Centre for International Governance Innovation

Digital Policy Hub

Digital Policy Hub – Working Paper

CBDC Governance: Programmability, Privacy and Policies

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About the Hub

The Digital Policy Hub at CIGI is a collaborative space for emerging scholars and innovative thinkers from the social, natural and applied sciences. It provides opportunities for undergraduate and graduate students and post-doctoral and visiting fellows to share and develop research on the rapid evolution and governance of transformative technologies. The Hub is founded on transdisciplinary approaches that seek to increase understanding of the socio-economic and technological impacts of digitalization and improve the quality and relevance of related research. Core research areas include data, economy and society; artificial intelligence; outer space; digitalization, security and democracy; and the environment and natural resources.

The Digital Policy Hub working papers are the product of research related to the Hub's identified themes prepared by participants during their fellowship.

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Key Points

- Central banks are exploring, developing and implementing a new form of money: central bank digital currency (CBDC). In short, it is a digital version of a country's currency issued by its central bank.
- While significant research has focused on the economic and technological aspects, the governance perspective has not received enough consideration. This paper focuses on the topics of programmability and surveillance — from a governance perspective.
- Two concepts of programmability are discussed: programmable payments that automatically transfer funds based on predetermined conditions; and programmable money that refers to restrictions on usage. These new technological options can support social policies; however, they also raise questions about the authorities' influence and control, and how to ensure there is no abuse of power.
- Regarding surveillance, privacy is considered the most significant challenge in CBDC design. Meeting anti-money laundering (AML)/combatting the financing of terrorism (CFT) requirements while offering cash-like anonymity seems incompatible. Authorities' access to citizens' data could lead to state-level surveillance, threatening civil liberties and human rights. Even if safeguards are put in place, CBDC infrastructure could be changed and initial safeguards overridden, rendering this risk a time-consistency problem.
- This paper also discusses whether CBDC is needed and suggests that if it is, then legal protection for cash should be considered. Issues of centrality, pace and public involvement are compared with another new technology — artificial intelligence (AI).
- Eleven policy recommendations are suggested on privacy and data rights, accessibility, public participation and oversight, prohibiting programmable money, legislation protecting cash and more. Ultimately, democratic institutions uphold trust in CBDCs.

Introduction

> *The soul of money is trust. So the question becomes: which institution is best placed to generate trust?*
>
> —Agustín Carstens, general manager of the Bank for International Settlements (BIS) (2022)

Money and monetary systems are evolving (Battilossi, Cassis and Yago 2020; Graeber 2011; Weatherford 1997) and a most recent addition is CBDC. Although there is no single definition of CBDC, it is commonly thought of as digital versions of national currencies, issued by central banks (International Monetary Fund [IMF] 2020). CBDC represents the latest development in the evolution of money and the monetary system (Siklos 2023).

Supported by the BIS, as of November 2023, more than 130 central banks worldwide are exploring issuing a CBDC.[1] Central banks have various potential motivations for issuing CBDC. They range from offering "a more effective competition tool in digital payments than the current approach of regulation" (Usher et al. 2021) and new innovative financial functions (BIS 2023), to the declining use of cash, financial inclusion and crime prevention (Tronnier, Recker and Hamm 2020). Motivation also includes the prevention of currency substitution and protection of monetary sovereignty — that is, avoiding other digital currencies from displacing the national currency (Engert and Fung 2017; Diez de los Rios and Zhu 2020; Brooks 2021).

The Bank of Canada (BoC) is no exception in exploring CBDC. In June 2023, it concluded a public consultation about the possibility of issuing a digital Canadian dollar (BoC 2023).

This new form of money is expected to be available for inter-banking and cross-border payments and settlement (referred to as wholesale CBDC), and also for the use of the general public (referred to as retail CBDC) (Bech, Shimizu and Wong 2017). In this paper, the focus is on the latter.

Retail CBDC offers many potential benefits. Among them are providing digital access to central bank money, protecting monetary sovereignty and making our society safer (BIS et al. 2020). Moreover, in the digital economy age — with more online transactions and electronic payment systems — CBDC can support a more innovative economy and provide an alternative to existing commercial payment methods (Usher et al. 2021).

So far, central banks — and research — have primarily focused on the economic and technical aspects of CBDC, rendering governance and potential social implications underexplored. For example, the literature review by Francesca Carapella and Jean Flemming (2020) focuses on CBDC's effect on commercial banks, monetary policy and financial stability. Frédéric Tronnier, Michael Recker and Peter Hamm (2020) identify research relating to motivations, economic aspects, monetary policy and other categories, stating with regard to society that "literature on the legal and societal facets of CBDCs has been scarce."

Sebastian Infante et al. (2023) focus on the banking sector and financial stability. They argue that CBDC can reduce financial frictions, affect deposit markets and enhance the payment system, but at the same time, CBDC can present significant risks. These risks include bank disintermediation, associated reduction in bank credit and potential adverse effects on financial stability. James Chapman et al. (2023) discuss the impacts of CBDCs on traditional banking, with banking-related topics such as payment demand, lending and liquidity, and identify new research questions — relating to the payments ecosystem and the cryptocurrency space. Yen Hai Hoang, Vu Minh Ngo and Ngoc Bich Vu (2023) approach their literature review through a text-mining technique, concluding that research on CBDCs has significantly changed since 2020. Despite the change, in 2023, the primary research themes identified do not include governance or social implications.

A similar sentiment has been expressed in a speech delivered by the general manager of the BIS, Agustín Carstens, on September 27, 2023. He stated that "much of the discussion around CBDCs focuses on technology. But, as this audience knows, this is only part of the challenge" (Carstens 2023b).

1 See www.atlanticcouncil.org/cbdctracker.

Therefore, the main goals of this paper are to look at key design features, highlight the topic of governance and raise issues that require further exploration. The next section discusses the connections between design choices and technical aspects of a system and their implications on governance. Then the topics of programmability and surveillance are presented as social concerns that derive from the inherent digital nature of the currency. In light of the concerns, the following section raises the question of whether CBDC is required, and argues in favour of legislative protection of cash and further public participation. The paper ends with policy recommendations.

Without the trust of the public, a CBDC will inevitably fail. This trust is not just about relying on central banks to manage monetary issues and protect private financial data. Trust in central banks and CBDCs also depends on the democratic institutions that protect individual rights and uphold the gentle balance of power between authorities.

Governance, Design and Technical Aspects

> *Careful design and policy considerations will underpin trust in CBDCs.*
>
> —Kristalina Georgieva, managing director of the IMF (2022)

The design choices and technical aspects of a system have significant implications on its governance. Since CBDCs are currently explored and designed in different central banks, various models and technical aspects are being considered and each has varying implications for governance.

There are numerous technical design choices and architectures (for example, Hong Kong Monetary Authority 2021; BIS 2023); this section focuses on three: the direct and indirect operational model of CBDC; token and account-based verification; and technologies and architecture to enhance privacy. These topics are presented in their abstract form to exemplify their relations with governance, from a privacy perspective.

Operational Model: Direct and Indirect

There is a fundamental distinction between direct CBDC and indirect CBDC (Auer and Böhme 2020; BIS et al. 2020). Direct CBDC (often referred to as a one-tier system) refers to a model in which consumers engage directly with the central banks. This model can be considered a “game changer”: it can transfer many of the functions operated by commercial banking to the central bank. To say it another way, direct CBDC is a model to operate CBDC so that the financial infrastructure and services are ultimately centralized.

While the idea of a direct CBDC was discussed in the literature, it is clear that it is very unlikely that any central bank would consider implementing this model since it will render financial intermediaries, that is, financial institutions such as commercial banks, unnecessary.

Moreover, the direct CBDC model would face enormous operational and policy challenges, such as eliminating the existing balance of direct claims on central and

commercial banks and handing the central bank the work and responsibilities of commercial banks. The right model, therefore, is "best designed as part of a two-tier system, with an appropriate division of labour between the central bank and private sector intermediaries for the distribution and circulation of CBDC" (Hong Kong Monetary Authority 2021, 10). Additionally, some legislation (in the United States) has already begun to bar central banks from offering products and services directly to individuals (Post 2022).

The indirect CBDC operational model is two tier: the central bank issues CBDCs and uses intermediaries, such as commercial banks and other authorized institutions, to issue or distribute CBDCs to users. The indirect model presents several privacy concerns: a greater number of points where data is collected; increasing cybersecurity risks; and data misuse or abuse at each of the collection points (Jiang 2023).

Verification: Token-Based and Account-Based

Similarly, another technical design option that will highly influence the privacy of the users is in regard to the question of whether CBDC will be account-based, token-based or some mixture of both.

In its abstract form, an account-based CBDC refers to the idea that ownership of the currency is linked to a digital identity and a digital account maintained directly at the central bank or indirectly by one of its authorized institutions. The way this works resembles accounts currently used for digital payments, such as commercial bank accounts.

In contrast, a token-based CBDC refers to the idea that the ownership of the currency is linked to a digital token, which can be stored in a digital wallet. This kind of CBDC does not necessitate identity or an account, and it resembles the passing of physical cash.

The main difference is the verification of transactions. While account-based CBDC requires the verification of user identity, a token-based account requires the verification of the authenticity of the token. These design choices present implications for privacy (Auer and Böhme 2020; cf. Jiang 2023; Chaum, Grothoff and Moser 2021, 8–14). Token-based accounts are recognized as more privacy-friendly; however, they "can still be exploited for surveillance purposes" (Big Brother Watch 2023, 62), for example, by designing traceable tokens.

Privacy-Enhancing Technologies and Anonymizing Transactions

Privacy-enhancing technologies (PETs) are technologies that assist in maximizing privacy. A paper published by the BoC (Darbha and Arora 2020) suggests several cryptographic methods to argue that designing a CBDC with advanced privacy features is possible. Some of their examples include the following:

- **Zero-knowledge proofs** can provide assurance that data is true without revealing it, such as validating that an account has enough money to perform a transaction without revealing its balance.

- **Homomorphic encryption** enables performing computations on encrypted data without decrypting it, such as paying interest on a balance that is not revealed.
- **Differential privacy and anonymization** ensure personal information cannot be extracted from data sets while preserving the ability to use the data for research and analytics, for example, by adding noise or removing identifiers.

Any PETs that would be implemented should be "embedded into the architecture of the CBDC system, not bolted on as an extra layer" (Jiang 2023).

Integrating PETs with a privacy-focused design could result in a CBDC that preserves privacy. For instance, the Reserve Bank of India is exploring an option of having a "right to be deleted": a person can request to delete transactions from the network's ledger in order to maintain anonymity (Singh 2023).

More recently, the Swiss National Bank (2023) introduced a novel way to preserve some of the anonymity in the transactions. The report points out that "Cash provides *full anonymity* for both payer and payee but cannot be used in online transactions. Credit and debit cards are *confidential* for the user, provided that only banks and card operators see personal information. Users have to trust that they keep it secure" (ibid.; author's emphasis).

Building upon these distinctions, a method is introduced to preserve the payer's anonymity. The way to ensure that transactions are not illegal is to disclose the identity of the merchant to the commercial bank, which will keep that information confidential. The data that the central bank could see regards the transaction amount, but not the identity of the payer or merchant. In this way, CBDC can be designed to provide cash-like anonymity to payers.

Despite this novel concept, cash-like privacy should guarantee privacy to both sides, with no overwatching intermediaries. The challenge of solving how CBDC will provide cash-like privacy while enabling AML/CTF remains.

Social Concerns: Focusing on Programmability and Surveillance

> *Privacy is an important user requirement but it is the most difficult to solve. The difficulty lies in ensuring privacy protection technologically rather than just promising it, and at the same time ensuring that such a high level of protection cannot be abused.*
>
> —Thomas Moser, Swiss National Bank[2]

The technological improvement the CBDC brings to payment systems is expected to profoundly transform the global financial infrastructure. This transformation has the potential to change the social and political fabric of societies and, therefore, preparations must be arranged for it in a democratic way. The digital nature of the currency presents various social concerns, related to democracy, civil liberties and human rights. This paper focuses on two topics: programmability and surveillance. Other topics such as economic issues, interoperability and digital identification are beyond the scope of this paper.

In this section, two distinct meanings of programmability are given: programmable payments and programmable money. Both can support policy objectives; however, they also raise questions about the limits of government power to influence individuals and society. The second topic, surveillance, regards access and control of individual financial data. The argument is that government access to this data threatens civil liberties and that the digital nature of this money poses the problem that even if a reasonable system is agreed upon today, it might be changed in the future.

The combination of the ability to program digital money to have restrictions, together with the ability of a future government to control and surveil individuals' financial data, could lead to limiting freedoms and acting against political dissidents (Freiman 2023c). Indeed, the Government of Canada has often served as an example among opponents of CBDC around the world: "During the truckers' protests, even a democratic and liberal government was not afraid to use financial instruments against those involved in protests in Ottawa. How easy would that be with a CBDC?" (ibid.).

Programmability and Policy Objectives: Programmable Payments and Programmable Money

Discussions about CBDC often provoke the notion of "programmability." The combination of a digital form of money and a computer program yields various meanings to this notion. Two common ones are programmable payments and programmable money.

2 See www.bis.org/about/bisih/topics/cbdc/tourbillon.htm.

Programmable Payments

Programmable payments allow for the automatic transfer of funds upon meeting predetermined conditions and regard how a person or a machine interacts with money.

For those familiar from the world of cryptocurrencies, specifically the world of blockchain and distributed ledger technology, the concept of "smart contracts" comes to mind. Smart contracts are automated computer scripts that execute coded contracts — initially coined by Nick Szabo (1994) as a "computerised transaction protocol that executes the terms of a contract."

Smart contracts offer an alternative to human-based intermediaries or third parties. When agents digitally "shake hands" — digitally sign a smart contract — it is enforced by coded rules that run over decentralized nodes (see Cadogan [2023] for legal enforcement). This meaning is technical and points to a certain "how." While remaining agnostic to the technical infrastructure of CBDC, this concept points to the automation of payments.

A practical example is automatic payments. Take rent as an example. It is possible to customize a recurring payment under the condition that every X day of the month, Y dollars will go from an account into Z's account. Nevertheless, this automation presents no novelty.

The novelty CBDC offers comes as an ability to pay machines with central bank money. Think of a person paying for a parking spot — automatically; currently, the person paying must use a commercial electronic payment service such as a credit card that is automatically charged when their licence plate goes through a gate or when they press a button on an app. They cannot pay for this digital service automatically with physical cash — central bank money. With CBDC, it will be possible to automate these transactions. The shift toward machines paying other machines is a growing trend that currently excludes physical cash (and central bank money), but with CBDC it may be possible to include central bank money in these automated transactions.

The automation of payments could be a source of serious concern. For example, consider the new possibility that can emerge with the automation of fine collecting from alleged criminals by the state, before giving them the opportunity to appeal the decision (Wenker 2022). This use might optimize the collection of fines.

The proper governance of CBDC will ensure that the same legal procedures that apply on traditional bank accounts and money are also applied on these new abilities. Otherwise, automating collection of fines may violate the autonomy of the individual, the right to a fair trial and the principle of the presumption of innocence. Automation can even lead to creating a new set of incentives for collecting fines.

Programmable Money

A second meaning of programmability is programmable money. This consists of the ability to program built-in rules that will impose restrictions on the usage of money. This programming of money, unlike programable payments, is done by those who govern the CBDC infrastructure.

There are two "flavours" of programmable money: one that limits certain money for specific goals and one that applies to all money.

The first flavour of programmable money is the ability to integrate it into the economy as purpose-bound money (Monetary Authority of Singapore 2022). Purpose-bound money is money with a designated purpose such as paying for rent, food or medicine. Purpose-bound money can ensure welfare allowance would be used only for the purposes it was designed for. This can support social policies and make the welfare system more efficient. Currently, China's Ministry of Human Resources and Social Security is exploring ways to integrate their CBDC — the digital yuan — with its social credit system through social security cards (Xiangyun 2023).

An additional meaning of programmable money applies to all money. It consists of imposing conditions on how money is spent. In the world of CBDC, it is "built-in rules, imposing restrictions on the usage of that money" (European Data Protection Supervisor 2023). With CBDC programmable money, "a government could also define a positive or negative interest rate to incentivize or disincentive the use of money for the purchase of a particular good; limit its use to a certain category of services; set an expiry date" (ibid.).

These conditions for spending money can support policy objectives. For example, it is possible to incentivize specific populations or regions by having the cost of essential goods and services — for senior citizens, low-income households, people living in remote places or struggling individuals — automatically subsidized.

However, programming money can enable regulators to limit when, where and how CBDC is spent, giving an unprecedented ability to influence people's behaviour. As such, without proper governance on the CBDC infrastructure, there is a risk that programming money would be abused by authorities. For the sake of the example, consider a set of restricting conditions that can be applied to support a policy: the ability to limit people above 30 years old (identity limitation) to spend money only within 5 km surrounding where they live (geo-fencing), only between 6:00 a.m. and 6:00 p.m. (time limitation) and only in grocery shops (merchant limitation).

Of course, the example above reminds us of an authoritarian regime, and "in authoritarian societies, central bank money in digital form could become an additional instrument of government control over citizens" (Prasad 2021, 22). However, the point is that programmable money can be used to restrict individuals and populations in other forms of governance, too. Whatever the reasons are, the risk is that through programming the money, policy objectives would be enforced in a way that would harm the dignity and autonomy of individuals to make independent and autonomous decisions concerning the use of their money. When applied to a population, it can lead to systemic oppression.

However, even without this risk, the new option of programming money poses serious questions about governments' influence and control over individuals (Freiman 2023b; Big Brother Watch 2023, 64–5). Authorities might act against socially "inadequate" transactions, such as those relating to harming the environment, pornography consumption, gambling, food choices, purchasing VPN (virtual private network) services and so on.

The argument is not against measures geared toward inappropriate or inadequate behaviours that are deemed socially unacceptable, but rather against the potential abuse of power by those who determine what is considered inadequate. Authorities, in general, use the tools at their disposal. If authorities have this power, they will be tempted to use it. What mechanisms ensure that they will not have this power to begin with? The good intentions of politicians cannot be considered as a mechanism.

Avoiding Surveillance and Protecting Privacy

The European Central Bank (2021) notes that 43 percent of respondents to a public consultation on the digital euro ranked privacy as the most important aspect of the digital euro, well ahead of other features. Similarly, Canadian respondents have ranked the ability to make private transactions as the most important potential feature of a digital Canadian dollar (BoC 2023, 32).

Perhaps the most significant challenge in designing CBDC is privacy. Digital currencies are prone to cyberattacks and data misuse and abuse, which can lead to the loss of sensitive information and funds. Therefore, when it comes to the national infrastructure of money — such as that of a potential CBDC — there is no doubt that the cybersecurity of this infrastructure and carefully managing its data governance will be prioritized.

The high priority of cybersecurity regards both infrastructure resilience and privacy. In early 2022, Eastern Caribbean CBDC's DCash experienced an outage, reminding all other developers of CBDC how crucial resilience is (Sundararajan 2022). In addition to infrastructure failure, a cybersecurity breach is a plausible option. However, the privacy risk is beyond that of a cybersecurity breach: CBDCs can significantly affect privacy since they potentially enable tracking people's financial transactions.

In this respect, a report by a group of central banks (BIS et al. 2021, 8) acknowledges three angles of data protection:

- what data is to be protected;
- from whom is it to be protected; and
- to what degree is it to be protected.

With CBDCs, protection of payments data, relating to the identity, comes in degrees. The group of central banks (ibid.) recognize three degrees of data protection for payments:

- **Confidential payments** contain data that identifies the parties but only to limited recipients.
- **Pseudonymous payments** contain data, but it cannot be linked to the identities of the parties.
- **Anonymous payments** contain no data that identifies the parties.

With regard to anonymous payments, anonymity is often exploited for illicit purposes, undermining AML/CFT measures. Therefore, anonymity "poses a policy trade-off: the more anonymity, the larger the risk for illicit use" (Soderberg et al. 2022). Full anonymity is not an option due to AML and CFT requirements (Soderberg et al. 2022;

BIS et al. 2020, 6). Additionally, anonymity may have to be ruled out because of a need to prevent excessive capital flows from outside the country or use it as a form of investment (European Central Bank 2020, 27).

If full anonymity is not possible, "identification at some level is hence central in the design of CBDCs" (BIS 2021, 82). Under the assumption that CBDCs are incompatible with full anonymity, keeping the transactional privacy that exists with physical cash becomes the challenge.

The inherent nature of CBDC, of having some identification next to the private financial data in a centralized format, raises serious surveillance concerns. Keeping data in a centralized format increases the "opportunities for state oversight in the process" (Big Brother Watch 2023, 57). Accessing transaction history gives insight into spending habits, locations and other sensitive personal data. In this respect, "privacy should be a priority, not only to protect citizens from the risks of potential state-level surveillance but also to reduce vulnerabilities to external cyberattacks by domestic or foreign parties" (World Economic Forum 2020, 20).

If the governance of CBDCs is not designed well, authorities could potentially control this data. A future government can justify access to financial data as an effort to increase security or bring prosperity, change the rules, and access the data. According to the Organisation for Economic Co-operation and Development 2023, 5), "CBDCs could enable governments to abridge civil liberties and human rights, using CBDC rails as a means to censor individuals and exert control over CBDC users; or as a way to exert control over individuals' transactions."

The digital nature of transactions allows future governments to take control of the payment infrastructure and its data. When the authorities have access to the private financial data of their citizens, members of the society could be excluded from the financial system, as "there are not too many steps needed to weaponize this new form of money to profile and identify social activism and political dissent, or impose restrictions on specific products or individuals" (Freiman 2023a; see also Prasad 2023; Snowden 2021; Epstein and Raskin 2023; Schueffel 2023).

CBDC as a New Technology

> *When it comes to money, the consent and trust of the public must be nurtured and continually maintained.*
>
> —Mark Carney, former governor of the BoC and the Bank of England (2021)

CBDC could be thought of as a new technology. Implementation potentially holds unknown risks and unintended social consequences. Whoever thought about the amount of asphalt cement that humanity would pour into their cities following the invention of the car? (Huesemann and Huesemann 2011; Morozov 2013). Similarly, Kristalina Georgieva said, "Retail CBDCs completely transform the financial system in a way that we do not quite know what consequences it could bring" (quoted in Strack 2023). In this section, the question of whether we need this technology is raised. If

the answer is yes, keeping a safe alternative is discussed. Lastly, the development is compared with AI to highlight three topics: centrality, pace and public involvement.

Questioning the Need of a CBDC

Do we need this new technology? In light of the monetary and economic concerns discussed earlier in the first section, governance and design challenges examined in the second section and the social concerns raised by programmability and surveillance in the third section, it is understandable that CBDC and its nature are heavily debated. In fact, CBDC became a political topic of dispute (see, for example, Tasker 2022; Schreckinger 2023) that might (see, for example, Alpher 2023; Maharrey 2023a) or already (see, for example, Maharrey 2023b) result with laws prohibiting its issuance. This section deals with the fundamental question of whether there is a need to issue a CBDC.

Some governments do not yet recognize a need for it. For example, a Swedish government inquiry has recently concluded that it does "not currently see sufficiently strong societal needs for the Riksbank to issue an e-krona" (Swedish Government Inquiries 2023, 18).

Additionally, experts and institutions have often expressed this view. Mervyn King, former governor of the Bank of England, said that "by far the most important question is what is the problem to which a CBDC is the solution?" (quoted in Cash 2022). Similarly, Olivier Fines, the head of the CFA Institute — a worldwide association for bankers, investors and finance chiefs — expressed that "even for a sophisticated and financially literate cohort like our members there is very little understanding of what CBDCs are" (quoted in Jones 2023). The Canadian Bankers Association (2022) has argued for the same.

In the European Union, members of the Committee on Economic and Monetary Affairs (ECON) have sent a letter to the European Central Bank, requesting to postpone the introduction of the digital euro (Members of the ECON Committee of the European Parliament 2023). Among their arguments was that the added value to the public is unclear since the combination of existing financial payment systems and cash largely overlaps with what the project offers (other arguments are about the need for democratic scrutiny and public oversight). The private sector can provide reliable, regulable solutions, such as stablecoins (Hayes 2023).

It might be that "CBDCs still have not found their raison d'être" (Eichengreen 2023), since private sector alternatives solve payment-related problems better. Moreover, while the CBDC-related technical solutions are reasonably clear, the governance of these solutions is not. In fact, often governance solutions are highly complex — "all this would require the equivalent of the Basel Committee on Banking Supervision, but on steroids" (ibid.). Instead, Barry Eichengreen suggests that it is possible to leave what CBDC offers to the private sector and regulate payment platforms' activities.

The Importance of Cash in a Digital Payment World

As digital payments and electronic means of payments continue to grow, the use of cash is in decline (Committee on Payments and Market Infrastructures 2023). Despite the decline, physical cash plays important roles, especially if CBDC is issued. Cash can provide an alternative safeguard against excessive surveillance or control by the authorities, guaranteeing the use of cash can build the public's trust in the financial ecosystem by respecting the payment choices of those who rely on it and making it available for everyone. From a system's point of view, physical cash can serve as a fall-back payment method in case of digital payment system failure.

Due to its digital and centralized nature, CBDC is inherently programmable, and those who govern the infrastructure can change its features. For example, a central bank can change the interest rates, holding limits, spending restrictions or different data regimes to the CBDC after promising the public not to. No design is resistant to modification over time (James 2023) and, in particular, centralized digital infrastructures are "inherently vulnerable to software updates that could override initial safeguards" (Freiman 2023b). Securing cash can safeguard against privacy loss, surveillance and control.

A negative example of implementing CBDC comes from Nigeria. Following the implementation of the eNaira in December 2022, the Central Bank of Nigeria restricted cash withdrawals for individuals to 100,000 naira (about US$225) per week (Central Bank of Nigeria 2022). The cash shortage led citizens to protest the restriction and further oppose the implementation of their CBDC (Anthony 2023).

Even when CBDC is planned to be a complementary payment method to physical cash, people worry that cash will eventually not be available. In Canada, for example, 87 percent of the nearly 90,000 participants of a public consultation agreed that "regulation should be introduced to require merchants to accept cash as a form of payment" (BoC 2023, 37). Cash can guarantee an alternative to CBDC.

In Austria, the chancellor said that "more and more people are worried that cash could be restricted as a means of payment" (quoted in Hülsemann 2023). He proposed a "right to cash" — having the use of cash for payments protected in the Austrian constitution (ibid.).

In the European Union, the European Commission proposes the digital euro and the right to cash in one package (European Parliament 2023). The rationale is not so much "the trend towards cashless payments but the trend to refuse cash payments as an alternative. If cash is not readily available or accepted, vulnerable groups are potentially excluded" (EpiCenter 2023). In London, United Kingdom, a journalist reported how difficult it is to live in a city where not all businesses accept cash (Hearing 2020). Cash is essential for those who rely on it for transactions for their daily livelihoods and for those who do not have access to financial services. Physical cash "guarantees financial inclusion more than any other means of payment" (World Economic Forum 2020, 19).

Lastly, cash can serve as a backup payment method in case of a digital payment system failure (World Economic Forum 2020; Lane 2020). In 2022, Eastern Caribbean CBDC experienced an outage (Sundararajan 2022), and Canada experienced a nationwide telecom outage (Canadian Radio-television and Telecommunication Commission 2022).

Given all of these reasons, if CBDC is issued, a legislative protection of cash is required.

Centrality, Pace and Public Involvement

In this section, CBDC is compared with another subset of new technology — AI. The comparison is made in three different but related aspects of development and implementation: centrality, pace and public involvement.

Centrality

While the AI industry is concentrated (Kollnig and Li 2023), AI technologies are developed and implemented in numerous forms and by countless individuals and entities worldwide. In contrast, the development of CBDC is centrally led by the BIS and central banks.

Pace

When it comes to the pace of the development and implementation of CBDC, a more measured and cautious approach is required. This contrasts the "move fast, break things" model associated with Silicon Valley's fast-paced approach to technological innovation and the hype surrounding the rapid and viral adoption of, for example, OpenAI's ChatGPT. The cautious approach reflects the carefulness exercised to safeguard stability and trust in monetary innovations (Gross and Kraft 2023).

Public Involvement

Despite the efforts of central banks to involve the public in discussions or consultations, the public, civil society organizations and other stakeholders could be much more engaged with the design itself. Nicholas Anthony — a policy analyst at the Cato Institute — captured a common sentiment among CBDC-related policy makers: "All too often, people usually find out about these types of developments years after the fact.... We're hoping the public can get more involved in the conversation before we are looking at it in the rear-view mirror" (quoted in Warmbrodt and Behsudi 2023).

The public participation in the design and implementation must be meaningful. One example of a public participation framework is that of the International Association for Public Participation (2018). Roughly, it states five stages: providing the public with information to understand the issue and available options; obtaining public feedback on alternatives and decisions; involving the public and working with them directly; working together with the public to create different options and determine the most favoured option; and finally, letting the public make the decision.

Policy Recommendations

> *Why is trust so important? If the public trusts the authorities' actions, they will incorporate them in determining their own behaviour. As a result, it is more likely that the authorities will achieve their objectives. In addition, trust fuels the legitimacy of policies. With trust, the public will be more willing to accept actions that involve short-term costs in exchange for long-term benefits. In sum, trust is vital for policy effectiveness.*
>
> —Agustín Carstens (2023a)

Since each country has its own unique development of CBDC suitable for its specific circumstances and requirements, there is no one-size-fits-all CBDC (Georgieva 2022). Every jurisdiction has different legal frameworks, motivations, governance structures and democratic processes. To paraphrase the first sentence of Leo Tolstoy's novel *Anna Karenina*: All democracies are fragile; and every democracy is fragile in its own way.

If programmable money is introduced and privacy is not considered, CBDC would not be merely a digital currency but a digital financial data ecosystem. Such an ecosystem would raise worries about state power and surveillance wherever it is implemented.

This paper focused on programmability and surveillance. Choosing specific technical aspects and introducing governance mechanisms that provide adequate checks and balances can potentially mitigate the concerns.

Ultimately, it is crucial for a CBDC to have the trust of the public in order to succeed. This trust encompasses more than the central banks. Trust also involves the democratic institutions that safeguard individual rights and maintain the delicate balance of power between authorities.

Below is a series of policy recommendations.

Before Moving Forward	
Do we need it?	Central banks should identify and communicate the problem a CBDC intends to solve, or the unique novelty that CBDC can introduce to the public.
It is the public's decision	The decision to issue a CBDC must be taken by the legislative branch, rather than the central bank, after meaningfully engaging with the public, experts and civil society organizations.
If Moving Forward	
Life-cycle engagement	The design, implementation and oversight of CBDC must involve civil society organizations dealing with consumer protection, human rights and civil liberties.
Desired characteristics of CBDC	Secure, free of charge, easy to use, widely accessible, widely accepted, not requiring an online connection, instantly settling payments.

Privacy and Rights	
Maximizing privacy, by design	Design must maximize the privacy of the CBDC end user.
Minimize data collection	Minimum necessary data collection and make it impossible to surveil or control user data at the infrastructure level.
User data rights	Users should have a right to access, share and have their data portable, with informed consent freely given.
Accessibility	
As accessible as cash	Design should strive for not requiring a bank account or identification.
Safeguarding the Future	
Public oversight of CBDC	Have a public oversight of the governance of CBDC
No programmable money	Programmable money must be prohibited by law.
Legislative protection of cash	The continued usage of physical cash must be guaranteed by legislation protection with businesses forced to accept cash.

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