privacy risks? Relatedly, will a CBDC be an opportunity for the government to reexamine its anti-money laundering laws?
- What other government agencies will have access to the CBDC infrastructure, and how should other data tools, such as fraud controls, be built on top of the CBDC infrastructure?
- Cash is anonymous because of its inherent physical nature. However, if anonymity were to exist for CBDC bearer instruments in a CBDC, that will almost certainly make financial crime easier. How should central banks and their interagency partners balance privacy with crime prevention?
- How should central banks develop and execute a comprehensive cyber risk management program to include capacity planning, business continuity and disaster recovery planning, crisis simulation and playbook development, and other sound response and recovery practices?

A CBDC will introduce a novel technology platform to a nation's entire economy, and likely impact the direction and speed of financial innovation within the central bank's jurisdiction. For the innovation promise to be realized, a CBDC must offer a great consumer experience and widespread merchant acceptance.

- How can a CBDC support and be a catalyst for responsible innovation in the digital economy and ensure interoperability with existing and future payments solutions?
- What are the minimum data sets that will be needed to authorize a transaction, and what is the additional data required to conduct due diligence and fraud protection, thereby improving transaction outcomes? Relatedly, how will these data sets be protected, and what are the limitations on their use?
- What processes should the central bank put in place that sets clearly and appropriately defined roles for the public and private sectors in a CBDC ecosystem?

- Moreover, what steps can policy makers undertake to support innovation, including minimizing policy uncertainty, that might diminish investment in the wider payments landscape?
- How can the central bank ensure that the design of CBDC is interoperable with existing and future regulated payment solutions for cross-border payments?
- When considering a potential CBDC, policymakers must determine the value proposition for consumers and businesses, the use case(s) for which it is envisioned, and what outcomes it is intended to achieve. Identification of use cases that are genuinely complementary and additive to existing private digital payments will assist in the attractiveness of a CBDC for users and help avoid consumer confusion, unnecessary overlap, and potential disintermediation of the financial sector.

Not the end, but the beginning of a dialogue

We posed a series of questions policymakers and central bankers should answer in their CBDC journeys. As stated before, the decision to issue a CBDC uniquely belongs to a nation and its central bank. But policymakers are not alone as they answer all the questions. The private sector has much to offer in these deliberations, and we welcome continuing this dialogue.

Annex 1: Text descriptions of figures

Figure 1: Global CBDC progress tracker. Figure 1 displays a world map in which the countries are color-coded to indicate their progress toward developing a CBDC. The map tracks 105 countries and is coupled with a stacked bar graph showing the percentage of countries at each stage of development. While 9% of tracked countries have already launched a CBDC, 14% are in the “pilot” stage, another 23% are in the “development” stage, 42% are in the “research” stage, 9% are no longer actively pursuing a CBDC, and 3% have cancelled their efforts.

Figure 2: Infrastructure tier and payment tier interaction. Figure 2 displays the movement of tokens between different actors in a “two-tier” approach to CBDC implementation. The tokens begin in the “infrastructure” tier, comprised of a central bank that mints and issues each token. The tokens then travel through intermediaries—such as banks and fintechs—which distribute the tokens to the “payment” tier, comprised of consumer and merchant digital wallets. When a consumer initiates a payment to a merchant, an intermediary must validate this transaction. Once the transaction has been validated, the central bank burns the consumer’s token and mints new tokens with merchant ownership, allowing the transaction to take place in real time.

Figure 3: Potential ecosystem roles and responsibilities. Figure 3 summarizes the responsibilities of six actors in the CBDC ecosystem. Central banks and regulators develop standards for CBDC acceptance, issue tokens, and drive adoption through intermediaries. Financial institutions, fintechs, and consumer tech platforms monitor digital wallets, maintain security infrastructure, and foster interoperability. Networks implement risk management capabilities and facilitate transactions. Merchants accept payments through merchant wallets. Lastly, consumers understand the various use cases and acquire wallets to use their CBDC.

References

- Adrian, T., & Mancini-Griffoli, T. (2019). *The Rise of Digital Money*. International Monetary Fund. <https://www.imf.org/en/Publications/fintech-notes/Issues/2019/07/12/The-Rise-of-Digital-Money-47097>
- Alwazir, J., Davidovic, S., Farias, A., Khan, A., Khiaonarong, T., Kiff, J., Malaika, M., Monroe, H. K., Sugimoto, N., Hervé, T., & Zhou, P. (2020, June 26). *A Survey of Research on Retail Central Bank Digital Currency*. International Monetary Fund. <https://www.imf.org/-/media/Files/Publications/WP/2020/English/wpia2020104-print-pdf.ashx>
- Ansar, S., Demirgüç-Kunt, A., Hess, J., Klapper, L., & Singer, D. (2017). *The global finindex database measuring financial inclusion and the fintech revolution*. World Bank Group. <https://globalindex.worldbank.org/>
- Arauz, A., Garratt, R., & Ramos, D. F. (2021). Dinero Electrónico: The rise and fall of Ecuador's central bank digital currency. *Latin American Journal of Central Banking*, 2(2). <https://doi.org/10.1016/j.latcb.2021.100030>
- Ardic, O., & Bossone, B. (2021). *Central Bank Digital Currencies for Cross-Border Payments*. The World Bank. <https://openknowledge.worldbank.org/bitstream/handle/10986/36764/Central-Bank-Digital-Currencies-for-Cross-border-Payments-A-Review-of-Current-Experiments-and-Ideas.pdf?sequence=1&isAllowed=y>
- Armeliu, H., Guibourg, G., Johansson, S., & Schmalholz, J. (2020). *E-krona design models: pros, cons and trade-offs*. Sveriges Riksbank. https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200618/2020_2-e-krona-design-models-pros-cons-and-trade-offs.pdf
- Atlantic Council. (2022). *Central Bank Digital Currency Tracker*. <https://www.atlanticcouncil.org/cbdctracker/>
- Bain, B., Light, J., & Kharif, O. (2020, March 4). Facebook weighs Libra revamp to win over reluctant regulators. *Bloomberg*. <https://www.bloomberg.com/news/articles/2020-03-03/facebook-weighs-libra-revamp-to-win-over-reluctant-regulators>
- Bank for International Settlements. (2018). *Central bank digital currencies*. <https://www.bis.org/cpmi/publ/d174.pdf>
- (2020). *Annual Economic Report*. <https://www.bis.org/publ/arpdf/ar2020e.pdf>
- (2021). *Annual Economic Report*. <https://www.bis.org/publ/arpdf/ar2021e.pdf>
- Bank for International Settlements Innovation Hub. (2021). *Inthanon-LionRock to mBridge: building a multi CBDC platform for international payments*. <https://www.bis.org/publ/othp40.pdf>
- (2022). *Project Dunbar: International settlements using multi-CBDCs*. https://www.mas.gov.sg/-/media/MAS-Media-Library/development/fintech/Dunbar/Project_Dunbar_Report_2022.pdf

Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, Bank for International Settlements. (2020, October 9). *Central bank digital currencies: foundational principles and core features*. <https://www.bis.org/publ/othp33.pdf>

Bank of England. (2020). *Discussion Paper: Central Bank Digital Currency Opportunities, Challenges, and Design*. <https://www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper>

Bank of Japan. (2020). *The Bank of Japan's Approach to Central Bank Digital Currency*. https://www.boj.or.jp/en/announcements/release_2020/data/rel201009e1.pdf

Boar, C., Wehrli, A. (2021). *Ready, steady, go? – results of the third BIS survey on central bank digital currency*. Bank of International Settlements. <https://www.bis.org/publ/bppdf/bispap114.pdf>

Board of Governors of the Federal Reserve System. (2021, March 22). *FedNow Service, Frequently Asked Questions*. https://www.federalreserve.gov/paymentsystems/fednow_faqs.htm

— (2022). *Money and Payments: The U.S. Dollar in the Age of Digital Transformation*. <https://www.federalreserve.gov/publications/files/money-and-payments-20220120.pdf>

Bossu, W., Itatani, M., Margulis, C., Rossi, A., Weenink, H., & Yoshinaga, A. (2020). *Legal Aspects of Central Bank Digital Currency: Central Bank and Monetary Law Considerations*. International Monetary Fund. <https://www.imf.org/en/Publications/WP/Issues/2020/11/20/Legal-Aspects-of-Central-Bank-Digital-Currency-Central-Bank-and-Monetary-Law-Considerations-49827>

Brainard, L. (2021, May 24). *Private Money and Central Bank Money as Payments Go Digital: an Update on CBDCs*. Board of Governors of the Federal Reserve System. <https://www.federalreserve.gov/newsevents/speech/brainard20210524a.htm>

Buckley, R. P., & Didenko, A. N. (2021). *Central Bank Digital Currencies a Potential Response to the Financial Inclusion Challenges of the Pacific*. Asian Development Bank. <https://www.adb.org/sites/default/files/publication/720016/central-bank-digital-currencies-pacific.pdf>

Committee on Payments and Market Infrastructures. (2021, December 9). *Covid-19 accelerated the digitalization of payments*. Bank of International Settlements. https://www.bis.org/statistics/payment_stats/commentary2112.pdf

- Christodorescu, M., English, E., Gu, C., Harper, C., Kumaresan, R., Minaei, M., Sheffield, C., Raghuraman, S., & Zamani, M. (2021). *Cross-border payments for Central Bank Digital Currencies via Universal Payment Channels*. Visa Economic Empowerment Institute. <https://usa.visa.com/content/dam/VCOM/global/ms/documents/veei-cross-border-payments-for-cbdc.pdf>
- Christodorescu, M., Gu, C., Kumaresan, R., Ozdayi, M., Price, B., Raghuraman, S., Saad, M., Sheffield, C., Xu, M., & Zamani, M. (2020, December 14). *Towards a Two-Tier Hierarchical Infrastructure: An Off-line Payment System for Central Bank Digital Currencies*. Cornell University. <https://arxiv.org/pdf/2012.08003.pdf>
- Cœuré, B. (2021). *Central bank digital currency: the future starts today* [Speech transcript]. Bureau of International Settlements <https://www.bis.org/speeches/sp210910.htm>
- De Nederlandsche Bank. (2020). *Central Bank Digital Currency Objectives, preconditions and design choices*. [https://www.dnb.nl/media/c3qgn4lk/202004_nr_1-2020- - central bank digital currency - objectives- preconditions_and_design_choices.pdf](https://www.dnb.nl/media/c3qgn4lk/202004_nr_1-2020_-_central_bank_digital_currency_-_objectives_-_preconditions_and_design_choices.pdf)
- DiPippo, G. (2022, February 24). *Options for a digital dollar: central bank digital currencies and stablecoins*. Center for Strategic & International Studies. <https://www.csis.org/analysis/options-digital-dollar-central-bank-digital-currency-and-stablecoins>
- Financial Action Task Force. (2021). *Updated guidance for a risk-based approach, virtual assets and virtual asset service providers*. <https://www.fatf-gafi.org/media/fatf/documents/recommendations/Updated-Guidance-VA-VASP.pdf>
- Financial Stability Board. (2022, February 14). *Assessment of risks to financial stability from crypto-assets*. https://g20.org/wp-content/uploads/2022/02/FSB-Report-on-Assessment-of-Risks-to-Financial-Stability-from-Crypto-assets_.pdf
- G7. (2021, October 14). *Public Policy Principles for Retail Central Bank Digital Currencies*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1025235/G7_Public_Policy_Principles_for_Retail_CBDC_FINAL.pdf
- Garratt, R., Lee, M., Martin, A., & Torregross, J. (2022, February 7). *The future of payments is not stablecoins*. *Liberty Street Economics*. <https://libertystreeteconomics.newyorkfed.org/2022/02/the-future-of-payments-is-not-stablecoins/>
- Gobierno Banco Central de Mexico. (2021, December 29). *El @Banxico informa que hacia 2024 tendrá una moneda digital propia en circulación, por considerar de suma importancia estas nuevas tecnologías y la infraestructura de pagos de última generación como opciones de gran valor para avanzar en la inclusión financiera en el país*. <https://twitter.com/GobiernoMX/status/1476376240873517061?s=20>
- Gu, Catherine. (2021, September 30). *Make digital currency interoperable*. *The Visa Blog*. <https://usa.visa.com/visa-everywhere/blog/bdp/2021/09/29/making-digital-currency-1632954547520.html>
- Kiff, J. (2022, January 13). *DLT-based wholesale CBDC experiments*. *Kiffmeister Chronicles*. <https://kiffmeister.blogspot.com/2021/08/dlt-based-wholesale-cbdc-experiments.html>
- Khan, C. M., van Oordt, M. R., & Zhu, Y. (2021, December 24). *Best before? Expiring central bank digital currency and loss recovery*. Bank of Canada. <https://www.bankofcanada.ca/wp-content/uploads/2021/12/swp2021-67.pdf>

Kihara, L., & Wada, T. (2019, August 2). *Former Japan central banker warns Facebook's Libra may undermine monetary policy*. *Reuters*.
<https://www.reuters.com/article/us-japan-facebook-libra/former-japan-central-banker-warns-facebooks-libra-may-undermine-monetary-policy-idUSKCN1US0SK>

Lagarde, C. (2018, November 14). *Winds of Change: The Case for New Digital Currency*. International Monetary Fund.
<https://www.imf.org/en/News/Articles/2018/11/13/sp111418-winds-of-change-the-case-for-new-digital-currency>

Lee, M., Malone, B., & Martin, A. (2020, August 12). *Token or account-based? A digital currency can be both*. *Liberty Street Economics*.
<https://libertystreeteconomics.newyorkfed.org/2020/08/token-or-account-based-a-digital-currency-can-be-both/>

Maniff, J. L. (2020, December 2). *Inclusion by Design: Crafting a Central Bank Digital Currency to Reach All Americans*. Federal Reserve Bank of Kansas City.
<https://www.kansascityfed.org/research/payments-system-research-briefings/inclusion-by-design-crafting-central-bank-digital-currency/>

Mester, L. J. (2021, October 5). *Cybersecurity and the Federal Reserve*. Federal Reserve Bank of Cleveland.
<https://www.clevelandfed.org/newsroom-and-events/speeches/sp-20211005-cybersecurity-and-the-federal-reserve.aspx>

Monetary Authority of Singapore, Bank of Canada. (2019, May 2). *Jasper-Ubin Design Paper: enabling cross-border high value transfer using distributed ledger technologies*.
<https://www.mas.gov.sg/-/media/Jasper-Ubin-Design-Paper.pdf?la=en&hash=3E88EAAB16401A0A2AA9AB556CB45DF004C2753C>

Panetta, F. (2021, June 15). *Cash still king in times of COVID-19* [Speech Transcript]. European Central Bank.
<https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210615~05b32c4e55.en.html>

Prasad, E. (2021). *The future of money: How the digital revolution is transforming currencies and finance*. Harvard University Press.

Selgin, G. (2022, February 9). *A "narrow" path to efficient digital currency*. Cato Institute.
<https://www.cato.org/briefing-paper/narrow-path-efficient-digital-currency>

Singh, A., & Zandi, M. (2021, November 22). *The impact of payment cards on economic growth*. Moody's Analytics.
<https://usa.visa.com/content/dam/VCOM/regional/na/us/visa-everywhere/documents/the-impact-of-payment-cards-on-economic-growth.pdf>

Soderberg, G., Bechara, M., Bossu, W., Che, N., Davidovic, S., Kiff, J., Lukonga, I., Mancini-Griffoli, T., Sun, T., & Yoshinaga, A. (2022). *Behind the scenes of central bank digital currency: emerging trends, insights, and policy lessons*. International Monetary Fund.
<https://www.imf.org/-/media/Files/Publications/FTN063/2022/FTNEA2022004.ashx>

Sveriges Riksbank. (2020, October 29). *Payments in Sweden in 2020*.
<https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/press-releases/2020/payments-in-sweden-2020/#:~:text=Instead%2C%20people%20in%20Sweden%20are,so%2Dcalled%20e%2Dkrona>

— (2021). *E-krona pilot Phase 1*.
<https://www.riksbank.se/globalassets/media/rapporter/e-krona/2021/e-krona-pilot-phase-1.pdf>

Toh, Y. L., & Tran, T. (2020, June 24). *How the COVID-19 Pandemic May Reshape the Digital Payments Landscape*. Federal Reserve Bank of Kansas City. <https://www.kansascityfed.org/research/payments-system-research-briefings/covid19-pandemic-may-reshape-digital-payments-landscape/>

U.S. Department of the Treasury. (2019, September 13). *Treasury Sanctions North Korean State-Sponsored Malicious Cyber Groups*. <https://home.treasury.gov/news/press-releases/sm774>

Visa. (2021). *The Crypto Phenomenon: Consumer Attitudes & Usage*. <https://usa.visa.com/content/dam/VCOM/regional/na/us/Solutions/documents/visa-crypto-consumer-perceptions-white-paper.pdf>

World Bank. (2021). *Central Bank Digital Currency a Payments Perspective*. <https://openknowledge.worldbank.org/handle/10986/36765>

World Bank Group, Global Partnership for Financial Inclusion. (2021). *The impact of COVID-19 on digital financial inclusion*. https://www.gpfi.org/sites/gpfi/files/sites/default/files/5_WB%20Report_The%20impact%20of%20COVID-19%20on%20digital%20financial%20inclusion.pdf

World Economic Forum. (2021). *Digital currency governance consortium white paper series: defining interoperability*. https://www3.weforum.org/docs/WEF_Defining_Interoperability_2021.pdf

Zhang, T. (2020, October 30). *New forms of digital money: Implications for monetary and financial stability*. International Monetary Fund. <https://www.imf.org/en/News/Articles/2020/10/30/sp103020-new-forms-of-digital-money>

Notes

¹ Currently, there is no agreed upon definition, or taxonomy, for a CBDC. For instance, the IMF defines a CBDC as “a digital representation of sovereign currency that is issued by a jurisdiction’s monetary authority and appears on the liability side of the monetary authority’s balance sheet” (Bossu et al, 2020). The World Bank broadens definition to include centralized versus decentralized ledgers arguing the CBDC is a “central bank liability that is digitally created and recorded on centralized or decentralized ledgers” (Ardic et al, 2021). Finally, the Committee on Payments and Market Infrastructures (CPMI) concedes, “CBDC is not a well-defined term. It is used to refer to a number of concepts. However, it is envisioned by most to be a new form of central bank money” (CPMI, 2018).

² Sweden’s Riksbank argues that certain qualities that one would associate with a token-based CBDC actually exhibit the qualities of an account-based CBDC: “despite being bearer instruments, a token e-krona is digital and thus requires all transactions to be recorded in a register or a ledger to avoid the risk of fraudulent use or double spending. The ledger is in all relevant senses also a form of account” (Riksbank, 2020). The Riksbank goes on to argue that concerning whether a CBDC should be token versus account is, “a mistaken focus for the discussion since the difference between an account- and a token-based model is only a matter of technology and legal definitions.”

³ This figure is based upon the CPMI Red Book data published for 27 jurisdictions for the period 2012–20.

⁴ The monetary base, or M0, is equal to coin, currency, physical paper, and central bank reserves. M1, which also includes M0, is the money supply that is composed of currency, demand deposits, other liquid deposits—which includes savings deposits. Similarly, M2, which includes M1, is a measure of the money supply that includes cash, checking deposits, and easily-convertible near money.

About Visa Inc.

Visa Inc. (NYSE: V) is the world's leader in digital payments. Our mission is to connect the world through the most innovative, reliable, and secure payment network—enabling individuals, businesses, and economies to thrive. Our advanced global processing network, VisaNet, provides secure and reliable payments around the world, and is capable of handling more than 65,000 transaction messages a second. The company's relentless focus on innovation is a catalyst for the rapid growth of digital commerce on any device for everyone, everywhere. As the world moves from analog to digital, Visa is applying our brand, products, people, network, and scale to reshape the future of commerce.

For more information, visit About Visa, visa.com/blog and @VisaNews.



Visa Economic Empowerment Institute

